2018

COURSE CATALOG

UNIST Vision and Goal

VISION

World Leading University to Advance Science and Technology for the Prosperity of Humankind

Cultivating creative global leaders who will usher in new scientific paradigms
through convergence in science and technology

GOALS

To be Ranked within the Top 10 Science and Technology University by 2030

Education
Cultivation of creative leaders that excel in science and technology

Research
Realization of convergence science and technology, indicating the new paradigm

STRATEGIES

Creativity, Interdisciplinary Education, Globalization, and Research–Intensive

Creativity

IT–based student–centered discussion classes (Flipped learning)

Interdisciplinary Education

Mandatory requirement to complete two or more areas of concentration

All professors are appointed to undertake two or more schools

Globalization

All courses at UNIST are conducted in 100% English

Expansion of foreign professors and students by 20%

Research Intensive

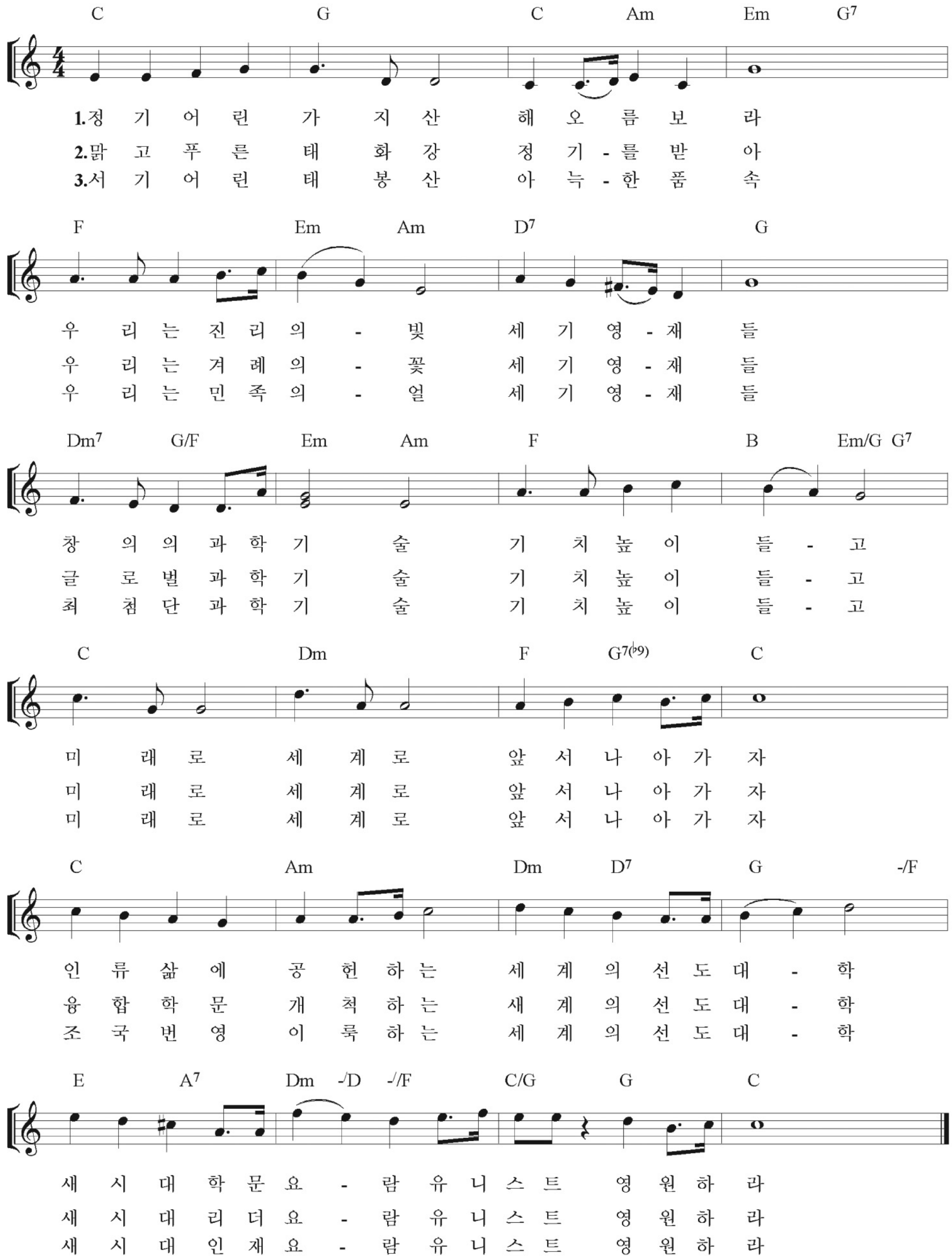
Research topics for thrust area

– Next–Generation Energy

– Advanced Materials

교 가

박종해 글
김준범 곡


C G C Am Em G7
1.정 기 어 린 가 지 산 해 오 름 보 라
2.맑 고 푸 른 태 화 강 정 기 - 를 받 아
3.서 기 어 린 태 봉 산 아 늑 - 한 품 속
F Em Am D7 G
우 리 는 진 리 의 - 빛 세 기 영 - 재 들
우 리 는 겨 레 의 - 꽃 세 기 영 - 재 들
우 리 는 민 족 의 - 얼 세 기 영 - 재 들
Dm7 G/F Em Am F B Em/G G7
창 의 의 과 학 기 술 기 치 높 이 들 - 고
글 로 벌 과 학 기 술 기 치 높 이 들 - 고
최 첨 단 과 학 기 술 기 치 높 이 들 - 고
C Dm F G7(♭9) C
미 래 로 세 계 로 앞 서 나 아 가 자
미 래 로 세 계 로 앞 서 나 아 가 자
미 래 로 세 계 로 앞 서 나 아 가 자
C Am Dm D7 G -/F
인 류 삶 에 공 헌 하 는 세 계 의 선 도 대 - 학
융 합 학 문 개 척 하 는 세 계 의 선 도 대 - 학
조 국 번 영 이 룩 하 는 세 계 의 선 도 대 - 학
E A7 Dm -/D -/F C/G G C
새 시 대 학 문 요 - 람 유 니 스 트 영 원 하 라
새 시 대 리 더 요 - 람 유 니 스 트 영 원 하 라
새 시 대 인 재 요 - 람 유 니 스 트 영 원 하 라

2018 UNIST Academic Calendar

Year	Month	Date	Schedules
2018 Spring Semester	2	26(Mon)	2018 Spring Semester Begins
		26(Mon) ~ 3.2(Fri)	Course Changes and confirmation
	3	23(Fri)	End of first quarter of the semester
	4	16(Mon) ~ 20(Fri)	Mid-term Exams
		20(Fri)	End of second quarter of the semester, Submission deadline for Courses List of the summer session, Leave of Absence application deadline(General)
	5	7(Mon)	Holiday - Children's Day
		18(Fri)	End of third quarter of the semester [Graduate school]Deadline for 'Nomination of Thesis Committee' submission
		21(Mon) ~ 23(Wed)	Return application for the summer session
		22(Tue)	Holiday - Buddha's birthday
		28(Mon) ~ 6.1(Fri)	Application for Interdisciplinary major
		30(Wed) ~ 6.1(Fri)	Course Registration for the summer session
	6	6(Wed)	Holiday - Memorial Day
		13(Wed)	Holiday - 2018 Local election
		11(Mon) ~ 15(Fri)	Final Exams
		15(Fri)	The end of spring semester
		16(Sat) ~ 8.26(Sun)	Summer Vacation
		20(Wed) ~ 7.31(Tue)	Summer Session
	7	2(Mon) ~ 9(Mon)	[Graduate school]Submit the application for the program change
		4(Wed)	Due date for grading
		16(Mon) ~ 25(Wed)	Leave of absence/Return application for the fall semester
	8	1(Wed) ~ 3(Fri)	Undergraduate Course Registration for the fall semester
		15(Wed)	Holiday - National Liberation Day
		16(Thu)	Due date for summer session grading
		17(Fri)	Conferral of degrees
		20(Mon) ~ 22(Wed)	Tuition fee payment for the fall semester

Year	Month	Date	Schedules
2018 Fall Semester	8	27(Mon)	2018 Fall semester Begins
		27(Mon) ~ 31(Fri)	Course changes and confirmation
	9	21(Fri)	End of first quarter of the semester
		24(Mon)~ 26(Wed)	Holiday – Chuseok(Korean Thanksgiving Day)
		28(Fri)	Holiday – UNIST Foundation Day
	10	3(Mon)	Holiday – National Foundation Day
		9(Tue)	Holiday – Hangul Proclamation Day
		15(Mon) ~ 19(Fri)	Mid-term exams
		19(Fri)	End of second quarter of the semester, Submission deadline for Courses List of the winter session, Leave of Absence application deadline(General)
	11	16(Fri)	End of third quarter of the semester [Graduate school]Deadline for 'Nomination of Thesis Committee' submission
		19(Mon) ~ 21(Wed)	Return application for the winter session
		26(Mon) ~ 30(Fri)	Application for Interdisciplinary major
		28(Wed) ~ 30(Fri)	Course Registration for the winter session
	12	10(Mon) ~ 14(Fri)	Final Exams
		14(Fri)	The end of fall semester
		15(Sat) ~ 2019.2.24(Sun)	Winter Vacation
		24(Mon) ~ 2019.2.1(Fri)	Winter Session
		25(Tue)	Holiday – Christmas
		28(Fri)	Due date for grading
	2019 1	1(Tue)	Holiday – New Year's Day
		2(Wed) ~ 8(Tue)	[Graduate school]Submit the application for the program change
		7(Mon) ~ 16(Wed)	Leave of absence/Return application for the spring semester, 2019
		30(Wed) ~ 2.1(Fri)	Undergraduate Course Registration for the spring semester, 2019
	2	4(Mon)~6(Wed)	Holiday – Lunar New Year's Day
		11(Mon)	Due date for winter session grading
		12(Tue)	Commencement Ceremony
		18(Mon) ~ 20(Wed)	Tuition fee payment for the spring semester, 2019

※ Schedules above are subject to change according to the school policies.

Undergraduate

Undergraduate

Contents

Required Credit for Graduation

□ Engineering Field

<table>
<tr><td rowspan="3">Major</td><td rowspan="3">Major</td><td colspan="3">1st Track/2nd Track</td><td>54/18</td><td rowspan="3">75</td></tr>
<tr><td colspan="3">Internship</td><td>3</td></tr>
<tr><td colspan="3">Interdisciplinary Project</td><td>P</td></tr>
<tr><td rowspan="10">Fundamental</td><td rowspan="7">Math & Science</td><td colspan="3">Calculus I/Calculus II</td><td>6</td><td rowspan="10">40</td></tr>
<tr><td colspan="3">Differential Equations/Applied Linear Algebra/Statistics : Choose two</td><td>6</td></tr>
<tr><td colspan="3">General Physics I, II</td><td>6</td></tr>
<tr><td colspan="3">General Physics Lab I, II</td><td>2</td></tr>
<tr><td colspan="3">General Chemistry I, II</td><td>6</td></tr>
<tr><td colspan="3">General Chemistry Lab I, II</td><td>2</td></tr>
<tr><td colspan="3">General Biology</td><td>3</td></tr>
<tr><td rowspan="2">IT</td><td colspan="3">Introduction to AI Programming I</td><td>3</td></tr>
<tr><td colspan="3">Introduction to AI Programming II</td><td>3</td></tr>
<tr><td>MGT</td><td colspan="3">Entrepreneurship & Big Data</td><td>3</td></tr>
<tr><td rowspan="10">Liberal Arts</td><td rowspan="6">English[1)]</td><td rowspan="2">Group1</td><td colspan="2">English Foundation</td><td rowspan="6">4</td><td rowspan="10">27</td></tr>
<tr><td colspan="2">English Forward</td></tr>
<tr><td rowspan="2">Group2</td><td colspan="2">English Forward</td></tr>
<tr><td colspan="2">Building Writing or Building Speaking</td></tr>
<tr><td rowspan="2">Group3</td><td colspan="2">Building Writing</td></tr>
<tr><td colspan="2">Building Speaking</td></tr>
<tr><td rowspan="3">Language</td><td colspan="2">Chinese Foundation</td><td rowspan="3">Choose one</td><td rowspan="3">2</td></tr>
<tr><td colspan="2">Chinese Forward</td></tr>
<tr><td colspan="2">Spanish Foundation</td></tr>
<tr><td>AHS</td><td colspan="2">At most 2 courses among the courses in the same field (those with the same middle number) will be recognized as an AHS completion. If He/She has taken more than 2 courses in the same field, the courses except for 2 of them will not be recognized as an AHS completion but added up to the total credits for graduation.
※ Please refer to the page 24.</td><td>Choose over seven</td><td>21</td></tr>
<tr><td>Leadership</td><td>ULP[2)]</td><td colspan="4">UNIST Leadership Program</td><td>8AU</td></tr>
<tr><td colspan="7">Total 142 credits / 8AU</td></tr>
</table>

1) Students who have an English level test score of 90 or higher can choose other liberal art courses instead of 2 required English courses(4 credits). ※ Applied from freshman in 2017
2) Students who entered UNIST in 2009 should take 'UNIST Leadership Program', 4AU(Activity Unit, 1AU=1Hour/week)

☐ Business Administration Field

Major	Major	1st Track/2nd Track		54/18	75
		Internship		3	
		Interdisciplinary Project		P	
Fundamental	Math & Science	Calculus I		3	30
		Applied Linear Algebra / Statistics		6	
		General Physics		3	
		General Chemistry		3	
		General Biology		3	
	IT	Introduction to AI Programming I		3	
		Introduction to AI Programming II		3	
	MGT	Entrepreneurship & Big Data		3	
		Economics		3	
Liberal Arts	English[1]	Group1: English Foundation		4	27
		Group1: English Forward			
		Group2: English Forward			
		Group2: Building Writing or Building Speaking			
		Group3: Building Writing			
		Group3: Building Speaking			
	Language	Chinese Foundation	Choose one	2	
		Chinese Forward			
		Spanish Foundation			
	AHS	*At most 2 courses among the courses in the same field (those with the same middle number) will be recognized as an AHS completion. If He/She has taken more than 2 courses in the same field, the courses except for 2 of them will not be recognized as an AHS completion but added up to the total credits for graduation.* ※ Please refer to the page 24.	Choose over seven	21	
Free Elective					9
Leadership	ULP[2]	UNIST Leadership Program			8AU
Total 141 credits / 8AU					

1) Students who have an English level test score of 90 or higher can choose other liberal art courses instead of 2 required English courses(4 credits). ※ Applied from freshman in 2017
2) Students who entered UNIST in 2009 should take 'UNIST Leadership Program', 4AU(Activity Unit, 1AU=1Hour/week)

☐ Credit Requirement for Each track

School	Track	Interdisciplinary Major (Required/Elective)			
		1st Track	2nd Track	Total	
				1Tr	2Tr
Mechanical, Aerospace and Nuclear Engineering	Mechanical and Aerospace Engineering (MAE)	33/21	9/9	54	18
	Nuclear Science and Engineering (NSE)	33/21	12/6	54	18
	System Design and Control Engineering (SDC)	24/30	0/18	54	18
Urban and Environmental Engineering	Environmental Science and Engineering (ESE)	9/45	9/9	54	18
	Urban Infrastructure Engineering (UIE)	18/36	9/9	54	18
	Disaster Management Engineering (DME)	18/36	9/9	54	18
Design and Human Engineering	Industrial Design (ID)	36/18	0/18	54	18
	Human Factors Engineering (HFE)	24/30	0/18	54	18
Materials Science and Engineering	Advanced Materials Science (AMS)	21/33	9/9	54	18
	Nano Materials Engineering (NME)	21/33	9/9	54	18
Energy and Chemical Engineering	Energy Engineering (ENE)	31/23	12/6	54	18
	Chemical Engineering (ACE)	21/33	15/3	54	18
Electrical and Computer Engineering	Electrical Engineering (EE)	36/18	18/0	54	18
	Computer Science & Engineering (CSE)	33/21	9/9	54	18
Life Sciences	Biological Sciences (BIO)	23/31	15/3	54	18
	Biomedical Engineering (BME)	30/24	12/6	54	18
Natural Science	Physics (PHY)	33/21	12/6	54	18
	Chemistry (CHEM)	28/26	12/6	54	18
	Mathematical Sciences (MTH)	33/21	12/6	54	18
Business Administration	Management (MGT)	21/33	18/0	54	18
	Finance & Accounting (FIA)	21/33	12/6	54	18
	Entrepreneurship (EPS) [1]	-/-	12/6	0	18
Management Engineering	Management Engineering (MGE)	30/24	9/9	54	18

1) Students can choose EPS track only as a 2nd track, not for the 1st track.

□ Degree conferred for Each Track

School	Degree	Track	Remark
School of Mechanical, Aerospace and Nuclear Engineering 기계항공및원자력공학부	B.S. in Mechanical, Aerospace and Nuclear Engineering 공학사	Mechanical and Aerospace Engineering (MAE) 기계항공공학	
		Nuclear Science and Engineering (NSE) 원자력 공학 및 과학	
		System Design and Control Engineering (SDC) 제어설계공학	
School of Urban and Environmental Engineering 도시환경공학부	B.S. in Urban and Environmental Engineering 공학사 or 이학사	Environmental Science and Engineering (ESE) 환경과학공학	
		Urban Infrastructure Engineering (UIE) 도시건설공학	
		Disaster Management Engineering (DME) 재난관리공학	
School of Design and Human Engineering 디자인및인간공학부	B.S. in Design and Human Engineering 공학사	Industrial Design (ID) 산업디자인	
		Human Factors Engineering (HFE) 인간공학	
School of Materials Science and Engineering 신소재공학부	B.S. in Materials Science and Engineering 공학사	Advanced Materials Science (AMS) 신소재과학	
		Nano Materials Engineering (NME) 나노재료공학	
School of Energy and Chemical Engineering 에너지및화학공학부	B.S. in Energy and Chemical Engineering 공학사	Energy Engineering (ENE) 에너지공학	
		Chemical Engineering (ACE) 화학공학	
School of Electrical and Computer Engineering 전기전자컴퓨터공학부	B.S. in Electrical and Computer Engineering 공학사	Electrical Engineering (EE) 전기 및 전자공학	
		Computer Science and Engineering (CSE) 컴퓨터공학	
School of Life Sciences 생명과학부	B.S. in Biological Sciences 이학사	Biological Sciences (BIO) 생명과학	
	B.S. in Biomedical Engineering 공학사	Biomedical Engineering (BME) 생명공학	
School of Natural Science 자연과학부	B.S. in Natural Science 이학사	Physics (PHY) 물리학	
		Chemistry (CHEM) 화학	
		Mathematical Sciences (MTH) 수리과학	
School of Business Administration 경영학부	Bachelor of Business Administration (B.B.A.) 경영학사	Management (MGT) 경영학	
		Finance & Accounting (FIA) 재무·회계학	
		Entrepreneurship (EPS) 벤처경영	
School of Management Engineering 경영공학부	B.S. in Management Engineering 공학사	Management Engineering(MGE) 경영공학	

Division of General Studies

1. School Introduction

The Division of General Studies (DGS) is central to the mission of UNIST, providing the education for creative engineering, global leadership, and trans-disciplinary, integrative knowledge for contributing to the future of humankind. Liberal arts and basic science courses enable students to attain higher levels of thinking, analyzing and understanding the wider world, while IT and English courses provide the tools for making a global impact. Upon successful completion of the freshmen curriculum at DGS, each student may choose two specialized fields (departments/tracks) in accordance with the UNIST regulation for advancement into the major fields of study.

2. Undergraduate Programs

1) Math & Science

The Math & Science area is designed to provide a solid basic knowledge in the students' specialties by offering General Science courses like Mathematics, Physics, Chemistry, Biology, and also enabling students to study more effectively and efficiently by harmonizing theoretical studies and laboratory works.

2) IT

The IT area is designed to teach the basic knowledge of computer programming, practical IT skills, and the applications and potential of IT. For engineering students, the topics are: the basics of computer programming and how to formulate solutions for existing engineering problems by numerous case studies, through lectures and laboratory practices. For students of management majors, the concepts, operations and application of information systems for business purposes are presented. A number of courses are offered to help students understand and use fundamental computer system principles, so that they will function more efficiently and effectively as future engineers and managers.

3) Management

Management is focused on cultivating fundamental knowledge of Business Administration by offering courses like Innovation and Entrepreneurship and Economics.

4) English

The main goal of the English courses is to cultivate fundamental knowledge of English. Students, according to their English proficiency, will take two English courses which provide the students with opportunities to acquire not only comprehension skills, such as listening and reading, but also production skills like speaking and writing. Students will participate in student-centered learning by means of on-line materials and in class meetings with instructors. Upon completion of the required English courses, students will advance to elective English courses that focus on uses of English appropriately by styles, culture, and context.

5) Language

The main goal is to educate global citizens by cultivating fundamental knowledge of languages other than English. Courses offered are Chinese Foundation and Chinese Forward, and try to increase the students' interests through various teaching methods.

6) AHS (Arts, Humanities & Social Sciences)

Various AHS courses are offered to increase the creative power of engineering and business students. In these courses, the students will also acquire basic knowledge in AHS areas by the means of discussions, presentations, and LMS (Learning Management System) which set them apart from the general education courses at other universities.

7) Free Elective

The field is formed with free elective courses. It should offer various courses, so the students can attend the courses more freely.

8) UNIST Leadership Program (belongs to the Leadership Center)

The goal of the Leadership Program is to build up students' character as UNISTARS with characteristics such as honesty, sincerity, cooperative spirit, mutual respect, etc. through participation in team activities following a creative planning process. It also aims to foster students' leadership qualities such as discussion skills, presentation skills, ability to organize and operate a team, and mentoring juniors, etc.

3. Curriculum ※ Course opening semester is subject to be changed according to School's situation.

□ Fundamental

Category	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
M&S	MTH111	Calculus I 미적분학 I	3-3-1		1
	MTH112	Calculus II 미적분학 II	3-3-1		2
	MTH201	Differential Equations 미분방정식	3-3-0	Prerequisite: MTH111	1,2
	MTH203	Applied Linear Algebra 응용선형대수	3-3-0		1,2
	MTH211	Statistics 통계학	3-3-0		1,2
	PHY101 (PHY102)	General Physics I (General Physics I H) 일반물리학 I (고급일반물리학 I)	3-3-0	()is a honor course	1
	PHY103 (PHY104)	General Physics II (General Physics II H) 일반물리학 II (고급일반물리학 II)	3-3-0	()is a honor course	2
	PHY105	General Physics 일반물리학	3-3-0		1
	PHY107	General Physics Lab I 일반물리학실험 I	1-0-2		1
	PHY108	General Physics Lab II 일반물리학실험 II	1-0-2		2
	CHM101	General Chemistry I 일반화학 I	3-3-0		1
	CHM102	General Chemistry II 일반화학 II	3-3-0		2
	CHM103	General Chemistry 일반화학	3-3-0		2
	CHM105	General Chemistry Lab I 일반화학실험 I	1-0-2		1
	CHM106	General Chemitry Lab II 일반화학실험 II	1-0-2	Prerequisite: CHM101, CHM105	2
	BIO101	General Biology 일반생물	3-3-0		1,2
IT	ITP107	Introduction to AI Programming I 기초 인공지능 프로그래밍 I	3-2-2		1,2
	ITP117	Introduction to AI Programming II 기초 인공지능 프로그래밍 II	3-2-2		2[1)]
MGT	MGT102	Entrepreneurship & Big Data 기업가정신과 빅데이터	3-3-0		1,2
	MGT106	Economics 경제원론	3-3-0		1

1) Engineering Programming II (ITP117) will be opened in 1^{st} semester, 2018.

☐ Liberal Art

Category	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ENG[1]	ENG100	English Foundation	2-2-0		1,2
	ENG107	English Forward	2-2-0	Prerequisite: ENG100	1,2
	ENG108	Building Writing	2-2-0	Prerequisite: ENG107	1,2
	ENG109	Building Speaking	2-2-0	Prerequisite: ENG107	1,2
LNG[2]	LNG201	Chinese Foundation	2-2-0		1,2
	LNG202	Chinese Forward	2-2-0		1,2
	LNG203	Korean Foundation	2-2-0	Only for internationals (substitute for Chinese)	1,2
	LNG204	Korean for Everyday	2-2-0		1,2
	LNG205	Spanish Foundation	2-2-0		1,2
AHS[3]	AHS101	Law and Social Life 법과 사회생활	3-3-0		1,2
	AHS111	Arts and Creativity 예술과 창의성	3-3-0		1,2
	AHS121	Music and Creativity, Piano 음악과 창의성, 피아노	3-1-2		1,2
	AHS122	Music and Creativity, Strings 음악과 창의성, 현악	3-1-2		1,2
	AHS131	Literature and Creativity 문학과 창의성	3-3-0		1,2
	AHS141	Media and Culture 미디어와 문화	3-3-0		1,2

Category	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
AHS[3]	AHS151	History of Korean Civilization 한국문명사	3-3-0		1,2
	AHS152	Evolution of Civilization 문명의 발전	3-3-0		1,2
	AHS161	What is I? 나의 정체성	3-3-0		1,2
	AHS171	Science of Human Behavior 인간행동의 과학	3-3-0		1,2
	AHS181	Discovering Anthropology 인류학의 발견	3-3-0		1,2
	AHS186	Understanding Political Science 정치학의 이해	3-3-0		1,2
	AHS201	Law and Technology 법과 과학기술	3-3-0		1,2
	AHS211	Design Thinking 디자인 씽킹	3-2-1		1,2
	AHS221	Advanced Piano 피아노 연주	3-1-2		1,2
	AHS222	Chamber Music 실내악	3-1-2		1,2
	AHS231	A Poetics of the Novel 소설의 시학	3-3-0		1,2
	AHS241	Effective Communication 효과적 커뮤니케이션	3-3-0		1,2
	AHS251	Histor of Modern Korea 한국 근현대사	3-3-0		1,2
	AHS252	History of Contemporary World 현대 세계사	3-3-0		1,2
	AHS253	History of Science and Technology 과학기술사	3-3-0		1,2
	AHS254	Understanding Korea 한국의 이해	3-3-0		1,2
	AHS261	Contemporary Philosophy 현대 철학	3-3-0		1,2
	AHS271	Cognitive Science 인지 과학	3-3-0		1,2
	AHS281	Society and Culture 사회와 문화	3-3-0		1,2
	AHS286	Science and Technology Policy 과학기술 정책	3-3-0		1,2
	AHS291	Globalization and Economy 세계화와 글로벌경제	3-3-0		1,2

1) Students who have an English level test score of 90 or higher can choose other liberal art courses instead of 2 required English courses(4 credits). ※ Applied from freshman in 2017
2) International students are recommended to take one of Korean courses instead of taking chinese courses.
3) Students are required to take 7 courses (21 Credits) at least and at most 2 courses among the courses in the same field (those with the same middle number) will be accredited.

☐ Free Elective

Cate gory	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Sem ester
ENG	ENG201	Introduction to English Styles	3-3-0	Prerequisite: ENG107	1
	ENG202	English Language & Culture	3-3-0	Prerequisite: ENG107	2
	ENG203	English for Business	3-3-0	Prerequisite: ENG107	1
	ENG204	English for Science and Technology	3-3-0	Prerequisite: ENG107	2
	ENG205	Critical Academic Literacy	3-3-0	Prerequisite: ENG107	-
	ENG206	English Language Information and Data	3-3-0	Prerequisite: ENG107	2
	ENG207	Global English in Engineering Community	3-3-0	Prerequisite: ENG107	1
	ENG401	Writing in Academic Disciplines	3-3-0		
	ENG402	Technical Writing in English	3-3-0		
AHS	AHS301	Understanding Copyrights and Patents 지적 재산권	3-3-0		-
	AHS310	Topics in Arts 예술 특강	3-3-0		-
	AHS320	Topics in Music 음악 특강	3-1-2		-
	AHS330	Topics in Literature 문학 특강	3-3-0		-
	AHS340	Topics in Communication Studies 커뮤니케이션 특강	3-3-0		-
	AHS350	Topics in History 역사 특강	3-3-0		-
	AHS360	Topics in Philosophy 철학 특강	3-3-0		-
	AHS370	Topics in Psychology 심리학 특강	3-3-0		-
	AHS380	Topics in Anthropology 인류학 특강	3-3-0		-
	AHS391	Climate Change Humanity 기후변화인문학	3-3-0		2
	AHS397	Sports and Health 스포츠와 건강	1-0-2		-
	AHS398	AHS Special Topics Ⅰ AHS 특강 Ⅰ	Variable		-
	AHS399	AHS Special Topics Ⅱ AHS 특강 Ⅱ	Variable		-

4. Required Mathematics Course

□ Complete based on 1TR

School	Track	Course No.	Course Title	Semester
Mechanical, Aerospace and Nuclear Engineering	MAE	MTH203	Applied Linear Algebra	2-2
		MTH201	Differential Equations	2-1
	NSE	MTH203	Applied Linear Algebra	2-2
		MTH201	Differential Equations	2-1
	SDC	MTH203	Applied Linear Algebra	2-2
		MTH201	Differential Equations	2-1
Urban and Environmental Engineering	ESE	MTH201	Differential Equations	2-1
		MTH203 or MTH211	Applied Linear Algebra or Statistics	2-2
	UIE	MTH201	Differential Equations	2-1
		MTH203 or MTH211	Applied Linear Algebra or Statistics	2-2
	DME	MTH201	Differential Equations	2-1
		MTH203 or MTH211	Applied Linear Algebra or Statistics	2-2
Design & Human Engineering	ID	MTH203	Applied Linear Algebra	2-1
		MTH211	Statistics	2-2
	HFE	MTH203	Applied Linear Algebra	2-1
		MTH211	Statistics	2-2
Materials Science and Engineering	AMS	MTH203	Applied Linear Algebra	2-1
		MTH201	Differential Equations	2-2
	NME	MTH203	Applied Linear Algebra	2-1
		MTH201	Differential Equations	2-2
Energy and Chemical Engineering	ENE	MTH203	Applied Linear Algebra	2-2
		MTH201	Differential Equations	2-1
	ACE	MTH203	Applied Linear Algebra	2-1
		MTH201	Differential Equations	2-2
Electrical and Computer Engineering	EE	MTH203	Applied Linear Algebra	2-1
		MTH201	Differential Equations	2-2
	CSE	MTH203	Applied Linear Algebra	2-1
		MTH201	Differential Equations	2-2
Life Sciences	BIO	MTH203	Applied Linear Algebra	2-1
		MTH211	Statistics	2-2
	BME	MTH201	Differential Equations	2-2
		MTH203 or MTH211	Applied Linear Algebra or Statistics	2-2
Natural Science	PHY	MTH203	Applied Linear Algebra	2-1
		MTH201	Differential Equations	2-2
	CHEM	MTH203	Applied Linear Algebra	2-1
		MTH201	Differential Equations	2-2
	MTH	MTH203	Applied Linear Algebra	2-1
		MTH201	Differential Equations	2-2
Business Administration	MGT	MTH203	Applied Linear Algebra	1-2
		MTH211	Statistics	1-2
	FIA	MTH203	Applied Linear Algebra	1-2
		MTH211	Statistics	1-2
Management Engineering	MGE	MTH211	Statistics	2-1
		MTH203	Applied Linear Algebra	1-2

※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' 12 credits.

☐ When student choose tracks from another field

▶ Fundamentals required to Engineering field students when they choose Business field tracks as 2nd track

Course No.	SBA		
	MGT	FIA	EPS
MGT106	✔	✔	✔
MTH211	✔	✔	

▶ Fundamentals required to Business Administration field students when they choose Engineering field tracks as 2nd track

Course No.	MANE			UEE			DHE		MSE		ECHE		ECE		SLS		SNS		
	MAE	NSE	SDC	ESE	UIE	DME	ID	HFE	AMS	MNE	ENE	ACE	EE	CSE	BIO	BME	PHY	CHEM	MTH
MTH111											✔								
MTH112	✔	✔	✔					✔			✔						✔		✔
MTH201	✔	✔	✔	✔	✔	✔			✔	✔		✔	✔	✔		✔	✔		✔
MTH211																			
PHY101[1]	✔	✔	✔								✔						✔		
PHY103	✔	✔	✔						✔	✔	✔	✔	✔	✔		✔	✔		
PHY107	✔	✔	✔						✔	✔			✔	✔			✔		
PHY108	✔	✔	✔						✔	✔			✔	✔			✔		
CHM101									✔	✔	✔	✔			✔	✔			
CHM102									✔	✔	✔	✔			✔	✔		✔	
CHM105									✔	✔		✔						✔	
CHM106									✔	✔		✔						✔	

1) Students who complete 'General Physics' in 2009 don't have to take 'General Physics I' because they were designated as similar courses in 2009.

▶ Fundamentals required by another School students when they choose School of Management Engineering track as 2nd track

Course No.	SME
	MGE
MTH211	✔

▶ Accepted courses to take when change the field

Category			Course
Business administration	⇒	Engineering	Calculus[1] = Calculus I
			Business Programming = Engineering Programming I
Engineering	⇒	Business administration	Calculus I = Calculus[1]
			Engineering Programming I = Business Programming
			General Physics I = General Physics
			General Chemistry I = General Chemistry

1) 'Calculus' is abolished from 2017 and both BA and engineering field students should take 'CalculusI'.

5. Replacement of Dynamics of IT ※ For students who entered 2009~2012 and majored track before 2014

▶ Designated course by the school ※ Complete based on 1TR

School	Track	Course No.	Course Title
Mechanical, Aerospace and Nuclear Engineering	SDM, TFP	MEN250	Mechanical Drawing and Lab
	NSE	NSE480	Introduction to Nuclear Engineering IT
Urban and Environmental Engineering	Numerical Modeling and Analysis		
Design & Human Engineering	Interactive Technology / Computational Tools for Engineers : Choose one		
Materials Science and Engineering	MSE	AMS390	Introduction to Computational Materials Science
Energy and Chemical Engineering	ENE	ENE480	Scientific Expression with IT
	ACE	ACE301	Computational Methods for Chemical Engineering
Electrical and Computer Engineering		CSE201	Digital Logic (= Digital System Lab)
Life Sciences	BIO	ACE301 or BME301	Computational Methods for Chemical Engineering / Computational Methods for Biosciences and Bioengineering : Choose one
	BME	BME301	Computational Methods for Biosciences and Bioengineering
Natural Science	NCS	ACE301 or BME301	Computational Methods for Chemical Engineering / Computational Methods for Biosciences and Bioengineering : Choose one
Business Administration			Dynamics of IT

6. AHS Courses

▶ Liberal Arts

At most 2 courses in the same field will be accredited as AHS required credits to all students (including students who entered before 2016) who register Liberal Arts courses from 2016.

AHS101	Law and Social Life 법과 사회생활	3-3-0
AHS201	Law and Technology 법과 과학기술	3-3-0
AHS111	Arts and Creativity 예술과 창의성	3-3-0
AHS211	Design Thinking 디자인 씽킹	3-2-1
AHS121	Music and Creativity, Piano 음악과 창의성, 피아노	3-1-2
AHS122	Music and Creativity, Strings 음악과 창의성, 현악	3-1-2
AHS221	Advanced Piano 피아노 연주	3-1-2
AHS222	Chamber Music 실내악	3-1-2
AHS131	Literature and Creativity 문학과 창의성	3-3-0
AHS231	A Poetics of the Novel 소설의 시학	3-3-0
AHS141	Media and Culture 미디어와 문화	3-3-0
AHS241	Effective Communication 효과적 커뮤니케이션	3-3-0
AHS151	History of Korean Civilization 한국문명사	3-3-0
AHS152	Evolution of Civilization 문명의 발전	3-3-0
AHS251	Histor of Modern Korea 한국 근현대사	3-3-0
AHS252	History of Contemporary World 현대 세계사	3-3-0
AHS253	History of Science and Technology 과학기술사	3-3-0
AHS254	Understanding Korea 한국의 이해	3-3-0
AHS161	What is I? 나의 정체성	3-3-0
AHS261	Contemporary Philosophy 현대 철학	3-3-0
AHS171	Science of Human Behavior 인간행동의 과학	3-3-0
AHS271	Cognitive Science 인지 과학	3-3-0
AHS181	Discovering Anthropology 인류학의 발견	3-3-0
AHS186	Understanding Political Science 정치학의 이해	3-3-0
AHS281	Society and Culture 사회와 문화	3-3-0
AHS286	Science and Technology Policy 과학기술 정책	3-3-0
AHS291	Globalization and Economy 세계화와 글로벌경제	3-3-0

▶ Free Elective

AHS courses which are changed from Liberal Arts to Free Elective in 2016 will be recognized as Liberal Arts if He/She taken courses before 2016.
It is the same as course retake after 2016.

※ Courses which are changed from Liberal Arts to Free Elective in 2016

AHS310	Topics in Arts 예술 특강	3-3-0
AHS320	Topics in Music 음악 특강	3-1-2
AHS330	Topics in Literature 문학 특강	3-3-0
AHS340	Topics in Communication Studies 커뮤니케이션 특강	3-3-0
AHS350	Topics in History 역사 특강	3-3-0
AHS360	Topics in Philosophy 철학 특강	3-3-0
AHS380	Topics in Anthropology 인류학 특강	3-3-0
AHS398	AHS Special Topics Ⅰ AHS 특강 Ⅰ	Variable
AHS399	AHS Special Topics II AHS 특강 II	Variable

7. History of Courses Change of 2009–2018

□ Math

2009		2010		2017~
MTH101 Calculus (3)	⇨	MTH101 Calculus (3) MTH111 Calculus Ⅰ (3) MTH112 Calculus II (3)	⇨	MTH111 Calculus Ⅰ (3) MTH112 Calculus II (3)
-	⇨	MTH103 Applied Linear Algebra (3)		

※ Student already took Calculus in 2009 should take 'Applied Linear Algebra, Differential Equations, Statistics' 3 courses.

□ Science

2009		2013~
CHE104 General Chemistry Lab (2)	⇨	CHM105 General Chemistry Lab Ⅰ (1) CHM106 General Chemistry Lab II (1)
PHY106 General Physics Lab (2)	⇨	PHY107 General Physics Lab Ⅰ (1) PHY108 General Physics Lab II (1)

□ MGT

2009		2010		2011		2014		2018
GMT105 Economics (3)	⇨	GMT105 Microeconomics (3)	⇨	GMT106 Economics (3)	⇨	MGT106 Economics (3)		
				GMT102 Innovation and Entrepreneurship (3)	⇨	MGT102 Innovation and Entrepreneurship (3)	⇨	MGT102 Entrepreneurship & Big Data

□ IT

2009-1		2009-2		2010		2013		2018
ITP103 Java (2)	⇨	ITP106 Intro. to Programming (3)	⇨	ITP107 Engineering Programming (3)	⇨	ITP107 Engineering Programming I (3)	⇨	ITP107 Introduction to AI Programming I (3)
ITP104 C++ (2)				ITP108 Business Programming (3)		ITP108 Business Programming (3)		

2009-1		2009-2		2011		2013		2018
ITP101 Excel (2)	⇨	ITP105 Practical IT (2)	⇨	ITP117 Engineering Programming Lab (2)	⇨	ITP117 Engineering Programming II (2)	⇨	ITP117 Introduction to AI Programming II (3)
ITP102 Access (2)				ISM202 Dynamics of IT Lab (2)	⇨	ISM202 Business IT (2)		

2009		2012		2013~
ISM201 Dynamics of IT (3)	⇨	ISM201 Dynamics of IT (3) or designated course by ENG school	⇨	IT course designated by ENG school (3) ISM201 Dynamics of IT (3)

□ Liberal Art

2009		2010		2014		2015		2017
-	⇨	ENG100 English Foundation(0)			⇨	ENG100 English Foundation(2)		
ENG101 Intermediate English (2)	⇨	ENG107 English Forward (2)						
ENG102 Advanced English (2)	⇨	ENG108 Building Writing (2)						
		ENG109 Building Speaking & Grammar (2)						
-		-	⇨	LNG203 Korean Language I (1)	⇨	LNG203 Korean Foundation (2)		
-		-	⇨	LNG204 Korean Language II (1)	⇨	LNG204 Korean for Everyday (2)		
-		-		-		-	⇨	LNG205 Spanish Foundation (2)

2015		2016		2017		2018
-	⇨	AHS101 Law and Social Life (3)				
-	⇨	AHS186 Understanding Political Science (3)				
-	⇨	AHS201 Law and Technology (3)				
-	⇨	AHS271 Cognitive Science (3)				
-	⇨	AHS286 Science and Technology Policy (3)				
		AHS151 History of Korean Culture (3)	⇨	AHS151 History of Korean Civilization (3)		
AHS151 History of Science (3)	⇨	AHS253 History of Science (3)	⇨	AHS253 History of Science and Technology (3)		
				AHS141 Communication Theory (3)	⇨	AHS141 Media and Culture (3)

□ Free Elective

2009		2010		2015
ENG103 Building English Writing (2)	⇨	ENG110 English Language & Culture (3)	⇨	ENG202 English Language & Culture (3)
ENG104 Building English Grammar for Speaking (2)	⇨	ENG111 English for Business (3)	⇨	ENG203 English for Business (3)
ENG105 English24 (3)	⇨	ENG106 Intro. to English Styles (3)	⇨	ENG201 Introduction to English Styles (3)

2014		2015		2017		2018
ENG112 English for Science and Technology (3)	⇨	ENG204 English for Science and Technology (3)				
ENG113 Academic Reading and Writing (3)	⇨	ENG205 Academic Reading and Writing (3)			⇨	ENG205 Critical Academic Literacy (3)
-	⇨	ENG206 English Information and Data(3)				
-		-	⇨	ENG207 Global English in Engineering Community (3)		
-		-		-	⇨	ENG401 Writing in Academic Disciplines (3)
-		-		-	⇨	ENG402 Technical Writing in English

2015		2016~
-	⇨	AHS301 Understanding Copyrights and Patents (3)
AHS300 Climate Change Humanity (3)	⇨	AHS391 Climate Change Humanity (3)
AHS305 Sports and Health (1)	⇨	AHS397 Sports and Health (1)
AHS301 AHS Special Topics Ⅰ (V)	⇨	AHS398 AHS Special Topics Ⅰ (V)
AHS301 AHS Special Topics Ⅱ (V)	⇨	AHS399 AHS Special Topics Ⅱ (V)

8. Course Descriptions

1) Math & Science

MTH111 Calculus I [미적분학 I]

Calculus I is the branch of mathematics dealing with change, rate of change, and motion and it applies in many areas, e.g. engineering, the physical sciences, and the biological sciences. We will investigate the concepts of differentiation and integration of real-valued functions of single variables and their applications. The topics include trigonometrics, logarithmics, hyperbolic functions and their inverse functions, limits, sequence, series and convergence as well as differentiation and integration.

MTH112 Calculus II [미적분학 II]

Beyond basic calculus we study differentiation and integration of vector-valued functions of multi-variables and their applications. The topics include vector functions, partial derivatives, multiple integrals and vector calculus.

MTH201 Differential Equations [미분방정식]

This course studies ordinary differential equations and their existence and uniqueness, and methods for their solution, including series methods and Laplace transforms, systems of differential equations and their solvability, stability, and numerical methods.

MTH203 Applied Linear Algebra [응용선형대수]

This course studies solving systems of linear equations, matrix algebra, linear transformations, determinants, rank, vector spaces, eigenvalues and eigenvectors and diagonalization.

MTH211 Statistics [통계학]

This course introduces the concepts of probability and distribution, expectation, distributions of functions of random variables, statistical inference, estimation, and statistical tests.

PHY101 General Physics I [일반물리학 I]

Physics I is the first half of a one-year introductory university physics course intended for students who plan to major in the fields of science and engineering. It introduces the fundamental concepts and analytical descriptions of classical mechanics, wave mechanics, and thermodynamics. Topics covered include measurement basics of physical quantities, vectors, translational motions in one, two, and three dimensions, force, conservation laws of energy and momentum, rotational motion, gravitation, fluid mechanics, description of waves, kinetics of gases, and thermodynamic laws. Knowledge of calculus is routinely used but the emphasis is placed on understanding basic concepts. E-educational system will be actively used in conjunction with class lectures.

PHY102 General Physics I H [고급일반물리학 I]

Students, who take this course will learn in-depth physics and will experience a new world of physics. It covers the same contents as General Physics I.

PHY103 General Physics II [일반물리학 II]

Physics II is the second half of a one-year introductory university physics course intended for students who plan to major in the fields of science and engineering. It introduces the fundamental concepts and analytical descriptions of electricity, magnetism, optics, and also modern physics based on quantum physics. Topics covered include electric forces and fields, electric energy, capacitance and resistance, circuits, magnetic forces and fields, induction, electromagnetic waves, reflection and refraction of light, wave optics, atomic physics, electrical conduction of solids, and subatomic (nuclear, elementary particles) physics. Knowledge of calculus is routinely used but the emphasis is placed on understanding basic concepts. An E-education system will be actively used in conjunction with class lectures.

PHY104 General Physics II H [고급일반물리학 II]

Students, who take this course will learn in-depth physics and will experience a new world of physics. It covers the same contents as General Physics II.

PHY105 General Physics [일반물리학]

Physics is a one-semester introductory university physics course intended for students planning to major in technology management. This course focuses on providing students with the fundamental ideas of general physics area to help them understand modern technology from a technology management perspective. Hence the majority of course is devoted to discussing the basic principles and concepts of physics although knowledge of calculus is assumed. Topics covered will be selected from classical mechanics, thermodynamics, electricity and magnetism, optics, and modern physics. The E-educational system will be actively used in conjunction with class lectures.

PHY107 General Physics Lab Ⅰ[일반물리학실험Ⅰ], PHY108 General Physics Lab Ⅱ[일반물리학실험Ⅱ]

This laboratory has been designed to assist students in the General Physics I & II. Laboratory work constitutes an essential part of all physics courses. This lab does not only give an opportunity to the engineering students to establish a bridge between the theoretical concept that they learn in classroom and the real physics experiments, but also helps them to improve their application skills. Experiments in this lab have been specifically designed to cover the fundamental aspects of General Physics I & II. General Physics I lab covers nine mechanical experiments and General Physics II lab covers nine experiments of electricity and magnetism.

CHM101 General Chemistry I [일반화학 I]

This course presents the concepts and models of chemistry. Topics include atomic and molecular structure, nomenclature, chemical reaction and stoichiometry, atomic structure and periodicity, chemical bonding, physical and chemical equilibrium, and thermochemistry. This course is designed for students who plan to major in science and engineering.

CHM102 General Chemistry II [일반화학 II]

As the continuation of General Chemistry I, this course includes acid and base, chemical kinetics, electrochemistry, transition metal chemistry, nuclear chemistry, and organic chemistry. This course is designed for students who plan to major in science and engineering.

CHM103 General Chemistry [일반화학]

This course presents chemistry conceptually, focusing on the study of how atoms combine to form materials, on what materials are made of, and why they behave as they do. This course is designed for students who plan to major in the business administration.

CHM105 General Chemistry Lab Ⅰ[일반화학실험Ⅰ]

This course is designed to demonstrate fundamental principles of general chemistry in a laboratory environment. This laboratory and its experiments help students understand the underlying concepts, experimentation and of laboratory instruments and techniques. It will be an effective way to make chemistry more fun.

CHM106 General Chemistry LabⅡ[일반화학실험Ⅱ]

This course is a continuation of CHM105 with emphasis upon solution properties, kinetics, equilibrium, acids and bases, and quantitative analysis.

BIO101 General Biology [일반 생물]

This is a one-semester course dealing with the principles and concepts of biology needed for success in higher level science courses. Topics include the organization of living matter, cell structure, enzymes, metabolism, energy transformation, reproduction, genetics, and DNA technology. Each class will consist of two lectures per week.

2) Management

MGT102 Entrepreneurship & Big Data [기업가정신과 빅데이터]

This course provide a broad-based introduction to entrepreneurship and big data analysis for all UNIST students. It consists of two parts: (1) Entrepreneurship and (2) Big data.
The Entrepreneurship part is intended to be an introduction to the business world for students who aspire to become entrepreneurs or leaders, whether launching new ventures directly from school or aspiring to lead an organization later in their careers. Knowledge and insights gained from this course help students develop deeper understanding of the mindset, leadership, and attributes of successful entrepreneurs. Furthermore, by examining their entrepreneurial processes, students will be able to shape and define their core values, personal philosophies, leadership, as well as understand and

identify opportunities to create something new and better for the world. It is a “think about it” course in which students learn entrepreneurship and get the feel for what management in the real world is about. Upon successful completion of the course, every student is expected to be charged with enthusiasm for the study at the UNIST, excitement for the business world, and confidence for his/her professional career in the future. The Big data part provides an introduction to data science and analytics especially focusing on the new trend of big data analytics and their applications. Big data is becoming a growing necessity within managers for better decisions to understand better various phenomenon in business. To obtain opportunity to realize enormous gains in terms of efficiency, productivity, revenue, profitability and better decision, big data is becoming less of a competitive advantage and more like an industry standard. This course explores cutting-edge companies supporting an exciting new generation of business analytics. This course aims to demonstrate how the winners of the future will use big data to seek the truth, and to guide on how to win customers, beat competitors, and boost the bottom line with big data. Through this part, students learn to explain what big data is, and how it will transform the enterprise; learn more about the trends in big data and how managers use them effectively to make critical decision; read and discuss case studies of big data use in big companies; discuss real-world examples from a variety of organizations leveraging big data; explore how to link big data initiatives in organization’s value creation process; explore values surrounding operationalizing big data in organization, including educational challenges.

MGT106 Economics [경제원론]

This course aims to provide a basic understanding of Economics. This course provides an introduction to the analysis of the principles underlying the behavior of individual consumers and business firms. Topics include problems of international trade, distribution of incom, problems of environmental pollutions, and effects of various market structures on economic activity.

3) IT

ITP107 Introduction to Artificial Intelligence Programming I [기초 인공지능 프로그래밍 Ⅰ]

This course aims to introduce fundamental concepts and methodologies of computer programming in Python which will lead to develop basic components of artificial intelligence systems and applications. Students will learn basic programming skills such as using programming syntax, making a logical decision, and looping a logic as well as introductory computer algorithms such as data sort and search from on/offline lectures. Students will also gain hands-on programming experiences with artificial intelligence examples.

ITP117 Introduction to Artificial Intelligence Programming II [기초 인공지능 프로그래밍 Ⅱ]

This course aims to teach basic problem solving skills using Python and deliver an experience to develop foundational artificial intelligence applications and systems using a deep learning tool. This course also aims to teach how to use hardware platforms such as Raspberry-Pi and Jetson to develop artificial intelligence applications. With the tools provided, students will gain hardware control experiences such as controlling cameras, displays, and motors as well as gain programming experiences on artificial intelligence such as image classification with MNIST and CIFAR-10 datasets and music generation.

4) English

ENG100 English Foundation

This course is offered for students who need training in four English skills (listening, reading, speaking, and writing) at the low intermediate level (level 1 from the placement test). Through engaging in authentic tasks, the students will build English proficiency required for academic communication. The class will address diverse topics designed for online and offline activities.

ENG107 English Forward

This course is the general English class which focuses on training in production skills at the high-intermediate level. The major goal of the course is to help the students placed to level 2 grow more autonomous in learning English through online and offline integrated learning activities. By actively participating in various tasks, the students will improve their English skills mainly for academic purposes.

ENG108 Building Writing

This course is a practice of English writing along with building grammatical competence necessary for a good writer in an academic field. The students will actively participate in on-line and in-class practices of English papers, essays, and correspondence.

ENG109 Building Speaking

This course is a practice of English speaking and conversation in relation to appropriate uses of English grammar in speaking. The students are expected to develop fluency and accuracy in English speaking by learning through on-line materials and participating in classroom activities.

5) Foreign Languages

LNG201 Chinese Foundation

Chinese Foundation is intended for the students who have never studied Chinese language before. The objectives of this course are to enable the students to master some basic knowledge about Chinese language (phonetics, grammar structures, characters etc.) and gain the ability to use the knowledge in simple conversations.

LNG202 Chinese Forward

Chinese Forward is intended for the students who have learned Chinese language for one semester before. The objective of this course is to improve students' ability to use Chinese, including listening, speaking, reading and writing. This course will be accomplished through the use of board and in class practices. Students will have the chance to make simple conversations about their daily lives with other students and the instructor as well as write some easy essays.

LNG203 Korean Foundation

The aim of this class is developing abilities of non-native speakers. In the beginner level 1 the aim is that of fundamental communication in Korean, beginning with learning vowels and consonants, self-introductions, shopping, express of numbers, phone numbers, dates and prices, ask and give for direction, talking about your friend's schedule etc. Vocabulary related to time and location and students can also make sentences by themselves using basic verbs. Also, students will understand and express themselves in every day life situations.

LNG204 Korean for Everyday

The purpose of the lecture is to improve Korean language ability of learners who are educated Korean language for more than 75 hours or has Korean language ability corresponding to the above. The lecture will make learners perform basic language functions required to daily life such as expressing a plan, ability, symptoms, describing, asking opinions, making suggestions, promising and expressing experience.

LNG205 Spanish Foundation

Spanish Foundation is intended for the students who have never studied Spanish language before. The objectives of this course are to enable the students to master some basic knowledge about Spanish language (phonetics, grammar structures, characters etc.) and gain the ability to use the knowledge in simple conversations.

6) AHS

AHS 101 Law and Social Life [법과 사회생활]

This course explores a range of legal disciplines which purport to explain how we are governed globally and which propose projects for improving global governance through law. We will focus on the field of international law and organization, examining the history of ideas, legal doctrines, institutional and administrative structures developed over the last century to organize and legalize international economic and political life.

AHS111 Arts and Creativity [예술과 창의성]

This course introduces students to the use of arts and design to develop fresh approaches to creating new content in the arts, humanities, and technologies. Students explore diverse themes and topics in the contemporary arts, digital humanities, and product prototyping to create novel media objects or compositions through teamwork. Readings include a selection of classic and contemporary critical cultural texts from the arts and design.

AHS121 Music and Creativity, Piano [음악과 창의성, 피아노]

This course encourages students to develop creativity and excellence in the study of music through piano performance. The first few classes will be devoted to the history of Western classical music, and the rest will focus on the performance of piano music. Students will have an opportunity of performing both solo piano literature and ensemble piano music with proper musical technique. Students will also be able to develop good communicative skills through the process of making music together to arrive at interpretive and creative conclusions for an end-of-semester concert performance.

AHS122 Music and Creativity, Strings [음악과 창의성, 현악]

This course encourages students to develop creativity and excellence in the study of music through string performance. During the first three weeks of class, history of Western music will be introduced. The rest of the semester will focus on exploring string instruments of choice. Students will have an opportunity of performing string quartet literature with proper instrumental technique and creative musicianship. Students will also be able to develop good communicative skills through chamber music performance, and learn the value of teamwork. The concert that is held at the end of the semester, will give students the opportunity to perform in front of a large audience, allowing them to take a glimpse of the life of string quartet performers.

AHS131 Literature and Creativity [문학과 창의성]

To understand literary genres, which are the formal structure of literature, this course aims to develop critical thinking and basic skills of analysis. For this aim, it surveys poetry, fiction, drama, and the literary essay (including a travelogue, a diary, and reportage). While comprehending individual works on the basis of their stylistic traits, students are expected to learn literary terms and build their own aesthetic judgment through group discussions and guided discussions with the instructor. This course is particularly designed for freshmen who have been rarely exposed to various forms in literature.

AHS141 Media and Culture [미디어와 문화]

This course aims to introduce you to a topic ranging from human interaction, TV, film, and sound to communicative consequences of globalization, and to provide you with a way of thinking about fundamental concepts that you will find in other areas of communication studies and further applyin an interdisciplinary field. Fundamental concepts discussed in the course will facilitate a new way of thinking and learning knowledge and skills that constitute moral and ethical views on our lives.

AHS151 History of Korean Civilization [한국문명사]

This course traces the emergence of a distinctive civilization on the Korean peninsula in Northeast Asia from prehistory to the modern day. It looks at the emergence of both Korean culture and a Korean state and then turns to how Korea managed to maintain its cultural and political autonomy over the centuries. It examines social and cultural changes, the status of women, the rise of ideologies such as nationalism, communism, and democracy, and the transformation of the religious landscape of Korea.

AHS152 Evolution of Civilization [문명의 발전]

This course is designed to chronologically explore the major events, issues, and debates that have shaped the world from the birth of civilization to the present. While focusing on the West, the course also pays attention to how the West interacted with the rest of the world. Students will be guided to consider how politics and economy shaped society and culture.

AHS161 What is I? [나의 정체성]

In this course we shall examine various philosophical views at the preliminary level. The aim of the course is to provide the students with a general introduction to seminal questions in philosophy, to lead them to engage in deep thinking and reflections on important matters in life, and to enable them to make their own arguments on a given issue in a critical and reasonable fashion.

AHS171 Science of Human Behavior [인간행동의 과학]

This course explores the introductory in psychology, such as perception, learning, memory, sleep and mental illness. There will be an overview of history of psychology, cognitive psychology, evolutionary psychology, social psychology, developmental psychology, educational psychology, clinical psychology, counseling psychology, and so forth.

AHS181 Discovering Anthropology [인류학의 발견]

The course introduces a cultural perspective on human behavior based on anthropology, the comparative study of cultures. The concepts and terms for social scientific study of culture are introduced through the presentation of case studies from diverse cultures, through the viewing of ethnographic films and other materials. Topics covered include social structure, social institutions, family and kinship, economic organization, politics and ritual behavior. In addition to ethnography, archaeology and linguistics are included for their contributions to anthropology.

AHS 186 Understanding Political Science [정치학의 이해]

This course introduces the key concepts, theories, methods and issues of political science, divided into three subfields of political theory, comparative politics, and international relations. While political theory provides students with a solid understanding of the concepts underpinning the discipline, comparative politics introduces the analysis of political institutions, processes, and outcomes at the national level. Finally, international relations will introduce students to the increasing importance of supranational institutions and actors. Major case studies from Korea, the USA, Europe and other regions may be presented.

AHS 201 Law and Technology [법과 과학기술]

An introduction to and exploration ofthe intersection of science and the law, focusing on the intellectual property system and the various means by which the conduct and products of scientific research are regulated. The course will analyze and compare American, international, and theoretical alternative systems. The course will also explore particular scientific areas in depth (Possible examples could include the human genome project; the Internet and cyberspace; cloning; the law of the sea; international cooperation on Antarctica; and outer-space exploration).

AHS211 Design Thinking [디자인 씽킹]

Using the design process and DBL(Design-Based Learning) we solve the problem in visual ways under the double diamond methodology which is spreaded from D. SCHOOL at Stanford University to use Design Thinking to work on multiple real world challenges in a diverse team. Tenets of design thinking including being human-centered, prototype-driven, and mindful of process. Topics include design processes, innovation methodologies, human factors, visualization, rapid prototyping, team dynamics, storytelling, and project leadership. It is more for collaborative and multidisciplinary project activity that make students familiar with basic perceptual concepts as well as two-dimensional and three-dimensional visual concepts. It moves into a more sophisticated problem-solving environment in which structure, organization, composition, proportion, scale will be emphasized.

AHS221 Advanced Piano [피아노 연주]

This course is reserved for students who already have fundamental knowledge and experience of piano playing. Students will further develop and refine their piano technique through performing advanced piano repertoire and technical exercises. Since the course deals with difficult piano pieces in different styles, extensive practice outside of class will be required.

AHS222 Chamber Music [실내악]

This course is reserved for students who already have fundamental knowledge and experience of string playing, or for students who have taken AHS 122. Students will further develop their instrumental skills through exploring advanced string chamber music repertoire.

AHS231 A Poetics of the Novel [소설의 시학]

This course aims to examine the genre of novel by looking into various aspects such as plot, point of view, characters, figurative language, motif, etc. A critical attention will also be paid to the context surrounding the work of a novel. Given the popularity and dominance of novel in contemporary literature, a close reading of a novel or two in this course will help students comprehend the genre and narrative in general. A group discussion based on in-depth analysis of the literary work will be the core of classroom activities and students will be expected to develop independent and critical thinking.

AHS241 Effective Communication [효과적 커뮤니케이션]

In this course, we'll learn about rhetoric as fundamental concepts and skills for communication. This will involve considering how communication is produced, in what way its meanings are shared in particular contexts, and how engaging in certain texts and meanings shapes various effective communicative forms of public life.

AHS251 History of Modern Korea [한국 근현대사]

This course covers the contemporary Korean history after the Korean War(1950-1953). With the emphasis on the aftermath of the Cold War, the development of the democratization movement, the progression of nationalism, the success of industrialization, and the transnational movement of Korean pop culture (Hallyu 韓流), the class will examine such crucial topics of our days as nationalism, civil society, social/technology, gender, regionalism, historiography, religion, and popular culture.

AHS252 History of Contemporary World [현대 세계사]

This course is designed to thematically explore how modern world has been shaped. Taking global perspective, it traces the flow of people, idea, culture, money, and technology in the 20th century. The goal of this course is to help you better understand our current world.

AHS253 History of Science and Technology [과학기술사]

Science and technology have produced both benefits and risks since the beginning of human civilization. This course encourages students to critically examine how historical, cultural and political contexts have influenced the developmental pathways of science/technology and vice versa. Students will analyze how public perception of science/technology has been constructed within specific social, political and local circumstances. Our ultimate goal is challenging: we aim to devise a new system where the public can trust science/technology and science/technology can meet with the public’s practical concerns in current society.

AHS254 Understanding Korea [한국의 이해]

Korea is often known as “the hermit kingdom” or “the land of morning calm” to Westerners. Contrary to the static and even passive images in such expressions, Korea has gone through swift changes internally and externally. As an introduction of Korea particularly designed for UNIST's international students, this course aims to examine various issues regarding what makes the current shape of Korea by dealing with specific topics in society, culture, history, literature, and others. In order to keep an academic depth while covering the topics comprehensively, instructors in the Division of General Studies will take turns to teach individually or collaboratively. Course materials are English translations and class discussion will also be conducted in English.

AHS261 Contemporary Philosophy [현대 철학]

This course deals with the central issues of contemporary philosophy. We will discuss in depth at least one of the main branches in philosophy such as metaphysics, logic, ethics, philosophy of science, and philosophy of mind. Since the issues covered in contemporary philosophy are diverse, the specific contents of the course may vary. There are no prerequisites for this course.

AHS 271 Cognitive Science [인지 과학]

Cognitive science is the interdisciplinary scientific study of the mind and its processes. It examines what cognition is, what it does and how it works. It includes research on intelligence and behaviour, especially focusing on how information is represented, processed, and transformed (in faculties such as perception, language, memory, attention, reasoning, and emotion) within nervous systems (humans or other animals) and machines (e.g. computers). Cognitive science consists of multiple research disciplines, including psychology, artificial intelligence, philosophy, neuroscience, linguistics, and anthropology.

AHS281 Society and Culture [사회와 문화]

This course aims to provide students with a solid understanding of society and culture by examining various social and economic institutions, processes, and issues. The course will specifically focus on topics and issues that figure prominently in social trends and patterns of change; the issues may include gender roles, family, education, identity, environmental issues and globalization. Each of these issues will be examined through anthropological, sociological, comparative or/and historical perspectives.

AHS 286 Science and Technology Policy [과학 기술 정책]

Science and technology policy is very important since if fulfills the two functions of boosting research and development (R&D) and linking it with the industrial sector. In this class, students are expected to understand the government's role in framing and carrying out the policy, and they should know the characteristics of Korea’s national innovation system. Students will be able to understand current situation of Korea by understanding the changes that were made during the last half of 20th century. Students will also discuss the future pathways for furthering science and technology policy development in Korea.

AHS291 Globalization and Economy [세계화와 글로벌경제]

This course focuses on what constitute the key economic issues that feature in the debate over economic globalization and what challenges each issue faces. We will start discussing the key economic issues from the 5th week to the final (15th) week. Especially, you will team up with other classmates and each team will prepare for in-class presentation and present for the 12th to the final (15th) weeks on one of the key economic issues covered in class. In addition, this course, to make students better grasp the key economic issues and their challenges that stem from the process of economic globalization, will provide students with lectures on the introductory and core principles of economics (microeconomics) which will be covered in class over the 1st to the 4th (or 5th) weeks.

7) Free Electives

ENG201 Instruction to English Styles

This course is an introduction to various English styles. Through reading and listening to varieties of English(informal and formal English; newspaper; correspondence; stories etc.), students will understand appropriate uses of English styles to different time and place.

ENG202 English Language and Culture

This course introduces the crucial relationship between English language and culture. Students are expected to learn how to manage different communicative tasks appropriately to the cultural and contextual constraints. Through reading and listening to various texts/episodes of English, students will practice how to handle communicative problems in terms of culture.

ENG203 English for Business

This course will help the students understand practical English in a business situation. Students will learn and practice how to function in business-related contexts in English appropriately and effectively.

ENG204 English for Science and Technology

The course is designed to engage students in English for science and technology. To this end, the course offers situation-based listening and speaking activities, content-based reading exercises, and scientific research writing practices. At the end of this course, students will be able to achieve necessary English proficiency as scientists.

ENG205 Critical Academic Literacy

The course is designed to develop students' academic reading and writing processes. Toward this end, the course covers the nature of academic writing, critical thinking and argumentation, while students engage in academic content area reading followed by in-depth discussion. At the end of this course, students will be able to critically evaluate and read academic contents, and re-synthesize the contents.

ENG206 English Language, Information, and Data

“English Language, Information, and Data" introduces and discusses the theory of language underlying the large-scale collection of texts designed for research purposes, To this end, the course focuses on the principles of the theory and practice of the corpus linguistic approach to language with computerized text analysis programs. Specifically, the statistical quantitative analysis of language and the quantitative analysis of semantic prosody are discussed to account for understanding human cognition, interaction, behaviour and discourses. The course also discusses the application of analysis results in the diverse areas of scientific disciplines.

ENG207 Global English in Engineering Community

Global English in Engineering Community is designed to help engineering students develop strategies to achieve interactional goals, either in speaking or writing, when English is used with speakers with other cultures. The course emphasizes acquisition of some of the interaction strategies that will promote proper relations in the globalized world, e.g., ways to communicate engineering topics, establish rapport, and further minimize cultural differences. Further, the course accommodates to textual competence of English used as an international language in an engineering community.

ENG401 Writing in Academic Disciplines

The course is designed to help entry level graduate students expand their knowledge of scientific English in the relevant fields and develop the essential communication skills needed in the specific contexts. The major aim of the course, therefore, is to build up students' confidence in using English in a variety of academic settings of scientific community. To this end, the course consists of student presentations, workshops, lectures and discussions involving various types of scientific writing.

ENG402 Technical Writing in English

This course is designed to help graduate students in engineering and science with their course-specific writing tasks. You will find the course most productive if you are already engaged in a research project; you can then use your own data in the course assignments. As the author of your own paper, you will be responsible for leading group discussions and for explaining assigned readings.

AHS301 Understanding Copyrights and Patents [지적 재산권]

This course introduces the intellectual property rights protected by copyright law with particular attention to issues of Cyberlaw (e.g., software and digital copying), Entertainment Law (e.g., music industry), and Communications Law (e.g., cable-related issues). International aspects will be considered as well.

In addition, the course introduces the history and structure of the patent system, focusing on what patents are and how they function. Students will also learn the requirements for obtaining a patent. Patent enforcement is explained in relation to the issues of infringement, defenses to infringement, and remedies.

AHS310 Topics in Arts [예술 특강]

This course focuses on a special topic in the field of Arts. The particular contents of this course will be chosen by the instructor each semester when it is offered.

AHS320 Topics in Music [음악 특강]

This course focuses on a special topic in the field of music. The particular contents of this course will be chosen by the instructor each semester when it is offered.

AHS330 Topics in Literature [문학 특강]

This course focuses on a special topic in the field of literature. The particular contents of this course will be chosen by the instructor each semester when it is offered.

AHS340 Topics in Communicate Studies [커뮤니케이션 특강]

This course focuses on a special topic in the field of communication. The particular contents of this course will be chosen by the instructor each semester when it is offered.

AHS350 Topics in History [역사 특강]

This course focuses on a special topic in the field of history. The particular contents of this course will be chosen by the instructor each semester when it is offered.

AHS360 Topics in Philosophy [철학 특강]

This course focuses on a special topic in the field of philosophy. The particular contents of this course will be chosen by the instructor each semester when it is offered.

AHS370 Topics in Psychology [심리학 특강]

This course focuses on a special topic in the field of psychology. The particular contents of this course will be chosen by the instructor each semester when it is offered.

AHS380 Topics in Anthropology [인류학 특강]

This course focuses on a special topic in the field of anthropology. The particular contents of this course will be chosen by the instructor each semester when it is offered.

AHS391 Climate Change Humanity [기후변화인문학]

This course is designed for students who are interested and major in engineering, natural science, and other majors, with displines of climate change. Climate change, as reality or sometime ideology, has been influencing our world life and modality of research, and also our way of thinking. Thus, as engineer and scientist, there is need to think over the issue and more importantly reflect our structure of thinking (both logically and scientifically) and conscienceness, to have identity as UNIST engineer and scientist.

AHS397 Sports and Health [스포츠와 건강]

The course provides instruction in fitness activities for the development of physical and mental health.

AHS398 AHS Special Topics Ⅰ[AHS 특강 Ⅰ]

This course focuses on a special topic in any field of AHS.

AHS399 AHS Special Topics Ⅱ [AHS 특강 Ⅱ]

This course focuses on a special topic in any field of AHS.

School of Mechanical, Aerospace and Nuclear Engineering

1. School Introduction

The School of Mechanical, Aerospace and Nuclear Engineering (SMANE) consists of three tracks such as Mechanical and Aerospace Engineering (MAE), Nuclear Science and Engineering (NSE) and System Design and Control Engineering (SDC). The SMNE focuses on world-class research and education in order to nurture creative experts and scholars who can contribute to the development and advancement of cutting-edge industries. Interdisciplinary approaches with the state-of-the-art facilities by concentrating on a variety of research fields, including design, manufacturing, thermofluid engineering, system control, robotics, system analysis, unmanned vehicles, aerospace engineering, energy, nuclear reactions, nuclear fuels and nuclear fuel cycle, nuclear fuel cladding and structural materials, nuclear reactor/system, and many nuclear applications. Although the SMANE provides two disciplines with students it together emphasizes the creativity and ingenuity of the education.

2. Undergraduate Programs

□ Track Introduction

1) Mechanical and Aerospace Engineering (MAE)

Mechanical and Aerospace Engineering deals with numerous systems and has a variety of important applications such as automobiles, aircraft, ships, home appliances, electronic devices, power plants and so on. The mechanical systems and the fundamental science and technology of mechanical and aerospace engineering have made dramatic advances and high impacts on the global economies and the standard of living. In the track of mechanical and aerospace engineering, students are educated and trained to learn the underlying principles of mechanical and aerospace engineering and to apply the knowledge to real-world examples and case studies hands-on. Disciplines include thermodynamics, fluid mechanics, solid mechanics, dynamics, machine design, advanced materials processing, laser-assisted manufacturing, micro/nano machining, unmanned vehicle control, MEMS, biomedical products, controls and mechatronics, acoustics, tribology and so on.

2) Nuclear Science and Engineering (NSE)

The science and engineering principles for nuclear engineering are provided, which are related to using the energy released from nuclear fission or fusion such as nuclear power generation, nuclear propulsion, nuclear radiation applications. Education and research topics include design principles and analyses for nuclear reactions, commercial light water reactors and next-generation nuclear reactors such as liquid-metal-cooled fast reactor and gas-cooled reactor for hydrogen generation, nuclear fusion reactor, fuel cycle and nuclear waste disposal, systems and components for nuclear reactors, reactor theory, nuclear thermo-hydraulics, nuclear fuel and cladding, nuclear structural materials, liquid metal magnetohydrodynamics, nuclear radiation applications, nuclear chemistry, nuclear reliability, radiation materials, nuclear thermodynamics, radioactive waste, and nuclear instrumentation and control.

3) System Design and Control Engineering (SDC)

System Design and Control Engineering focuses on; (i) rehabilitation robotics (ii) additive manufacturing & simulation (iii) smart factory control, and (iv) machine healthcare. The objective of this track is to provide a course of study that will enable the student: (i) to complement his/her viewpoint of the design activity from sketching to the logical engineering process of creating something new, or modifying/rearranging something that pre-exists for improvement, and thus (ii) to think not only creatively, but also systematically for the design of products, processes or other systems. The track provides the student with essential engineering design knowledge and tools to begin a productive professional career in industry or academia. Furthermore, the track teaches the student how to plan and manage the entire product development process. This will prepare the student to succeed not merely as an engineer designer but also as a design manager who is capable of driving the new product development projects.

☐ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1st Track	2nd Track	
MAE	Required	33	9[1)]	
	Elective	21	9[2)]	
NSE	Required	33	12	
	Elective	21	6	
SDC	Required	24	-	
	Elective	30	18	

1) Students who choose MAE as their 2nd track are required to take at least three out of eight courses: Thermodynamics, Fluid mechanics, Solid MechanicsI, Solid MechanicsII, Dynamics, Mechanical Engineering Lab, Mechanical Drawing and Lab, and Heat Transfer.
2) Students who choose MAE as their 2nd track can take additional required courses for the credits of elective courses.

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
MAE	MTH203	Applied Linear Algebra	2-2
	MTH201	Differential Equations	2-1
NSE	MTH203	Applied Linear Algebra	2-2
	MTH201	Differential Equations	2-1
SDC	MTH203	Applied Linear Algebra	2-2
	MTH201	Differential Equations	2-1

※ Complete based on 1TR
※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' 12 credits.

▶ Fundamentals required to Business field students when they choose Engineering field tracks as 2nd track

Course Title	MAE	NSE	SDC
Calculus II	✔	✔	✔
Differential Equations	✔	✔	✔
General Physics Ⅰ	✔	✔	✔
General Physics Ⅱ	✔	✔	✔
General Physics Lab Ⅰ	✔	✔	✔
General Physics Lab Ⅱ	✔	✔	✔

3. Curriculum ※ Course opening semester is subject to be changed according to School's situation.

□ Mechanical and Aerospace Engineering (MAE)

▶ Required : Core

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MAE	MEN210	Thermodynamics 열역학	3-3-0		1
	MEN220	Fluid Mechanics 유체역학	3-3-0		2
	MEN230	Solid Mechanics Ⅰ 고체역학 Ⅰ	3-3-0		1
	MEN231	Solid Mechanics Ⅱ 고체역학 Ⅱ	3-3-0	Prerequisite: MEN230	2
	MEN250	Mechanical Drawing and Lab 기계제도 및 실습	3-2-2		1
	MEN270	Dynamics 동역학	3-3-0		2
	MEN300	Mechanical Engineering Lab Ⅰ 기계공학실험 Ⅰ	3-1-4	Prerequisite: MEN231, MEN310	2
	MEN310	Heat Transfer 열전달	3-3-0	Prerequisite: MEN210, MEN220	1
Total Credit			24		

▶ Required : Selective[1)]

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MAE	MEN211	Applied Thermodynamics 응용열역학	3-3-0	Prerequisite: MEN210	2
	MEN301	Numerical Analysis 수치해석	3-3-0		2
	MEN320	Applied Fluid Mechanics 응용유체역학	3-3-0	Prerequisite: MEN220	1
	MEN350	Manufacturing Processes and Lab 기계공작법 및 실습	3-2-2	Prerequisite: MEN230	1
	MEN351	Machine Element Design 기계요소설계	3-3-0	Prerequisite: MEN231	2
	MEN370	Dynamic Systems and Control 시스템제어	3-3-0		1
Total Credit			18		

1) Selective requirements for the 1st track students: Take at least three out of six courses: Applied Thermodynamics, Numerical Analysis, Applied Fluid Mechanics, Manufacturing Processes and Lab, Machine Element Design, and Dynamic Systems and Control.

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MAE	MEN302	Introduction to Finite Element Method 유한요소법개론	3-3-0	Prerequisite: MEN230	2
	MEN303	Applied Engineering Mathematics 응용공학수학	3-3-0		1
	MEN352	Creative Engineering Design Ⅰ (Capstone Design) 창의적공학설계 Ⅰ (캡스톤 디자인)	3-1-4		2
	MEN400	Mechanical Engineering Lab II 기계공학실험 II	3-1-4	Prerequisite: MEN231, MEN270, MEN310	1
	MEN411	Combustion 연소공학	3-3-0	Prerequisite: MEN210, MEN220	1
	MEN412	Air-Conditioning and Refrigeration 공기조화냉동	3-3-0	Prerequisite: MEN210	2
	MEN413	Computational Fluid Dynamics 전산유체역학	3-3-0	Prerequisite: MEN301, MEN320	2
	MEN414	Design of Fluid Thermal Systems 열유체시스템 설계	3-3-0	Prerequisite: MEN310	2
	MEN431	Introduction to Plastic Deformation 소성학개론	3-3-0	Prerequisite: MEN231	1
	MEN432	Introduction to Mechanics of Composite Materials 복합재역학개론	3-3-0	Prerequisite: MEN230	1
	MEN451	Introduction to MEMS MEMS개론	3-3-0		2
	MEN452	Creative Engineering Design II (Capstone Design) 창의적공학설계 II (캡스톤 디자인)	3-1-4		1
	MEN453	Computer Aided Engineering 컴퓨터이용공학	3-2-2		1
	MEN454	Optimal Design 최적설계	3-2-2		1
	MEN457	Introduction to Electric-Electronic Engineering 전기전자공학개론	3-3-0	Prerequisite: PHY103	1
	MEN461	Introduction to Robotics 로봇공학	3-3-0		2
	MEN470	Mechanical Vibration 기계진동학	3-3-0	Prerequisite: MEN270	2
	MEN481	UAV Flight Control and Simulation 무인기 비행제어 및 시뮬레이션	3-3-0	Prerequisite: MEN270, MEN370	1
	MEN482	UAV Navigation and Flight Computers 무인기 항법 및 운용	3-3-0	Prerequisite: MEN270, MEN370	2
	MEN497	Special Topics in Mechanical Engineering Ⅰ 기계공학 특론 Ⅰ	3-3-0		-
	MEN498	Special Topics in Mechanical Engineering II 기계공학 특론 II	3-3-0		-
	MEN499	Special Topics in Mechanical Engineering Ⅲ 기계공학 특론 Ⅲ	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
SDC	SDC405	3D Printing 3D 프린팅	3-3-0		1
UIE	UIE204	Mechanics of Materials 재료역학	3-3-0	Prerequisite: UIE201	2
	UIE303	Structural Analysis 구조역학	3-3-0	Prerequisite: UIE204	1
	UIE304	Matrix Structural Analysis 매트릭스구조해석	3-3-0		1
	UIE408	Introduction to Structural Dynamics 구조동역학개론	3-3-0		-
ID	IID201	Design Elements and Principles 디자인요소와 원리	3-2-2		1
	IID221	Design History & Contexts 디자인 역사와 맥락	3-3-0		1
AMS	AMS202	Introduction to Materials Science and Engineering 재료공학개론	3-3-0	Identical: NME202, ENE216	1
	AMS311	Introduction to Metallic Materials 금속재료개론	3-3-0		-
NME	NME270	Introduction to Polymer Materials 고분자재료개론	3-3-0		2
	NME354	Introduction to Semiconductor 반도체개론	3-3-0		2
BME	BME421	Nano-Bioengineering 나노바이오공학	3-3-0		2
Total Credit			102		

□ Nuclear Science and Engineering (NSE)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
NSE	NSE213	Fundamentals of Nuclear Engineering 원자력 공학 개론	3-3-0		1
	NSE214	Introduction to Nuclear Fuel Cycle Engineering 핵주기공학 개론	3-3-0		1
	NSE221	Nuclear Radiation Engineering & Experiment 원자력방사선공학 및 실험	3-2-2		2
	NSE222	Nuclear Materials Engineering & Experiment 원자력재료공학 및 실험	3-2-2		2
	NSE223	Nuclear Chemical Engineering 원자력화학공학	3-3-0		2
	NSE311	Introduction to Nuclear Reactor Theory 원자로이론 개론	3-3-0		2
	NSE312	Introduction to Nuclear Reliability Engineering 신뢰도 공학 개론	3-3-0		1
	NSE313	Nuclear Fuel Engineering & Experiment 핵연료공학 및 실험	3-2-2		1
	NSE325	Nuclear System Engineering & Experiment 원자로계통공학 및 실험	3-2-2		2
	NSE411	Introduction to Radiation Materials Science 방사선 재료 과학 개론	3-3-0		2
	NSE421	Nuclear Reactor Lab 원자로실험	3-0-6		-
	NSE480	Introduction to Nuclear Engineering IT 원자력 IT 개론	3-2-2		2
Total Credit			36		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
NSE	NSE216	Fundamentals of Electromagnetics 전자기학개론	3-3-0		1
	NSE316	Thermodynamics and Metallurgy of Nuclear Materials 원자력재료 열역학	3-3-0		2
	NSE317	Basic MHD Renewable Energy Engineering 전자기 신재생 에너지공학 기초	3-3-0	Prerequisite: NSE216	1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
NSE	NSE318	Nuclear Engineering Design and Lab Ⅰ 원자력공학종합설계프로젝트 Ⅰ	2-0-4	Capstone Design	1
	NSE326	Nuclear Reactor Numerical Analysis 원자로 수치해석	3-3-0		1
	NSE327	Radioactive Waste Management 방사성폐기물관리	3-3-0		1
	NSE328	Nuclear Engineering Design and Lab II 원자력공학종합설계프로젝트 II	2-0-4	Capstone Design	2
	NSE329	Nuclear Engineering Design and Lab Ⅲ 원자력공학종합설계프로젝트 Ⅲ	2-0-4	Capstone Design	2
	NSE416	Nuclear Engineering Design and Lab Ⅳ 원자력공학종합설계프로젝트 Ⅳ	2-0-4	Capstone Design	1
	NSE400	Special Topics on Nuclear Engineering and Science Ⅰ 원자력공학 및 과학 특론 Ⅰ	3-3-0		-
	NSE401	Special Topics on Nuclear Engineering and Science II 원자력공학 및 과학 특론 II	3-3-0		-
	NSE402	Special Topics on Nuclear Engineering and Science Ⅲ 원자력공학 및 과학 특론 Ⅲ	3-3-0		-
	NSE403	Special Topics on Nuclear Engineering and Science Ⅳ 원자력공학 및 과학 특론 Ⅳ	3-3-0		-
	NSE404	Special Topics on Nuclear Engineering and Science Ⅰ 원자력공학 및 과학 특론 Ⅴ	3-3-0		-
	NSE426	Instrumentation and Control Systems 원전계측제어시스템	3-3-0		2
MAE	MEN210	Thermodynamics 열역학	3-3-0		1
	MEN211	Applied Thermodynamics 응용열역학	3-3-0	Prerequisite: MEN210	2
	MEN220	Fluid Mechanics 유체역학	3-3-0		2
	MEN230	Solid Mechanics Ⅰ 고체역학 Ⅰ	3-3-0		1
	MEN270	Dynamics 동역학	3-3-0		2
	MEN301	Numerical Analysis 수치해석	3-3-0		2
	MEN310	Heat Transfer 열전달	3-3-0	Prerequisite: MEN210, MEN220	1
	MEN320	Applied Fluid Mechanics 응용유체역학	3-3-0	Prerequisite: MEN220	1
	MEN457	Introduction to Electric-Electronic Engineering 전기전자공학개론	3-3-0	Prerequisite: PHY103	1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
NME	NME202	Introduction to Materials Science and Engineering 재료공학개론	3-3-0	Identical: AMS202, ENE216	1
	NME203	Thermodynamics of Materials 재료열역학	3-3-0	Identical: AMS203	1
ENE	ENE212	Physical Chemistry Ⅰ 물리화학 Ⅰ	3-3-0	Identical: ACE203, CHM231	1
	ENE322	Instrumental Anaysis 기기분석	3-3-0	Identical: ACE391, CHM391	1
	ENE416	Introduction to Nanoscience and Nanotechnology 나노과학 및 기술	3-3-0	Identical: ACE416, CHM371	1
	ENE480	Scientific Expression with IT 공학IT개론	3-2-2		2
CSE	CSE232	Discrete Mathematics 이산수학	3-3-0		1,2
	CSE311	Operating Systems 운영체제	3-3-0	Prerequisite: CSE221, CSE251	1,2
	CSE341	Principles of Programming Languages 프로그래밍언어	3-3-0	Prerequisite: CSE241	1,2
	CSE421	Database Systems 데이터베이스 시스템	3-3-0	Prerequisite: CSE221, CSE241	1
PHY	PHY204	Electromagnetism Ⅱ 전자기학 Ⅱ	3-3-0	Prerequisite: PHY203	2
	PHY301	Quantum Physics Ⅰ 양자물리학 Ⅰ	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY303	Thermal and Statistical Physics 열 및 통계물리학	3-3-0	Prerequisite: PHY101, PHY103	2
	PHY315	Solid State Physics Ⅰ 고체물리학 Ⅰ	3-3-0	Prerequisite: PHY301	2
Total Credit			**110**		

□ System Design and Control Engineering (SDC)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
SDC	SDC202	Computational Tools for Engineers 공학전산기법	3-3-0		2
	SDC401	Introduction to Mechatronics 메카트로닉스 개론	3-3-0		1
	SDC403	Project Lab 프로젝트 랩	3-3-0		1
MAE	MEN230	Solid Mechanics Ⅰ 고체역학 Ⅰ	3-3-0		1
	MEN250	Mechanical Drawing and Lab 기계제도 및 실습	3-2-2		1
	MEN270	Dynamics 동역학	3-3-0		2
	MEN300	Mechanical Engineering Lab Ⅰ 기계공학실험 Ⅰ	3-1-4	Prerequisite: MEN231, MEN310	2
	MEN370	Dynamic Systems and Control 시스템제어	3-3-0		1
Total Credit			**24**		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
SDC	SDC302	Circuit Theory & Lab 회로이론 및 실습	3-2-2		1
	SDC304	Manufacturing System Design & Simulation 생산시스템설계 및 시뮬레이션	3-3-0		2
	SDC306	System Dynamics 시스템 동역학	3-3-0		2
	SDC402	Applied Robotics 응용로봇공학	3-3-0		2
	SDC405	3D Printing 3D 프린팅	3-3-0		1
	SDC410	Special Topics in SDC Ⅰ SDC 특론 Ⅰ	3-3-0		2
	SDC420	Special Topics in SDC II SDC 특론 II	3-3-0		-
	SDC430	Special Topics in SDC Ⅲ SDC 특론 Ⅲ	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MAE	MEN210	Thermodynamics 열역학	3-3-0		1
	MEN220	Fluid Mechanics 유체역학	3-3-0		2
	MEN231	Solid Mechanics II 고체역학 II	3-3-0	Prerequisite: MEN230	2
	MEN301	Numerical Analysis 수치해석	3-3-0		2
	MEN302	Introduction to Finite Element Method 유한요소법개론	3-3-0	Prerequisite: MEN230	2
	MEN310	Heat Transfer 열전달	3-3-0	Prerequisite: MEN210, MEN220	1
	MEN350	Manufacturing Processes and Lab 기계공작법 및 실습	3-2-2	Prerequisite: MEN230	1
	MEN351	Machine Element Design 기계요소설계	3-3-0	Prerequisite: MEN231	2
	MEN352	Creative Engineering Design I (Capstone Design) 창의적공학설계 I (캡스톤 디자인)	3-1-4		2
	MEN451	Introduction to MEMS MEMS개론	3-3-0		2
	MEN452	Creative Engineering Design II (Capstone Design) 창의적공학설계 II (캡스톤 디자인)	3-1-4		1
	MEN453	Computer Aided Engineering 컴퓨터이용공학	3-2-2		1
	MEN470	Mechanical Vibration 기계진동학	3-3-0	Prerequisite: MEN270	2
ID	IID232	3D CAD 3D CAD	3-2-2		2
HFE	HFE301	Experimental Design 실험계획법	3-3-0	Prerequisite: MTH211	1
	HFE305	Physical Computing 피지컬 컴퓨팅	3-2-2		1
CSE	CSE463	Machine Learning 기계 학습	3-3-0	Prerequisite: EE211, CSE331	2
MGT	MGT364	Database 데이터 베이스	3-3-0		1
MGE	MGE303	Data Mining 데이터 마이닝	3-3-0		1
Total Credit			81		

▶ Other

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
	HSE207	Engineering Mechanics 공학역학	3-3-0	only opened upon request of retaking courses from students who already took the courses before.	
	SDC201	Engineering Drawing and Analysis 기계제도 및 해석	3-2-2		
	HSE308	System Control 시스템 제어	3-3-0		
	SDC301	Introduction to Engineering Systems Design (Design Project 3) 공학 시스템 디자인 개론 (디자인 프로젝트 3)	3-3-0		

4. History of Courses Change of 2017–2018

Category	2017		2018
MAE	<New>	⇨	MEN400 (Elective) Mechanical Engineering Lab II 기계공학실험 II
	<New>	⇨	MEN414 (Elective) Design of Fluid Thermal Systems 열유체시스템설계
	<New>	⇨	MEN481 (Elective) UAV Flight Control and Simulation 무인기 비행제어 및 시뮬레이션
	<New>	⇨	MEN482 (Elective) UAV Navigation and Flight Computers 무인기 항법 및 운용
	MEN300 (Required) Mechanical Engineering Lab 기계공학실험	⇨	MEN300 (Required) Mechanical Engineering Lab I 기계공학실험 I

Category	2017		2018
	<New>	⇨	NSE313 (Required) Nuclear Fuel Engineering & Experiment 핵연료공학 및 실험
	NSE216 (Elective) Fundamentals of Electromagnetics 전자역학 개론	⇨	NSE216 (Elective) Fundamentals of Electromagnetics 전자기학 개론
	NSE418 (Elective) Fundamentals of Magnetohydrodynamics 자기유체역학 개론	⇨	NSE317 (Elective) Basic MHD Renewable Energy Engineering 전자기 신재생 에너지공학 기초
NSE	NSE314 (Required) Nuclear Engineering Design and Lab Ⅰ 원자력공학종합설계프로젝트 Ⅰ	⇨	NSE318 (Elective) Nuclear Engineering Design and Lab Ⅰ 원자력공학종합설계프로젝트 Ⅰ
	NSE324 (Required) Nuclear Engineering Design and Lab Ⅱ 원자력공학종합설계프로젝트 Ⅱ	⇨	NSE328 (Elective) Nuclear Engineering Design and Lab Ⅱ 원자력공학종합설계프로젝트 Ⅱ
	NSE334 (Required) Nuclear Engineering Design and Lab Ⅲ 원자력공학종합설계프로젝트 Ⅲ	⇨	NSE329 (Elective) Nuclear Engineering Design and Lab Ⅲ 원자력공학종합설계프로젝트 Ⅲ
	NSE414 (Required) Nuclear Engineering Design and Lab Ⅳ 원자력공학종합설계프로젝트 Ⅳ	⇨	NSE416 (Elective) Nuclear Engineering Design and Lab Ⅳ 원자력공학종합설계프로젝트 Ⅳ
SDC	<New>	⇨	SDC306 (Elective) Manufacturing System Design & Simulation 생산시스템 설계 및 시뮬레이션

5. Course Descriptions

□ Mechanical and Aerospace Engineering (MAE)

MEN210 Thermodynamics [열역학]

Thermodynamics is the most fundamental course in Mechanical Engineering. This course aims to have students understand various fundamental laws of thermodynamics and to develop the ability to apply them to various thermal systems. It covers energy, heat and work, enthalpy, entropy, laws of thermodynamics, thermodynamic properties, analysis of cycle performance and various engineering cycles.

MEN211 Applied Thermodynamics [응용열역학]

This course is focused on the application of the principles of thermodynamics to understand the properties of ideal gas mixtures. Topics cover available energy, availability and second-law efficiency, chemical reactions, thermodynamic relations and phase and chemical equilibrium. The basics of molecular dynamics and statistical thermodynamics are introduced.

MEN220 Fluid Mechanics [유체역학]

This is an introductory course in Fluid Mechanics. Topics covered include fundamental concepts of fluid mechanics, fluid statics, governing equations in integral form, governing equations in differential form, Bernoulli equation, dimensional analysis, viscous flow in ducts, and boundary layer flows.

MEN230 Solid Mechanics Ⅰ [고체역학Ⅰ]

In this course, students perform an in-depth study on the concept of stress-strain analysis, based on statics (force and moment) and mechanics of deformable bodies. Students learn to analyze the force and moment applied on the cross-section of a beam subjected to tension, compression, bending, and torsion. Methods to determine stress-strain distribution and deflection of beams are presented. Energy methods based on the equilibrium between strain energy and external work, alternative to force-moment equilibrium, are also introduced.

MEN231 Solid MechanicsⅡ [고체역학Ⅱ]

This course builds upon Solid Mechanics and introduces the mechanical behavior of various materials, including metals, ceramics, polymers, and composites. A rigorous definition of three-dimensional stresses and strains is presented, based on which the mechanical behavior is analyzed. Students learn representative failure modes, including fracture, fatigue, wear, and creep, and methods are presented to predict the failure mode and life based on various failure criteria. Various case studies are performed to demonstrate failure analysis techniques.

MEN250 Mechanical Drawing and Lab [기계제도 및 실습]

This course is provided in two modes - lecture and lab - that run in parallel. In lectures, lines, projections, views, and tolerances, which are fundamental components of mechanical drawings, are presented. The lab component allows the students to apply the knowledge obtained in lectures to produce drawings utilizing CAD software. In the term project, 3-4 students work as a team to execute the project in a creative and practical manner. The projects will help students learn to work efficiently in a teamwork environment and improve their communication skills.

MEN270 Dynamics [동역학]

This course introduces various dynamics systems. For dynamics analysis, principles and applications of Newton's law, work-energy methods, and impulse-momentum methods will be covered in this course.

MEN300 Mechanical Engineering Lab Ⅰ [기계공학실험 Ⅰ]

This course provides students with practical and experimental techniques for observation and measurement of mechanical principles and physical phenomena and focuses on analyzing experimental results and writing technical reports.

MEN301 Numerical Analysis [수치해석]

This course introduces numerical methods with emphasis on algorithm construction, analysis and implementation. It includes programming, round-off error, solutions of equations in one variable, interpolation and polynomial approximation, approximation theory, direct solvers for linear systems, numerical differentiation and integration, and initial-value problems for ordinary differential equations.

MEN302 Introduction to Finite Element Method [유한요소법개론]

In this course, the theory and formulation behind the finite element method will be introduced. To gain hands-on experience of the finite element method, practical applications in engineering will be covered.

MEN303 Applied Engineering Mathematics [응용공학수학]

This course provides a comprehensive, thorough, and up-to-date treatment of engineering mathematics. It is intended to introduce applied mathematics that are most relevant for solving practical problems to students of engineering, physics, mathematics, computer science, and related fields. A course in elementary calculus is the sole prerequisite.

MEN310 Heat Transfer [열전달]

This course deals with heat transfer problems associated with steady and transient conductions, forced and free convections, and radiation. Basic heat transfer mechanism, formulation of the problems and their solution procedures, and empirical correlations will be introduced. Also, some examples of practical applications will be discussed.

MEN320 Applied Fluid Mechanics [응용유체역학]

In this course, based on the topics learned in MEN220, advanced topics such as viscous flows, inviscid flows, lift and drag, basic turbulent flows, fundamentals of compressible flows, and turbomachinery will be covered.

MEN350 Manufacturing Processes and Lab [기계공작법 및 실습]

The course introduces engineering materials used in industry from the perspectives of composition, microstructures, properties, and heat treatment. It provides an extensive knowledge of various manufacturing processes, develops basic mathematical descriptions for selected processes, and helps students apply these concepts to process selection and planning. Manufacturing processes ranging from traditional (casting, machining, forging, powder metallurgy, injection molding, welding) to nontraditional/cutting-edge (electrodischarge machining, rapid prototyping, microfabrication) are introduced. From the manufacturing standpoint, the students learn the advantages and limitations of various processes in terms of quality, cost, and productivity. The lab component of this course allows the students to design and manufacture mechanical components hands-on.

MEN351 Machine Element Design [기계요소설계]

This course prepares students to design mechanical systems both at component- and system-level in a creative and comprehensive manner. Students learn to analyze, select, and synthesize machine components, as applied to springs, bearings, shafts, gears, fasteners, and other elements in a mechanical system. In addition, students learn to identify and quantify the specifications and trade-offs for the selection and application of components, which are commonly used in the design of complete mechanical systems. The course will require team projects in which the students will learn to develop conceptual design, optimize design parameters, and work efficiently in a teamwork environment.

MEN352 Creative Engineering Design Ⅰ [창의적공학설계Ⅰ]

In this course, students will develop their design capabilities through a team-project. To accomplish a given objective, students should define the problem, design and manufacture the system, and evaluate the final product by themselves. Through the whole process, students can broaden their understanding about creative engineering design.

MEN370 Dynamic Systems and Control [시스템제어]

Automatic control has played a vital role in various engineering and technological fields. It is not only important in space vehicles, missile guidance systems, aircraft autopiloting, and robots, but also in modern manufacturing and industrial processes. This course covers dynamic modeling and response of systems with mechanical, hydraulic, thermal and electrical elements, linear feedback control systems design, and analysis in time and frequency domains. Students learn basic mathematical and computational tools for modeling and analysis of dynamic systems. They are also trained to identify, model, analyze, design, and simulate dynamic systems in various engineering disciplines using a unified approach.

MEN400 Mechanical Engineering Lab Ⅱ [기계공학실험 Ⅱ]

This is the second course of a two-semester sequence covering fundamentals of instrumentation and measurement and their application in engineering testing and experimentation. This course involves instructor-designed experiments and focuses on the application of the fundamental principles learned in MEN300 to more advanced tests and measurement applications.

MEN411 Combustion [연소공학]

Combustion is based on thermodynamics, heat transfer, and fluid mechanics. This course deals with the energy conversion process from chemical to mechanical energy. Since energy consumption mostly occurs during the combustion process, the topics include not only flames and their characteristics but also practical combustion machines.

MEN412 Air-conditioning and Refrigeration [공기조화냉동]

This course covers the basic engineering principles of air-conditioning and refrigeration systems based on the topics in thermodynamics, heat transfer, and fluid mechanics. Cooling load calculation methods, Psychrometric chart, Air-conditioning system design based on thermodynamic cycle analysis, and performance analysis for major components such as compressor, condenser, evaporator and expander are introduced. It also discusses various alternative refrigeration methods and refrigerants.

MEN413 Computational Fluid Dynamics [전산유체역학]

This class is designed for use in introductory and intermediate courses in computational fluid dynamics (CFD) for students of aerospace engineering, mechanical engineering, and civil engineering with interest in fluid mechanics and heat transfer. Fundamental knowledge of programming and graphics is required for the applications of methods presented throughout the text. Since one learns a great deal by developing his or her own code to solve some partial differential equations, no program listing is included, and it is encouraged that students develop their own codes for the solutions of the proposed problems. For purposes of analysis, the numerical solutions of the sample problems are presented in tables. In the initial stage, the emphasis is on finite difference methods for solving parabolic, elliptic and hyperbolic equations, and in the final stage, the solution schemes is extended o the solution of a system of partial differential equations.

MEN414 Design of Fluid Thermal Systems [열유체시스템설계]

This course covers various design methods for various practical applications related to thermal/fluid engineering such as fluid machineries, duct systems, heat exchangers, and heat pumps. In addition, this course covers design of energy production/conversion systems including future renewable energies such as hydropower, tidal power, wind power, solar photovolaics, geothermal energy, biomass energy, and fuel cells.

MEN431 Introduction to Plastic Deformation [소성학개론]

This course deals with the fundamental theory of plasticity including the constitutive relations in plastic deformation and the methods of analysis for grasping the deformation behavior. The analytic solution of nonlinear problems in plastic deformation will be covered.

MEN432 Introduction to Mechanics of Composite Materials [복합재역학개론]

This course will introduce students to the fundamental mechanics of composite (more than one phase) solids. The primary objective of this course is to engage the students in important concepts related to material constitutive responses of composite materials at both micro- and macro- scales. Students should gain a basic understanding of the fundamental techniques used to analyze composite structures. Topics of the course will include effective stiffness properties of composites, constitutive description of laminated plates, and laminated plate theory. Failure theories and experimental results for laminated composites will also be discussed.

MEN451 Introduction to MEMS [MEMS 개론]

This course introduces MEMS, one of the most typical interdisciplinary research areas. Physical principles of micro structure and micro-fabrication techniques will be taught first and case studies of design, fabrication, and applications of diverse micro devices including micro-mechanical sensors (accelerometer, pressure sensor, flow sensor, temperature sensor), micro-actuator, and microfluidics will be covered in this course.

MEN452 Creative Engineering DesignⅡ [창의적공학설계Ⅱ]

In this course, students can develop their design ability as an independent mechanical engineer through a term-project where they propose an engineering problem including its necessity, design, manufacture, evaluate and present the system by themselves.

MEN453 Computer Aided Engineering [컴퓨터이용공학]

In this course, students study the theories and algorithms of CAE used in the design and manufacture of various products. Through these studies, the students will develop their capabilities to design, analyse, and manufacture various products using CAE techniques.

MEN454 Optimal Design [최적설계]

In this course, various optimization theories and algorithms are introduced, in order to improve students' capabilities in optimization including defining a problem, developing formulae, and adopting proper algorithms.

MEN457 Introduction to Electric-Electronic Engineering [전기전자공학개론]

Introduction to electric-electronic engineering: This course is designed to provide the mechanical engineering students with basic electrical and electronic skills and knowledge required for experimental set-ups. For example, basic circuit theory, fundamental electromagnetics, op amp, dc power supply, diode, rectification circuits will be discussed.

MEN461 Introduction to Robotics [로봇공학]

Robot definition, history, and its components/Open and closed loop Kinematics and inverse kinematics/Jacobian and Inverse Jacobian/Dynamics/Actuators, sensors, vision, voice recognition/Robot Controls/Robot Projects

MEN470 Mechanical Vibration [기계진동학]

This course introduces concepts of mechanical vibration, including free and forced vibration of single/multi-degree of freedom systems. Relevance of eigenvalue problems to multiple DOF system analysis is introduced together with some numerical techniques. Finally, numerical approximation and techniques for the distributed systems are studied.

MEN481 UAV Flight Control and Simulation [무인기 비행제어 및 시뮬레이션]

This course covers aircraft dynamic models, low-level flight control (autopilot) design, guidance, navigation, and high-level path planning for the autonomous operation of unmanned air vehicles (UAVs). Matlab/Simulink computer simulations will be used throughout the course to help students put theory into practice.

MEN482 UAV Navigation and Flight Computers [무인기 항법 및 운용]

This course is intended to introduce to student (i) the basic concepts of signals and signals processing including UAV/Aircraft navigation data, (ii) the various instruments used for navigation, methods of processing the navigation data, choice of flight computers and issues related to flight software implementation, and (iii) practical experiences to develop a UAV, flight computer, or navigation system as a project.

MEN497~499 Special Topics in Mechanical Engineering I~ III [기계공학 특론 I ~ III]

In this course, special topics in mechanical engineering are discussed based on the knowledge of the principles of solid mechanics, dynamics, thermodynamics, fluid mechanics, heat transfer, manufacturing process, system design, and power system engineering. Topics may include machine design, advanced materials processing, laser-assisted manufacturing, micro/nano machining, MEMS, biomedical products, controls and mechatronics, acoustics and dynamics, tribology, heat problems in microchips and light emitting diodes, wind power, blood flow, micro/nanofluidics, heat exchanger design in nuclear power plants, and combustion in engines.

□ Nuclear Science and Engineering (NSE)

NSE213 Fundamentals of Nuclear Engineering [원자력 공학 개론]

This course deals with physical basics and engineered application of the nuclear energy and the main objective is to provide the student with general understanding and knowledge of the nuclear engineering. The fundamentals of nuclear physics and interaction of radiation with matters are studied. The basic principles of nuclear reactor are investigated and various nuclear reactor concepts are discussed. The nuclear energy conversion and radiation protection are studied as well.

NSE214 Introduction to Nuclear Fuel Cycle Engineering [핵주기공학 개론]

This course introduces the nuclear fuel cycle which is the progression of nuclear fuel through a series of differing stages. It consists of steps in the front end, which are the preparation of the fuel, steps in the service period in which the fuel is used during reactor operation, and steps in the back end, which are necessary to safely manage, contain, and either reprocess or dispose of spent nuclear fuel. Depending on the reprocessing of the spent fuel, the specific topics include an open fuel cycle (or a once-through fuel cycle) and a closed fuel cycle considered in terms of sustainability of nuclear energy and nonproliferation. In particular, nuclear waste disposal (spent fuel) techniques will be discussed in terms of economics, safety and public acceptance.

NSE216 Fundamentals of Electromagnetics [전자기학 개론]

This course focuses on the electromagnetic theories as a basis for plasma engineering, nuclear fusion, radiation and nuclear engineering. The basic concepts on electricity and magnetism are included. Specific topics will include vector algebra and calculus; electrostatics in material media for Coulomb's Law, Gauss's Law, and boundary-value problems; steady electric currents for Ohm's law and Kirchhoff's law; magnetostatics in magnetic media for Ampere's Law, Biot-Savart law, and vector potential; time-varying electromagnetics for Faraday's Law and Maxwell's equation.

NSE221 Nuclear Radiation Engineering & Experiment [원자력방사선공학 및 실험]

The basic concepts and definition about radiation dosimetry are introduced and the biological effects on cells and human body organs are discussed. It also covers the generation, amplification, transfer and measurement of the electronic signal from various radiation detector based on the physics theory of the electronics signal and noise. The course also explores methods of radiation counting, timing and imaging system.

NSE222 Nuclear Materials Engineering & Experiment [원자력재료공학 및 실험]

This subject introduces basic concepts and applications of materials science and engineering to nuclear energy systems, while laboratory practices are designed for experiencing property tests of the lectured materials. Lectures include the essential knowledge of materials science and engineering as well as the effects of radiation and environments on material properties. The experiments are concerned with mechanical test and data analysis, phase transformation, observation by optical and electron microscopes, corrosion tests and irradiation effects.

NSE223 Nuclear Chemical Engineering [원자력화학공학]

This course will introduce students to the fundamental principles of nuclear chemical engineering as the first and foremost step to become scientists and engineers specialized in nuclear fuel cycle and radioactive waste management as well as nuclear materials and nuclear thermal hydraulics. At the end of this course, students will understand the fundamentals of chemical and electrochemical processes in nuclear power plants and nuclear fuel cycle systems.

NSE311 Introduction to Nuclear Reactor Theory [원자로이론 개론]

This course covers fundamental theory of nuclear fission reactors. Specific topics includes the followings: nuclear fission phenomenon, the chain nuclear reaction, diffusion/ moderation/absorption of neutron, multi-group neutron diffusion equations, heterogeneous reactor, reactor dynamics, reactivity and its change, perturbation theory and adjoint solutions, etc.

NSE312 Introduction to Nuclear Reliability Engineering [신뢰도 공학 개론]

Reliability evaluation is very important in safety-critical systems such as nuclear power plants. This course is designed to provide undergraduate students with the fundamentals and principles for reliability engineering. The course will cover the basic knowledge of reliability engineering and probabilistic modelling methods.

NSE313 Nuclear Fuel Engineering & Experiment [핵연료공학 및 실험]

This course starts with introducing various nuclear fuels utilized in nuclear reactors worldwide. The lecture will later focus on low-enriched UO2 fuel used in commercial nuclear power plants (NPP) in Korea. Understanding design principles of UO2 fuel associating with its structural evolution and material property change during the reactor operation and gaining some hands-on experience in thermophysical and metallurgical experiments using nuclear fuel materials are the essential prerequisites to be a capable nuclear engineer who can possibly invent new innovative features that enhance the safety of NPPs. Nuclear fuel experiments included are as follows: fuel fabrication, phase transformation enthalpy measurement of fuel/cladding materials, thermal conductivity measurement of nuclear fuel.

NSE316 Thermodynamics and Metallurgy of Nuclear Materials [원자력재료 열역학]

Extreme environment, such as very high temperature and severe radiation damage, for nuclear materials is mandated inside advanced nuclear energy systems. The performance of nuclear materials, and their life expectancy, are also the keys to safe and extended operation of current fleet of commercial nuclear power plants worldwide. This course provides fundamentals and basics of thermodynamic behavior of common nuclear materials, and their metallurgy, which together determines microstructure evolution of those materials under aforementioned extreme conditions during the reactor operation. Thus, this subject is essential to fully understand design principles adopted for Generation IV nuclear reactors and to predict degradation of material performance, which leads to prevention of their premature failure for the safety sake.

NSE317 Basic MHD Renewable Energy Engineering [전자기 신재생 에너지공학 기초]

The basic concept on the electromagnetic electricity generation and its magnetohydrodynamic (MHD) characteristics of electrically conducting liquid metal is introduced. The course focuses on the fundamental approach in therms of the electromagnetics and fluid mechanics for the understanding the liquid metal flow in the magnetic environment and MHD/electromagnetic generator and pumps, which are used for sodium coolant circulation in a sodium fast reactor (SFR), one of the future generation IV reactors, and liquid lithium circulation in the blanket of a nuclear fusion reactor. Students learn the magnetohydrodynamic principle of the metal fluid flow and its application.

NSE318 Nuclear Engineering Design and Lab I [원자력공학종합설계프로젝트 I]

In this course, students will have a chance to get the practical experience in nuclear fuels and fuel cycle, and nuclear fuel cladding and structural materials. In the nuclear fuels and fuel cycle area, students will first learn the fuel, fuel design criteria, fuel performance analysis code and then have a chance to analyze the in-reactor performance of the fuel. Then they will learn how to manufacture the fuel and have a chance to actually fabricate the fuel pellet with simulated material. Then they will be asked to analyze the results. In nuclear fuel cladding and structural materials area, students will learn the basic principles for the design and analysis of fuel cladding and structural components with commercial structural analysis code. And, material properties of fuel cladding and structural components will be reviewed and the proper material design and analysis using computational thermodynamics software will be practiced.

NSE327 Radioactive Waste Management [방사성폐기물관리]

The objectives of this course are to provide student with an understanding of radioactive waste management requirements and practices, to make them aware of social, economic, and environmental concerns as well as technical research needs. This course will cover both high level waste including spent nuclear fuel and low and intermediate level waste including operation and decommissioning waste.

NSE328 Nuclear Engineering Design and Lab II [원자력공학종합설계프로젝트 II]

Design of various nuclear fission energy systems and fast reactor technology require a variety of knowledge such as reactor physics, neutron data, radiation measurement and liquid metal magnetohydrodynamics. Through this course, students will learn how to design and develop nuclear systems based on the above-mentioned knowledge. Students will participate in comprehensive design and lab activities such as 1) set up a design goal, 2) identify design parameters of the system and sketch the performance of the proposed system, 4) establish quantitative models and/or setup experimental devices that show the performance of the system, 5) identify multiple constraints in the project, and develop an optimized solution.

NSE325 Nuclear System Engineering & Experiment [원자로계통공학 및 실험]

In this course, a variety of design constraints such as design principles, requirements, functions and technical specifications that govern the overall phases of design processes will be introduced to point out drawbacks and enhancement directions of nuclear systems. In addition, through implementations of small-scale mockups, an engineering chance realizing new ideas that are created by students would be provided.

NSE326 Nuclear Reactor Numerical Analysis [원자로 수치해석]

The partial differential equations to be solved for real world nuclear engineering applications such as the nuclear reactor core design, core transient analysis, and core depletion calculations, cannot be solved analytically in most cases. Instead, computer can be utilized to obtain approximate solutions of the PDEs. This course covers techniques which can solve numerically the PDEs found in nuclear engineering, e.g., finite difference, finite element, and advanced nodal methods.

NSE329 Nuclear Engineering Design and Lab III [원자력공학종합설계프로젝트 III]

This course covers practical engineering and design problems of both nuclear reactor systems and nuclear fuel cycle systems through design codes and measurements. For nuclear thermal-hydraulics, students will learn a core thermal-hydraulic code and a safety analysis code for nuclear reactors. As a more advanced and visualized approach, students will also learn a 3D computational fluid dynamics code. For nuclear fuel cycle, students will participate in design and analysis of nuclear fuel cycle systems including proliferation resistant molten-salt recycling technology for spent fuel, closed nuclear fuel cycle with waste transmutation reactor systems, safety system of disposal and storage for radioactive waste, and nonproliferation technology of nuclear energy systems.

NSE400~404 Special Topics on Nuclear Engineering and Science I~ V [원자력공학 및 과학 특론 I ~ V]

This course introduces new research topics in nuclear engineering and science.

NSE411 Introduction to Radiation Materials Science [방사선 재료 과학 개론]

Severe radiation environment is the unique feature of nuclear energy systems. In this regard, this course introduces fundamental theories and mechanisms of radiation interactions with materials on the assumption which the attendees are already familiar with common material science and engineering principles. More specifically, the radiation damage process, the formalism for the prediction of the amount and spatial configuration of the damage produced by bombarding particles, and eventual materials property degradation, are covered throughout the course.

NSE416 Nuclear Engineering Design and Lab IV [원자력공학종합설계프로젝트 IV]

Students will be introduced to the background theories and practical experimental procedures of nuclear fuel performance experiments and modeling, including thermophysical property measurements and metallurgical specimen preparation for electron microscopes, with common methodologies and softwares utilized for such data analysis. Probabilistic safety assessment (PSA) is to quantitatively evaluate the safety of a nuclear power plant. Students will understand the PSA by analyzing a nuclear power plant PSA model and get skills such as event tree/fault tree analysis, human reliability analysis, and risk-informed applications.

NSE421 Nuclear Reactor Lab [원자로실험]

Basic introduction to small research reactor will firstly given. Then experiments on important basic principles and to measure important physics parameters will be followed; basic reactor operation and criticality, measurement of reactor period and reactivity, experiment to measure critical mass, experiment to measure control rod worth, experiment to measure temperature coefficient of reactivity and experiment on neutron activation analysis.

NSE426 Nuclear Power Plant Instrumentation and Control Systems [원전계측제어시스템]

This course provides the fundamentals of instrumentation and control (I&C) systems in nuclear power plants. The basic electronic engineering and principles of I&C will be introduced. Students will get fundamental knowledge and skills of I&C from lectures and experiments.

NSE480 Introduction to Nuclear Engineering IT [원자력 IT 개론]

This course covers basic computer and IT technology necessary for nuclear reactor physics analysis, thermal hydraulics system design, nuclear fuel performance analysis, nuclear material, radiation protection analysis, nuclear reactor safety analysis: Operating System (Windows, Linux), Computing Tools (Matlab, Mathematica, Labview), Programming Language (FORTRAN, C, JAVA), Script Language (Perl, Python, Batch File), Parallel Programming (OpenMP, MPI)

□ System Design and Control Engineering (SDC)

SDC201 Computational Tools for Engineers [공학전산기법]

This course studies essential and practical computational tools and methods for engineers and designers. Students will improve their understanding of computer programming and IT applications in engineering design. Practical laboratories and projects with MATLAB and LabView will complement the course.

SDC302 Circuit Theory & Lab [회로이론 및 실습]

The aims of this course are to develop understanding of the principles and the fundamental concepts of circuit analysis, and to extend the students'ability to apply system analysis to other branches of engineering. This course integrates a number of concepts introduced in other courses in the disciplines of physics and mathematics. Students will see how abstract theoretical ideas work in practice. The course will focus on both hands-on experience and design practice.

SDC304 Manufacturing System Design & Simulation [생산시스템설계 및 시뮬레이션]

This course studies manufacturing system configuration, process flow design and their evaluation. The student will learn the basic concepts and methods of simulation techniques to design and evaluate manufacturing systems in which all workcells, including robots, material handling systems and other auxiliary equipment are functioning to maximum efficiency and productivity.

SDC401 Introduction to Mechatronics [메카트로닉스개론]

This course covers the basic control, instrumentation, and electrical systems. The course starts with an overall view of basic theories of signal processing and control. Based on such knowledge, various sensors and actuators with a microcontroller will be introduced and used for lab experiments. MATLAB and Arduino will be intensively used for hands-on activities and class projects.

SDC306 System Dynamics [시스템 동역학]

This course covers systematic lumped-parameter modeling, analysis, and simulation of multi-energy domain systems including mechanical, fluid, electrical, and thermal systems in temporal and frequency domains. Students will learn how to model multi-energy domain systems in a systematic manner using an energetic approach based on bond graph with analogies found between the domains, and can analyze those systems' characteristics and confirm the characteristics with simulations.

SDC402 Applied Robotics [응용로봇공학]

This introduction to the basic modeling, design, planning, and control of robot systems provides a solid foundation for the principles behind robot design. Students will learn the basic methodologies and tools in robotics research and applications to move forward and experiment further in the robotics field.

SDC403 Project Lab [프로젝트 랩]

Students and strategic partners from industry will work in project teams and undertake innovative technology development or product design projects involving product specification, conceptual design, detailed design and prototype-making/testing. The teams must aim to disseminate completed project outcomes to industry. The progress of each project will be reviewed based on formal presentations

SDC405 3D Printing [3D 프린팅]

This course aims to introduce to the additive manufacturing (AM) technology and its applications. Students will examine various methods (i.g., Fused Deposition Method(FDM), Stereolithograpy(SLA), Selective Laser Sintering (SLS)) of additive manufacturing technologies, and understand the basic AM process from CAD models to the physical prototyping. In addition, contemporary issues in AM will be introduced, and assignments with FDM and SLS machines will be conducted during the course.

SDC410, 420 Special Topics in SDC I, II [SDC 특론 I, II]

In these courses contemporary topics in various areas related to system design and control engineering will be covered. Topic selection will be made based upon special interests.

School of Urban and Environmental Engineering

1. School Introduction

Environmental pollution and climate change caused by industrialization and urbanization are directly related to the survival of human society. With no surprise, studies on these issues are gaining in importance. Urban and environmental engineering is an interdisciplinary research field focusing on environmental protection and sustainable urban development with ultimately aiming toward the improvement of human welfare. In this division, students will gain fundamental knowledge related to urban and environmental issues, and will study more advanced courses represented by three tracks: Environmental Science and Engineering (environmental analysis, water and air treatment, climate change, global environment, environmental modeling), Urban Infrastructure Engineering (urban planning, structural mechanics and design, health monitoring, construction materials), and Disaster Management Engineering. The School of Urban and Environmental Engineering is committed to developing innovative technologies in the fields of urban and environmental engineering and educating leaders who will have a large impact on our profession and society.

2. Undergraduate Programs

□ Track Introduction

1) Environmental Science and Engineering (ESE)

This track focuses on local as well as global issues related to environmental pollution and climate change. We provide a comprehensive collection of courses on important environmental subjects including pollution control and analysis, climate modelling, environmental fate models, remote sensing, and hydrology. Our mission is to educate students with the highest quality technical and professional standards and produce qualified professionals committed to challenge the environmental issues we face today.

2) Urban Infrastructure Engineering [UIE]

The mission of the UIE track is to develop engineers with essential expertise in planning, design, construction, and management of urban built environment, who have the enthusiastic nature of their special role in the future of human society. The UIE program consists of major disciplines in urban and civil engineering, such as urban planning, construction materials, structural mechanics and design, smart sensing and control, and geotechnical engineering. Through innovative education and research, the students will develop dynamic abilities on creating sustainable and resilient urban infrastructure systems for our future generations.

3) Disaster Management Engineering (DME)

The Disaster Management Engineering track provides an interdisciplinary undergraduate education, integrating the diverse expertise of urban/civil engineering, environmental engineering and earth/climate engineering to mitigate the impact of unexpected disasters. The track focuses on (1) natural hazard monitoring/prediction; (2) sustainable and resilient infrastructure; (3) disaster risk reduction/prevention; and (4) water resources and flood management.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1st Track	2nd Track	
ESE	Required	9	9	
	Elective	45	9	
UIE	Required	18	9	
	Elective	36	9	
DME	Required	18	9	
	Elective	36	9	

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
ESE	MTH201	Differential Equations	2-1
	MTH203 or MTH211	Applied Linear Algebra or Statistics	2-2
UIE	MTH201	Differential Equations	2-1
	MTH203 or MTH211	Applied Linear Algebra or Statistics	2-2
DME	MTH201	Differential Equations	2-1
	MTH203 or MTH211	Applied Linear Algebra or Statistics	2-2

※ Complete based on 1TR
※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' 12 credits.

▶ Fundamentals required to Business field students when they choose Engineering field tracks as 2nd track

Course Title	ESE	UIE	DME
Differential Equations	✔	✔	✔

3. Curriculum ※ Course opening semester is subject to be changed according to School's situation.

□ Environmental Science and Engineering (ESE)

▶ Required : Choose 3 courses

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ESE	ESE201	Introduction to Environmental Engineering 환경공학개론	3-3-0		1
	ESE203	Global Environment 지구환경	3-3-0		1
	ESE333	Introduction to Remote Sensing 원격탐사개론	3-3-0		2
	ESE337	Environmental Thermodynamics 환경열역학	3-3-0		1
Total Credit			12		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ESE	ESE202	Environmental Chemistry 환경화학	3-3-0		1
	ESE204	Water Pollution 수질오염	3-3-0		2
	ESE205	Air Pollution 대기오염	3-3-0		2
	ESE232	Atmosphere and Ocean Sciences 대기해양과학	3-3-0		2
	ESE241	Environmental Mathematics 환경수학	3-3-0		-
	ESE311	Water Treatment Engineering 수처리공학	3-3-0		-
	ESE312	Soil Pollution 토양오염	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ESE	ESE313	Aquatic Chemistry Laboratory 수질화학실험	3-2-2		-
	ESE314	Environmental Data Analysis and Practice 환경데이터분석	3-3-0		1
	ESE331	Analysis of Pollutants 오염물질분석/실험	3-2-2		1
	ESE334	Atmospheric Dynamics 대기역학	3-3-0		-
	ESE335	Biogeochemistry 생지화학	3-3-0		-
	ESE341	Environmental Aquatic Organic Chemistry 환경수유기화학	3-3-0		-
	ESE411	Water and Wastewater Engineering 상하수도공학	3-3-0		1
	ESE412	Environmental Remediation 환경복원	3-3-0		-
	ESE413	Waste Management 폐기물처리/재활용	3-3-0		-
	ESE414	Environmental Bioprocess 환경생물공정	3-3-0		2
	ESE415	Environmental Toxicology 환경독성학	3-3-0		-
	ESE416	Hydraulics 수리학	3-3-0		2
	ESE417	Water Treatment Modeling: Principles and Practice 수처리모델링	3-3-0		2
	ESE421	Special Topics in Environmental Engineering Ⅰ 환경공학특론 Ⅰ	3-3-0		1
	ESE422	Special Topics in Environmental Engineering Ⅱ 환경공학특론 Ⅱ	3-3-0		-
	ESE423	Special Topics in Environmental Engineering Ⅲ 환경공학특론 Ⅲ	3-3-0		-
	ESE431	Climate Dynamics 기후역학	3-3-0	Prerequisite: ESE232, ESE334	1
	ESE432	Earth Environment Numerical Analysis 지구환경전산실습	3-2-2		1
	ESE434	Climate Change Engineering 기후변화공학	3-3-0		2
	ESE435	GIS-Based Modeling GIS 기반 모델링	3-3-0		1
	ESE436	Statistics in Earth and Environmental Sciences 지구환경통계학	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ESE	ESE437	Multimedia Environmental Modelling 다매체환경모델링	3-3-0	Prerequisite: ESE331	2
	ESE441	Special Topics in Earth Science Ⅰ 지구환경특론 Ⅰ	3-3-0		-
	ESE442	Special Topics in Earth Science Ⅱ 지구환경특론 Ⅱ	3-3-0		-
	ESE443	Special Topics in Earth Science Ⅲ 지구환경특론 Ⅲ	3-3-0		-
UIE	UIE210	Geographic Information System 지리정보시스템	3-3-0		2
DME	DME201	Introduction to Natural Hazards 자연재해개론	3-3-0		1
	DME221	Atmospheric Chemistry 대기화학	3-3-0		-
	DME311	Probability Concepts in Engineering 공학확률	3-3-0		2
	DME321	Numerical Modeling and Analysis 수치모델링 및 분석	3-3-0		2
	DME342	Hydrology 수문학	3-3-0		-
	DME421	Weather Analysis and Prediction 날씨 분석 및 예측	3-3-0		2
	DME422	Satellite Remote Sensing 위성원격탐사	3-3-0		-
MAE	MEN220	Fluid Mechanics 유체역학	3-3-0		2
BIO	BIO331	Microbiology 미생물학	3-3-0		1
CHEM	CHM211	Organic Chemistry Ⅰ 유기화학 Ⅰ	3-3-0		1
	CHM212	Organic Chemistry Ⅱ 유기화학 Ⅱ	3-3-0		2
	CHM231	Physical Chemistry Ⅰ 물리화학 Ⅰ	3-3-0		1
	CHM232	Physical Chemistry Ⅱ 물리화학 Ⅱ	3-3-0		2
	CHM391	Instrumental Analysis 기기분석	3-3-0		2
Total Credit			**141**		

☐ Urban Infrastructure Engineering (UIE)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
UIE	UIE201	Introduction to Civil Engineering 건설공학개론	3-3-0		1
	UIE203	Introduction to Urban Planning 도시계획개론	3-3-0		1
	UIE204	Mechanics of Materials 재료역학	3-3-0	Prerequisite: UIE201	2
	UIE210	Geographic Information System 지리정보시스템	3-3-0		2
Total Credit			12		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
UIE	UIE303	Structural Analysis 구조역학	3-3-0	Prerequisite: UIE204	1
DME	DME311	Probability Concepts in Engineering 공학확률	3-3-0		2
Total Credit			6		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
UIE	UIE202	Sustainable Design 환경설계론	3-1-4		-
	UIE301	Urban Transportation Planning 교통계획	3-3-0		1
	UIE304	Matrix Structural Analysis 매트릭스구조해석	3-3-0		1
	UIE305	Soil Mechanics 토질역학	3-3-0		1
	UIE306	Concrete Structures 콘크리트구조공학	3-3-0	Prerequisite: UIE204	-
	UIE307	Properties of Concrete 콘크리트재료공학	3-2-2		2
	UIE308	Structural Engineering Lab 구조공학실험	3-1-4	Prerequisite: UIE204	1
	UIE309	Urban Development 도시개발론	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
UIE	UIE401	Steel Structures 강구조공학	3-3-0	Prerequisite: UIE204	-
	UIE402	Design of Structural Systems 구조시스템설계	3-3-0		-
	UIE403	Foundation Engineering 기초공학	3-3-0		2
	UIE404	Infrastructure Engineering 사회기반시설공학	3-3-0		-
	UIE405	Urban Design 도시설계	3-3-0		-
	UIE408	Introduction to Structural Dynamics 구조동역학개론	3-3-0		-
	UIE409	Construction Materials 건설재료공학	3-3-0		2
	UIE410	Special Topics in Urban Infrastructure Engineering Ⅰ 도시건설공학특론 Ⅰ	3-3-0		-
	UIE411	Special Topics in Urban Infrastructure Engineering Ⅱ 도시건설공학특론 Ⅱ	3-3-0		-
	UIE412	Special Topics in Urban Infrastructure Engineering Ⅲ 도시건설공학특론 Ⅲ	3-3-0		-
ESE	ESE201	Introduction to Environmental Engineering 환경공학개론	3-3-0		1
	ESE314	Environmental Data Analysis and Practice 환경데이터분석	3-3-0		1
	ESE333	Introduction to Remote Sensing 원격탐사개론	3-3-0		2
	ESE411	Water and Wastewater Engineering 상하수도공학	3-3-0		1
	ESE416	Hydraulics 수리학	3-3-0		2
	ESE417	Water Treatment Modeling: Principles and Practice 수처리모델링	3-3-0		2
	ESE435	GIS-Based Modeling GIS 기반 모델링	3-3-0		1
DME	DME321	Numerical Modeling and Analysis 수치모델링 및 분석	3-3-0		2
	DME331	Disaster Management 재난관리	3-3-0		1
	DME332	Disaster Risk Analysis 재난위험성 분석	3-3-0		-
	DME342	Hydrology 수문학	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
DME	DME422	Satellite Remote Sensing 위성원격탐사	3-3-0		-
	DME431	Disasters and Environmental Economics 재난 및 환경경제학	3-3-0		-
	DME432	Vulnerability and Capacity Analysis 재해취약성 및 수용력분석	3-3-0	Prerequisite: UIE210	-
MAE	MEN220	Fluid Mechanics 유체역학	3-3-0		2
MGE	MGT211	Microeconomics 미시경제학	3-3-0	Prerequisite: MGT106	2
	MGT315	Econometrics 계량경제학	3-3-0	Prerequisite: MGT211	-
Total Credit			105		

□ Disaster Management Engineering (DME)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
DME	DME201	Introduction to Natural Hazards 자연재해개론	3-3-0		1
	DME311	Probability Concepts in Engineering 공학확률	3-3-0		2
	DME331	Disaster Management 재난관리	3-3-0		1
Total Credit			9		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ESE	ESE201	Introduction to Environmental Engineering 환경공학개론	3-3-0		1
UIE	UIE201	Introduction to Civil Engineering 건설공학개론	3-3-0		1
	UIE203	Introduction to Urban Planning 도시계획개론	3-3-0		1
Total Credit			9		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
DME	DME202	Man-made Disasters 인적재해	3-3-0		-
	DME221	Atmospheric Chemistry 대기화학	3-3-0		-
	DME321	Numerical Modeling and Analysis 수치모델링 및 분석	3-3-0		2
	DME332	Disaster Risk Analysis 재난위험성 분석	3-3-0		-
	DME341	Water Resources Engineering 수자원공학	3-3-0		-
	DME342	Hydrology 수문학	3-3-0		-
	DME411	Hazard Analysis for System Safety 재해분석과 시스템안전성	3-3-0		-
	DME421	Weather Analysis and Prediction 날씨 분석 및 예측	3-3-0		2
	DME422	Satellite Remote Sensing 위성원격탐사	3-3-0		-
	DME431	Disasters and Environmental Economics 재난 및 환경경제학	3-3-0		-
	DME432	Vulnerability and Capacity Analysis 재해취약성 및 수용력분석	3-3-0	Prerequisite: UIE210	-
	DME491	Special Topics in Disaster Management Engineering Ⅰ 재난관리공학특론 Ⅰ	3-3-0		-
	DME492	Special Topics in Disaster Management Engineering Ⅱ 재난관리공학특론 Ⅱ	3-3-0		2
	DME493	Special Topics in Disaster Management Engineering Ⅲ 재난관리공학특론 Ⅲ	3-3-0		-
ESE	ESE203	Global Environment 지구환경	3-3-0		1
	ESE204	Water Pollution 수질오염	3-3-0		2
	ESE205	Air Pollution 대기오염	3-3-0		2
	ESE232	Atmosphere and Ocean Sciences 대기해양과학	3-3-0		2
	ESE311	Water Treatment Engineering 수처리공학	3-3-0		-
	ESE312	Soil Pollution 토양오염	3-3-0		-
	ESE314	Environmental Data Analysis and Practice 환경데이터분석	3-3-0		1
	ESE333	Introduction to Remote Sensing 원격탐사개론	3-3-0		2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ESE	ESE334	Atmospheric Dynamics 대기역학	3-3-0		-
	ESE411	Water and Wastewater Engineering 상하수도공학	3-3-0		1
	ESE412	Environmental Remediation 환경복원	3-3-0		-
	ESE416	Hydraulics 수리학	3-3-0		2
	ESE417	Water Treatment Modeling: Principles and Practice 수처리모델링	3-3-0		2
	ESE435	GIS-Based Modeling GIS 기반 모델링	3-3-0		1
UIE	UIE204	Mechanics of Materials 재료역학	3-3-0	Prerequisite: UIE201	2
	UIE210	Geographic Information System 지리정보시스템	3-3-0		2
	UIE301	Urban Transportation Planning 교통계획	3-3-0		1
	UIE303	Structural Analysis 구조역학	3-3-0	Prerequisite: UIE204	1
	UIE304	Matrix Structural Analysis 매트릭스구조해석	3-3-0		1
	UIE305	Soil Mechanics 토질역학	3-3-0		1
	UIE306	Concrete Structures 콘크리트구조공학	3-3-0	Prerequisite: UIE204	-
	UIE307	Properties of Concrete 콘크리트재료공학	3-2-2		2
	UIE308	Structural Engineering Lab 구조공학실험	3-1-4	Prerequisite: UIE204	1
	UIE309	Urban Development 도시개발론	3-3-0		-
	UIE401	Steel Structures 강구조공학	3-3-0	Prerequisite: UIE204	-
	UIE403	Foundation Engineering 기초공학	3-3-0		2
	UIE404	Infrastructure Engineering 사회기반시설공학	3-3-0		-
	UIE405	Urban Design 도시설계	3-3-0		-
	UIE408	Introduction to Structural Dynamics 구조동역학개론	3-3-0		-
	UIE409	Construction Materials 건설재료공학	3-3-0		2
MAE	MEN220	Fluid Mechanics 유체역학	3-3-0		2
Total Credit			135		

4. History of Courses Change of 2017-2018

Category	2017		2018
ESE	<New>	⇨	ESE417 (Elective) Water Treatment Modeling: Principles and Practice 수처리모델링

5. Course Descriptions

□ Environmental Science and Engineering (ESE)

ESE201 Introduction to Environmental Engineering [환경공학개론]

For students majoring in “Environmental Engineering”, this course deals with basic concepts of environmental research fields, such as air, water, soil, waste and microbiology.

ESE202 Environmental Chemistry [환경화학]

The goal of this course is to study basic knowledge of chemistry to identify natural phenomena in air, water and soil systems and to develop students’ ability to apply this knowledge for the remediation of the environment contaminated by toxic chemical compounds.

ESE203 Global Environment [지구환경]

The aim of this course is to comprehensively understand various environmental problems, such as geophysical and chemical phenomena, on the basis of earth and environmental sciences. Human influences such as urbanization, industrialization and the increased use of fossil energy will be studied as major causes of global warming, environmental pollution, stratospheric ozone depletion and the desertification process. Students are encouraged to participate in the class by group or individual presentation of their own research on selected problems.

ESE204 Water Pollution [수질오염]

The reasons for water pollution and the characteristics of water pollutants will be studied. On the basis of this knowledge, the analytical methods for various water pollutants and removal mechanisms will be discussed.

ESE205 Air Pollution [대기오염]

The physico-chemical characteristic of air pollutants, long-range transport, hazardous effects and emission reduction will be studied.

ESE232 Atmosphere and Ocean Sciences [대기해양과학]

This course is an introduction to the dynamics and phenomenology of Earth''s atmosphere and ocean circulations. Special emphasis is placed in understanding how energy and momentum transports are effected in the atmosphere and oceans, and how they influence Earth''s climate.

ESE241 Environmental Mathematics [환경수학]

Mathematics is one of tools to be used to understand and analyze the environmental problems, with various environmental science knowledge, as those have somewhat different methodologies towards solutions to existing environmental problems. This course includes fundamentals of math., such as linear algebra and partial differential equations, and applications with respect to transport phenomena of particles and colloids in aquatic environments.

ESE311 Water Treatment Engineering [수처리공학]

This course will provide comprehensive coverage of water treatment facility design emphasizing coagulation, flocculation, sedimentation, filtration, disinfection, redox reactions and adsorption.

ESE312 Soil Pollution [토양오염]

This course covers the wide range of soil pollution studies, including reasons for soil pollution, environmental impact of soil pollution and the remediation and treatment of polluted soils.

ESE313 Aquatic Chemistry Laboratory [수질화학실험]

This course covers basic principles and laboratory techniques for the analysis of fresh water, contaminated waters and waste waters, with an emphasis on instrumental techniques.

ESE314 Environmental Data Analysis and Practice [환경데이터분석]

This course delivers the basic knowledgement on environmental data analysis and provides some practices using MATLAB. This course begins with basic MATLAB techniques to visualize statistical results, including very basic elements of environmental statistics. I welcome anyone who is interested in environmental data analysis.

ESE331 Analysis of Pollutants [오염물질분석/실험]

In this course, the principle of instrumental analysis for various pollutants from different environmental media will be studied. Furthermore, experimental skills for the analysis of pollutants will be obtained.

ESE333 Introduction to Remote Sensing [원격탐사개론]

This course provides a qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data in the performance of environmental monitoring and natural resource inventories. This course introduces key applications of remote sensing as well as basic digital image processing techniques (e.g. image enhancement, image classification). The students will use the state-of-the-art software and hardware to examine satellite and airborne remote sensing data.

ESE334 Atmospheric Dynamics [대기역학]

Atmospheric dynamics is the study of lareg-scale atmospheric motions associated with weather and climate. Atmospheric dynamics is the study of large-scale atmospheric motions associated with weather and climate. A basic assumption for describing such motions is to regard the atmosphere as a continuous fluid medium and apply the fundamental conservation laws of mass, momentum, and thermodynamic energy, which are expressed in terms of partial differential equations over space and time. Solving those differential equations with some systematic simplifications based on observations, the students will obtain physical insights to the role of atmospheric motions in determining the observed weather and climate. The class will cover in depth the Chapters 1-6 of An Introduction to Dynamic Meteorology written by James R. Holton. The presented topics include fundamental and apparent forces, basic conservation laws, circulation and vorticity, atmospheric motion in the presence of friction, and the quasi-geostrophic analysis of large-scale atmospheric motion.

ESE335 Biogeochemistry [생지화학]

Biogeochemistry is the scientific discipline that involves the study of the chemical, physical, geological, and biological processes and reactions that govern the composition of the natural environment. This course focuses on stable isotope biogeochemistry with emphasis on carbon, oxygen, and nitrogen. Theoretical principles, isotope fractionation, and variation of isotopes in nature with emphasis on the ocean, atmosphere, and biosphere will be presented and discussed. Stable isotope techniques, applications of stable isotopes in research, and introduction to mass spectrometry will form the applied component of the course.

ESE337 Environmental Thermodynamics [환경열역학]

This course offers the basic understanding of thermodynamics relating to environmental and atmospheric fields and covers the fundamental laws of thermodynamics, properties of fluids, heat effects, and phase equilibria.

ESE341 Environmental Aquatic Organic Chemistry [환경수유기화학]

Both natural and synthetic organic chemicals are abundant in environments, in waters including air, surface and ground water, and water combined with solids. Studies of characteristics and fate of the chemicals provide basic understanding cycle and effects on eco-system, of the organics. This course includes basic chemistry and application on actual environmental problems, with some projects with aquatic eco-systems to be dealt with.

ESE411 Water and Wastewater Engineering [상하수도공학]

This course covers fundamental hydraulics related with pipe flows and the design of water and wastewater systems by estimating demand capacity and the optimal operations of the systems.

ESE412 Environmental Remediation [환경복원]

The purpose of this course is to learn various physical, chemical and biological remediation methods for contaminated surface and underground environmental compartments (soil, sediment and ground water etc.). Through this course, students will learn how to determine which remediation method is most appropriate for a given contamination/case.

ESE413 Waste Management [폐기물처리/재활용]

This course covers (1) waste generation, collection and transportation, (2) waste treatment and (3) waste recycling and recovery technologies.

ESE414 Environmental Bioprocess [환경생물공정]

This course examines biological wastewater processes used to remove organic materials and nutrients from various wastewater. Sorption of pollutants using microorganisms and plants, aerobic and anaerobic degradation of organic contaminants, sludge treatment and the production of biofuels will be studied.

ESE415 Environmental Toxicology [환경독성학]

Environmental toxicology deals with metabolism of hazardous chemicals and exposure assessment for human and other living organisms. During this course, the toxicity of various pollutants (persistent organic pollutants, heavy metals, pesticides and pharmaceuticals), risk assessment, such as through the use of biosensors, and regulation policies will be covered.

ESE416 Hydraulics [수리학]

This course provides the principles and fundamental theories related to the mechanical properties of liquids based on fluid mechanics. It focuses on various engineering applications of fluids and their properties.

ESE417 Water Treatment Modeling: Principles and Practice [수처리모델링]

This course delivers the basic principles on chemical and biological water treatments with its modeling practices. In this class, we will be using the modeling software (Comsol Multiphysics) to simulate water flow and the fate and transport of pollutants in a water treatment facility.

ESE421~3 Special Topics in Environmental Engineering Ⅰ ~ Ⅲ [환경공학특론 Ⅰ ~ Ⅲ]

This course introduces new research topics in environmental engineering.

ESE431 Climate Dynamics [기후역학]

This is an introductory course on the scientific background and mechanisms for the climate change and global warming. Course topics include the global energy balance of the Earth's climate system, atmospheric and oceanic energy transports and the impacts of greenhouse gases on the climate system. Limitations and uncertainty about future climate predictions will be also discussed in the class for an unbiased view to this debating phenomenon.

ESE432 Earth Environment Numerical Analysis [지구환경전산실습]

The goals of this course are to provide a working knowledge of the basic methods of objective analysis of meteorological, oceanographic, and related data. The topics concentrate on techniques for extracting information from data directly, such as compositing, time series analysis, singular value decomposition, principal component analysis, and filtering. Both theories and application skills via a computer program such as Matlab, Fortran, Grads will be covered.

ESE434 Climate Change Engineering [기후변화공학]

This course covers diverse topics on the causes, effects, and mitigation methods of global warming. For this purpose, we will focus on recent technologies for carbon dioxide capture and storage, clean use of fossil fuels, and new and renewable energies.

ESE435 GIS-Based Modeling [GIS 기반 모델링]

The purpose of the course is to present geographical, temporal, environmental modeling concepts using GIS-based modeling languages and techniques. Practical laboratory experience with state-of-the-art software and hardware will be used. At the conclusion of this course, students will be able to make informed decisions about the transformation of conceptual models to mathematical models using GIS components. This course includes various modeling concepts and techniques such as spatial interpolation, suitability/capability modeling, terrain form modeling, hydrologic modeling, diffusion modeling, calibration modeling, accessibility modeling, optimization modeling, and rainfall-runoff modeling.

ESE436 Statistics in Earth and Environmental Sciences [지구환경통계학]

Earth and Environmental Sciences often deal with huge data collected from observations and model simulations. A careful application of statistical methods to the data leads to comprehensive descriptions of geophysical phenomena or processes, validations of existing theories, and new findings of nature. This course is aimed for junior and senior students who completed the basics of statistics. The course will review the basics of statistics first, and cover the various statistical methods frequently used in the modern research, such as the regression, time series analysis, and the principal component analysis.

ESE437 Multimedia environmental modelling [다매체환경모델링]

This course will deal with the principle of multimedia environmental fate models for persistent organic pollutants. After 2-3 weeks of lectures, students will start to make their own multimedia models using Visual Basic.

ESE441 Special Topics in Earth Science I [지구환경특론I]

This course introduces new research topics in earth science.

ESE442 Special Topics in Earth Science II [지구환경특론II]

This course introduces new research topics in earth science.

ESE443 Special Topics in Earth Science III [지구환경특론III]

This course introduces new research topics in earth science.

□ Urban Infrastructure Engineering (UIE)

UIE201 Introduction to Civil Engineering [건설공학개론]

This core course introduces the oldest interdisciplinary engineering discipline that deals with the design, construction, and maintenance of the natural and built environment. The topics covered here include structural engineering and materials, geotechnical engineering, hydraulics and hydrology. In addition, engineering mechanics with emphasis on statics will be discussed.

UIE202 Sustainable Design [환경설계론]

This course covers the sustainable disciplines of designing natural and human environments, focusing on fashioning physical and social interventions informed by human behavior and environmental processes.

UIE203 Introduction to Urban Planning [도시계획개론]

This course is an introduction to the methods and history of urban planning. Students will learn the methods used in various sub-fields of planning and will develop an ability to critically evaluate different techniques and approaches used within these disciplines.

UIE204 Mechanics of Materials [재료역학]

This course introduces a branch of engineering mechanics that focuses on the internal effects of stress and strain in a solid body subjected to external loads. It covers critical fundamentals for the strengths of materials and the deformations of solid bodies, which include stress and strain; mechanical properties of materials; various external actions such as axial load, torsion, bending, and shear; stress and strain transformations; and stability problems for axially loaded members.

UIE210 Geographic Information System [지리정보시스템]

This course covers fundamental theoretical knowledge relevant to the development and use of geographic information systems, including data models, spatial representation, and cartographic principles. The course will expose students to a wide-spread GIS software and will provide hands-on practice in database development, data retrieval, and analysis.

UIE301 Urban Transportation Planning [교통계획]

This course discusses fundamental characteristics of the urban transportation system as a component of urban structure, methodologies for the analysis of transportation problems, planning urban transportation, and the transportation planning process.

UIE303 Structural Analysis [구조역학]

This course is intended to provide students with the theory and application of modern structural analysis as it applies to trusses, beams, and frames. Particular emphasis is placed on developing the students' intuition to understand how structures react with applied loadings and the abilities to model and analyze civil and architectural structures.

UIE304 Matrix Structural Analysis [매트릭스구조해석]

This course is designed to provides students with fundamental concepts in the methods of matrix structural analysis used in current practice. This covers the formation of global analysis equations, member force-deformation relations, virtual work principles, and introduction to nonlinear analysis.

UIE305 Soil Mechanics [토질역학]

This course provides a general introduction to the mechanical properties of soils and geotechnical engineering. Soil properties, identification/ classification, groundwater within soils, and soil's behavior under applied stress are emphasized. Geotechnical design applications such as earthworks, slope stability, and foundations are also discussed.

UIE306 Concrete Structures [콘크리트구조공학]

This course discusses the material properties, strength, behavior, and design of reinforced and prestressed concrete members subjected to moment, shear, axial, and torsional forces, and also introduces domestic and international design code provisions applying to concrete structures.

UIE307 Properties of Concrete [콘크리트재료공학]

Concrete is one of the most important building materials. In lectures and labs, the students will learn concrete mixture proportioning and the mechanical behavior of concrete including strength, cracking, creep and shrinkage.

UIE308 Structural Engineering Lab [구조공학실험]

This course is intended for students to conduct a series of hands-on experiments to better understand fundamental concepts in structural mechanics. The experiments include warping phenomenon, prestressed concrete, failure of truss structure, bridge building competition, etc.

UIE309 Urban Development [도시 개발론]

This course introduces fundamental concepts and theories applied to local economic development including growth, trade, product-cycle, flexible specialization, and entrepreneurship theories.

UIE401 Steel Structures [강구조공학]

This course introduces the design of steel structures and the behavior of steel members and their connections, when subjected to axial load, bending, shear, torsion, and combined loads. Theoretical, experimental, and practical principles for proportioning members (e.g., beams, girders, columns) and their connections (bolted, welded) are discussed. Emphasis is given to the design of plate girders, composite beams, slender columns, and eccentric shear connections.

UIE402 Design of Structural Systems [구조시스템설계]

Theories of structural analysis are applied to urban infrastructure systems such as buildings, bridges, and underground structures. Emphasis is placed on developing the student's ability to model and analyze challenging engineering structures that may be encountered in professional practice. Classical methods are reviewed to develop a deeper understanding of fundamental sciences of engineering mechanics, and matrix structural analysis is also covered with assistance of computer-based practice.

UIE403 Foundation Engineering [기초공학]

This course presents analysis, design, and constructive aspects of shallow and deep foundations for complex or unusual soil conditions, and earth retaining structures including retaining walls, and sheet pile bulkheads. The main objective of this course is to enable students to select the best foundation solution for different types of civil engineering problems. After completing the course, students are able to design deep and shallow foundations.

UIE404 Infrastructure Engineering [사회기반시설공학]

This course provides an introduction to technical aspects of urban infrastructures such as tall, long-span, and large-space civil structures (schools, gymnasiums, etc.), transportation systems (bridges, roads, tunnels, subways, airports, etc.), water supply and drainage systems, waste treatment plants, electricity and gas distribution facilities, energy production plants, and so on. The students will gain a better understanding of urban infrastructure systems.

UIE405 Urban Design [도시설계]

Introduction of fundamental urban design theory and practice will be offered in this course. Students are expected to critically look at built environment and how architecture defines and delimits physical space, and to study local and historical examples of urban design.

UIE408 Introduction to Structural Dynamics [구조동역학개론]

This introductory course is designed to provide students with fundamental concepts in structural dynamics and its application to civil engineering. The students gain a basic understanding of vibration characteristics of single and multi degree-of-freedom systems. This course includes hands-on experiments for students to better understand theories of structural dynamics in physical systems.

UIE409 Construction Materials [건설재료공학]

The selection of proper construction materials is essential to build sustainable and resilient infrastructures. This course is designed to provide integrated knowledge of the properties of construction materials with emphasis on two major construction materials (i.e., steel and concrete) covering from elastic, plastic and fracture properties to porosity and thermal and environmental responses.

UIE410 Special Topics in Urban infrastructure Engineering I [도시건설공학특론 I]

In this course, subject offerings of new and developing areas of knowledge in urban infrastructure engineering will be given with intention to augment the existing curriculum. See course information for topics and prerequisites.

UIE411 Special Topics in Urban Infrastructure Engineering II [도시건설공학특론 II]

In this course, subject offerings of new and developing areas of knowledge in urban infrastructure engineering will be given with intention to augment the existing curriculum. See course information for topics and prerequisites.

UIE412 Special Topics in Urban Infrastructure Engineering III [도시건설공학특론 III]

In this course, subject offerings of new and developing areas of knowledge in urban infrastructure engineering will be given with intention to augment the existing curriculum. See course information for topics and prerequisites.

□ Disaster Management Engineering (DME)

DME201 Introduction to Natural Hazards [자연재해개론]

This course provides students with the causes and effects of natural disasters such as typhoon, heavy rainfall, flooding and drought, earthquakes, volcanic eruptions, tsunami, landslides. In particular, the physical and dynamical aspects of severe and hazardous disasters are examined. Also, some cases studies will be used to investigate human, economic, and environmental consequences of destructive natural hazards.

DME202 Man-made Disasters [인적재해]

The goal of the course is to provide a basic overview of the various types of human-induced and industrial hazards and their potential for causing disasters. The purpose is to familiarize students with the basic concepts of man-made disasters and societal vulnerability.

DME221 Atmospheric Chemistry [대기화학]

The aim of this course is to understand the chemical composition and fate of gases and particulate matters in the atmosphere. This course focuses on various environmental issues such as acid rain, photochemical reactions, ozone depletion, and air pollutants associated with climate change.

DME311 Probability Concepts in Engineering [공학확률]

The aim of this course is to identify and model non-deterministic engineering problems using probability theories. This course focuses on the introduction of stochastic concepts and simulation models, and their applications to real decision-making problems in various engineering disciplines including civil engineering.

DME321 Numerical Modeling and Analysis [수치모델링 및 분석]

This course introduces the basics concept of numerical modeling and provides students with numerical methods. In addition, students have experience of numerical modeling and analysis in MATLAB.

DME331 Disaster Management [재난관리]

The goal of the course is to provide understanding of the general principles of management and their specific applications in the field of disaster management. The objective is to identify and examine the essential and fundamental elements of disaster mitigation, preparedness, response and recovery within an inclusive management policy framework.

DME332 Disaster Risk Analysis [재난위험성 분석]

This course introduces the basic elements, processes and techniques of research utilized for description and analysis with special reference to disaster management. This course reviews how research is done and how to understand scholarly work including reading, understanding and applying studies from the field of disaster research.

DME341 Water Resources Engineering [수자원공학]

This course introduces engineering design concepts for water resources and engineering implications, including design and analysis of systems directly concerned with use and control of water; quantitative introduction to hydrology, hydraulic engineering, and water resources planning.

DME342 Hydrology [수문학]

This course covers the movement and distribution of water and principles of hydrologic cycle, with a particular emphasis in the areas of water management.

DME411 Hazard Analysis for System Safety [재해분석과 시스템안전성]

The course introduces the concept of safety assessment of complex systems, such as: power plants, industrial facilities and offshore platforms. However, the same principles are also applied in computer science to software safety. The course will focus on hazards, mishap, risk, and all the different hazard analysis types. Special attention will be given to: fault tree analysis, event tree analysis, common cause failures, and failure mode and effects analysis. (Suggested courses: MTH211 Statistics).

DME421 Weather Analysis and Prediction [날씨 분석 및 예측]

Most disaster damages in Korea are related to the high-impact weather events. This course provides how to analyze current weather using variable observation data and how to predict future weather using empirical method as well as numerical method.

DME422 Satellite Remote Sensing [위성원격탐사]

This course deals with the basic principle of remote sensing and its applications for environmental science and engineering. Among remote sensing methods, satellite remote sensing will be focused.

DME431 Disasters and Environmental Economics [재난 및 환경경제학]

This course covers the costs of natural and man-made disasters, the existing policy frameworks for mitigating these costs in the industrialized world, and the ways in which these policies might be adapted for the developing world.

DME432 Vulnerability and Capacity Analysis [재해취약성 및 수용력분석]

This course provides knowledge on methods of risk identification and hazard analysis and the development of disaster management capacity of a community or region. The objective is to develop skills to assess the risk associated with a variety of scenarios and resultant vulnerability.

DME491~3 Special Topics in Disaster Management Engineering I~III [재난관리공학특론 I~III]

This undergraduate-level course is designed for subject offerings of new and developing areas in disaster & risk management engineering intended to augment the existing curriculum. See class schedule or course information for further information.

School of Design and Human Engineering

1. School Introduction

UNIST school of Design and Human Engineering is unique by its joint program of Design and Human Factors, with an engineering basis. Design is nowadays the driving force behind most innovations: bringing solutions to real-world problems, but always based on a human-centered approach. Within our school you can go for an industrial design engineering program, for a human factors engineering program and for a combination of both. The industrial design engineer is a global player, able to master the whole design process, from research to ideas and from concept to production. Human factors engineers master the cognitive, physical, and physiological characteristics of human beings that are applicable to the design of devices and systems, and are able to apply the knowledge in real world design problems in order to optimize human well-being and overall system performance. Our school is pioneering a relevant curriculum that prepares design & human factors engineers for essential roles in industry today.

2. Undergraduate Programs

□ Track Introduction

1) Industrial Design (ID)

The goal of Industrial Design track is to foster creative designers who can lead the innovative design of product and product-service systems. It provides interdisciplinary courses on design knowledge, methods and techniques across the entire product development process, including problem definition, user and market analysis, needs finding, creative idea generation, form and function development, design engineering, prototyping and business start-up. Students majoring in the ID track will play an essential role as integrative design thinkers and practitioners in future society, leading positive and innovative change in our society by employing user-centered design and scientific methods.

2) Human Factors Engineering (HFE)

The goal of Human Factors Engineering track is to educate students to understand human abilities, capabilities and the human centred design process. To achieve this goal, students learn to design experimental studies that investigate human performance, behaviour or cognition, to analyse human behavioural and physiological data, and to use these processes and data to improve the usability, safety and comfort of products, services or systems. The track provides courses covering fundamental knowledge in human factors engineering and human performance, as well as research methods. Our curriculum aims to prepare students to solve real world design problems by applying rigorous engineering methodologies.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1st Track	2nd Track	
ID	Required	36	-	
	Elective	18	18	
HFE	Required	24	-	
	Elective	30	18	

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
ID	MTH203	Applied Linear Algebra	2-1
	MTH211	Statistics	2-2
HFE	MTH203	Applied Linear Algebra	2-1
	MTH211	Statistics	2-2

※ Complete based on 1TR
※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' 12 credits.

▶ Fundamentals required to Business field students when they choose Engineering field tracks as 2nd track

Course Title	ID	HFE
Calculus II	✔	✔

3. Curriculum

※ Course opening semester is subject to be changed according to School's situation.

□ Industrial Design (ID)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ID	IID201	Design Elements and Principles 디자인요소와 원리	3-2-2		1
	IID202	Product Design Fundamentals 제품디자인기초	3-2-2	Prerequisite: IID201	2
	IID206	Design Visualization 디자인 시각화	3-2-2		1
	IID232	3D CAD 3D CAD	3-2-2		2
	IID301	Product Design Ⅰ 제품디자인 Ⅰ	3-2-2	Prerequisite: IID202	1
	IID302	Product Design II 제품디자인 II	3-2-2	Prerequisite: IID301	2
	IID332	UX Design Research Methods UX 디자인 연구 방법	3-3-0		2
	IID405	Design Communication 디자인 커뮤니케이션	3-2-2		2
	IID431	Creative Design 1 창의디자인 1	3-2-2	Prerequisite: IID302	1
	IID432	Creative Design 2 창의디자인 2	3-2-2	Prerequisite: IID431	2
HFE	HFE202	Human Factors Fundamentals 인간공학개론	3-3-0		1
	HFE401	Capstone Design 캡스톤 디자인	3-2-2		1
Total Credit			36		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ID	IID221	Design History & Contexts 디자인 역사와 맥락	3-3-0		1
	IID231	Design Knowledge and Skills 디자인 지식과 기술	3-3-0		2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ID	IID233	Design for Sustainability 지속가능한 디자인	3-3-0		2
	IID304	Interactive Technology 인터랙티브 기술	3-3-0		2
	IID315	Design Methodology 디자인 방법론	3-3-0		1
	IID324	Prototyping for Design 디자인 프로토타이핑	3-3-0		1
	IID341	Fundamental Electrical-Electronic Practice 기초전기전자실습	3-2-2		1
	IID342	Electronic Sensor and Controller 전자 센서 및 제어기	3-2-2		2
	IID404	Product Service System Design 제품서비스시스템디자인	3-2-2		1
	IID410	Special Topics in IID Ⅰ 통합산업디자인특론 Ⅰ	3-3-0		-
	IID420	Special Topics in IID Ⅱ 통합산업디자인특론 Ⅱ	3-3-0		-
	IID430	Special Topics in IID Ⅲ 통합산업디자인특론 Ⅲ	3-3-0		-
HFE	HFE205	Physical Ergonomics 인체인간공학	3-3-0		2
	HFE206	Cognitive Ergonomics 인지인간공학	3-3-0	Prerequisite: HFE202	2
	HFE301	Experimental Design 실험계획법	3-3-0	Prerequisite: MTH211	1
	HFE303	Color Science & Engineering 색채과학과 공학	3-3-0		1
	HFE304	High Touch Design 하이터치 디자인	3-2-2		1
	HFE305	Physical Computing 피지컬 컴퓨팅	3-2-2		1
	HFE306	Usablility Engineering 사용성공학	3-3-0		2
	HFE308	Sensation and Perception 감각과 지각	3-3-0		2
	HFE406	Affective Engineering 감성공학	3-3-0		2
MAE	MEN230	Solid Mechanics Ⅰ 고체역학 Ⅰ	3-3-0		1
SDC	SDC202	Computational Tools for Engineers 공학전산기법	3-3-0		2
	SDC405	3D Printing 3D 프린팅	3-3-0		1
MGT	MGT204	Marketing Management 마케팅 관리	3-3-0		1,2
	MGT473	Entrepreneurship and Venture Management 창업과 벤처	3-3-0		1
Total Credit			**78**		

□ Human Factors Engineering (HFE)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
HFE	HFE202	Human Factors Fundamentals 인간공학개론	3-3-0		1
	HFE205	Physical Ergonomics 인체인간공학	3-3-0		2
	HFE206	Cognitive Ergonomics 인지인간공학	3-3-0	Prerequisite: HFE202	2
	HFE301	Experimental Design 실험계획법	3-3-0	Prerequisite: MTH211	1
	HFE306	Usablility Engineering 사용성공학	3-3-0		2
	HFE401	Capstone Design 캡스톤 디자인	3-2-2		1
ID	IID201	Design Elements and Principles 디자인요소와 원리	3-2-2		1
SDC	SDC202	Computational Tools for Engineers 공학전산기법	3-3-0		2
Total Credit			**24**		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
HFE	HFE303	Color Science & Engineering 색채과학과 공학	3-3-0		1
	HFE304	High Touch Design 하이터치 디자인	3-2-2		1
	HFE305	Physical Computing 피지컬 컴퓨팅	3-2-2		1
	HFE308	Sensation and Perception 감각과 지각	3-3-0		2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
HFE	HFE309	Work Measurement Methods 작업측정 및 방법	3-3-0		2
	HFE310	Brain and Human Behavior Ⅰ - Common to humans 뇌와 인간행동 Ⅰ - 공통특성	3-3-0		1
	HFE311	Brain and Human Behavior Ⅱ - Difference between humans 뇌와 인간행동 Ⅱ - 개인차	3-3-0		2
	HFE404	Brain-Computer Interface Design 뇌-컴퓨터 인터페이스 디자인	3-3-0		1
	HFE405	Safety Engineering 안전공학	3-3-0		2
	HFE406	Affective Engineering 감성공학	3-3-0		2
	HFE407	Research Practicum in Human Factors 인간공학 연구 실무	3-3-0		2
	HFE410	Special Topics in HFE Ⅰ 인간공학 특론 Ⅰ	3-3-0		-
	HFE420	Special Topics in HFE Ⅱ 인간공학 특론 Ⅱ	3-3-0		-
ID	IID202	Product Design Fundamentals 제품디자인기초	3-2-2	Prerequisite: IID201	2
	IID206	Design Visualization 디자인 시각화	3-2-2		1
	IID231	Design Knowledge and Skills 디자인 지식과 기술	3-3-0		2
	IID232	3D CAD 3D CAD	3-2-2		2
	IID304	Interactive Technology 인터랙티브 기술	3-3-0		2
	IID341	Fundamental Electrical-Electronic Practice 기초전기전자실습	3-2-2		1
SDC	SDC304	Manufacturing System Design & Simulation 생산시스템설계 및 시뮬레이션	3-3-0		2
CSE	CSE463	Machine Learning 기계 학습	3-3-0	Prerequisite: EE211, CSE331	2
MGT	MGT363	Operations Research 계량경영학	3-3-0	Identical: MGE201	2
Total Credit			**66**		

4. History of Courses Change of 2017–2018

Category	2017		2018
ID	<New>	⇨	IID341 (Elective) Fundamental Electrical-Electronic Practice 기초전기전자실습
	<New>	⇨	IID342 (Elective) Electronic Sensor and Controller 전자 센서 및 제어기
HFE	<New>	⇨	HFE310 (Elective) Brain and Human Behavior Ⅰ - Common to humans 뇌와 인간행동 Ⅰ - 공통특성
	<New>	⇨	HFE311 (Elective) Brain and Human Behavior Ⅱ - Difference between humans 뇌와 인간행동 Ⅱ - 개인차

5. Course Descriptions

□ Industrial Design (ID)

IID201 Design Elements and Principles [디자인 요소와 원리]

The objective of this course is to give an introduction into design and the role of design and the designer. People and their context are at the heart of design. Therefore, the role of human factors in design will be emphasized next to the introduction of basic elements and principles of 2D and 3D design. Students acquire understanding of and knowledge about the interaction between people, products and environments at both the individual and societal level. Through some small design projects accompanied by creativity techniques students start to learn the basic skills of problem solving.

IID202 Product Design Fundamentals [제품디자인기초]

This is an introduction to the fundamentals of developing three-dimensional form designs, with a focus on form appreciation and its application. Students will develop a critical understanding of and appreciation for 3D form and design aesthetic, through lectures, formative design critique sessions, peer review and discussion. Through a final terminal product design project, students learn skills ranging from solving observed design problems to constructing prototypes and mockups to communicate design intent.

IID206 Design Visualization [디자인시각화]

The objective of this course is to develop the ability of visualizing design ideas. Sketching and visualization is the core of learning to design. This course is set up to foster both pragmatic skills as well as an understanding of the role and use of sketching as a tool for design thinking and communication. Students learn to make perspective drawings, sketches, renderings, and simulations through hand drawing. During the second half of the course, and in parallel with this hand drawing, students use the computer to learn visualizing methods and techniques with vector and raster graphics.

IID232 3D CAD [3D CAD]

This course aims to develop practical ability of product design utilizing 3D CAD. Students learn about how to generate and deal with 3D CAD data for product design and development. It involves the concept of integrated product design process with 3D CAD, modeling methods and techniques of master, assembly, exploded and part models for detail design, generation of engineering drawing and photo-realistic rendering for communication, and kinematic simulation and assemble-ability test of assembly model for test and refinement of design. Students also learn about producing and transferring 3D CAD data for development of physical prototypes and mass production.

IID301 Product Design I [제품디자인 I]

The goal of this course is to acquire knowledge and skills in solving problems with a focus on electronics and mechanics for engineering product design. Students learn about fundamentals in electronics, control and mechanics necessary for engineering design though lectures and a series of design tasks and short projects. Through a final engineering design project, students learn skills ranging from technical problem solving with engineering approaches to constructing technologically functional prototypes with scientific and engineering rationales.

IID332 UX Design Research Methods [UX 디자인 연구 방법]

This course aims to acquire the ability to select and apply appropriate design methods, techniques and tools throughout the product design process. Students learn about various design research approaches and strategies to tackle design challenges. These research methods are typical for each stage of the design process. It involves user research methods for internally and externally analyzing the company and identifying user needs, for example by way of survey, interviews and context mapping. In the concept development stage research involves observation techniques in confronting users with early sketches and models. Usability testing is part of the prototyping stage finally followed by market research. Both lectures and studio work are part of this course.

IID302 Product Design II [제품디자인 II]

This studio course aims at developing students’ ability to design products focusing on product innovation with the consideration of user, market, technology and environment trends, as well as sustainability issues. Students apply various user-centered methods in their design project. They also investigate production processes and techniques, characteristics of materials in the stage of developing product specification. Through a final product design project, students develop an innovative product concept that satisfies user experience, market needs and sustainability requirements.

IID341 Fundamental Electrical-Electronic Practice [기초전기전자실습]

In this class, students can learn how to deal some tools and instruments which are basic but very important to develop an electrical or electronic product. Through this class, students can understand the physical meaning of an electrical/electronic signal as well as an electrical circuit diagram. The method of how to utilize the basic electrical components, such as a resistor, a capacitor or a diode, will be dealt. Students can also learn and practice how to handle a power supply, a soldering iron, a cable, a multimeter, and an oscilloscope. Eventually, they will have abilities to implement their own product with less mistakes, as they have knowledge and experience about handling electrical/electronic tools and instruments.

IID342 Electronic Sensor and Controller [전자 센서 및 제어기]

In this lecture, various electrical-electronic sensors and digital control techniques are covered as aspects of an embedded system. Covered topics include expandable ARM processor-based single board controller, firmware development, digital-analog interface, and various I/O devices. Hands-on design experiments are performed to ensure students' understanding their own systems. Through this lecture, students can develop their abilities to implements diverse interactive products.

IID405 Design Communication [디자인 커뮤니케이션]

The objective of this course is to train communication skills and techniques and explore career perspective. For the early half of the semester, emphasis is given to portfolio design and self-promotion. Students learn about the relationships between communication and design practice with industry. From the oral presentation of design ideas to the use of visualization methods and prototypes of various levels of detail and fidelity, students will develop their ability to effectively communicate their design intentions to a variety of stake holders. For the last half of the semester, students investigate professional areas related to design. They develop a greater understanding of career in or related to design through searching for potential jobs and interviewing professionals in industry.

IID431 Creative Design 1 [창의디자인 1]

This design project course aims to explore the design process in a company context with an initial focus on the fuzzy front-end, leading to a search for opportunities for new product development in this particular company context. Taking the company’s expertise, product portfolio and production capacity into account, the search should deliver various new ‘search fields’ with product ideas for every field. The most promising product idea will be chosen to elaborate into a model. Students are required to utilize and integrate prior knowledge and skills acquired in previous semesters in order to identify problems, and conceive and propose a novel idea or design concept. Final outcomes include concept visualization, a design model, a report and a presentation which includes a two-minutes video pitch. The course runs through team teaching among ID professors.

IID432 Creative Design 2 [창의디자인 2]

This is the terminal degree project course. It aims to enhance and exhibit students' ability of product design in a holistic and integrative way by executing a product development project in a company context. Students go through an internal and external analysis of the company, problem definition, conceptualization, developing design specification, detail design, prototyping, testing, marketing, and public presentation. The course runs through team teaching among ID professors.

IID221 Design History & Contexts [디자인 역사와 맥락]

This is an introductory course in design history, context of design and communication design. For the first 8 weeks, students learn about the development of design history in the context of cultural, social and technological evolvement. For the last 8 weeks, students learn about visual language and fundamental design theories for creating two-dimensional form. It involves elements of design, spatial relationships, typography and imagery. This focuses on finding creative visual solutions to communication problems using technical skills.

IID231 Design Knowledge and Skills [디자인 지식과 기술]

This course introduces knowledge and skills of information design with focus on the visual representation of data. Students will be introduced to the basics of information visualization where the intersection of text and image, perception and cognition, beauty and function, logic and emotion enables us to reveal what hides behind the data and to address effective messages. In this class, students will explore conceptual and visual solutions using various computational tools, and on the creative process of organizing, visualizing and communicating information. The course will have a theoretical component, as we will cover the main rules of the discipline, and also a practical one: to design infographics and data visualizations.

IID233 Design for Sustainability [지속가능한 디자인]

Today there is an urgent need for radical changes in our production and consumption patterns so as to delink economic growth and environmental pressure and avoid catastrophic consequences. Given the capabilities of designers to imagine and create, the following question is raised: what can designers do for a more sustainable future? In 'Sustainability: design for future', an introductory course to design for sustainability, we critically examine the unsustainable culture of contemporary society, and explore the roles of design for more sustainable ones. It particularly focuses on developing solutions that provoke behavior change that promotes sustainability. The course offers a systemic overview of the environmental and social challenges that we face today, a series of dialog on our unsustainable culture and behavior, ongoing efforts to change them particularly through the behavior change of consumers, and a hands-on experience to design products, services, and systems that influence behavior change towards a sustainable future.

IID304 Interactive Technology [인터랙티브 기술]

In this class, students will learn ways to design and implement one highly-finished interactive prototype by going through the iterative prototyping process of the design concepts they have generated. Students will discuss and practice how to apply technologies from the perspective of design; specifically, they will learn essential engineering skills comprising physical computing skills, and programming skills (using Arduino & Processing) for the hardware and software development of their prototypes. Along with this, students will conduct ideation of their designs from the initial phase of the course until finalization, in order to generate one novel and creative interactive product idea. Ideation will be done based on engineering skill practice, technology trend research and user needs exploration.

IID315 Design Methodology [디자인 방법론]

The objective of this course is to acquire a deeper understanding of designing as a problem solving activity. Student investigate the definitions and characteristics of design and design problem, and learn about design process. They learn design process from two perspectives; an individual's cognitive process for problem solving with a focus of creativity and a systematic and collaborative product development process in organization. Lectures, discussions and assignments help the students to develop the ability to think critically about the design process and methods, and thus to improve their own design processes.

IID324 Prototyping for Design [디자인 프로토타이핑]

The course aims to foster an understanding of the role and use of design prototyping as method for design ideation, development and communication. To achieve this the course will cover prototyping principles and strategies as related to design process, and appropriate skills, strategies and approaches for the application of the prototyping method during industrial design.

IID404 Product Service System Design [제품 서비스 시스템 디자인]

The objective of this course is to acquire knowledge about product-service system innovation from business and public sector. It focuses on systematic approaches to handle complex design problems that arise from social and technological change. Through lectures of fundamental theories about PSSD and design practice, students gain an increased understanding of the connection of a product with services that composes a system and the business meaning of product-service development to related industry. As the final outcome, students develop and present a feasible service related to a newly designed product.

IID410,420,430 Special Topics in IID I, II, III [통합산업디자인특론 I, II, III]

In these courses contemporary topics in various areas related to Industrial Design will be covered. Topic selection will be made based upon special interests.

□ Human Factors Engineering (HFE)

HFE202 Human Factors Fundamentals [인간공학개론]

This course surveys human factors engineering emphasizing the systems approach to workplace and machine design. It includes a discussion of basic human factors research and design methods, visual processes and design methods, selection of statistical techniques for application to human factors data, visual and auditory processes, display and control design, and effects of environmental stressors on humans.

HFE205 Physical Ergonomics [인체인간공학]

This course provides students with a working knowledge of key areas of physical ergonomics. These include: the physiology of the human musculoskeletal system; work capacity; occupational biomechanics; and digital human movement modeling. This knowledge will be applied to problems in product and environment design.

HFE206 Cognitive Ergonomics [인지인간공학]

This course studies how products and systems can be improved by understanding human cognitive characteristics and applying fundamental theories of psychology to design and engineering problems.

HFE301 Experimental Design [실험계획법]

The course describes procedures for designing, conducting and analyzing experiments efficiently and effectively. It includes the fundamentals of research, experimental design alternatives, fitting and testing statistical models, and data interpretation and presentation. Both design and statistical issues will be discussed and computer software packages to implement the methods presented will be illustrated extensively.

HFE306 Usability Engineering [사용성공학]

In the context of the design of interactive computer systems (e.g. Human-Computer Interaction), this course deals with definition of usability, what metrics can be used to measure and quantify it and what techniques and methods can be used to improve and achieve it. Course material will be delivered by lecture and student assessment is via exams and a single full-semester class project. Individual classes will also be devoted to supporting and critiquing project work.

HFE310 Brain and Human Behavior Ⅰ – Common to humans [뇌와 인간행동Ⅰ–공통특성]

This course will introduce the nature of human behavior. Students will learn how the brain works and how the researchers find it. Students will understand the behavior of other people as well as their own. We will deal with various basic topics in psychology such as brain biology, perception and memory.

HFE311 Brain and Human Behavior Ⅱ – Difference between humans [뇌와 인간행동Ⅱ-개인차]

This course will introduce the nature of human behavior. Students will learn how the brain works and how the researchers find it. Students will understand the behavior of other people as well as their own. We will deal with various topics in psychology which explains the difference between humans, such as intelligence, personality and mental illness.

HFE401 Capstone Design [캡스톤 디자인]

The objective of this course is to apply knowledge of design and human factors to the design of a product, service or system. Integration of research on human factors into the process will be required. Students work in teams to design and develop functional prototypes (hardware/software), computer simulations, and/or professional reports with real applications. At the end of the semester, students showcase their efforts at the school exhibition.

HFE303 Color Science & Engineering [색채과학과 공학]

This course deals with the human vision, fundamentals of color science, and its applications. Human visual system, psychophysics, CIE colorimetry, color appearance, and engineering issues related to color imaging systems such as displays or camera will be taught. Student will conduct a project related to the human visual perception and application system.

HFE304 High Touch Design [하이터치 디자인]

High Touch Design is a process that tries to develop a user friendly, compatible and aesthetic product based upon human factors and psychophysiological knowledge. Variables in High Touch design include combinatorial sets of design variables among (Human x Product x Task x Environment x Culture). A hierarchical analysis of complex variables, matrix analysis of integrated variables, structural analogy in creative design will be covered. The term project will be assigned to create a non-existing product.

HFE305 Physical Computing [피지컬 컴퓨팅]

This course introduces students to the area of physical computing - the use of sensors and actuators to sense and respond to natural human actions and activities. This course is about creating systems and products that bridge the gap between the physical and digital worlds by providing the knowledge, skills, examples and experience to realize novel and compelling forms of physical-digital connection. It takes the form of a studio course supplemented by a series of tutorials covering basic technical material. Students will develop skills in conceiving, designing, prototyping and critiquing systems that realize physical-digital interaction design.

HFE308 Sensation and Perception [감각과 지각]

This course provides an overview of contemporary theory and research in perception, including related computational and biological issues along with their applications. We learn how human beings acquire, process and utilize information about objects and events in the environment, covering vision, audition, taste, smell, touch, and multi-sensory integration.

HFE309 Work Measurement Methods [작업측정 및 방법]

This course aims to introduce methods for assessing and improving human performance and manufacturing productivity. Topics studied include basic industrial engineering tools, work measurement procedures, data acquisition, analysis and applications, performance evaluation and appraisal, and learning curve etc.

HFE404 Brain-Computer Interface Design [뇌-컴퓨터 인터페이스 디자인]

This course introduces the fundamentals of Brain-Computer Interface (BCI). Students will learn how to sense, process and use signals captured from the brain to develop functional interfaces between the human brain and external devices.

HFE405 Safety Engineering [안전공학]

This course provides students with a general understanding of occupational and systems safety. Students will learn how to apply system safety methodologies to workplace design evaluation, accident analysis and consumer product design, as well as gain an understanding of human error analysis, accident potential recognition, occupational safety and health legislation, and safety considerations in consumer product design.

HFE406 Affective Engineering [감성공학]

Translation of human affections into design features is the objective of Affective Engineering. This course focuses upon the techniques and relevant theories of Affective Engineering. Exemplar products and studies will be introduced to show that Affective Engineering plays a role in designing more attractive products.

HFE407 Research Practicum in Human Factors [인간공학 연구 실무]

This course deals with special topics in ACE (Affect, Cognition, and/or Ergonomics). The instructor will introduce basics, advances, and recent activities in ACE-related research areas. Students will present and criticize journal papers from these areas. For the team-based project, each team will define their research topic, design experiments, run pilot/main experiments, and write a professional research report.

HFE410, 420 Special Topics in HFE I, II [인간공학 특론 I, II]

In these courses contemporary topics in various areas related to Human and Systems Engineering will be covered. Topic selection will be made based upon special interests.

School of Materials Science and Engineering

1. School Introduction

The School of Materials Science and Engineering is an interdisciplinary field which emphasizes the study of processing-structure-property relations in materials. In order to develop new materials and find their applications, it is important to understand the fundamental relationship between the structure, processing and properties. The school of Materials Science and Engineering covers conventional materials to most advanced materials including nano materials and beyond.

2. Undergraduate Programs

☐ Track Introduction

1) Advanced Materials Science (AMS)

Students in Advanced Materials Science(AMS) track will learn how the structure is controlled during the manufacturing process by various chemical, thermal, mechanical, electrical and other treatments. AMS track is directed towards understanding of various materials such as metals, ceramics, semiconductors, polymers and hybrid materials at both macroscopic and microscopic scale. Advanced materials in this area include structural materials covering cars, aerospace and ships, electronic materials covering semiconductors and displays, and energy materials covering solar cells, fuel cells, batteries and supercapacitors. We expect the students to play a key role in a wide range of modern science, technologies and industrial fields based on the knowledge of materials science and engineering.

2) Nano Materials Engineering (NME)

Students in Nano Materials Engineering (NME) track will learn the basic knowledges of nano materials science and engineering. NME track is directed towards understanding of various nano materials, nano structures and its applications mostly in the nano regime. Nano materials design and synthesis, nano processing and nano devices fabrications are in the scope of this specialized track. We envision that the students will pioneer realization of nano materials in modern nano science and technologies based on the knowledge of nano materials.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1st Track	2nd Track	
AMS	Required	21	9	
	Elective	33	9	
NME	Required	21	9	
	Elective	33	9	

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
AMS	MTH203	Applied Linear Algebra	2-1
	MTH201	Differential Equations	2-2
NME	MTH203	Applied Linear Algebra	2-1
	MTH201	Differential Equations	2-2

※ Complete based on 1TR
※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' 12 credits.

▶ Fundamentals required to Business field students when they choose Engineering field tracks as 2nd track

Course Title	AMS	NME
Differential Equations	✔	✔
General Physics II	✔	✔
General Physics Lab I	✔	✔
General Physics Lab II	✔	✔
General Chemistry I	✔	✔
General Chemistry II	✔	✔
General Chemistry Lab I	✔	✔
General Chemistry Lab II	✔	✔

3. Curriculum ※ Course opening semester is subject to be changed according to School's situation.

□ Advanced Materials Science (AMS)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
AMS	AMS202	Introduction to Materials Science and Engineering 재료공학개론	3-3-0	Identical: NME202, ENE216	1
	AMS203	Thermodynamics of Materials 재료열역학	3-3-0	Identical: NME203	1
	AMS210	Defects in Crystals 결정결함론	3-3-0		2
	AMS230	Introduction to Crystallography 결정학개론	3-3-0	Prerequisite: AMS202 or NME202	2
	AMS390	Introduction to Computational Materials Science 전산재료과학개론	3-3-0		2
Total Credit			15		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
AMS	AMS312	Phase Transformations in Materials 재료상변태	3-3-0	Identical: ENE410	1
	AMS350	Solid State Physics of Materials Ⅰ 재료고체물리 Ⅰ	3-3-0	Prerequisite: AMS202 or NME202	2
	AMS400	Materials Lab 1 재료실험 1	3-1-4		1
NME	NME313	Mechanical Behavior of Materials 재료의기계적거동	3-3-0	Prerequisite: AMS202 or NME202	1
Total Credit			12		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
AMS	AMS311	Introduction to Metallic Materials 금속재료개론	3-3-0		-
	AMS351	Thin Film Technology 박막공학	3-3-0		1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
AMS	AMS353	Surface Science of Materials 재료표면과학	3-3-0	Prerequisite: AMS202 or NME202	-
	AMS360	Bio-inspired Materials Science 바이오소재과학	3-3-0	Identical: BME435	2
	AMS401	Transmission Electron Microscopy 전자현미경학	3-3-0		-
	AMS402	Materials Lab 2 재료실험2	3-1-4		-
	AMS431	Magnetic Properties of Materials 재료의 자기적 성질	3-3-0		-
	AMS432	Piezoelectric Materials 압전재료	3-3-0		1
	AMS433	Introduction to Ceramics 세라믹 물성학	3-3-0		2
	AMS491	Special Topics in Advanced Materials Science Ⅰ 신소재과학특론 Ⅰ	3-3-0		-
	AMS492	Special Topics in Advanced Materials Science Ⅱ 신소재과학특론 Ⅱ	3-3-0		-
	AMS493	Special Topics in Advanced Materials Science Ⅲ 신소재과학특론 Ⅲ	3-3-0		-
	AMS494	Special Topics in Advanced Materials Science Ⅳ 신소재과학특론 Ⅳ	3-3-0		-
NME	NME251	Introduction to Nanomaterials 나노재료개론	3-3-0		2
	NME270	Introduction to Polymer Materials 고분자재료개론	3-3-0		2
	NME315	Physical Metallurgy 물리금속학	3-3-0	Prerequisite: NME313	-
	NME330	Nano-Electroceramics 나노전자세라믹스	3-3-0		2
	NME350	Modern Physics of Materials 재료현대물리	3-3-0		1
	NME353	Physical Chemistry of Materials : Reaction Engineering 재료물리화학 : 반응공학	3-3-0		1
	NME354	Introduction to Semiconductor 반도체개론	3-3-0		2
	NME355	Introduction to nano-energy Materials 나노에너지재료	3-3-0		1
	NME356	Introduction to Nanophotonics 나노포토닉스 개론	3-3-0		-
	NME372	Polymer Physics 고분자 물리	3-3-0		2
	NME401	Nano Materials Lab 1 나노재료실험 1	3-1-4		1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
NME	NME402	Nano Materials Lab 2 나노재료실험 2	3-1-4		-
	NME452	Nano-Semiconducting Devices 나노반도체소자	3-3-0		1
	NME454	Nano-Materials Reliability 나노소재신뢰성	3-3-0		1
	NME455	Display Engineering 디스플레이공학	3-3-0		1
	NME471	Polymer Composites 고분자 복합재료	3-3-0		2
	NME472	Introduction to Flexible Electronics 유연전자소자 개론	3-3-0		1
	NME491	Special Topics in Nano Materials Engineering I 나노재료공학특론 I	3-3-0		-
	NME492	Special Topics in Nano Materials Engineering II 나노재료공학특론 II	3-3-0		-
	NME493	Special Topics in Nano Materials Engineering Ⅲ 나노재료공학특론 Ⅲ	3-3-0		-
	NME494	Special Topics in Nano Materials Engineering Ⅳ 나노재료공학특론 Ⅳ	3-3-0		-
MAE	MEN230	Solid Mechanics I 고체역학 I	3-3-0		1
	MEN301	Numerical Analysis 수치해석	3-3-0		2
	MEN431	Introduction to Plastic Deformation 소성학개론	3-3-0	Prerequisite: MEN231	1
ENE	ENE312	Electrochemistry 전기화학	3-3-0	Identical: ACE312	2
PHY	PHY201	Classical Mechanics 고전역학	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY301	Quantum Physics I 양자물리학 I	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY303	Thermal and Statistical Physics 열 및 통계물리학	3-3-0	Prerequisite: PHY101, PHY103	2
CHEM	CHM211	Organic Chemistry I 유기화학 I	3-3-0	Identical: ACE201, ENE211	1
	CHM351	Inorganic Chemistry I 무기화학 I	3-3-0	Identical: ACE304, ENE311	1
	CHM371	Introduction to Nanochemistry 나노화학개론	3-3-0	Identical: ACE416, ENE416	2
	CHM391	Instrumental Analysis 기기분석	3-3-0	Identical: ACE391, ENE322	2
		Total Credit	**135**		

□ Nano Materials Engineering (NME)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
NME	NME203	Thermodynamics of Materials 재료열역학	3-3-0	Identical: AMS203	1
	NME251	Introduction to Nanomaterials 나노재료개론	3-3-0		2
	NME270	Introduction to Polymer Materials 고분자재료개론	3-3-0		2
	NME313	Mechanical Behavior of Materials 재료의기계적거동	3-3-0	Prerequisite: AMS202 or NME202	1
	NME330	Nano-Electroceramics 나노전자세라믹스	3-3-0		2
Total Credit			15		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
NME	NME202	Introduction to Materials Science and Engineering 재료공학개론	3-3-0	Identical: AMS202, ENE216	1
	NME350	Modern Physics of Materials 재료현대물리	3-3-0		1
	NME401	Nano Materials Lab 1 나노재료실험 1	3-1-4		1
AMS	AMS312	Phase Transformations in Materials 재료상변태	3-3-0	Identical: ENE410	1
Total Credit			12		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
NME	NME315	Physical Metallurgy 물리금속학	3-3-0	Prerequisite: NME313	-
	NME353	Physical Chemistry of Materials : Reaction Engineering 재료물리화학 : 반응공학	3-3-0		1
	NME354	Introduction to Semiconductor 반도체개론	3-3-0		2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
NME	NME355	Introduction to nano-energy Materials 나노에너지재료	3-3-0		1
	NME356	Introduction to Nanophotonics 나노포토닉스 개론	3-3-0		-
	NME372	Polymer Physics 고분자 물리	3-3-0		2
	NME402	Nano Materials Lab 2 나노재료실험 2	3-1-4		-
	NME452	Nano-Semiconducting Devices 나노반도체소자	3-3-0		1
	NME454	Nano-Materials Reliability 나노소재신뢰성	3-3-0		1
	NME455	Display Engineering 디스플레이공학	3-3-0		1
	NME471	Polymer Composites 고분자 복합재료	3-3-0		2
	NME472	Introduction to Flexible Electronics 유연전자소자 개론	3-3-0		1
	NME491	Special Topics in Nano Materials Engineering Ⅰ 나노재료공학특론 Ⅰ	3-3-0		-
	NME492	Special Topics in Nano Materials Engineering II 나노재료공학특론 II	3-3-0		-
	NME493	Special Topics in Nano Materials Engineering Ⅲ 나노재료공학특론 Ⅲ	3-3-0		-
	NME494	Special Topics in Nano Materials Engineering Ⅳ 나노재료공학특론 Ⅳ	3-3-0		-
AMS	AMS210	Defects in Crystals 결정결함론	3-3-0		2
	AMS230	Introduction to Crystallography 결정학개론	3-3-0	Prerequisite: AMS202 or NME202	2
	AMS311	Introduction to Metallic Materials 금속재료개론	3-3-0		-
	AMS350	Solid State Physics of Materials Ⅰ 재료고체물리 Ⅰ	3-3-0	Prerequisite: AMS202 or NME202	2
	AMS351	Thin Film Technology 박막공학	3-3-0		1
	AMS353	Surface Science of Materials 재료표면과학	3-3-0	Prerequisite: AMS202 or NME202	-
	AMS360	Bio-inspired Materials Science 바이오소재과학	3-3-0	Identical: BME435	2
	AMS390	Introduction to Computational Materials Science 전산재료과학개론	3-3-0		2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
AMS	AMS400	Materials Lab 1 재료실험 1	3-1-4		1
	AMS401	Transmission Electron Microscopy 전자현미경학	3-3-0		-
	AMS402	Materials Lab 2 재료실험2	3-1-4		-
	AMS431	Magnetic Properties of Materials 재료의 자기적 성질	3-3-0		-
	AMS432	Piezoelectric Materials 압전재료	3-3-0		1
	AMS433	Introduction to Ceramics 세라믹 물성학	3-3-0		2
	AMS491	Special Topics in Advanced Materials Science Ⅰ 신소재과학특론 Ⅰ	3-3-0		-
	AMS492	Special Topics in Advanced Materials Science II 신소재과학특론 II	3-3-0		-
	AMS493	Special Topics in Advanced Materials Science Ⅲ 신소재과학특론 Ⅲ	3-3-0		-
	AMS494	Special Topics in Advanced Materials Science Ⅳ 신소재과학특론 Ⅳ	3-3-0		-
MAE	MEN230	Solid Mechanics Ⅰ 고체역학 Ⅰ	3-3-0		1
	MEN301	Numerical Analysis 수치해석	3-3-0		2
	MEN431	Introduction to Plastic Deformation 소성학개론	3-3-0	Prerequisite: MEN231	1
ENE	ENE312	Electrochemistry 전기화학	3-3-0	Identical: ACE312	2
PHY	PHY201	Classical Mechanics 고전역학	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY301	Quantum Physics Ⅰ 양자물리학 Ⅰ	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY303	Thermal and Statistical Physics 열 및 통계물리학	3-3-0	Prerequisite: PHY101, PHY103	2
CHEM	CHM211	Organic Chemistry Ⅰ 유기화학 Ⅰ	3-3-0	Identical: ACE201, ENE211	1
	CHM351	Inorganic Chemistry Ⅰ 무기화학 Ⅰ	3-3-0	Identical: ACE304, ENE311	1
	CHM371	Introduction to Nanochemistry 나노화학개론	3-3-0	Identical: ACE416, ENE416	2
	CHM391	Instrumental Analysis 기기분석	3-3-0	Identical: ACE391, ENE322	2
Total Credit			135		

4. History of Courses Change of 2017–2018

Category	2017		2018
AMS	<NEW>	⇨	AMS493 (Elective) Special Topics in Advanced Materials Science Ⅲ 신소재과학특론 Ⅲ
	<NEW>	⇨	AMS494 (Elective) Special Topics in Advanced Materials Science Ⅳ 신소재과학특론 Ⅳ
	AMS497 (Elective) Special Topics in Advanced Materials Science Ⅰ 신소재과학특론 Ⅰ	⇨	AMS491 (Elective) Special Topics in Advanced Materials Science Ⅰ 신소재과학특론 Ⅰ
	AMS498 (Elective) Special Topics in Advanced Materials Science II 신소재과학특론 II	⇨	AMS492 (Elective) Special Topics in Advanced Materials Science II 신소재과학특론 II
NME	<NEW>	⇨	NME493 (Elective) Special Topics in Nano Materials Engineering Ⅲ 나노재료공학특론 Ⅲ
	<NEW>	⇨	NME494 (Elective) Special Topics in Nano Materials Engineering Ⅳ 나노재료공학특론 Ⅳ
	NME497 (Elective) Special Topics in Nano Materials Engineering Ⅰ 나노재료공학특론 Ⅰ	⇨	NME491 (Elective) Special Topics in Nano Materials Engineering Ⅰ 나노재료공학특론 Ⅰ
	NME498 (Elective) Special Topics in Nano Materials Engineering II 나노재료공학특론 II	⇨	NME492 (Elective) Special Topics in Nano Materials Engineering II 나노재료공학특론 II

5. Course Descriptions

□ Advanced Materials Science (AMS)

AMS202 Introduction to Materials Science and Engineering [재료공학개론]

The need for new materials is now increasing as both the mechanical and (opto-)electronic devices become small, light, and integrated. The understanding of basic structures and properties of materials in the areas of metals, semiconductors, ceramics, and polymers is essential to develop new materials. The main background of this course is educating the fundamental sciences and techniques associated with various structures, properties, and engineering process. This lecture is to help students understand the relationship between microstructures of materials and physical (mechanical, electrical, magnetic, optical) and chemical properties.

AMS203 Thermodynamics of Materials [재료열역학]

This course is one of the fundamental courses in Materials Science and Engineering as a topic in the field of Applied Physical Chemistry, and is focused on the understanding of material properties and fundamental phenomena related to material processes. Specific topics will include gas state properties and structures, thermodynamic laws, and equilibrium state.

AMS210 Defects in Crystals [결정결함론]

As well known in the materials science field, the properties of materials are strongly influenced by the population of intrinsic and extrinsic defects in crystals. This course contains three main sections: point defects (zero-dimensional defects), dislocations (one-dimensional defects), and planar defects (two-dimensional defects). The properties, characteristics, kinetics, energetics and thermodynamics of those defects in crystals will be discussed.

AMS230 Introduction to Crystallography [결정학개론]

This course covers the derivation of symmetry theory; lattices, point groups, space groups, and isotropic and anisotropic properties of crystals. This course also covers the principles and applications of x-ray diffraction and electron diffraction to identify cystal structure.

AMS311 Introduction to Metallic Materials [금속재료개론]

This course aims to basically understand the microstructure and mechanical properties of metallic materials, which include ferrous and non-ferrous metals and alloys. Dislocation, phase transformation, and strengthening mechanisms will be covered in this course. The relationship between microstructure and mechanical properties in metallic materials will also be discussed.

AMS312 Phase Transformations in Materials [재료상변태]

The state of matter is dependent upon temperature, thermal history, and other variables. In this course the science of structural transitions is treated, with the purpose in mind of utilizing them for producing materials with superior properties. The subjects covered include the methods of structural analysis, solidification, solid state transformation, and order-disorder transition.

AMS350 Solid State Physics of Materials I [재료고체물리 I]

This course will provide fundamental knowledges of physics of solids on the basis of quantum and statistical mechanics. Topics include crystal structures, reciprocal lattice, x-ray diffraction, lattice dynamics, solid state thermodynamics, free and nearly free electron models, kinetic theory and transport, energy band theory, metal/semiconductor/insulator, and semiconductor physics and devices.

AMS351 Thin Film Technology [박막공학]

The need for thin films is now increasing as the electronic devices become small, light and integrated. In addition, fabrication of thin films from bulk materials is necessary to maximize their performance. Therefore, in this course we study the basic principles and techniques for the fabrication of thin films, the characterization methods and the applications of thin films.

AMS353 Surface Science of Materials [재료표면과학]

In low dimensional materials, the surfaces plays an important role in governing the material's whole property. The physical and chemical properties of the surface is different from that of bulk materials, and these novel properties of the surface can be used to develop new functional materials. This course covers the structure of the surface, the physical, chemical, and electronic properties of the surface, the physics and chemistry behind surface phenomena.

AMS360 Bio-inspired Materials Science [바이오소재과학]

The objectives of the course are to offer an overview of bio-inspired materials, bio-inspired intelligent structures, and bio-inspired morphing structures through advanced understanding of material properties, design and structural behavior at different levels (material, element, structural and system levels). We will discuss emerging applications for bio-inspired structures and the impact of bio-inspired and bio-derived ideas on nano- and related technologies.

AMS390 Introduction to Computational Materials Science [전산재료과학개론]

This course will focus on introducing computational methods, numerical techniques, theories and algorithms in describing the equilibrium, kinetics, diffusion and evolution of materials. During the course, students will be exposed to first-hands-on experience in various numerical treatments and computational methods for various topics such as linear algebra, fast fourier transformation, differential equation, Monte Carlo Potts model, phase field model, finite difference/elements, and etc. The main objective of this course is let students understand the advantages, disadvantages and pitfalls of various methods, and therefore grab the idea that the computational materials science can play a fundamental role in designing structures of materials, processes and devices for better performance.

AMS400 Materials Lab1 [재료실험1]

This course provides an experimental introduction to key concepts in materials such as metals, ceramics, and semiconductors and the relationships among structure, properties and performance will be examined.

AMS401 Transmission Electron Microscopy [전자현미경학]

Theoretical and practical aspects of conventional and high-resolution transmission electron microscopy and related techniques will be covered; Imaging theory, electron diffraction theory and spectroscopy such as energy dispersive x-ray spectroscopy and electron energy loss spectroscopy.

AMS402 Materials Lab2 [재료실험2]

This course provides an experimental introduction to key concepts in materials such as metals, ceramics, and semiconductors and the relationships among structure, properties and performance will be examined.

AMS431 Magnetic Properties of Materials [재료의 자기적 성질]

Magnetism is one of the most actively studied research area in modern science and technology. It is a collective phenomenon, involving the mutual cooperation of enormous numbers of particles. This course introduces elementary magnetostatics and atomic origins of magnetism. Students will learn properties of ferro-, para- dia- and antiferro-magnetics and the theories that describe them. In addtion, magnetic phenomena and magnetic materials in technological applications will be introduced.

AMS432 Piezoelectric Materials [압전 재료]

Piezoelectricity that is one of the most interesting physical phenomena in solid-state physics will be introduced and discussed in this course. Given that the most widely used piezoelectric materials are ferroelectric materials, our discussion will cover a range of material classes, i.e., from dielectrics to ferroelectrics from fundamentals to applications. This lecture aims primarily at providing an extensive overview on the state-of-the-art in piezoelectrics and related materials from fundamentals to applications, followed by in-depth discussion on the remaining challenges and future directions for the researchers of next generation.

AMS433 Introduction to Ceramics [세라믹 물성학]

This course is designed to provide students with the core understanding necessary to pursue the subject of ceramics as it now exists and to be prepared for any surprises likely to emerge. Key concepts will be developed in a sequence which builds on firm foundations, using the materials learned so that their significance is continuously reinforced. The nature of defects which intrudes upon the perfect geometry of ideal crystal structures, migration of matter and charge, chemical and phase equilibria are among the subjects discussed.

AMS491~4 Special Topics in Advanced Materials Science I~II [신소재과학 특론 I~II]

This course covers cutting-edge technologies with applications in advanced materials science and engineering, especially on advanced structural materials, characterization, multifunctional metallic composites, polymer materials, spintronic materials, bio-inspired materials, electronic materials, graphene, low-dimensional crystals, optoelectronic materials, and nano devices. This content is changeable depending on instructor.

□ Nano Materials Engineering (NME)

NME202 Introduction to Materials Science and Engineering [재료공학개론]

The need for new materials is now increasing as both the mechanical and (opto-)electronic devices become small, light, and integrated. The understanding of basic structures and properties of materials in the areas of metals, semiconductors, ceramics, and polymers is essential to develop new materials. The main background of this course is educating the fundamental sciences and techniques associated with various structures, properties, and engineering process. This lecture is to help students understand the relationship between microstructures of materials and physical (mechanical, electrical, magnetic, optical) and chemical properties.

NME203 Thermodynamics of Materials [재료열역학]

This course is one of the fundamental courses in Materials Science and Engineering as a topic in the field of Applied Physical Chemistry, and is focused on the understanding of material properties and fundamental phenomena related to material processes. Specific topics will include gas state properties and structures, thermodynamic laws, and equilibrium state.

NME251 Introduction to Nanomaterials [나노재료개론]

Low-dimensional materials such as nanodot, nanotube, graphene, is considered as a promising future materials for nanotechnology, due to its unique size-dependent properties (mechanical, thermal, chemical, electronic, optical, and magnetic). This course will cover an interdisciplinary introduction to processing, structure, and properties of materials at the nanometer scale.

NME270 Introduction to Polymer Materials [고분자재료개론]

This course is designed to provide an introduction to the basic concept of polymer and various kinds of polymer materials. Students will learn basic chemical synthesis and polymer properties such as thermal, chemical, physical, mechanical, and electro-optic characteristics.

NME313 Mechanical Behavior of Materials [재료의 기계적거동]

This course explores the phenomenology of mechanical behavior of materials at the macroscopic level and the relationship of mechanical behavior to material structure and mechanisms of deformation and failure. Topics covered include elasticity, viscoelasticity, plasticity, creep, fracture, and fatigue. Case studies and examples are drawn from structural and functional applications that include a variety of material classes: metals, ceramics, polymers, thin films, composites, and cellular materials.

NME315 Physical Metallurgy [물리금속학]

The objective of this course is to reinforce fundamental concepts and introduce advanced topics in physical metallurgy with emphasis on microstructural evolution and structure-properties relations. Topics will include equilibrium phase diagrams, thermodynamics, diffusional and martensitic transformation kinetics, recrystallization, and grain growth etc.

NME330 Nano-Electroceramics [나노 전자세라믹스]

A ceramic is an inorganic, non-metallic solid. Modern state-of-the-art electronics and displays are based on ceramic semiconducting materials such as silicon (Si) and gallium arsenide (GaAs). This course will present the principles and concepts of electronic device operation and fabrication (e.g. how transistors work and how they are made) using ceramic nanomaterials, mainly focusing on Si and GaAs. It begins with the electrical and structural properties of ceramic nanomaterials and the operation of the ceramic-based p-n junctions and transistors.

NME350 Modern Physics of Materials [재료현대물리]

The course is directed at the development of a background in the basic physics required to understand the behavior of electrons in atoms, molecules and solids. Examples to illustrate the application of these techniques will be centered in the free and nearly free electron theory of solids. The application of modern physics to many state-of-the-art materials analysis techniques will be demonstrated throughout the course.

NME353 Physical Chemsistry of Materials : Reaction Engineering [재료물리화학 : 반응공학]

This course is designed to extend the concepts and knowledge learned from subject NME203 Thermodynamics of materials and provide fundamental knowledge of thermodynamics for materials scientists and engineers. It covers phase equilibrium, calculation of heat capacitance, and the relation between free energy and phase diagram.

NME354 Introduction to Semiconductor [반도체개론]

Concerning present and projected needs, this course provides a strong intuitive and analytical foundation for dealing with solid state devices. Emphasis is placed on developing a fundamental understanding of the internal working of the most basic solid state device structures, such as silicon based, metal-semiconductor contact, PN junction, MOS capacitor, bipolar transistor, and MOSFET.

NME355 Introduction to Nano-Energy Materials [나노에너지재료]

This course deals with basic nano-energy materials such as metal, semiconductor, oxide, and carbon based materials to realize electronic, photovoltaic, electrochemical, piezoeletric, and thermoelectric devices. In addition, students will learn fundamental principles of the charge carrier transport of nano-scale materials in devices and their characterization tools.

NME356 Introduction to Nanophotonics [나노포토닉스개론]

Nanophotonics is the study of the behavior of light on the nanometer scale. In this course, the basic concept of nanophotonics and its applications will be covered. Students learn the novel properties of light at the nanometer scale as well as highly power efficient and new functional devices for engineering applications including optics, or the interaction of light with particles or substances, at deeply subwavelength length scales, and measurement technologies such as near-field scanning optical microscopy (NSOM), photoassisted scanning tunnelling microscopy, and surface plasmon optics.

NME372 Polymer Physics [고분자물리]

This course presents the various physical properties (e.g. mechanical, optical, and transport) of polymers with respect to the underlying physical chemistry of polymers in melt, solution, and solid state. Topics include conformation and molecular dimensions of polymer chains; an examination of the structure and thermodynamics of glassy, crystalline, and rubbery elastic states of polymers; liquid crystallinity, microphase separation, multi-component polymer system.

NME401 Nanomaterials Lab1 [나노재료실험1]

This course is a selective senior subject in the Department of Materials Science and Engineering for Organic, Semiconducting and Metalic Materials. The laboratory subject combines experiments illustrating electrical/optical/magnetic properties of materials and structure-property relationships through practical materials.

NME402 Nanomaterials Lab2 [나노재료실험2]

This course is a selective senior subject in the Department of Materials Science and Engineering for Organic, Semiconducting and Metalic Materials. The laboratory subject combines experiments illustrating electrical/optical/magnetic properties of materials and structure-property relationships through practical materials.

NME452 Nano-Semiconducting Devices [나노반도체소자]

Concerning present and projected needs, this course provides a strong intuitive and analytical foundation for dealing with solid state devices. Emphasis is placed on developing a fundamental understanding of the basic process used in integrated- circuit(IC), such as vacuum, thin films, etching, lithography, diffusion, thermal process, ion implantation etc.

NME454 Nano-Materials Reliability [나노소재 신뢰성]

This course covers mechanical behavior of zero through three dimensional nanstrucutre materials. Since nano-materials generally has high surface-to-volume ratio and are generally attached to other materials such as substrates, it is important and interesting to understand their mechanical behavior. This course provides ideas to resolve reliability issues in nano devices such as delamination, crack propagation, and degradation failure during design and manufacturing.

NME455 Display Engineering [디스플레이공학]

This course will provide the basic concept of display devices such as organic light-emitting diodes (OLEDs), liquid crystal display (LCD), and so on. The basic principle of devices such as how to operate, how to calculate and increase the device efficiency and which kinds of materials used will be studied.

NME471 Polymer Composites [고분자 복합재료]

The demand for composite materials is ever increasing with regard to both mechanical and multi-functional properties (such as electrical and thermal conductivity). The understanding of basic structure and properties of materials that are currently being used for composite materials is essential to develop novel materials. In addition, nano-composites are of great interest due to their promising potential replacing with conventional composite materials. The main background of this course is introducing the fundamentals of science and technologies associated with composites. The lecture is to help undergraduate student understand the requirement of materials for composites and relationship between reinforcing material and matrix.

NME472 Introduction to Flexible Electronics [유연 전자소자 개론]

Flexible electronics is a technology for fabricating opto-electronic devices with mechanically flexible and stretchable forms using rigid and soft materials, including plastic substrates. This course provides an introduction to recent trends in flexible and wearable electronic devices, and the physics and chemistry of soft, elastic materials for the flexible electronics.

NME491~4 Special Topics in Nano Materials Engineering I~II [나노재료공학 특론 I~II]

This course covers cutting-edge technologies with applications in nano materials engineering, especially on nanostructured materials, multi-functional composites, hybrid polymer materials, spintronics materials, organic/inorganic optical materials, electronic materials, low-dimensional materials, optoelectronic materials, and nano-devices. This content is changeable depending on instructor.

School of Energy and Chemical Engineering

1. School Introduction

The School of Energy and Chemical Engineering was designed for an emerging field combining chemical engineering principles with research about energy conversion and storage. Students can learn fundamental science and engineering principles that can be used to improve the quality of life on earth and solve the most challenging issues of the 21st century. The field of Energy and Chemical Engineering encompasses a wide range of interests including green chemical processes, chemical engineering, advanced materials, and energy conversion and storage. Students can achieve in-depth knowledge and hands-on experience on catalysts, nanomaterials and devices, polymers, fine chemicals, applied molecular chemistry, and other chemical and energy engineering-related subjects.

2. Undergraduate Programs

□ Track Introduction

1) Energy Engineering (ENE)

The Energy Engineering track will cover the principles and application of the energy conversion (fuel cells, solar cells) and energy storage devices (rechargeable batteries, hydrogen storage). It is interdisciplinary program in which students can learn about the broad applications of electrochemistry, design of new energy-related materials, and understanding of energy conversion and storage devices. This track aims to produce creative scientific minds that are familiar with the principles of materials chemistry, electrochemistry, material engineering, and energy conversion and storage system.

2) Chemical Engineering (ACE)

The Chemical Engineering track is a discipline focusing on the application of chemical engineering to a variety of specific areas, including energy and the environment, catalysis, reaction engineering, systems and process design, nanotechnology, polymers and colloids and biotechnology. It is a multi-scale engineering program in which students can learn about the creative design of new chemicals, materials, processes and systems by translating molecular level information into novel engineering principles. This track aims to produce brilliant and creative scientific minds that are familiar with the principles of chemical engineering and the cutting-edge equipment available at the state-of-the-art facilities provided by UNIST.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1st Track	2nd Track	
ENE	Required	31	12	
	Elective	23	6	
ACE	Required	21	15	
	Elective	33	3	

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
ENE	MTH201	Differential Equations	2-1
	MTH203	Applied Linear Algebra	2-2
ACE	MTH201	Differential Equations	2-1
	MTH203	Applied Linear Algebra	2-2

※ Complete based on 1TR
※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' 12 credits.

▶ Required Experimental Courses

Track	Course No.	Required Experimental course	Remarks
ENE	ENE223	Lab for Energy Materials	Choose two
	ENE314	Energy Conversion and Storage Lab	
	ENE323	Solar Cells Lab	
ACE	ACE302	Advanced Chemical Engineering Laboratory	Choose two
	ACE341	Engineering Biology Laboratory	
	ACE361	Organic/Physical Chemistry Laboratory	

※ Complete based on 1TR

▶ Fundamentals required to Business field students when they choose Engineering field tracks as 2nd track

Course Title	ENE	ACE
Calculus II	✔	
Differential Equations		✔
General Physics Ⅰ	✔	
General Physics Ⅱ	✔	✔
General Physics Lab Ⅰ		
General Physics Lab Ⅱ		
General Chemistry Ⅰ	✔	✔
General Chemistry Ⅱ	✔	✔
General Chemistry Lab Ⅰ		✔
General Chemistry Lab Ⅱ		✔

3. Curriculum ※ Course opening semester is subject to be changed according to School's situation.

□ Energy Engineering (ENE)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ENE	ENE211	Organic Chemistry Ⅰ 유기화학 Ⅰ	3-3-0	Identical: ACE201, CHM211	1
	ENE212	Physical Chemistry Ⅰ 물리화학 Ⅰ	3-3-0	Identical: ACE203, CHM231	1
	ENE213	Analytical Chemistry 분석화학	3-3-0	Identical: CHM291	1
	ENE221	Organic Chemistry Ⅱ 유기화학 Ⅱ	3-3-0	Identical: ACE202, CHM212	2
	ENE222	Physical Chemistry Ⅱ : Kinetics 물리화학 Ⅱ : 동역학	3-3-0		2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ENE	ENE223	Lab for Energy Materials 에너지 재료 실험	2-0-4		2
	ENE226	Polymer Concepts 고분자과학개론	3-3-0	Identical: ACE351, CHM372	2
	ENE311	Inorganic Chemistry Ⅰ 무기화학 Ⅰ	3-3-0	Identical: ACE304, CHM351	1
	ENE312	Electrochemistry 전기화학	3-3-0	Identical: ACE312	2
	ENE313	Solid State Chemistry Ⅰ 고체화학 Ⅰ	3-3-0	Identical: ACE321, CHM454	1
	ENE314	Energy Conversion and Storage Lab 에너지 변환 및 저장실험	2-0-4		1
	ENE322	Instrumental Anaysis 기기분석	3-3-0	Identical: ACE391, CHM391	1
	ENE323	Solar Cells Lab 태양전지실험	2-0-4		1
Total Credit			**36**		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ENE	ENE216	Fundamentals of Materials Science 재료과학개론	3-3-0	Identical: AMS202	2
	ENE218	Fundamentals of Energy Conversion Systems 에너지 변환 시스템 개론	3-3-0		-
	ENE316	Electronic Devices 전자소자	3-3-0		1
	ENE317	Fundamentals of Energy Materials 에너지재료개론	3-3-0	Identical: CHM313	1
	ENE319	Physical Chemistry Ⅲ : Quantum Mechanics 물리화학 Ⅲ : 양자역학	3-3-0		1
	ENE321	Polymer Material Science 고분자재료과학	3-3-0	Prerequisite: ENE226 Identical: ACE352	2
	ENE326	Inorganic Chemistry II 무기화학 II	3-3-0	Identical: ACE326, CHM352	2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ENE	ENE327	Solid State Chemistry II 고체화학 II	3-3-0	Prerequisite: ENE311, ENE313	-
	ENE400	Special Topics in ECS Ⅰ 에너지공학특론 Ⅰ	3-3-0		-
	ENE401	Special Topics in ECS II 에너지공학특론 II	3-3-0		-
	ENE402	Special Topics in ECS Ⅲ 에너지공학특론 Ⅲ	3-3-0		-
	ENE403	Special Topics in ECS Ⅳ 에너지공학특론 Ⅳ	3-3-0		-
	ENE404	Special Topics in ECS Ⅴ 에너지공학특론 Ⅴ	3-3-0		-
	ENE410	Phase Transformation 재료상변태	3-3-0	Identical: AMS312	2
	ENE412	Principle of Solution Processing 용액공정개론	3-3-0		2
	ENE413	Introduction to New Energy Conversion and Storage 신에너지 변환 및 저장 개론	3-3-0		2
	ENE414	Surface Analytical Chemistry 표면분석화학	3-3-0		2
	ENE415	Solid State Physics 고체물리학	3-3-0		1
	ENE416	Introduction to Nanoscience and Nanotechnology 나노과학 및 기술	3-3-0	Identical: ACE416, CHM371	1
	ENE420	Fundamentals of Energy Organic Materials 에너지유기재료개론	3-3-0		1
	ENE421	Fundamentals of Semiconductor Fabrication 반도체공정개론	3-3-0		2
	ENE422	Fundamentals of Electrochemical System 전기화학시스템개론	3-3-0	Prerequisite: ENE212	1
	ENE480	Scientific Expression with IT 공학IT개론	3-2-2		2
Total Credit			69		

□ Chemical Engineering (ACE)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ACE	ACE201	Organic Chemistry Ⅰ 유기화학 Ⅰ	3-3-0	Identical: ENE211, CHM211	1
	ACE203	Physical Chemistry Ⅰ 물리화학 Ⅰ	3-3-0	Identical: ENE212, CHM231	1
	ACE311	Chemical Reaction Engineering 반응공학	3-3-0	Prerequisite: MTH201, ACE203 or ACE231	2
	ACE331	Transport Phenomena Ⅰ 전달현상 Ⅰ	3-3-0	Prerequisite: MTH201, ACE203 or ACE231	1
	ACE351	Introduction to Polymer Science and Engineering 고분자과학개론	3-3-0	Prerequisite: ACE201 Identical: ENE226, CHM372	1
Total Credit			15		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
	ACE212	Introduction to Chemical Process 화학공정개론	3-3-0		1
	ACE231	Chemical Engineering Thermodynamics 화공열역학	3-3-0		2
Total Credit			6		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ACE	ACE202	Organic Chemistry Ⅱ 유기화학 Ⅱ	3-3-0	Identical: ENE221, CHM212	2
	ACE240	Engineering Biochemistry 공학생화학	3-3-0		2
	ACE241	Fundamentals in Engineering Biology 공학생물학	3-3-0		1
	ACE301	Computational Methods for Chemical Engineering 화학공학전산	3-3-0		2
	ACE302	Advanced Chemical Engineering Laboratory 첨단화학공학실험	2-0-4		1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ACE	ACE304	Inorganic Chemistry Ⅰ 무기화학 Ⅰ	3-3-0	Identical: ENE311, CHM351	1
	ACE312	Electrochemistry 전기화학	3-3-0	Identical: ENE312	1
	ACE321	Solid State Chemistry 고체화학	3-3-0	Prerequisite: ACE203, ACE311 or ENE222 Identical: ENE313, CHM454	1
	ACE326	Inorganic Chemistry Ⅱ 무기화학 Ⅱ	3-3-0	Identical: ENE326, CHM352	2
	ACE332	Transport Phenomena Ⅱ 전달현상 Ⅱ	3-3-0		2
	ACE340	Biochemical Engineering 생물화학공학	3-3-0		1
	ACE341	Engineering Biology Laboratory 생물화학공학실험	2-0-4		2
	ACE352	Polymer Materials 고분자재료	3-3-0	Prerequisite: ACE351 Identical: ENE321	2
	ACE361	Organic/Physical Chemistry Laboratory 유기물리화학실험	2-0-4		2
	ACE391	Instrumental Analysis 기기분석	3-3-0	Identical: ENE322, CHM391	2
	ACE401	Special Topics in Chemical Engineering Ⅰ 화학공학특론 Ⅰ	3-3-0		1,2
	ACE402	Special Topics in Chemical Engineering Ⅱ 화학공학특론 Ⅱ	3-3-0		-
	ACE403	Special Topics in Chemical Engineering Ⅲ 화학공학특론 Ⅲ	3-3-0		-
	ACE404	Special Topics in Chemical Engineering Ⅳ 화학공학특론 Ⅳ	3-3-0		-
	ACE405	Special Topics in Chemical Engineering Ⅴ 화학공학특론 Ⅴ	3-3-0		-
	ACE416	Nanomaterials Chemistry 나노재료화학	3-3-0	Prerequisite: ACE203, ACE311 or ENE222, ACE304 Identical: ENE416, CHM371	2
	ACE431	Introduction to Catalysis 촉매개론	3-3-0		1
	ACE432	Chemical Engineering Mathematics 화공수학	3-3-0		
	ACE441	Introducton to Molecular Biotechnology 분자생물공학	3-3-0		2
ENE	ENE216	Fundamentals of Materials Science 재료과학개론	3-3-0	Identical: AMS202	2
	ENE222	Physical Chemistry Ⅱ : Kinetics 물리화학 Ⅱ : 동역학	3-3-0		2
	ENE319	Physical Chemistry Ⅲ : Quantum Mechanics 물리화학 Ⅲ : 양자역학	3-3-0		1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MAE	MEN211	Applied Thermodynamics 응용열역학	3-3-0	Prerequisite: MEN210	2
AMS	AMS351	Thin Film Technology 박막공학	3-3-0		1
NME	NME452	Nano-Semiconducting Devices 나노반도체소자	3-3-0		1
	NME454	Nano-Materials Reliability 나노소재신뢰성	3-3-0		1
CHEM	CHM232	Physical Chemistry II 물리화학 II	3-3-0		2
	CHM291	Analytical Chemistry I 분석화학 I	2-0-4	Identical: ENE213	1
	CHM333	Physical Chemistry III 물리화학 III	3-3-0		1
Total Credit			99		

4. History of Courses Change of 2017–2018

Category	2017		2018
ENE	<New>	⇨	ENE413 (Elective) Introduction to New Energy Conversion and Storage 신에너지 변환 및 저장 개론
	<New>	⇨	ENE414 (Elective) Surface Analytical Chemistry 표면분석화학

5. Course Descriptions

□ Energy Engineering (ENE)

ENE211 Organic Chemistry I [유기화학 I]

Introduction to the classification, structure, reactions, and reaction mechanisms of carbon compounds. The objective of the course is that students will understand the classification, structure, nomenclature, reactions, reaction mechanisms, and synthesis of carbon compounds including halocarbons, alkenes, and alcohols. Thereby, this course can provide a solid foundation in the fundamentals of organic chemistry essential for the rational study of polymers, materials, biochemistry and molecular biology.

ENE212 Physical Chemistry I [물리화학 I]

The course is a general study of thermodynamics in the areas of physical chemistry covering the classical nature of energy conversion between heat, mechanical work, and the macroscopic variables such as temperature, volume and pressure in chemical systems. Thermodynamics provides the essential strategies for (1) calculating energy conversion, for example, in engines and (2) for determining the equilibrium composition of chemically reacting systems.

ENE213 Analytical Chemistry [분석화학]

The course handles general separation, spectroscopical identification, and quantification of the chemical components of interest. Qualitative analysis gives a rough identity of the chemical species in a sample and quantitative analysis gives more specific amount of one or more of these components. This course also treats the methods for qualitative and quantitative analyses including any instrumental approaches. This course helps you prepare analytical ability and design your experiments in chemistry.

ENE216 Fundamentals of Materials Science [재료과학개론]

This course will cover essential knowledge on a broad range of topics of materials science such as crystal structures and physical properties of materials. Through this course, students will take a chance to have an insight into various materials which are of critical importance for energy applications.

ENE218 Fundamentals of Energy Conversion Systems [에너지 변환 시스템 개론]

This course is designed to introduce the system and design of energy conversion and storage devices for renewable energy sources. Students will first learn about energy sources available on earth including kinetic, solar, and chemical. Next, the course will provide students with a review of the thermodynamic concepts behind energy constant and energy transfer via an energy conversion device. Finally, this course will tie together concepts of renewable energy sources and thermodynamics teaching students about design elements for energy conversion and storage devices, in which renewable energy sources are converted and stored.

ENE221 Organic Chemistry II [유기화학 II]

This course deals with the structure, nomenclature, reactions, reaction mechanisms, and synthesis of carbon compounds that contain oxygen and nitrogen. This is the second part of a two-semester organic chemistry course offered to introduce students to the principles of organic chemistry and to communicate the excitement of scientific discovery. The basic objective of organic chemistry II is to continue to lay a solid foundation of organic chemistry for students of future advanced studies in chemistry and other important areas such as biochemistry, medical fields, applied life sciences that require thorough understanding of organic chemistry.

ENE222 Physical Chemistry II : Kinetics [물리화학 II : 동역학]

This course is designed to provide an understanding of kinetics as it applies to chemical reactions from the microscopic viewpoint and the theoretical foundation required for designing chemical reactors for controlling chemical reactions. Chemical kinetics includes investigations of how different experimental conditions can influence the speed of a chemical reaction and yield information about the reaction's mechanism and transition states, as well as the construction of mathematical models that can describe the characteristics of a chemical reaction.

ENE223 Lab for Energy Materials [에너지 재료 실험]

This course offers a hands-on opportunity of basic organic, inorganic, and physical chemistry experiments that are essential for students majoring in energy conversion and storage. We will particularly emphasize the basic lab skills related to the understanding and characterizations of energy materials.

ENE226 Polymer Concepts [고분자과학개론]

This course offers general concepts of polymers. Understanding synthesis, characterization, and processing of polymers are important issues in contemporary materials science and engineering. Solid concepts on the structure-property relationship of synthetic polymers allow us to design new structures of polymers for application-specific purposes. Specifically, photo- and electro-active polymers will be discussed in details.

ENE311 Inorganic Chemistry I [무기화학 I]

This course presents the concepts and models of chemistry. Topics include atomic and molecular structure, nomenclature, chemical reaction and stoichiometry, thermochemistry, periodicity, atomic structures and chemical bonding. This course is designed for students who plan to major in one of the engineering schools.

ENE312 Electrochemistry [전기화학]

This course covers fundamentals related to electrochemical science and engineering as well as its applications. These include: redox reactions, electrochemical cells, thermodynamics related to electrochemistry, and electrode kinetics. In the second half of the course participants will explore how the aforementioned principles can be applied to electrochemical energy conversion, characterization of materials, and electrochemical sensors.

ENE313 Solid State Chemistry I [고체화학 I]

This course focuses on the basic principles of solid state chemistry. Structural, chemical, and physical aspects of inorganic solids, such as ionic solids, metal, and molecular solids, will be discussed. The course explores the relationship between electronic structure, chemical bonding, and atomic order. It also investigates the characterization of atomic arrangements in crystalline and amorphous solids: metals, ceramics, semiconductors, and polymers. Topics include: symmetry, basic crystallography, crystal structure, bonding in solids, characterization techniques (X-ray diffraction, microscopy, and spectroscopy) and crystal defects.

ENE314 Energy Conversion and Storage Lab [에너지 변환 및 저장 실험]

This 2 credit lab course deals with experiments related to energy conversion and storage devices such as batteries and fuel cells. The synthesis and characterization of its devices will be performed. Finally, students will be assessed on the results of their electrochemical conversation and storage.

ENE316 Electronic Devices [전자소자]

This course will cover the basic concepts, mechanisms, and applications of electronics devices. Topics will include band structure, electrical properties, optical properties of semiconductors, and its applications such as p-n junction diodes, field-effect transistors, light emitting diodes, and solar cells.

ENE317 Fundamentals of Energy Materials [에너지재료개론]

This course offers basic understandings and applications of the energy materials related to energy conversion and storage using organic and inorganic materials. It covers the roles of bonding defining the fundamental types of energy materials and structural defects, kinetics, and expands to in-depth understanding of electronic, magnetic materials and metals and ceramics, glasses and polymers. Finally, this course focuses on the material selection and design for the solar cells, fuel cell, and batteries. It also investigates not only the basic concepts and materials for light harvesting system, light-emitting diodes, solar cells, and thermoelectrics. Through this course, students will have a chance to enhance their understanding to energy materials.

ENE319 Physical Chemistry III : Quantum Mechanics [물리화학 III : 양자역학]

Topics in quantum mechanics, statistical mechanics, molecular dynamics, and molecular spectroscopy will be covered in this course. Through the study of quantum mechanics, students will further apply their knowledge of QM to understand how spectroscopy can be used to probe molecular systems. Through the study of molecular dynamics and molecular spectroscopy, students will discover how empirical reaction rates and molecular-based models can be used to gain insight into both simple and complex chemical systems.

ENE321 Polymer Material Science [고분자재료과학]

This course covers fundamental concepts and physical properties of polymers to provide knowledge on the structure analysis of polymers and thus, one can understand structural characteristics of polymers depending upon chemical structures, molecular weights, molecular structures and morphologies. Specifically, the close relationship between chemical structures and physical properties will be discussed in details.

ENE322 Instrumental Analysis [기기분석]

This course introduces the principles of analytical instruments which are needed in the characterization of various materials, and provides students with the opportunity to learn how to operate them in laboratories. This course deals with many integuments for spectroscopic analysis (NMR, FTIR, Raman, UV/VIS), x-ray analysis (XRD, XRF), surface analysis (AFM, XPS, SIMS), thermal analysis (DSC, TGA), Mass spectrometry, and electron microscopy (SEM, TEM).

ENE323 Solar Cells Lab [태양전지실험]

This course builds upon the fundamental principles of solar cells, their composition and structures. The course will delve into the inner workings and composition of solar cell structures, photovoltaic applications and advanced theories and next generation applications of solar cell structures. Particular attention will be given to the use and assessment of laboratory instruments used in solar cell analysis.

ENE326 Inorganic Chemistry II [무기화학 II]

Electronics structures, spectroscopic and magnetic properties of the coordination compounds will be discussed based on the crystal field theory and molecular orbital theory. In addition to the reactions and properties of the coordination compounds, and the catalytic properties of the organometallic compounds also will discussed.

ENE327 Solid State Chemistry II [고체화학 II]

This course is the second part of a two-quarter solid state chemistry course offered to introduce students to the basic principles of solid state chemistry and its application to engineering systems. The techniques commonly used to synthesize and study solid materials are introduced in the second part. Topics cover phase diagrams, electrical, magnetic and optical properties of solids. Examples are drawn from energy generation and storage devices such as batteries, fuel cells, and superconductors.

ENE400~404 Special Topics in ECS I~V [에너지공학특론 I~V]

This course is designed to introduce current topics in energy conversion and storage.

ENE410 Phase Tranformation [재료상변태]

This course addresses a broad overview of the phase transformations that are important to understand the relationships between structure and property in materials.
The topics covered include classification of phase, transformations, nucleation, spinodal decomposition, growth, formal kinetics of transformations, diffusional phase transformations, diffusionless phase transformations, and non-equilibrium materials.

ENE412 Principle of Solution Processing [용액공정개론]

This course provides an introduction to the principles and practice of the solution processing for energy devices. The discussion includes the solution chemistry, colloidal and interface, sol-gel process, inorganic-organic hybrid systems, and soft-materials chemistry, their theoretic parts, and analysis tools.

ENE413 Introduction to New Energy Conversion and Storage [신에너지 변환 및 저장 개론]

Energy is inevitable for human life and a secure and accessible supply of energy is crucial for the sustainability of modern societies. However, continuation of the use of fossil fuels is set to face multiple challenges: depletion of fossil fuel reserves, global warming and other environmental concerns, geopolitical and military conflicts and of late. Therefore, the issue of new energy is becoming significant. This lecture aims to help you understand the basic concepts and reaction mechanisms of new energy conversion and storage device in terms of electochemistry. Also, this course will cover several experimental techniques of electrochemistry to measure the performance of new energy conversion and storage device.

ENE414 Surface Analytical Chemistry [표면분석화학]

Surface analytical chemistry deals with the fundamental understanding of the surface chemistry and application of the surface analytical methods. Characterization of various phenomena such as corrosion and passivation at surfaces and interfaces, and will be covered.

ENE415 Solid State Physics [고체물리학]

This course introduces various theoretical concepts and practical applications of solid-state physics at the beginning level. It focuses on a range of phenomena related with electron and phonon behaviors in periodic crystal structures. Topics include free electron models, crystal and magnetic structure, reciprocal space, ferroelectricity, energy band theory, and Berry phase. Understanding those fundamental properties will help design of various energy materials such as solar cell, Li-ion battery, fuel cell and various photocatalysts.

ENE416 Introduction to Nanoscience and Nanotechnology [나노과학 및 기술]

This course deals with subjects in modern nanoscience and nanotechnology. As such, it will present the essential principles and application of the unique characteristics observed in materials of nanometer size.

ENE420 Fundamentals of Energy Organic Materials [에너지유기재료개론]

The course is a general study of organic materials in the areas of energy storage devices storing readily convertible chemical energy to operate a variety of systems such as mobile electronic devices and electric vehicles. This course will cover investigations of how different organic materials can influence the kinetics of electrochemical reactions as well as the theoretical foundation required for designing organic materials controlling the performance of energy storage devices. Topics include microscopic structure of ionic compounds/ionic solutions and their properties.

ENE421 Fundamentals of Semiconductor Fabrication [반도체공정개론]

The course is a general study of semiconductor fabrication processes in the areas of energy devices. This course will cover fundamentals of semiconductor fabrication from the crystal growth to various essential methods to fabricate practical energy devices. Topics on the fabrication processes include oxidation, lithography, etching, diffusion, ion implantation, deposition, etc. This course will give an opportunity to study fundamental knowledges on semiconductor fabrication processes for various energy devices.

ENE422 Fundamentals of Electrochemical System [전기화학시스템개론]

This course is directed toward advanced undergraduate students in science and engineering and toward practitioners engaged in the development of electrochemical systems. In order to understand electrochemical systems; Thermodynamics, Electrode Kinetics, and Transport Phenomena are the three fundamental area which underlie the treatment in this course.

ENE480 Scientific Expression with IT [공학IT개론]

The scientific research often requires IT technologies to obtain effective data, understand the meaning of numbers, or explain what they actually show. There are many programming tools to express scientific data. For instances, software "Origin" enables us to manipulate various graphs to obtain specific meaning, and software "Chemdraw" give us effective molecular geometry. In addition, "Endnote" makes it facile to handle the references. This course will give you chances to approach more IT-adopted scientific expression through various programs, which will include Origin, Chemdraw, Endnote, and 3DMAX, etc.

□ Chemical Engineering (ACE)

ACE201 Organic Chemistry I [유기화학 I]

This class is an introduction to the classification, structure, reactions, and reaction mechanisms of carbon compounds. The class is set up so that, upon completion, students will understand the different characteristics of carbon compounds, including their classification, structure, nomenclature, reactions, reaction mechanisms, and synthesis. Some examples are halocarbons, alkenes, and alcohols. This course will provide a solid foundation in organic chemistry and the fundamentals essential for the subsequent study of biochemistry, molecular biology, and materials applications of polymers.

ACE202 Organic Chemistry II [유기화학 II]

This course deals with the structure, nomenclature, reactions, reaction mechanisms, and synthesis of carbon compounds that contain oxygen and nitrogen. This is the second group of lectures in a two-semester organic chemistry course that is being offered to introduce students to the comprehensive, and somewhat rigorous, principles of organic chemistry and to communicate the excitement of scientific discovery. The basic objective of Organic Chemistry II is to continue to lay a solid organic chemistry foundation for further advanced studies in chemistry and other important fields, such as biochemistry, the medical field and applied life sciences, all of which require a thorough understanding of organic chemistry.

ACE203 Physical Chemistry I [물리화학 I]

The course is a general study of thermodynamics in the areas of physical chemistry covering the classical nature of energy conversion between heat, mechanical work, and the macroscopic variables such as temperature, volume and pressure in chemical systems. Thermodynamics provides the essential strategies for (1) calculating energy conversion, for example, in engines and (2) for determining the equilibrium composition of chemically reacting systems.

ACE212 Introduction to Chemical Process [화학공정개론]

This course enhances student understanding of the connection between the chemistry and the chemical process. Students will gain a solid understanding of what chemical processes do (convert raw materials into useful products using energy and other resources), and learn about the ways in which chemical engineers make decisions and balance constraints to come up with new processes and products. Students will learn material and energy balances as tools to achieve a real goal: workable, economical, and safe chemical processes and products.

ACE231 Chemical Engineering Thermodyanamics [화공열역학]

This course offers students the basic understanding of thermodynamics and its practical applications relevant to various chemical processes. Through this course, students will learn the fundamental principles/laws of thermodynamics and how they can be used to describe and analyze systematically a wide variety of thermodynamic properties and phenomena such as phase equilibria.
The 2nd track students are strongly recommended to take this course even if they have taken courses relevant to thermodynamics.

ACE240 Engineering Biochemistry [공학생화학]

This course is designed to teach students the various biochemicals and their reactions occurring within living organisms. Students are expected to learn basic concepts and principles of biochemistry and to develop integrated knowledge base to be a successful (bio)chemical engineer who wants to find careers in the field of biotechnology. Topics discussed will include water, amino acids and proteins, enzymes, bioenergetics, glycolysis, the citric acid cycle, gluconeogenesis, electron transport chain, photosynthesis etc. Because this lecture discusses energetics and reaction mechanisms, it is highly desired that a student has completed both one-semester organic chemistry and one-semester physical chemistry before taking this course.

ACE241 Fundamentals in Engineering Biology [공학생물학]

This course will emphasize the fundamental concepts of biology including an introduction to the disciplines of biochemistry, cell organization, metabolism, genetics, genomics, molecular biology, recombinant DNA technology and evolution that provide the foundation for modern biotechnology and bioengineering.

ACE301 Computational Methods for Chemical Engineering [화학공학전산]

A series of lectures provide basic principles of relevant numerical methods in the field of bio and chemical sciences. Lectures will be supplemented by hands-on demonstration and exercises with scientific computing tools, such as Matlab, Mathematica and Chemdraw. Introduction to scientific databases including NCBI and SciFinder will also be given.

ACE302 Advanced Chemical Engineering Laboratory [첨단화학공학실험]

The basic unit processes are understood through these experiments. This course covers fixed and fluidized beds, batch and continuous stirred tank reactors, catalytic reactors, ion exchange unit, enzyme reactors and so on.

ACE304 Inorganic Chemistry I [무기화학 I]

The course is designed for undergraduate students who plan to major in Energy and Chemical Engineering. The objective of this course is to understand basic principles of modern inorganic chemistry. Topics covered in this course include atomic and molecular structures, molecular shape and symmetry, group theory and molecular orbital theory, structure of solids, and acid-base and donor-acceptor chemistry.

ACE311 Chemical Reaction Engineering [반응공학]

This course is designed to provide (1) an understanding of kinetics as it applies to chemical reactions from the microscopic viewpoint and (2) the basis required for designing chemical reactors for controlling chemical reactions.

ACE312 Electrochemistry [전기화학]

This course covers fundamentals related to electrochemical science and engineering as well as its applications. These include: redox reactions, electrochemical cells, thermodynamics related to electrochemistry, and electrode kinetics. In the second half of the course participants will explore how the aforementioned principles can be applied to electrochemical energy conversion, characterization of materials, and electrochemical sensors.

ACE321 Solid State Chemistry [고체화학]

This course focuses on the basic principles of solid state chemistry. Structural, chemical, and physical aspects of inorganic solids, such as ionic solids, metal, and molecular solids, will be discussed. The course explores the relationship between electronic structure, chemical bonding, and atomic order. It also investigates the characterization of atomic arrangements in crystalline and amorphous solids: metals, ceramics, semiconductors, and polymers. Topics include: symmetry, basic crystallography, crystal structure, bonding in solids, characterization techniques (X-ray diffraction, microscopy, and spectroscopy) and crystal defects.

ACE326 Inorganic Chemistry II [무기화학 II]

In this course, entire coordination chemistry will be handled. Especially, with the knowledge of molecular orbital theory, structures, bonding, and electronic spectra of molecules are discussed. In addition, reactions and mechanisms of coordination compounds and their practical applications for catalysis will be provided.

ACE331 Transport Phenomena I [전달현상 I]

Most of the chemical operations are concerned with the behavior of fluids in process equipment. Underlying every step of the process are the principles of the transport phenomena, which include heat, mass and momentum transfer. The course covers balance equation, diffusion, steady-state, boundary conditions and flux laws.
Differential Equations and Physical Chemistry I are pre-required courses, and further it is strongly recommended that students should take Chemical Engineering Thermodynamics or a corresponding course in advance.

ACE332 Transport Phenomena II [전달현상 II]

This course offers an advanced level of understanding on the transport phenomena (momentum, heat, and mass transfer) from an unified viewpoint. We will learn how to derive rigorously the general balance equations from both microscopic and macroscopic approaches and how to apply such equations to solve a variety of real problems. We will also learn the microscopic interpretation of macroscopic transport properties such as viscosity, diffusion coefficient, heat conductivity, etc.

ACE340 Biochemical Engineering [생물화학공학]

This course will suggest the role of biochemcialengineer and knowledge which is essentially required for successful biochemicalengineer to design bioreactor. Key core parts include the kinetics for enzymeand microbial growth. In addition, selection of bioreactor and operation will be discussed. Separation of bioproducts, especially therapeutic proteins will be included in this lecture course.

ACE341 Engineering Biology Laboratory [생물화학공학실험]

This course introduces next-generation techniques in genetic, molecular, biochemical, and cellular engineering from a quantitative engineering perspective. Furthermore, the students will have the opportunity to have research-based experiences. The following areas are to be covered in the experimental portion of the course: 1) gene and genome engineering, 2) quantitative analysis of experiments, 3) cell cultivation, and 4) scientific communication based on useful applications of biological technologies.

ACE351 Introduction to Polymer Science and Engineering [고분자과학개론]

This course introduces the students to natural and synthetic polymers and their physical and chemical properties. Students will learn the structure and property of polymers, starting from single chain conformations. One emphasis will be on the universal static and dynamic behavior of polymers in good solvents, semi-dilute solvents, theta solvents, and in melts. In addition, this course will cover the basic chemical synthesis and chemical properties of different polymers.

ACE352 Polymer Materials [고분자재료]

This course is designed to provide an introduction to polymer materials science, including the synthesis, characterization, and applications of macromolecules. The emphasis will be on understanding the relationships between macromolecular architecture (and how it can be controlled and characterized), and the resulting chemical, physical and mechanical properties. Discussion of the recent literature will focus on how these structure-property relationships guide the design and synthesis of new materials and polymer-based reagents and devices. In addition, this course also intends to deal with the application of polymers towards various fields of science.

ACE361 Organic/Physical Chemistry Laboratory [유기물리화학실험]

This course is a complementary laboratory course to the Organic Chemistry (II), Physical Chemistry (II), and Polymer Related lectures. It is designed to aid students in developing more advanced laboratory skills and techniques for the practical application of organic/physical chemistry principles. The students will also learn to report on and discuss their results using standard scientific methodologies. This course offers a variety of experiments designed to introduce the advanced experimental methods needed in organic, physical, and polymer chemistry.

ACE391 Instrumental Analysis [기기분석]

This course introduces the principles of analytical instruments which are essential for the characterisation of various compounds and materials. The course provides students with the opportunity to learn how to operate them in laboratories. This course deals with many instruments for spectroscopic analysis (NMR, IR, UV/VIS, Raman), x-ray analysis (XRD, XRF), surface analysis (AFM, XPS, SIMS), thermal analysis (DSC, TGA), Mass spectrometry, and electron microscopy.

ACE401~405 Special Topics in Chemical Engineering I~V [화학공학특론 I~V]

This course is designed to introduce current topics in advanced chemical engineering. Through this course, students will understand how basic knowledge in chemical engineering is used in the research and development of chemical products and processes and discuss the future trends in chemical engineering.

ACE416 Nanomaterials Chemistry [나노재료화학]

This course is intended primarily as an introduction course to nanomaterials chemistry for undergraduate-level chemical engineers. The objective of this course is to understand basic concepts of nanoscience and nanotechnology and introduce general synthetic principles, characterization methods, and potential applications of nanostructured materials. These issues will be discussed with currently important nanomaterials, including silica, semiconducting, magnetic plasmonic, and carbon nanostructures.

ACE431 Introduction to Catalysis [촉매개론]

Catalysts are materials that enhance the kinetics of chemical reactions. This course provides the basis to understanding the interaction between catalysts and molecules; and the effects of the catalyst's surface structure on chemical reactions.

ACE432 Chemical Engineering Mathematics [화공수학]

This course is designed for advanced students in chemical engineering. The objective of this course is to apply the knowledge of reactor design and transport phenomena to mathematically formulating and describing physicochemical processes of chemical engineers' interest. Topics covered include the review of basic chemical engineering principles, ordinary differential equations, partial differential equations, and complex variables.

ACE441 Introduction to Molecular Biotechnology [분자생물공학]

Molecular biotechnology results from the convergence of many areas of research, such as molecular biology, microbiology, biochemistry, immunology, genetics, and cell biology. This course introduces a basic introduction to several key techniques used in biological engineering and illustrative examples and laboratory investigations that explore modern approaches within the context of engineering and technology.

School of Electrical and Computer Engineering

1. School Introduction

The school of electrical and computer engineering at UNIST is dedicated to educating students in interdisciplinary scholarship that will serve for our future society. Our teaching and research take places in interdisciplinary programs and institutes where traditional departmental boundaries are things of the past. Our mission is to provide enabling technologies for the future way of life through the convergence of electrical and computer engineering with new nano, bio, and environmental technologies. Our efforts will bring out exciting new technologies that will contribute not only to Ulsan's world-leading automotive, shipbuilding, and petroleum industries but also to industries and societies world-wide. The school of ECE is establishing collaborations with universities and companies on the other parts of the globe to provide global environment for education and researches. Come join our efforts to become a world leading institute in science and technology.

2. Undergraduate Programs

□ Track Introduction

1) Electrical Engineering (EE)

EE is a field of engineering that deals with everything from solid-state devices and designing integrated circuits to developing information and control systems. It focuses on research and development of IT convergence systems which are capable of enriching the future life of human being to be pleasant, secured, convenient and socially connected. A broad range of IT technologies in the EE areas are to be proactively merged together to create new benefits with the advent of ubiquitous information society driven by digital convergence. EE track encourages students and researchers alike to initiate a wide range of interactions among different areas in wireless communications and networking, intelligent control and assistive robotics, multimedia signal processing, digital/analog circuits design, VLSI design, high speed mixed-signal IC, RF and wireless IC design, power electronics and power interface circuit design, semiconductor devices, plasma and microwave engineering, optoelectronic devices. EE track encompasses the experimentation, design, modeling, simulation and analysis of devices, circuits as well as complete systems. The combination of the educational program and the leading edge testing facilities provides a full cycle exposure from concept to product realization, necessary for a top-notch quality engineer that can bring immediate contributions in both academia and industries. After graduation, the students in the EE track can work in national research institutes, research institutes of companies, or development departments of companies. In addition, they may continue to study in graduate schools.

2) Computer Science and Engineering (CSE)

While most of people are familiar with computers, not many people have a good understanding of what computer science and engineering (CSE) is really about. Implementation of computer programs that improve the quality of human life is an important aspect of computer science and engineering, however learning how to write computer programs is not the core discipline of computer science but just a necessary skill to implement and prove creative and innovative computational logics and ideas in many broad sub-areas of computer science such as algorithms, theoretical computer science, programming languages, operating systems, databases, networks, computer security, computer graphics, artificial intelligence, and many more. In CSE track, students learn foundational principles of the core sub-areas of computer science. Having this curriculum, we cultivate the finest computer scientists and engineers that have the ability of conducting highly creative and innovative research and creating high-quality computing solutions. CSE graduates typically find jobs in IT-related companies or national research institutes or continue to study in graduate schools.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1st Track	2nd Track	
EE	Required	36	18	
	Elective	18	0	
CSE	Required	33	9	
	Elective	21	9	

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
EE	MTH201	Differential Equations	2-1
	MTH203	Applied Linear Algebra	2-2
CSE	MTH201	Differential Equations	2-1
	MTH203	Applied Linear Algebra	2-2

※ Complete based on 1TR
※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' 12 credits.

▶ Fundamentals required to Business field students when they choose Engineering field tracks as 2nd track

Course Title	EE	CSE
Differential Equations	✔	✔
General Physics II	✔	✔
General Physics Lab I	✔	✔
General Physics Lab II	✔	✔

3. Curriculum ※ Course opening semester is subject to be changed according to School's situation.

□ Electrical Engineering (EE)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
EE	EE201	Basic Circuit Theory 회로이론	3-3-0		2
	EE231	Electromagnetics I 전자기학 I	3-3-0		1
	EE301	Microelectronics I 전자회로 I	3-3-0	Prerequisite: EE201	1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
EE	EE311	Signals and Systems 신호및시스템	3-3-0		1
EE	EE320[1]	Digital System Lab 디지털시스템실험	3-1-4	Prerequisite: EE201, CSE201	1
CSE	CSE201[2]	Digital Logic 디지털로직	3-3-0		1
Total Credit			18		

1) 2014&2015 admitted students should take 'Digital System Lab(EE320)'.
 - Students who entered UNIST before 2014 are not required to take.
2) EE new track students who already took 'Digital System Lab(CSE201)' should follow the 2014 curriculum.
 - EE old track students should follow the 2013(=2012) curriculum.
 - Digital Logic(CSE201) in the curriculum of 2015 or later = Digital System Lab(CSE201) in the 2014 curriculum.

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
EE	EE211	Probability and Introduction to Random Processes 확률과 랜덤프로세스개론	3-3-0		2
EE	EE302	Microelectronics II 전자회로 II	3-3-0	Prerequisite: EE301	2
EE	EE312	Introduction to Communications 통신개론	3-3-0	Prerequisite: EE211	1
EE	EE313	Introduction to Control 자동제어공학개론	3-3-0	Prerequisite: EE311	2
EE	EE321	Electronics Experiment Laboratory 전자회로실험	3-1-4	Prerequisite: CSE201, EE201, EE301	2
EE	EE331[1]	Electronic devices I 전자소자 I	3-3-0		1
EE	EE411	Digital Signal Processing 디지털신호처리	3-3-0	Prerequisite: EE311	1
Total Credit			21		

1) This course title of EE331 changes from "Introduction to electronic devices" to "Electronic devices I"

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
EE	EE204	Electromagnetism II 전자기학 II	3-3-0		2
EE	EE314	Introduction to Data Networks 데이터 네트워크 개론	3-3-0	Prerequisite: EE211	2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
EE	EE332	Electronic Devices II 전자소자 II	3-3-0	Prerequisite: EE331	2
	EE341	Introduction to Electrical Energy Systems 전기에너지공학개론	3-3-0		2
	EE401	Analog Integrated Circuits 아날로그집적회로설계	3-3-0	Prerequisite: EE301, EE302	1
	EE402	Introduction to VLSI Design 초고밀도 집적회로 설계	3-3-0	Prerequisite: EE301	1
	EE403	Introduction to RF Engineering RF 공학 개론	3-3-0	Prerequisite: EE201, EE301	2
	EE404	Fundamentals of Power Electronics 전력전자공학개론	3-3-0	Prerequisite: EE301, EE313	1
	EE412	Communication Systems 통신시스템	3-3-0	Prerequisite: EE312	1
	EE414[1)]	Introduction to Optimization 최적화 이론 개론	3-3-0		2
	EE431	Semiconductor VLSI Devices Engineering 반도체집적소자공학	3-3-0		2
	EE432	Optoelectronics 광전자공학	3-3-0		1
	EE480	Special Topics in EE Ⅰ 전자 및 전기공학특론 Ⅰ	3-3-0		-
	EE481	Special Topics in EE II 전자 및 전기공학특론 II	3-3-0		-
	EE482	Special Topics in EE Ⅲ 전자 및 전기공학특론 Ⅲ	3-3-0		-
	EE483	Special Topics in EE Ⅳ 전자 및 전기공학특론 Ⅳ	3-3-0		-
	EE484	Special Topics in EE Ⅴ 전자 및 전기공학특론 Ⅴ	3-3-0		-
CSE	CSE221	Data Structures 데이터구조	3-3-0	Prerequisite: CSE241	1,2
	CSE241[2)]	Object Oriented Programming 객체 지향 프로그래밍	3-3-0		1,2
	CSE301	Computer Architecture 컴퓨터구조	3-3-0	Prerequisite: CSE201, CSE251	1,2
	CSE463	Machine Learning 기계 학습	3-3-0	Prerequisite: EE211, CSE331	2
PHY	PHY213	Modern Physics 현대물리학	3-3-0	Prerequisite: PHY101, PHY103	2
	PHY301	Quantum Physics Ⅰ 양자물리학Ⅰ	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY427	Introduction to Plasma Physics 플라즈마 물리학 입문	3-3-0		-
Total Credit			**72**		

1) The course title of EE414 changes from "Introduction to Information and Multimedia Systems" to "Introduction to Optimization"
2) Object Oriented Programming(CSE241) in the curriculum of 2014 or later = Advanced Programming(CSE202) in the 2013 curriculum.

□ Computer Science and Engineering (CSE)

※ CSE old track students following 2009~2013 can take new courses in 2014&2015 curriculum as electives.

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
CSE	CSE221	Data Structures 데이터구조	3-3-0	Prerequisite: CSE241	1,2
	CSE241[1)]	Object Oriented Programming 객체 지향 프로그래밍	3-3-0		1,2
	CSE331	Introduction to Algorithms 알고리즘	3-3-0	Prerequisite: CSE221	1,2
Total Credit			9		

1) 'Object Oriented Programming(CSE241)' in the curriculum of 2014 or later = 'Advanced Programming(CSE202)' in the 2013 curriculum.

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
CSE	CSE201[1)]	Digital Logic 디지털로직	3-3-0		1
	CSE232	Discrete Mathematics 이산수학	3-3-0		1,2
	CSE251[2)]	System Programming 시스템 프로그래밍	3-3-0	Prerequisite: CSE241	1,2
	CSE301	Computer Architecture 컴퓨터구조	3-3-0	Prerequisite: CSE201, CSE251	1,2
	CSE311	Operating Systems 운영체제	3-3-0	Prerequisite: CSE221, CSE251	1,2
	CSE341	Principles of Programming Languages 프로그래밍언어	3-3-0	Prerequisite: CSE241	1,2
	CSE351	Computer Networks 컴퓨터네트워크	3-3-0	Prerequisite: CSE241, EE211	2
EE	EE211	Probability and Introduction to Random Processes 확률과 랜덤프로세스개론	3-3-0		2
Total Credit			24		

1) 'Digital Logic(CSE201)' in the curriculum of 2015 or later = 'Digital System Lab(CSE201)' in the 2014 curriculum.
2) When the students following the curriculum before 2016 take 'System Programming(CSE251)', it can be recognized as an elective course.

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
CSE	CSE332	Theory of Computation 계산 이론	3-3-0	Prerequisite: CSE232	2
	CSE411	Introduction to Compilers 컴파일러 개론	3-3-0	Prerequisite: CSE341	2
	CSE412	Parallel Computing 병렬 컴퓨팅	3-3-0	Prerequisite: CSE221, CSE311	2
	CSE421	Database Systems 데이터베이스 시스템	3-3-0	Prerequisite: CSE221, CSE241	1
	CSE462	Artificial Intelligence 인공지능	3-3-0	Prerequisite: CSE221	1
	CSE463	Machine Learning 기계 학습	3-3-0	Prerequisite: EE211, CSE331	2
	CSE464	Software Engineering 소프트웨어공학	3-3-0	Prerequisite: CSE221, CSE241	2
	CSE465	Mobile Computing 모바일 컴퓨팅	3-3-0	Prerequisite: CSE241, CSE351	1
	CSE471	Computer Graphics 컴퓨터 그래픽스	3-3-0	Prerequisite: CSE221, CSE241	1
	CSE480	Special Topic in CSE Ⅰ 컴퓨터 공학 특론 Ⅰ	3-3-0		1
	CSE481	Special Topic in CSE Ⅱ 컴퓨터 공학 특론 Ⅱ	3-3-0		1
	CSE482	Special Topic in CSE Ⅲ 컴퓨터 공학 특론 Ⅲ	3-3-0		-
	CSE483	Special Topic in CSE Ⅳ 컴퓨터 공학 특론 Ⅳ	3-3-0		-
	CSE484	Special Topic in CSE Ⅴ 컴퓨터 공학 특론 Ⅴ	3-3-0		-
EE	EE201[1)]	Basic Circuit Theory 회로이론	3-3-0		2
MTH	MTH204	Linear Algebra 선형대수학	3-3-0	Prerequisite: MTH203	2
	MTH260	Elementary Number Theory 정수론	3-3-0		2
Total Credit			**51**		

1) When the students with CSE as their 1st track follow the curriculum before 2016, they can take 'System Programming(CSE251)' as a required course in replacement of 'Basic Circuit Theory(EE201)'.
2) MTH204 and MTH260 are elective courses effective the academic year 2018 for CSE 1st track students.
3) Students who choose CSE as their 2nd track effective the academic year 2018 and beyond must complete at least 6 elective credits (out of the 9 elective credits) from CSE 300 or 400-level courses.

4. History of Courses Change of 2017-2018

Category	2017		2018
EE	<New>	⇨	EE332 (Elective) Electronic Devices II 전자소자 II
	EE331 (1TR Required) Introduction to Electronic Devices 전자소자개론	⇨	EE331 (1TR Required) Electronic Devices I 전자소자 I
	EE414 (Elective) Introduction to Information and Multimedia Systems 정보 및 멀티미디어 시스템 개론	⇨	EE414 (Elective) Introduction to Optimization 최적화 이론 개론

5. Course Descriptions

□ Electical Engineering (EE)

EE201 Basic Circuit Theory [회로이론]

The aims of this course are to make the students understand the principles and the fundamental concepts of circuit analysis; to develop the student's familiarity and understanding in modeling and analyzing circuits through a variety of real-world examples; and to extend the student's ability to apply system analysis to other branches of engineering. Memory, circuits, communication and control system, design of VLSI, magnetically coupled networks, power analysis, laplace transform, capacitor, inductor, and polyphase circuits are main topics of the course. The PSpice tool will be introduced and used for basic experiments. This course is focused on both hands-on experience and design practice.

EE211 Probability and Introduction to Random Processes [확률과 랜덤프로세스개론]

This course introduces probability, random process, confidence interval, experimental design and hypothesis testing, statistical average, correlation, spectral analysis for wide sense stationary processes, random signals and noise in linear systems.

EE231 Electromagnetics I [전자기학 I]

This course is the first half of one-year electromagnetics course. It deals with basic electro- and magnetostatic phenomena and the related theories using vector calculus, such as coulomb and ampere law, electric and magnetic fields and their boundary conditions at the interface of different media. It also covers the fundamental aspects of dielectric and magnetic materials, and electromagnetic induction.

EE301 Microelectronics Ⅰ [전자회로 Ⅰ]

This course covers an introduction to electronic circuits and the analysis and design of transistor amplifiers. First, the course extensively explains the basic operation principles of diodes, BJTs, and MOSFETs derived from physical structures and gives a concept of equivalent device models. Then, we will study the design and analysis of basic BJT and FET amplifiers and differential and multi-stage amplifiers.

EE302 Microelectronics Ⅱ [전자회로 Ⅱ]

This course is the succession of the MicroelectronicsⅠ course where the material covered focused on single elements and their operational principles. In Microelectronics Ⅱ, amplifiers, current mirrors, frequency response, and stability will be covered to understand the implementation of microelectronics.

EE311 Signals and Systems [신호및시스템]

This course introduces time-domain frequency domain response using Fourier series, Fourier transform, Laplace transform, discrete Fourier series and transform, sampling, z-transform, relationship between time and frequency descriptions of discrete and continuous signal and linear time invariant systems.

EE312 Introduction to Communications [통신개론]

This course introduces core concepts in analog and digital communication systems. The topics include Fourier transform, communication signals, amplitude modulation (AM), phase and frequency modulation (PM and FM), noise in communications, techniques in analog to digital transformation (sampling and quantization), and an introduction to source and channel coding.

EE313 Introduction to Control [자동제어공학개론]

This course introduces fundamentals of linear systems control: mathematical modeling, analysis, and design of systems, transfer function, root locus, bode diagram, nyquist method, and state space method.

EE314 Introduction to Data Networks [데이터 네트워크 개론]

This course provides an introduction to data networks. The topics covered in the course include the OSI 7-layer architecture and mathematical modeling of its underlying peer-to-peer protocols, with an emphasis on lower layers such as data link, MAC, and network layers.

EE341 Introduction to Electrical Energy Systems [전기에너지공학개론]

This course introduces elements of modern electrical energy systems, including energy resources, energy conversion, power delivery and processing. The course also covers the basic principles on power converters and electromechanical energy conversion.

EE320 Digital System Lab [디지털 시스템 실험]

This experiment course related to basic circuit theory and digital systems is focused on both hands-on experience and design practice with the following experiments: 1. Utilization of experimental equipments such as oscilloscope, power supply, and function generator, 2. Basic electric circuit theory with R, L, and C circuit networks, 3. Various digital circuit and systems, 4. Design specific digital system for given functionality as a term project.

EE321 Electronics Experiment Laboratory [전자회로실험]

Experiments related to circuit theory and electronic circuits are performed. This course is focused on both hands-on experience and design practice with the following experiments:
Circuit theory: 1. Measuring equipments and RC transient response, 2. Phasor and AC steady-state response, 3. 3-phase circuits. Electronic circuit: 4. Diode and BJT characteristics, 5. BJT and MOSFET amplifier, 6. Application of operational amplifiers. Design: 7. Sine/square wave function generator design, 8. Active filter design, 9. DC power supply design.

EE331 Electronic Devices Ⅰ [전자소자 Ⅰ]

This course covers fundamental physical concepts related to electronic devices, i.e., crystal structure of semiconductor materials, electronic energy band, dopants, carrier transport. Then it introduces the basic working principles of PN junction and Metal-Oxide-Semiconductor (MOS).

EE332 Electronic Devices Ⅱ [전자소자 Ⅱ]

This course covers operation principles of various electronic devices such as Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET), Bipolar Junction Transistor (BJT), Junction FET (JFET) and High Electron Mobility FET (HEMT). Microwave, photonic and power devices will be discussed as well.

EE401 Analog Integrated Circuits [아날로그집적회로설계]

This course covers basic concepts of fabrication, operation and design techniques related to CMOS integrated circuits. It also covers analysis and design of analog ICs using analytic techniques and CAD tools. Topics include amplifiers, current sources, output circuits, and other analog blocks.

EE402 Introduction to VLSI Design[초고밀도 집적회로 설계]

This course studies analysis and design techniques for implementations of very large-scale integrated (VLSI) circuits, MOS technology, logic, interconnect, and memory by using electronic design aid (EDA) tools. Topics include full custom design methodology of logic gate generations, timing/power simulations, layout, DRC/LVS rule checking, and floor plan. Projects will be conducted to develop and lay out circuits.

EE403 Introduction to RF Engineering [RF공학개론]

This course is intended to introduce the general background that is required for RF, microwave, mm-wave, and THz designs. After a brief review of EM and transmission line theory, microwave network and impedance matching concepts are introduced. With the understanding of microwave network, the design of microwave components including power divider, couplers, resonators, active RF circuits, and RF systems will be covered.

EE404 Fundamentals of Power Electronics [전력전자공학개론]

The objective of this course is to introduce essential elements for controling and interfacing electric power. Main topics include power rectifiers for AC-DC conversion, PFC circuits, various DC-DC converters, resonant converters, bidirectional converters, and inverters for DC-AC conversion. This course is focusing on static power conversions; however, an introduction to electromechanical energy conversion and the control and drives of electric machines will be served.

EE411 Digital Signal Processing [디지털신호처리]

This course introduces sampling of continuous-time signals and reconstruction of continuous signals from samples, spectral analysis of signals, fast Fourier transform, design of finite and infinite impulse response filters, signal flow graphs and filter implementation methods.

EE412 Communication Systems [통신시스템]

This course covers fundamental techniques for digital communication systems. The topics include analog to digital transformation using sampling and quantization, baseband and bandpass digital transmission, and an introduction to source and channel coding.

EE431 Semiconductor VLSI Devices Engineering [반도체집적소자공학]

In this course, we study in depth how the various semiconductor devices operate by using analytical approach and computer simulation. The fabrication processes and the operating principles of the manufacturing equipments are also covered. Finally, the application of semiconductor devices to actual integrated circuits and new types of devices will be discussed.

EE432 Optoelectronics [광전자공학]

This introductory course is intended to familiarize students with underlying principles of optoelectronic and optical communication devices. Topics of this course include an overview of laser, fiber optic communication systems, optics review, light wave fundamentals, light detectors, noise analysis, and system design.

EE414 Introduction to Optimization [최적화 이론 개론]

This course introduces the fundamentals of theories and applications for optimization. This course covers optimization theory, optimization algorithms, and optimization applications such as control, machine learning, communication and image and signal processing.

EE480 Special Topics in EE Ⅰ [전자및전기공학특론 Ⅰ]

This course introduces new research topics in the field of Electrical Engineering I.

EE481 Special Topics in EE Ⅱ [전자및전기공학특론 Ⅱ]

This course introduces new research topics in the field of Electrical Engineering II.

EE482 Special Topics in EE Ⅲ [전자및전기공학특론 Ⅲ]

This course introduces new research topics in the field of Electrical Engineering III.

EE483 Special Topics in EE Ⅳ [전자및전기공학특론 Ⅳ]

This course introduces new research topics in the field of Electrical Engineering Ⅳ.

EE484 Special Topics in EE Ⅴ [전자및전기공학특론 Ⅴ]

This course introduces new research topics in the field of Electrical Engineering Ⅴ.

□ Computer Science & Engineering (CSE)

CSE201 Digital Logic [디지털 로직]

To understand the basic principles of digital logic circuit, this course introduces the fundamental concepts, components and operations of digital systems. The topics to be covered include the theories of binary numbers, Boolean algebra, combination/sequential logics, registers, and counters and their implementation via hardware description languages.

CSE221 Data Structures [데이터구조]

This course introduces abstract data type concept such as array, queue, stack, tree, and graph to obtain the ability to program these abstract data types in computer programming languages.

CSE232 Discrete Mathematics [이산수학]

This course introduces discrete objects, such as permutations, combinations, networks, and graphs. Topics include enumeration, partially ordered sets, generating functions, graphs, trees, and algorithms.

CSE241 Object Oriented Programming [객체 지향 프로그래밍]

This course is a second programming course for Computer Science Engineering track with a focus on object-oriented programming. The goal of the course is to develop skills such as algorithm design and testing as well as the implementation of programs. This course requires students to implement a large number of small to medium-sized applications, and to learn how to use relevant development tools.

CSE251 System Programming [시스템 프로그래밍]

Through this course, students are provided a programmer's view on how computer systems execute programs, store information, and communicate. This will enable students to become more effective programmers allowing students to consider issues such as performance, portability and robustness when programming. This course will also serve as a foundation for upper level courses such as operating systems, computer networks, and computer organization. Various topics such as machine-level code and its generation by optimizing compilers, performance evaluation and optimization, and memory organization and management will be covered.

CSE301 Computer Architecture [컴퓨터구조]

This course provides students with a basic understanding of computer organization and architecture. It is concerned mostly with the hardware aspects of computer systems: structural organization and hardware design of digital computer systems; underlying design principles and their impact on computer performance; and software impact on computer.

CSE311 Operating Systems [운영체제]

This course introduces the objective and various forms of operating systems. Also resource management mechanisms such as process management, memory management, storage management and synchronization tools are covered in this course.

CSE331 Introduction to Algorithms [알고리즘]

This course introduces the basic concepts of design and analysis of computer algorithms: the basic principles and techniques of computational complexity (worst-case and average behavior, space usage, and lower bounds on the complexity of a problem), and algorithms for fundamental problems. It also introduces the areas of NP-completeness and parallel algorithms.

CSE332 Theory of Computation [계산이론]

This course is an introductory course on the theory of computation. The topics covered in this course includes: mathematical modelling of computing mechanisms (automatons), formal languages, computability, and basic complexity theory.

CSE341 Principles of Programming Languages [프로그래밍언어]

By studying the design of programming languages and discussing their similarities and differences, this course provide introduces the concept of modern programming languages and improves the ability to learn diverse programming languages.

CSE351 Computer Networks [컴퓨터 네트워크]

This course provides the fundamental concepts of computer networking and exercises for network programming. The topics covered in this course are data link, networking, transport, and application layers.

CSE411 Introduction to Compilers [컴파일러 개론]

This course introduces the design and implementation of compiler and runtime systems for programming languages. The topics covered include parsing techniques, lexcial and syntactic analysis, context analysis, and runtime systems.

CSE412 Parallel Computing [병렬 컴퓨팅]

As we enter the multicore era, parallel and distributed computing techniques now permeate most computing activities. This course is designed to let students follow rapid changes in computing hardware platforms and devices, and understand the concepts of parallel computing architecture, parallel programming models, parallel computing applications, and performance analysis.

CSE421 Database Systems [데이터베이스 시스템]

This course introduces the concept of databases and provides basic experience in database programming. This includes the design of relational model, relational algebra, and SQL. The second half of the class will focus on the under-the-hood of DBMS systems and database design principles are also in the scope of this course.

CSE462 Artificial Intelligence [인공지능]

Can machines think? Many pioneers in computer science have investigated this question. Artificial Intelligence (AI) is a branch of computer science dedicated to the creation of machines with intelligence. This course aims to introduce students to the field of AI and make them familiar with fundamental techniques for building intelligent systems.

CSE463 Machine Learning [기계 학습]

Machine learning is the science and engineering of building system that can learn from data. In recent years, machine learning has given us self-driving cars, effective web search, and accurate recommendation systems. This course will provide the theoretical underpinnings of machine learning, but also best practices in the machine learning industries. The courses include a broad introduction to machine learning, learning theory, and data mining.

CSE464 Software Engineering [소프트웨어 공학]

This course introduces various software development methods, the nature of software and development projects, software development models, project planning, and project management.

CSE465 Mobile Computing [모바일 컴퓨팅]

This course studies how mobile computing is different from conventional computing in the aspect of its concept, architecture and applications. Major enabling techniques of mobile computing such as sensing, mobile communication, machine learning, and system optimization for energy efficiency are explained with opportunities of implementing such technologies in Android platforms.

CSE471 Computer Graphics [컴퓨터 그래픽스]

This course introduces the theory behind the computer graphics for displaying 3D objects and the algorithms to improve the reality of the 3D computer graphics and provides the experience of 3D computer graphics programming with OpenGL.

CSE480 Special Topics in CSE Ⅰ [컴퓨터공학특론 Ⅰ]

This course introduces new research topics in the field of Computer Science & Engineering I.

CSE481 Special Topics in CSE Ⅱ [컴퓨터공학특론 Ⅱ]

This course introduces new research topics in the field of Computer Science & Engineering II.

CSE482 Special Topics in CSE Ⅲ [컴퓨터공학특론 Ⅲ]

This course introduces new research topics in the field of Computer Science & Engineering III.

CSE483 Special Topics in CSE Ⅳ [컴퓨터공학특론 Ⅳ]

This course introduces new research topics in the field of Computer Science & Engineering Ⅳ.

CSE484 Special Topics in CSE Ⅴ [컴퓨터공학특론 Ⅴ]

This course introduces new research topics in the field of Computer Science & EngineeringⅤ.

School of Life Sciences

1. School Introduction

School of Life Sciences aims to improve human health by interdisciplinary research and education in biomedical sciences and engineering through the convergence of fundamental biology, nanotechnology and various engineering principles. In order to meet the increased needs in healthcare and advanced medical theragnostics, school of life sciences pursues to train creative global leaders through interdisciplinary research and education programs.

2. Undergraduate Programs

□ Track Introduction

1) Biological Sciences (BIO)

Ground-breaking research achievements in biological sciences such as the human genome project, stem cell research, innovative therapies in cancers, and age-related diseases highlight the potential of biological sciences to be one of the most promising areas in science. The Biological Sciences track aims to produce brilliant and creative scientific minds that are familiar with the principles of biology and the cutting-edge equipment available at the state-of-the-art facilities provided by UNIST. Researches in the Biological Sciences track at UNIST are focused on age-related diseases, neuroscience, stem cells and regenerative medicine.

2) Biomedical Engineering (BME)

Biomedical engineering (BME) aims to improve human health by applying advanced engineering principles and methods to medical and biological problems, such as disease diagnostics, health monitoring, treatment, and therapy. In order to meet the increased needs in healthcare, BME track at UNIST pursues to train creative global leaders through top-class interdisciplinary research and education programs. Our competitive research programs include biochips, biomedical devices, biomimetics, biomaterials, molecular imaging, tissue engineering, drug delivery, bio-robots, genomics and genome engineering.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1^{st} Track	2^{nd} Track	
BIO	Required	23	15	
	Elective	31	3	
BME	Required	30	12	
	Elective	24	6	

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
BIO	MTH203	Applied Linear Algebra	2-1
	MTH211	Statistics	2-2
BME	MTH201	Differential Equations	2-2
	MTH203 or MTH211	Applied Linear Algebra or Statistics	2-2

※ Complete based on 1TR
※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' 12 credits.

▶ Fundamentals required to Business field students when they choose Engineering field tracks as 2^{nd} track

Course Title	BIO	BME
Differential Equations		✔
General Physics II		✔
General Chemistry I	✔	✔
General Chemistry II	✔	✔

3. Curriculum ※ Course opening semester is subject to be changed according to School's situation.

□ Biological Sciences (BIO)

※ It is mandatory that students whose 2nd track is Biological Sciences take all major courses chosen only from BIO code courses(except for BME324).
※ NBC students must check for viable replacement courses according to the course replacement list before registration.

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
BIO	BIO201	Molecular Biology 분자생물학	3-3-0		2
	BIO211	Biochemistry Ⅰ 생화학 Ⅰ	3-3-0	Identical: CHM321	1
	BIO301	Cell Biology 세포생물학	3-3-0	Prerequisite: BIO201, BIO211	1
	BIO302	Developmental Biology 발생학	3-3-0	Prerequisite: BIO201	1
	BIO332	Anatomy and Physiology 해부 및 생리학	3-3-0		2
Total Credit			15		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
BIO	BIO221	Biochemistry II 생화학 II	3-3-0	Identical: CHM322	2
	BIO261	Biochemistry Laboratory 생화학실험	2-0-4		1,2
	BIO333	Genetics 유전학	3-3-0	Prerequisite: BIO201 or BIO211	2
Total Credit			8		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
BIO	BIO202	Molecular Biology Laboratory 분자생물학실험	2-0-4		2
	BIO231	The Chemical Basis of Life 생명현상의 화학적 이해	3-3-0		2
	BIO303	Neurobiology 신경생물학	3-3-0		2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
BIO	BIO304	Current Topics in Biological Sciences 현대생명과학동향	2-2-0		1
	BIO305	Principles of Neurosciences Ⅰ 신경과학의 원리 Ⅰ	3-3-0		1
	BIO306	Principles of Neurosciences II 신경과학의 원리 II	3-3-0		2
	BIO314	Instrumental Bioanalysis 생물기기분석	3-3-0		-
	BIO316	Protein Science 단백질학	3-3-0		-
	BIO331	Microbiology 미생물학	3-3-0		1
	BIO361	Cell Biology & Genetics Laboratory 세포생물학 및 유전학실험	2-0-4		1
	BIO401	Special Topics in Biological Sciences Ⅰ 생명과학특론 Ⅰ	3-3-0		1
	BIO402	Special Topics in Biological Sciences II 생명과학특론 II	3-3-0		1
	BIO403	Special Topics in Biological Sciences Ⅲ 생명과학특론 Ⅲ	3-3-0		-
	BIO412	Microbial Physiology 미생물생리학	3-3-0	Prerequisite: BIO331	1
	BIO431	Bioinformatics 생정보학	3-3-0		1
	BIO432	Immunology 면역학	3-3-0		1
	BIO433	Biochemistry of Signal Tranduction and Regulation 세포신호전달	3-3-0	Prerequisite: BIO211, BIO221	1
	BIO436	Gene Expression 유전자발현	3-3-0		1
	BIO438	Endocrinology and Metabolism 내분비 및 대사학	3-3-0	Prerequisite: BIO211, BIO301	2
BME	BME202	Genomics Ⅰ 게놈학 Ⅰ	3-3-0		2
	BME203	Introduction to Bioinformatics 생물정보학 개론	3-3-0		1
	BME321	Introduction to Biomedical Optics 의광학 개론	3-3-0		2
	BME324	Genomics II 게놈학 II	3-3-0		1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
BME	BME325	Introduction to Quantitative Biology 정량적생물학개론	3-3-0		1
	BME405	Design Principles of Life 생명의 설계원리	3-3-0		1
	BME411	Physical Biology of the Cell 세포생물물리학	3-3-0		1
	BME413	Biomedical Instrumentation Laboratory 의료기기실험	3-1-4		2
	BME431	Biomedical Imaging 의생명이미징	3-3-0		2
CHEM	CHM211	Organic Chemistry Ⅰ 유기화학 Ⅰ	3-3-0	Identical: ACE201, ENE211	1
	CHM212	Organic Chemistry Ⅱ 유기화학 Ⅱ	3-3-0	Identical: ACE202, ENE221	2
	CHM231	Physical Chemistry Ⅰ 물리화학 Ⅰ	3-3-0	Identical: ACE203, ENE212	1
Total Credit			90		

□ Biomedical Engineering (BME)

※ It is mandatory that Students whose 2nd track is BME are able to get approval only BME code courses for elective credit(except for BIO431).

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
BME	BME211	Introduction to Biomedical Engineering 생명공학개론	3-3-0		1
	BME301	Computational Methods for Biosciences and Bioengineering 생명과학생명공학전산	3-3-0		2
	BME311	Transport Phenomena in Biological Systems 생체유체역학	3-3-0	Prerequisite: MTH201	1
	BME435	Tissue Engineering 조직공학	3-3-0	Identical: AMS360	1
Total Credit			12		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
BME	BME411	Physical Biology of the Cell 세포생물물리학	3-3-0		1
	BME413	Biomedical Instrumentation Laboratory 의료기기실험	3-1-4		2
	BME470	BME Senior Design Ⅰ -	3-1-4		1
	BME480	BME Senior Design Ⅱ -	3-1-4		2
BIO	BIO301	Cell Biology 세포생물학	3-3-0	Prerequisite: BIO201, BIO211	1
	BIO332	Anatomy and Physiology 해부 및 생리학	3-3-0		2
Total Credit			**18**		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
BME	BME202	Genomics Ⅰ 게놈학 Ⅰ	3-3-0		2
	BME203	Introduction to Bioinformatics 생물정보학 개론	3-3-0		1
	BME212	Bio-instrumental Analysis 바이오기기분석	3-3-0		2
	BME319	Optical Imaging 광학이미징	3-3-0		-
	BME321	Introduction to Biomedical Optics 의광학 개론	3-3-0		2
	BME324	Genomics Ⅱ 게놈학 Ⅱ	3-3-0		1
	BME325	Introduction to Quantitative Biology 정량적생물학개론	3-3-0		1
	BME401	Special Topics in Biomedical Engineering Ⅰ 생명공학특론 Ⅰ	3-3-0		-
	BME402	Special Topics in Biomedical Engineering Ⅱ 생명공학특론 Ⅱ	3-3-0		-
	BME403	Special Topics in Biomedical Engineering Ⅲ 생명공학특론 Ⅲ	3-3-0		-
	BME404	Advanced Topics in Genomics 고급 게놈학	3-3-0		2
	BME405	Design Principles of Life 생명의 설계원리	3-3-0		1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
BME	BME406	Drug Delivery Systems 약물전달시스템	3-3-0		2
	BME407	Bio-image Processing 바이오 영상 처리	3-3-0		2
	BME421	Nano-Bioengineering 나노바이오공학	3-3-0		1
	BME431	Biomedical Imaging 의생명이미징	3-3-0		2
	BME433	Lasers and Biomedical Applications 레이저와 바이오 응용	3-3-0		1
BIO	BIO201	Molecular Biology 분자생물학	3-3-0		2
	BIO202	Molecular Biology Laboratory 분자생물학실험	2-0-4		2
	BIO211	Biochemistry Ⅰ 생화학 Ⅰ	3-3-0	Identical: CHM321	1
	BIO221	Biochemistry II 생화학 II	3-3-0	Identical: CHM322	2
	BIO261	Biochemistry Laboratory 생화학실험	2-0-4		1,2
	BIO304	Current Topics in Biological Sciences 현대생명과학동향	2-2-0		1
	BIO333	Genetics 유전학	3-3-0	Prerequisite: BIO201 or BIO211	2
	BIO431	Bioinformatics 생정보학	3-3-0		1
MAE	MEN230	Solid Mechanics Ⅰ 고체역학 Ⅰ	3-3-0		1
	MEN301	Numerical Analysis 수치해석	3-3-0		2
	MEN413	Computational Fluid Dynamics 전산유체역학	3-3-0	Prerequisite: MEN301, MEN320	2
	MEN451	Introduction to MEMS MEMS개론	3-3-0		2
SDC	SDC302	Circuit Theory & Lab 회로이론 및 실습	3-2-2		1
	SDC405	3D Printing 3D 프린팅	3-3-0		1
AMS	AMS360	Bio-inspired Materials Science 바이오소재과학	3-3-0	Identical: BME435	2
ENE	ENE312	Electrochemistry 전기화학	3-3-0	Identical: ACE312	2
	ENE322	Instrumental Anaysis 기기분석	3-3-0	Identical: ACE391, CHM391	1
	ENE480	Scientific Expression with IT 공학IT개론	3-2-2		2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
ACE	ACE441	Introducton to Molecular Biotechnology 분자생물공학	3-3-0		2
EE	EE432	Optoelectronics 광전자공학	3-3-0		1
CSE	CSE463	Machine Learning 기계 학습	3-3-0	Prerequisite: EE211, CSE331	2
PHY	PHY213	Modern Physics 현대물리학	3-3-0	Prerequisite: PHY101, PHY103	2
	PHY303	Thermal and Statistical Physics 열 및 통계물리학	3-3-0	Prerequisite: PHY101, PHY103	2
CHEM	CHM371	Introduction to Nanochemistry 나노화학개론	3-3-0	Identical: ACE416, ENE416	2
	CHM421	Introduction to Chemical Biology 화학생물학개론	3-3-0		2
MGT	MGT473	Entrepreneurship and Venture Management 창업과 벤처	3-3-0		1
Total Credit			126		

▶ Suggested Path of the 1st track elective courses

If students whose 1st track is Biomedical Engineering are interested in one of focused areas such as Biomedical Devices and Regenerative Medicine, Imaging, Physical Biology, and Genomics, Biomedical Engineering(BME) highly recommends the following elective courses according to your academic interests. The classes listed in the table are strongly recommended, but are not required for graduation.

Year	Biomedical Devices and Regenerative Medicine	Physical Biology	Imaging	Genomics
2	BME212 BIO261 MEN230 EE201	BME203 BME202 BIO211	EE231 of PHY203 PHY213	BME202 BME203 BIO201 BIO211
3	BME302 BME311 BIO301 BIO332 MEN301 AMS360 ENE312 ENE322 CHM371	BME324 BME325 PHY303	BME325 BME319 BME321	BME325 BME324 BIO333 CSE331
4	BME406 BME435 MEN413 MEN451 SDC405 ENE480 ACE441 CHM421	BME404 BME405 BIO432	BME407 BME431 BME433 EE432	BME404 BIO431

4. History of Courses Change of 2017–2018

Category	2017		2018
BIO	<New>	⇨	BIO231 (Elective) The Chemical Basis of Life 생명현상의 화학적 이해
	<New>	⇨	BIO305 (Elective) Principles of Neurosciences I 신경과학의 원리 I
	<New>	⇨	BIO306 (Elective) Principles of Neurosciences II 신경과학의 원리 II
	BIO404 (Elective) Current Topics in Biological Sciences 현대생명과학동향	⇨	BIO304 (Elective) Current Topics in Biological Sciences 현대생명과학동향
BME	BME302 (Elective) Biomechanics 생체역학	⇨	<Closed>

5. Course Descriptions

□ Biological Sciences (BIO)

BIO201 Molecular Biology [분자생물학]

This course is designed to teach students about DNA with regard to its structure, replication, and roles in transcription and translation, as well as various related control mechanisms. It will also introduce the students to recent recombinant DNA technologies and the principles behind these methodologies.

BIO202 Molecular Biology Laboratory [분자생물학실험]

In this laboratory course, each student will be actively involved and conduct a series of experiments related to molecular biology subjects. The principles of each technique will also be discussed for future applications.

BIO211 Biochemistry I [생화학I]

This course is designed to teach students the various chemical processes occurring within every living organism. Topics discussed will include amino acids and proteins, molecules of heredity, enzymes, bioenergetics, glycolysis, the citric acid cycle, oxidative phosphorylation and gluconeogenesis, as well as others. This course will also cover macromolecules, their precursors and biosynthesis, and the chemical, physiological, and genetic regulation of biosynthesis.

BIO221 Biochemistry Ⅱ [생화학 Ⅱ]

This course is designed to teach students the various metabolic processes occurring within every living organism. Topics discussed will include bioenergetics, the citric acid cycle, oxidative phosphorylation, carbohydrate, lipid, and amino acid metabolisms, and their hormonal regulation.

BIO231 The Chemical Basis of Life [생명현상의 화학적 이해]

All processes that control the fate of cells and organisms are controlled by interaction of biomolecules - DNA, RNA, Proteins, Sugars, Lipids, Metabolites. We will explore the molecular, structural and chemical nature of these interactions. In each lecture, a biological topic will be paired with one or several chemical principles. After covering the fundamental principles, we will learn about how the knowledge and application of chemical reactivity and structure has enabled the biotechnology revolution and how it is applied in drug discovery. This course will teach students a basic understanding of chemical reactivity and structure needed that underlies all areas of modern biology and will help them in classes such as biochemistry and molecular biology.

BIO261 Biochemistry Laboratory [생화학실험]

Students will be trained with the latest biological sciences techniques through a series of laboratory courses. Each student will actively conduct, perform, record and report on various experiments during the semester. The principles behind each lab technique will be introduced and students will learn how to collect and interpret experimental results by preparing a laboratory report after each class.

BIO301 Cell Biology [세포생물학]

This course is designed to teach students about the cell at both a microscopic and molecular level. The lectures will focus on numerous related subjects, such as cell composition, cell structure, the cell cycle and its regulation, and cellular interactions with the environments.

BIO302 Developmental Biology [발생학]

Students will learn about the processes by which living organisms develop and grow. The control mechanisms involved in cell differentiation, embryonal development, growth, metamorphosis, and regeneration at both a molecular and genetic level will be taught and discussed.

BIO303 Neurobiology [신경생물학]

Neurobiology is a central component of modern biomedical sciences. The objective of this class is to help you gain a solid understanding of this discipline. You will be expect to understand the structures and functions of the key players, to understand the interaction between the components, to understand central principles that govern the network of nervous system, and to be able to apply this knowledge to solve noble problems.

BIO304 Current Topics in Biological Sciences [현대생명과학동향]

Biological science is one of the most exciting and rapidly developing areas of science. This course aims to inform students of recent topics in various fields of biological sciences such as molecular biology, cell biology, immunology, neuroscience, structural biology and developmental biology. The instructor will introduce current research topics and students are encouraged to share their opinions on the topics, discuss about challenging ideas and seek for possible answers to unanswered questions.

BIO305~306 Principles of Neurosciences Ⅰ~Ⅱ [신경과학의 원리 Ⅰ~Ⅱ]

Artificial intelligence and neuromorphic techniques are coming into our lives more than ever before and it is for sure that these technological advancements will change our lives tremendously. Now, we're anxious that AI will take over many of our jobs in the near future. However, we should ask ourselves seriously whether we even understand what intelligence means and how "real" neurons and nervous system are structured, work, and process various information, making animals adapt to survive in harsh surroundings.

BIO314 Instrumental Bioanalysis [생물기기분석]

This course is designed to give biological science and engineering students a fundamental understanding of bioanalytical tools and instruments. This course will cover the basic principles of qualitative and quantitative analyses of biomolecules, such as nucleic acids, carbohydrates, and proteins, and the fundamentals of instrumental bioanalysis, including electrochemical, chromatographic, spectroscopic, and spectrometric methods.

BIO316 Protein Science [단백질학]

This course will provide a general understanding of modern protein folding, structures, and protein engineering strategies. Topics include the fundamentals of proteins and protein complexes, analytical methods for protein structures and characterization, and biological and biochemical methods in protein design and manipulation, including biomedical and industrial application of engineered proteins.

BIO331 Microbiology [미생물학]

This course provides the basic concepts and fundamental aspects of microbiology, including genetics, physiology and classification. Topics covered will include the importance of microorganisms to ecosystems, their application to environmental issues, such as in bioremediation, and their various applications within diverse fields/industries.

BIO332 Anatomy and Physiology [해부및생리학]

This course introduces the structure and function of tissues and organs. Their systemic regulation will be discussed.

BIO333 Genetics [유전학]

This course is designed to teach students about all aspects of heredity and genes. The lecture series will include gene expression, variation, and regulatory mechanisms. In addition, recent research and technologies related with genetics will be presented.

BIO361 Cell Biology & Genetics Laboratory [세포생물학 및 유전학실험]

In this laboratory course, each student will be actively involved and conduct a series of experiments related to cell biology and genetics topics. The principles of each technique will also be discussed for future applications.

BIO412 Microbial Physiology [미생물생리학]

The purpose of this course is to provide an understanding of the structure and function of microorganisms, the relationship between structure and function in its environment. It will also provide the mechanisms of cell division, composition of microbial cell walls and membranes, aerobic and fermentative metabolism, and regulation of genes and metabolism.

BIO431 Bioinformatics [생정보학]

This course provides basic knowledge and skills for genome data analysis. Microarray and sequence data analysis as well as exercises with software tools are included. Elementary Statistics is the prerequisite.

BIO432 Immunology [면역학]

This course is designed to teach students about all aspects of the immune system in both health and disease. A series of lectures on immune cell components, development, and functions, the innate and acquired immune system, pathogenesis, malfunctions of the immune system, such as immunodeficiency and autoimmunity, inflammation and various immunological techniques and their applications will be given.

BIO433 Biochemistry of Signal Transduction and Regulation [세포신호전달]

Cellular signaling in higher organism is a major topic in modern medical and pharmacological research. Also, signal transduction is a subject that ranks among the most rapidly developing fields in biomedical sciences. Diseases such as cancer, diabetes and cardiovascular disorders are caused in part by disturbances in cellular signaling processing, and the majority of therapeutic drugs target corresponding cellular pathways. Accordingly, this lecture will concentrate on signaling and regulation in animal systems and in man. It is the aim of this lecture to understand the biochemical and physiological properties of signaling molecules and their regulation. Furthermore, the tools used for signal transduction and the organizational principle of signaling pathways will be discussed in this lecture.

BIO436 Gene Expression [유전자발현]

Gene expression is a fundamental cellular process decoding genetic/epigenetic information in response to physiological needs such as growth, development, and homeostasis. This course is specially designed to understand how multiple regulatory mechanisms can give rise to spatial/temporal and quality/quantity controls in gene expression at both mRNA and protein levels, thus fine-tuning gene function.

BIO438 Endocrinology and Metabolism [내분비 및 대사학]

This course will mainly focus on the metabolic syndrome and related signal transduction that are offered to students of Biochemistry, Cell Biology, and Molecular Biology. Students have to prepare the presentation of reviews and recent research articles.

BIO401~3 Special Topics in Biological Sciences I~III [생명과학특론 I~III]

This course will provide in-depth coverage of current hot topics in biological sciences.

□ Biomedical Engineering (BME)

BME202 Genomics Ⅰ [게놈학Ⅰ]

Genomics is the new name for genetics. It is a core of modern biology. Any students who are interested in biology and biotechnology are strongly recommended to learn genomics. Genomics 1 is an introduction. It covers areas such as sequencing, alignment, DNA synthesis, and genome writing and editing. Students who took this subject will be able to understand life in terms of information processing with much knowledge on how to use technologies to solve problems such as curing cancer and aging.

BME203 Introduction to Bioinformatics [생물정보학 개론]

This introductory course will cover the basic programming skills and algorithms used in bioinformatics research. Bioinformatics is a relatively new discipline in biomedical research, studying the information of biological system. Various knowledges, such as biological knowledge to ask the right question, logical insights to design the algorithm, computational skill to implement the program, and statistical knowledge to interpret large-scale data, are required to study bioinformatics. Among them, this class will mostly focus on the analysis of biological sequences, which is the fundamental format of biological information in nature.

BME211 Introduction to Biomedical Engineering [생명공학개론]

This course is an introduction to Biomedical Engineering (BME) and will demonstrate to students how to apply engineering knowledge and skills to real-word problems in medicine and biology. Course will covers the basis of biology and physiology, medical instruments, biomaterials, medical imaging, and computational biology. It is intended to facilitate the student's understanding in areas of BME and gain the core concept of BME, interdisciplinary research. Course is designed by composed lectures which provide the opportunity to learn various BME activities in academia as well as industry.

BME212 BIO-instrumental Analysis [바이오기기분석]

Instrumental analysis is crucial to research in molecular biology, biomedical engineering, chemical engineering, and many other field. The aim of this course is to provide undergraduate students with an understanding analytical instruments, not to instrument be considered “black boxes”. In this course, we will cover the various types of microscopes, centrifugation techniques for separation, chromatographic technique (HPLC and GC), PCR, various spectrophotometric techniques (NMR, NIR, UV) in biomedical analysis.

BME301 Computational Methods for Biosciences and Bioengineering Biomedical Engineering [생명과학생명공학전산]

This course provides key concepts and principles of numerical methods for biosciences and bioengineering. Lectures will be supplemented by hands-on demonstration and exercises by using scientific computing software tools, such as Matlab, Mathematica and/or their open source alternatives. Candidate topics to be covered include partial differential equations, time series analysis, stochastic modelling of biological processes, and graph-theoretic analysis of large-scale networks.

BME311 Transport Phenomena in Biological Systems [생체유체역학]

This course introduces the fundamental principles of transport phenomena with the specific examples in medical, biological, and bioengineering applications. This course uniquely integrates biological and engineering concepts to help engineers to establish and critically analyze models of biological transport and reaction processes. It covers topics in fluid mechanics, mass transport and biochemical interactions.

BME319 Optical Imaging [광학이미징]

The objective of this course is to understand the physical properties of light and its consequences on imaging. The course will cover the fundamentals of optics and various characteristics such as coherence, aberrations, polarization, electro-optics, acousto-optics and consider how they enable unique capabilities for light microscopy.

BME321 Introduction to Biomedical Optics [의광학 개론]

The objective of this course is to understand the working principle of various different areas of modern biomedical optics. Through this course, you will be able to understand the working principles of state-of-the-art microscope systems such as multiphoton, super-resolution, phase engineering, and tomography as well as light-tissue interaction for therapeutic applications.

BME324 Genomics Ⅱ [게놈학Ⅱ]

This course will explore the role of genomics in disease (e.g. cancer) study, diagnosis, prognosis, and treatment. Each student will have an opportunity to explore publicly available genome samples to understand what can be learned from examining genetic alterations that can correlate with disease initiation and development. We will discuss how an individual's risk of developing a disease can be assessed based on small genetic changes in nucleotide sequence as well as on larger structural variations that affect entire regions of a chromosome.

BME325 Introduction to Quantitative Biology [정량적생물학개론]

This course is designed to provide the quantitative and analytical tools for understanding and rational design of biological systems. The early part of the course covers the central dogma on a number basis and reviews recent progress in genetic/genomic engineering for various purposes. The latter part is devoted to the cellular information processing with two thematic topics of gene expression regulation and neural information processing. Rudimentary math and mandatory freshman science courses will suffice for prerequisite. Minimal experience in mathematical software is recommended but not required.

BME404 Advanced Topics in Genomics [고급 게놈학]

This course will review primary scientific research papers in the field of genomics. Each class, we will review one or two such papers in detail with some background and coverage of related research when appropriate. The paper to be discussed in detail will be assigned for reading.

BME405 Design Principles of Life [생명의 설계원리]

This course provides science and engineering majors with a theoretical and analytical overview of the biological systems across different scales of time and space. From the molecular mechanism of gene expression to neuronal electrophysiology to population genetics, exemplary modeling approaches will be discussed in an effort to convey penetrating physico-chemical concepts and mathematical methods. Particular emphasis will be placed on the design principles underlying the biological networks and their implications in bioengineering. First-year physics and biology would suffice the prerequisite requirement.

BME406 Drug Delivery Systems [약물전달시스템]

The way in which chemicals or drugs are administered have gained increasing attention to achieve prolong therapeutic effects and minimize the side effects. This course will provide undergraduate students with a basic understanding of the rationale behind the engineering of controlled drug delivery system, and design, development and optimization of drug delivery system. It covers physiological barriers in the human body including skin, gastrointestinal tract, nose, eyes, and brain, biopharmaceutical properties of drugs in drug transport, physiochemical principles in drug delivery, and engineering polymer systems for drug delivery.

BME407 Bio-image Processing [바이오 영상 처리]

This course aims to provide a fundamental, brand-new techniques of image processing and computer vision topics for biomedical engineer. Our course will be on learning fundamental concepts and principles underlying biomedical image processing which are based on computer science and mathematics. Also, We treat vision as a process of inference from noisy and uncertain data and emphasizes probabilistic, statistical, data-driven approaches. Topics include image formation, transformation, filtering, segmentation, optimization, detection and motion recognition. Finally, this course will consist of several programming homeworks and projects by MATLAB. I believe that this course will be useful for your research of biomedical application.

BME411 Physical Biology of the Cell [세포생물물리학]

This course will introduce students to skills of quantitative and semi-quantitative analysis applicable to broad number of topics even beyond biomedical topics but for purposes of class using the cell as a major focus. Topics include understanding basic structures and components of cells, designing, evaluating, and analyzing cellular experiments, and applying cell biology to biomedical research and engineering. Prerequisites are Biochemistry and Physical Chemistry or Thermodynamics.

BME413 Biomedical Instrumentation Laboratory [의료기기실험]

This course will provide the basic concept and hands-on experience of biomedical device. The course will be balanced with lecture and experiment covering the topics such as biological signal measurement, signal processing, and data analysis using LabVIEW programming. Through this course, students will gain the skill how to design, build, and control biomedical device for laboratory research.

BME421 Nano-Bioengineering [나노바이오공학]

This course discusses basic knowledge for interdisciplinary research in nanoscience, biology, electronic and mechanical engineering. This course, also, provides hand-on experiences on the modeling, microfabrication and characterization of bio-inspired microelectromechanical systems.

BME431 Biomedical Imaging [의생명이미징]

An introduction to the principles of biomedical imaging and its applications. A series of lectures provide demonstrations of basic principles of noninvasive imaging methods in biology and medicine, including x-ray, PET, MRI, ultrasound and optical imaging. Lectures by the professor will be supplemented by in-class discussions of problems in research, and hands-on demonstrations of imaging systems.

BME433 Lasers and Biomedical Applications [레이저와 바이오 응용]

The use of lasers in biomedical field has been tremendously increased for last two decades, ranging from optical diagnostics to laser therapy. This course will provide the fundamental understandings of lasers and laser-matter interactions, as well as various applications including optical imaging, diagnostics, and laser surgery. The course also covers the most recent advancements in laser technology for examples, fiber lasers and microlasers and their applications in biomedical field. This course is designed for senior undergraduate students, but not limited.

BME435 Tissue Engineering [조직공학]

This course is designed for both undergraduate and graduate-level students who have the desire for an introductory understanding of tissue engineering (TE) elements involved in Regenerative Medicine (RM). The course aims to attain the following two major objectives: (1) Primary objective: understand and explore the basic engineering and medical principles behind the TE, (2) Secondary objective: Understand the basic non-engineering/ analytic skills necessary for real-world development of the ‘commercializable’ biomedical products. Ethics involved in the RM will be briefly reviewed. Students will gain experiences in real-life research topics and engaged to ‘mock-up’ research activities as well as business (commercialization) development.

BME401~3 Special Topics in Biomedical Engineeirng I~III [생명공학특론 I~III]

This course discusses recent research trends on Biomedical Engineering. Especially, the interdisciplinary research examples such as biochips or lab-on-a-chips for analysis of nucleic acids, proteins, and cells in molecular or cell level. Proposal writing and oral presentation are also required.

BME470 BME Senior Design I & BME480 BME Senior Design II

All BME students are required to take a two-semester capstone course in the senior year: "Biomedical Engineering Senior Design I and II". This course was designed in order to BME seniors make the transition into industry through self-chosen team projects. Thus, course material emphasizes practical training such as entrepreneurship, market research, regulatory considerations, and client-based engineering project. Entire projects through two semesters are mentored by BME research faculty member. Students end their final semester with a demonstration of their prototype device and are judged by a panel of faculty and invited guests from industry. Through this course, BME senior students will learn how to identify product needs and assess potential obstacles, then use tools of project management and creativity development to solve real-world problems.

School of Natural Science

1. School Introduction

The school of natural science was founded in 2010 to promote the basic science education and to facilitate the creative interdisciplinary research between science and engineering. Since then, it has been offering MS and Ph.D degrees. Natural Science strives to improve the quality of human life through finding and understanding basic rules in nature. Historically, the convergence of basic science and engineering has been a key process for the advance of human civilization. We believe that the systematic interdisciplinary research between natural science and engineering will be able to speed up the convergence of these two disciplines and UNIST proudly provides an unprecedented and unique education system in Korea for this purpose.
From 2014, the school of natural science provides three majors, mathematical sciences, physics, and chemistry for undergraduate and graduate students. For the purpose of performing world top class research, UNIST has been recruiting several top researchers. As a result, the School of Natural Science will host at least two International Business Belt Campus Research Centers. This school is ready to soar to the apex of science and technology.

2. Undergraduate Programs

□ Track Introduction

1) Physics (PHY)

Physics forms a fundamental knowledge system and a framework of 'thinking' for almost every other contemporary science and technology. We incubate the next generation human resources to inherit and lead the diverse researches in modern physics by providing a set of related curriculums. In the physics track of UNIST, we offer not only basic physics courses such as classical mechanics, electromagnetism, quantum physics, statistical physics, mathematical physics and basic laboratory experiments, but also advanced courses for the future research such as solid state physics, optics, computational physics, plasma and beam physics, biological physics, particle physics, cosmology, advanced experiments, etc.

2) Chemistry (CHEM)

Chemistry is a central science that seeks the understanding of nature and interactions between atoms and molecules. In addition to this essential scientific question, modern development such as nanoscience offers new chances to explore the world of 'beyondatoms and molecules. The department offers lectures and experimental courses in all fields of chemistry: physical, organic, analytical, biological, and materials/polymers chemistry. The department stresses a research experience as an essential educational tool. Research opportunities with our world-class researchers are provided to all undergraduate students in the state-of-the art facilities and environment.

3) Mathematical Sciences (MTH)

Department of Mathematical Science explores the connections between mathematics and its applications at both the research and educational levels. In addition to focusing on traditional study in pure mathematics, our research at UNIST is devoted to encompass some of the most diverse and interdisciplinary research in the physical, business, economics, engineering, and biological sciences. The department provides a dynamic and engaging research environment in scientific computing, mathematical biology, finance, dynamical systems, image processing, number theory and analysis in PDEs. The undergraduate and graduate curriculum is planned with the following varied objectives: (1) to offer students an introduction to the fundamental study of quantity, structure, space, and change; (2) to prepare students for graduate study in pure or applied mathematics; (3) to serve the needs of students in fields that rely substantially on mathematics, such as the physics, biology, engineering, business and economics.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1st Track	2nd Track	
PHY	Required	33	12	
	Elective	21	6	
CHEM	Required	28	12	
	Elective	26	6	
MTH	Required	33	12	
	Elective	21	6	

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
PHY	MTH203	Applied Linear Algebra	2-1
	MTH201	Differential Equations	2-2
CHEM	MTH203	Applied Linear Algebra	2-1
	MTH201	Differential Equations	2-2
MTH	MTH203	Applied Linear Algebra	2-1
	MTH201	Differential Equations	2-2

※ Complete based on 1TR
※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' 12 credits.

▶ Fundamentals required to Business field students when they choose Engineering field tracks as 2nd track

Course Title	PHY	CHEM	MTH
Calculus II	✔		✔
Differential Equations	✔		✔
General Physics I	✔		
General Physics II	✔		
General Physics Lab I	✔		
General Physics Lab II	✔		
General Chemistry I			
General Chemistry II		✔	
General Chemistry Lab I		✔	
General Chemistry Lab II		✔	

3. Curriculum ※ Course opening semester is subject to be changed according to School's situation.

□ Physics (PHY)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
PHY	PHY201	Classical Mechanics 고전역학	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY203	Electromagnetism Ⅰ 전자기학 Ⅰ	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY301	Quantum Physics Ⅰ 양자물리학 Ⅰ	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY303	Thermal and Statistical Physics 열 및 통계물리학	3-3-0	Prerequisite: PHY101, PHY103	2
Total Credit			12		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
PHY	PHY204	Electromagnetism Ⅱ 전자기학 Ⅱ	3-3-0	Prerequisite: PHY203	2
	PHY207	Physics Lab Ⅰ 물리학실험 Ⅰ	3-1-4	Prerequisite: PHY101, PHY103	2
	PHY213	Modern Physics 현대물리학	3-3-0	Prerequisite: PHY101, PHY103	2
	PHY302	Quantum Physics Ⅱ 양자물리학 Ⅱ	3-3-0	Prerequisite: PHY301	2
	PHY307	Physics Lab Ⅱ 물리학실험 Ⅱ	3-1-4	Prerequisite: PHY101, PHY103	1
	PHY311	Computational Physics 전산물리학	3-3-0		1
	PHY313	Mathematical Physics 수리물리학	3-3-0	Prerequisite: PHY201, PHY203	1
Total Credit			21		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
PHY	PHY315	Solid State Physics Ⅰ 고체물리학 Ⅰ	3-3-0	Prerequisite: PHY301	2
	PHY321	Optics 광학	3-3-0	Prerequisite: PHY204	2
	PHY333	Astrophysics : Stars and Blackholes 천체물리학 : 항성과 블랙홀	3-3-0		1
	PHY334	Astrophysics : Galaxies and the Universe 천체물리학 : 은하와 우주	3-3-0		-
	PHY336	Physical Models of Life 생명현상의 물리학적 모형	3-3-0		2
	PHY407	Semiconductor and Precision Measurement Physics 반도체 및 계측 물리학	3-2-2		2
	PHY415	Solid State Physics Ⅱ : Quantum Material 고체물리학 Ⅱ : 양자물성	3-3-0		1
	PHY418	Polymer and Soft Matter Physics 고분자 및 연성물질물리학	3-3-0	Prerequisite: PHY303	2
	PHY425	Atomic and Molecular Physics 원자 및 분자물리학	3-3-0		-
	PHY427	Introduction to Plasma Physics 플라즈마 물리학 입문	3-3-0		-
	PHY428	Introduction to Beam Physics 빔 물리학 입문	3-3-0		-
	PHY429	Nuclear and Elementary Particle Physics 핵 및 입자물리학	3-3-0		-
	PHY435	Biological Physics 생물물리학	3-3-0		1
	PHY437	Nonlinear Dynamics 비선형동역학	3-3-0		-
	PHY439	Introduction to Modern Theoretical Physics 현대이론물리학 입문	3-3-0	Prerequisite: PHY313	2
	PHY441	Fluid Physics 유체물리학	3-3-0		1

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
PHY	PHY471	Special Topics in Physics Ⅰ 물리학 특강 Ⅰ	3-3-0		-
	PHY472	Special Topics in Physics II 물리학 특강 II	3-3-0		-
	PHY473	Special Topics in Physics Ⅲ 물리학 특강 Ⅲ	3-3-0		-
CHEM	CHM335	Quantum Chemistry 양자화학	3-3-0		1
MTH	MTH204	Linear Algebra 선형대수학	3-3-0	Prerequisite: MTH203	2
	MTH251	Mathematical Analysis Ⅰ 해석학 Ⅰ	3-3-0		1
	MTH313	Complex Analysis Ⅰ 복소해석학 Ⅰ	3-3-0		1
	MTH420	Fourier Analysis 푸리에 해석학	3-3-0		2
MAE	MEN220	Fluid Mechanics 유체역학	3-3-0		2
AMS	AMS230	Introduction to Crystallography 결정학개론	3-3-0	Prerequisite: AMS202 or NME202	2
	AMS431	Magnetic Properties of Materials 재료의 자기적 성질	3-3-0		-
EE	EE403	Introduction to RF Engineering RF 공학 개론	3-3-0	Prerequisite: EE201, EE301	2
	EE432	Optoelectronics 광전자공학	3-3-0		1
CSE	CSE332	Theory of Computation 계산 이론	3-3-0	Prerequisite: CSE232	2
BME	BME411	Physical Biology of the Cell 세포생물물리학	3-3-0		1
		Total Credit	**93**		

□ Chemistry (CHEM)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
CHEM	CHM201	Organic Chemistry Lab 유기화학실험	2-0-4		2
	CHM211	Organic Chemistry Ⅰ 유기화학 Ⅰ	3-3-0	Identical: ACE201, ENE211	1
	CHM212	Organic Chemistry Ⅱ 유기화학 Ⅱ	3-3-0	Identical: ACE202, ENE221	2
	CHM231	Physical Chemistry Ⅰ 물리화학 Ⅰ	3-3-0	Identical: ACE203, ENE212	1
	CHM232	Physical Chemistry Ⅱ 물리화학 Ⅱ	3-3-0		2
	CHM291	Analytical Chemistry Ⅰ 분석화학 Ⅰ	3-3-0	Identical: ENE213	1
	CHM301	Inorganic Chemistry Lab 무기화학실험	2-0-4	Choose one	1
	CHM302	Physical/Analytical Chemistry Lab 물리분석화학실험	2-0-4		2
	CHM321	Biochemistry Ⅰ 생화학 Ⅰ	3-3-0	Identical: BIO211	1
	CHM351	Inorganic Chemistry Ⅰ 무기화학 Ⅰ	3-3-0	Identical: ACE304, ENE311	1
	CHM352	Inorganic Chemistry Ⅱ 무기화학 Ⅱ	3-3-0	Identical: ACE326, ENE326	2
Total Credit			30		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
CHEM	CHM311	Synthetic Organic Chemistry 합성유기화학	3-3-0		1
	CHM313	Fundamental of Energy Materials 에너지재료개론	3-3-0	Identical: ENE317	1
	CHM322	Biochemistry Ⅱ 생화학 Ⅱ	3-3-0	Identical: BIO221	2
	CHM323	Medicinal Chemistry 의약화학	3-3-0	Prerequisite: CHM211, CHM212	2
	CHM324	Spectroscopy in Organic Chemistry 유기분광학	3-3-0		2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
CHEM	CHM333	Physical Chemistry Ⅲ 물리화학 Ⅲ	3-3-0		1
	CHM335	Quantum Chemistry 양자화학	3-3-0		1
	CHM336	Chemical Thermodynamics 화학열역학	3-3-0		-
	CHM337	Computational Chemistry 전산화학	3-3-0		1
	CHM371	Introduction to Nanochemistry 나노화학개론	3-3-0	Identical: ACE416, ENE416	2
	CHM372	Introduction to Polymer Chemistry 고분자화학개론	3-3-0	Identical: ACE351, ENE226	2
	CHM391	Instrumental Analysis 기기분석	3-3-0	Identical: ACE391, ENE322	2
	CHM401	Special Topics in Chemistry Ⅰ 화학특론 Ⅰ	3-3-0		-
	CHM402	Special Topics in Chemistry Ⅱ 화학특론 Ⅱ	3-3-0		-
	CHM403	Special Topics in Chemistry Ⅲ 화학특론 Ⅲ	3-3-0		-
	CHM421	Introduction to Chemical Biology 화학생물학개론	3-3-0		2
	CHM422	Introduction to Supramolecular Chemistry 초분자화학개론	3-3-0		1
	CHM431	Introduction to Molecular Spectroscopy 기초분자분광학	3-3-0		2
	CHM433	Solid State Physical Chemistry 고체물리화학	3-3-0		-
	CHM451	Inorganic Materials Analysis 무기재료분석	3-3-0		2
	CHM452	Organometallic Chemistry 유기금속화학	3-3-0		1
	CHM453	Bioinorganic Chemistry 생무기화학	3-3-0		-
	CHM454	Solid State Chemistry 고체화학	3-3-0	Identical: ACE321, ENE313	-
	CHM455	Crystallography 결정학	3-3-0		2
	CHM471	Block Copolymers 블록 코폴리머	3-3-0		1
	CHM473	Nanomaterials Chemistry 나노재료화학	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
PHY	PHY201	Classical Mechanics 고전역학	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY203	Electromagnetism Ⅰ 전자기학 Ⅰ	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY204	Electromagnetism Ⅱ 전자기학 Ⅱ	3-3-0	Prerequisite: PHY203	2
	PHY301	Quantum Physics Ⅰ 양자물리학 Ⅰ	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY302	Quantum Physics Ⅱ 양자물리학 Ⅱ	3-3-0	Prerequisite: PHY301	2
	PHY303	Thermal and Statistical Physics 열 및 통계물리학	3-3-0	Prerequisite: PHY101, PHY103	2
	PHY311	Computational Physics 전산물리학	3-3-0		1
	PHY313	Mathematical Physics 수리물리학	3-3-0	Prerequisite: PHY201, PHY203	1
	PHY321	Optics 광학	3-3-0	Prerequisite: PHY204	2
	PHY425	Atomic and Molecular Physics 원자 및 분자물리학	3-3-0		-
	PHY435	Biological Physics 생물물리학	3-3-0		1
MTH	MTH251	Mathematical Analysis Ⅰ 해석학 Ⅰ	3-3-0		1
	MTH313	Complex Analysis Ⅰ 복소해석학 Ⅰ	3-3-0		1
	MTH420	Fourier Analysis 푸리에 해석학	3-3-0		2
ENE	ENE312	Electrochemistry 전기화학	3-3-0	Identical: ACE312	2
ACE	ACE312	Electrochemistry 전기화학	3-3-0	Identical: ENE312	1
		Total Credit	**126**		

□ Mathematical Sciences (MTH)

※ For only 1st track students, up to 6 credits can be taken from outside mathematical sciences.

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MTH	MTH251	Mathematical Analysis Ⅰ 해석학 Ⅰ	3-3-0		1
	MTH302	Modern Algebra Ⅰ 현대대수학 Ⅰ	3-3-0		1
	MTH313	Complex Analysis Ⅰ 복소해석학 Ⅰ	3-3-0		1
	MTH351	General Topology 위상수학	3-3-0		2
Total Credit			12		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MTH	MTH204	Linear Algebra 선형대수학	3-3-0	Prerequisite: MTH203	2
	MTH252	Mathematical Analysis Ⅱ 해석학 Ⅱ	3-3-0	Prerequisite: MTH251	2
	MTH315	Ordinary Differential Equations 상미분방정식론	3-3-0	Prerequisite: MTH201	2
	MTH321	Numerical Analysis 수치해석학	3-3-0		2
	MTH342	Probability 확률론	3-3-0		2
	MTH413	Differential Geometry Ⅰ 미분기하학 Ⅰ	3-3-0		1
	MTH421	Introduction to Partial Differential Equations 편미분방정식개론	3-3-0	Prerequisite: MTH201	1
Total Credit			21		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MTH	MTH230	Set Theory 집합론	3-3-0		1
	MTH260	Elementary Number Theory 정수론	3-3-0		2
	MTH271	Methods of Applied Mathematics 응용수학방법론	3-3-0		-
	MTH281	Discrete Mathematics 이산수학	3-3-0		-
	MTH303	Modern Algebra II 현대대수학 II	3-3-0	Prerequisite: MTH302	2
	MTH314	Complex Analysis II 복소해석학 II	3-3-0		2
	MTH330	Introduction to Geometry 기하학 개론	3-3-0		-
	MTH333	Scientific Computing 과학계산	3-3-0		-
	MTH343	Financial Mathematics 금융수학	3-3-0		1
	MTH344	Mathematical Statistics 수리통계학	3-3-0		-
	MTH361	Mathematical Modeling and Applications 수리모형방법론	3-3-0		1
	MTH412	Dynamical Systems 동적 시스템	3-3-0		1
	MTH414	Differential Geometry II 미분기하학 II	3-3-0	Prerequisite: MTH413	-
	MTH420	Fourier Analysis 푸리에 해석학	3-3-0		2
	MTH432	Algebraic Topology 대수위상	3-3-0		-
	MTH461	Stochastic Processes 확률과정론	3-3-0		-
	MTH480	Topics in Mathematics I 수학 특강 I	3-3-0		-
	MTH481	Topics in Mathematics II 수학 특강 II	3-3-0		-
PHY	PHY201	Classical Mechanics 고전역학	3-3-0	Prerequisite: PHY101, PHY103	1
	PHY313	Mathematical Physics 수리물리학	3-3-0	Prerequisite: PHY201, PHY203	1
	PHY437	Nonlinear Dynamics 비선형동역학	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MAE	MEN220	Fluid Mechanics 유체역학	3-3-0		2
	MEN301	Numerical Analysis 수치해석	3-3-0		2
	MEN302	Introduction to Finite Element Method 유한요소법개론	3-3-0	Prerequisite: MEN230	2
CSE	CSE232	Discrete Mathematics 이산수학	3-3-0		1,2
	CSE463	Machine Learning 기계 학습	3-3-0	Prerequisite: EE211, CSE331	2
FIA	FIA401	Financial Engineering 금융공학	3-3-0	Prerequisite: MGT207 Identical: MGE411	2
MGE	MGE201	Operations Research Ⅰ 계량경영학 Ⅰ	3-3-0	Identical: MGT363	2
	MGE312	Quantitative Risk Management 정량적 리스크 관리	3-3-0	Prerequisite: MGT207 Identical: FIA404	2
	MGE412	Advanced Quantitative Finance 고급계량재무론	3-3-0	Prerequisite: MGE311 or MTH343	-
Total Credit			90		

4. History of Courses Change of 2017-2018

Category	2017		2018
PHY	PHY312 (Elective) Mathematical Physics Ⅱ 수리물리학 Ⅱ	⇨	<Closed> Substitution Course: PHY439
CHEM	<Closed>	⇨	CHM455 (Elective) Crystallography 결정학
	CHM422 (Elective) Supramolecular Chemistry 초분자화학	⇨	CHM422 (Elective) Introduction to Supramolecular Chemistry 초분자화학개론

5. Course Descriptions

□ Physics (PHY)

PHY201 Classical Mechanics [고전역학]

This course covers various aspects of the Newtonian mechanics, including kinematics, angular motion, gravity, collision, and oscillations. Elementary description of fluid and rigid bodies can be discussed. The course in part aims at training students with mathematical techniques for physics study. Variational principles and formulations of Lagrangians and Hamiltonians are introduced, and its connection to quantum mechanics and relativity is discussed.

PHY203 Electromagnetism I [전자기학 I]

This course is the first half of one-year electromagnetism course. It deals with basic electro- and magnetostatic phenomena and the related theories using vector calculus, such as Coulomb and Ampere law, electric and magnetic fields and their boundary conditions at the interface of different media. It also covers the fundamental aspects of dielectric and magnetic materials, and electromagnetic induction.

PHY204 Electromagnetism II [전자기학 II]

This course is the second half of the one-year electromagnetism course. The subjects covered are theories related to time-varying electromagnetic waves such as Maxwell's equations, wave equation, reflection and refraction of electromagnetic waves at the boundary of dielectric materials. Transmissions of electromagnetic waves in guided structures are discussed. Gauge transformations, special relativity, and radiation of electromagnetic fields are also introduced.

PHY207 Physics Lab I [물리학실험 I]

This course provides hands-on experience on the experimental physics. The purpose of the course is to deepen basic physical concepts by means of measurement and observation of physical phenomena.

PHY213 Modern Physics [현대물리학]

This course provides an overview of the two pillars of modern physics: special/general theory of relativity and quantum theory of light and matter. It is intended to bridge between General Physics (PHY101) and higher undergraduate physics courses, featuring logical connection between classical mechanics and electromagnetism to their modern counterparts. The key concepts to be covered include Lorentz transformation, equivalence principle, wave-particle duality, Planck's law of electromagnetic radiation, Schrödinger equation, uncertainty principle, electronic band structure, LASER, and so forth. Special emphasis will be placed on the close interplay between fundamental physics and technological applications.

PHY301 Quantum Physics I [양자물리학 I]

This course is the first half of one-year quantum mechanics course. It covers the experimental basis of quantum mechanics and its general formalism such as wave mechanics, Schrodinger equation, uncertainty principle, and Hilbert space. Students also learn about harmonic oscillator, angular momentum, spin, time-independent perturbation theory, and hydrogen atom.

PHY302 Quantum Physics II [양자물리 II]

This course is the second half of one-year quantum mechanics course. It deals with variational and WKB methods, He atom, charged particles in magnetic field, time-dependent perturbation theory, scattering, and Dirac equation, which are the key quantum mechanical phenomena in modern physics.

PHY303 Thermal and Statistical Physics [열 및 통계물리학]

This course is intended to provide science/engineering majors with the basic concepts of equilibrium thermodynamics as an analytical tool. The course will cover the fundamental laws of thermodynamics in relation to the free energy and phase transition with particular emphasis on the modern statistical interpretation of classical thermodynamic concepts. Applications in condensed matter and biophysical systems will provide a starting point for advanced studies in statistical physics and interdisciplinary research.

PHY307 Physics Lab II [물리학실험 II]

This course provides hands-on experience on the experimental physics. Students will learn advanced experiments which led to development of modern physics. The experimental set-ups are from a variety of physics fields such as optics, astrophysics, condensed matter physics and beam physics, etc, which basically cover modern physics. The course will deepen students' understanding of physical concepts and its applications.

PHY311 Computational Physics [전산물리학]

Computational physics is the study and implementation of numerical algorithms to solve problems in physics for which a quantitative theory is available. This course will start from the introduction of basic computational tools, and such tools will be used to develop computational analysis of a few sample problems including solutions of partial differential equations, Monte-Carlo simulations, molecular dynamics simulations, Fourier transforms, etc.

PHY313 Mathematical Physics [수리물리학]

The main objective of this course is to provide students with a repertoire of mathematical methods which are essential to the solution of problems encountered in the fields of Physics and Applied Physics. The contents will include probability and statistics, calculus of variations, partial differential equations, integral transforms, functions of complex variables. The student will demonstrate understanding of the methods by solving problems assigned as homeworks and given on the written examinations.

PHY315 Solid State Physics I [고체물리학 I]

This course is the first half of one-year introductory course to solid state physics course. This course covers crystal structure, lattice vibration, free electron theory in metals, the quantum electron theory and the concept of band theory, and electron transport in metal/semiconductor/insulator.

PHY321 Optics [광학]

This course provides undergraduate level topics in modern optics advanced from the basic knowledge of electromagnetic wave. This course begins with classical geometrical optics including ray-tracing, aberration, lens, mirros, and so on and then covers wave optics reviewing basic electrodynamics and including topics such as polarization, interference, wave guiding, Fresnel and Fraunhofer diffraction, and so on. Some topics in instrumentation and experiments are covered as well.

PHY333 Introduction to Astrophysics : Stars and Blackholes [천체물리학 : 항성과 블랙홀]

In astrophysics, observed astronomical phenomena are described with physics of various fields. This course introduces in topical fashion astrophysics of astronomical phenomena such as formation, evolution and structure of stars, and properties of compact objects such as white dwarfs, neutron stars and black holes.

PHY334 Introduction to Astrophysics : Galaxies and the Universe [천체물리학 : 은하와 우주]

In astrophysics, observed astronomical phenomena are described with physics of various fields. This course introduces in topical fashion astrophysics of astronomical phenomena such as nature and origin of galaxies, the large scale structure of the universe, and cosmology.

PHY336 Physical Models of Life [생명현상의 물리학적 모형]

This course aims to provide a strong quantitative background for the research in biological systems in a wide spectrum of spatiotemporal scales. It is also designed to provide physicists with inspiring biological contexts for their own fundamental physics research. From the molecular mechanism of gene expression to neuronal electrophysiology to population genetics, exemplary modeling approaches will be given in an effort to convey penetrating physico-chemical concepts and mathematical methods. No prerequisite is required but basic knowledge in calculus and linear algebra would suffice.

PHY407 Semiconductor and Precision Measurement Physics [반도체 및 계측 물리학]

This course is designed to provide an introduction to the electronics and measurement techniques used for various experiments in scientific and engineering fields. The topics covered include basics on electronics network theory, passive circuits, semiconductor diodes and transistors, operational amplifiers, and computer data acquisitions. Several essential elements for ultra-low noise electrical measurements including signal averaging, synchronous and lock-in detection, single electron transistors, SQUID sensors, etc. are also discussed.

PHY415 Solid State Physics II [고체물리학 II]

This course is the second of one-year introductory course to solid state physics course. This course covers ordered and disordered states, such as ferroelectricity, magnetism, point defect, interface physics and dislocation, in the solid.

PHY418 Polymer and Soft Matter Physics [고분자 및 연성물질 물리학]

Soft matter, often called complex fluids, is a group of materials which have structures much larger than atomic or molecular scale, and they are easily deformed by thermal stresses or fluctuations. Colloids, polymers, surfactants, emulsions, foams, gels, granular materials, and a number of biological materials are examples of soft matter. In this course, students will learn the general macroscopic physical properties of soft matters and their microscopic origins. The universal static and dynamic properties of polymers and their statistical mechanical analysis will be one of the major topics.

PHY425 Atomic and Molecular Physics [원자 분자 물리학]

This course starts with the most direct and concrete application of quantum mechanics to a realistic system. It covers electronic structure, electronic transitions, and excited states of hydrogenic and multi-electron atoms. Bond mechanisms between atoms, such as ionic bonds and covalent bonds are introduced and placed on the foot of quantum mechanics and theories of electronic structures. Vibrational and rotational structure is treated, and some introductions to polyatomic molecules and solid structure are also discussed.

PHY427 Introduction to Plasma Physics [플라즈마 물리 입문]

This course introduces basic plasma and charged particle phenomena that cover fusion plasmas, microwave sources, accelerators, and astrophysical plasmas. It provides basic understanding of charged particle motion under various electromagnetic environments. Basic fluid dynamics, waves in plasmas, and diffusion and sheaths are described. Plasma diagnostics and fusion plasmas are also introduced.

PHY428 Introduction to Beam Physics [빔 물리학 입문]

This course introduces the theory and application of charged particle beams that cover microwave sources, particle accelerators, and laser-plasma interactions. It provides basic understanding of charged particle motions under various electromagnetic environments such as magnets, RF cavities, and plasmas. Transverse beam optics, acceleration and longitudinal motion, collective description of beam distributions, and interaction between the beam and the EM fields are reviewed within the context of classical physics. Advanced concepts for beam generation and acceleration, and high frequency EM wave generation are also introduced.

PHY429 Nuclear & Elementary Particle Physics [핵 및 입자물리학]

This course covers introductory topics of nuclear and particle physics at the undergraduate level. The topics of nuclear physics include scattering theory, structure of nuclei, nuclear models, nuclear reactions, and so on. Particle physics deals with more fundamental particles that constitute nuclei and the primary topic of particle physics is so called standard model that includes fundamental particles such as quarks and leptons and fundamental interactions among those particles such as electro-weak and strong interactions (QED: quantum electrodynamics and QCD: quantum chromodynamics, respectively). The particle physics part of this course covers the basics of the standard model.

PHY431 General Relativity and Cosmology [일반상대론 및 우주론]

This course begins with a brief review of special relativity as a basis for general relativity and covers basic mathematical tools for general relativity such as tensor algebra and introductory differential geometry. Then, basic formalism of general relativity is developed. Modern cosmology is based upon general relativity and so recent observations and theoretical developments of modern cosmology are introduced based upon general relativity. Some astrophysical topics such as gravitational waves and blackholes are also covered.

PHY435 Biological Physics [생물물리학]

This course outlines the physical aspects of life phenomena ranging from the population genetics down to the molecular biology. Students will be introduced to the theoretical and experimental tools based on the fundamental notions of electrostatics and statistical mechanics. Key chapters include random walks, diffusion, structure and dynamics of macromolecules, cellular information processing, and other selected topics. Throughout the chapters, students will learn how those methodologies have been successfully applied to solve variety of biological problems and thus critically assess the power and limitations of modern tools for biophysics research. Acquaintance with basic biological concepts will be helpful but not required.

PHY437 Nonlinear Dynamics [비선형동역학]

This is an introductory course for the nonlinear dynamics and chaos. This course stresses analytical methods, concrete examples and geometric intuition. The theory is developed systematically, starting with first-order differential equations and their bifurcations, followed by phase plane analysis, limit cycles and their bifurcations, and culminating with the Lorenz equations, chaos, iterated maps, period doubling, renormalization, fractals, and strange attractors. The course will also cover some applications of nonlinear dynamics, such as mechanical vibrations, lasers, biological rhythms, superconducting circuits, insect outbreaks, chemical oscillators, genetic control systems, chaotic waterwheels, and even a technique for using chaos to send secret messages.

PHY439 Introduction to Modern Theoretical Physics [현대이론물리학 입문]

This course provides an overview of modern theoretical methods developed during the 20th century. It starts from special relativity with modern tensor notation and quantum mechanics including Dirac equation and path integral formalism. After introducing classical field theory, non-relativistic and relativistic quantum fields and their canonical quantization methods are discussed. Gauge theory and Feynman diagram are covered in their elementary level.

PHY441 Fluid Physics [유체물리학]

Static and dynamic properties of fluids will be introduced with the various physical phenomena in fluid flow. Attending the course will improve the ability of the students in understanding and applying the physical properties of flow by introducing many examples which we can see in everyday life.

PHY471~3 Special Topics in PHY I ~ III [물리학특강 I ~ III]

This course introduces new research topics in the field of Physics.

□ Chemistry (CHEM)

CHM201 Organic Chemistry Lab [유기화학실험]

This is a lab session of 2nd year organic chemistry courses, which covers basic organic transformations, purifications, and characterisations of organic compounds. The lab sessions provide basic knowledge and skills for simple reactions in organic chemistry. Safety will be a high priority.

CHM211 Organic Chemistry I [유기화학 I]

This class is an introduction to the classification, structure, and reaction mechanism of organic compounds. The class is set up so that, upon completion, students will understand the different characteristics of organic compounds, including their classification, structure, nomenclature, reaction mechanisms, and synthesis.

CHM212 Organic Chemistry II [유기화학 II]

This is a continuation of lectures in a two-semester organic chemistry course that is being offered to introduce students to the comprehensive principles of organic chemistry and to communicate the excitement of scientific discovery. The basic objective of Organic Chemistry 2 is to continue to lay a solid organic chemistry foundation for further studies in chemistry and related fields.

CHM231 Physical Chemistry I [물리화학 I]

This essential course is for undergraduate students who are interested in chemistry and chemistry-related fields. The course is designed to build basic physical concepts for fundamental understanding of equilibria in chemistry. Equilibria include physical change, such as fusion and vaporisation, and chemical change including electrochemistry. The details cover classical thermodynamics, particularly in terms of enthalpy and entropy. The students are expected to obtain a unified view of equilibrium and the direction of spontaneous change under the chemical potentials of bulk substances.

CHM232 Physical Chemistry II [물리화학 II]

A series of lectures on quantum chemistry is provided in this course. In the introductory part, lectures introduce the history of quantum mechanics including blackbody radiation, Planck's hypothesis, and Schrodinger equation. Basic concepts required for understanding quantum chemistry, such as discontinuity of energy states, wave function, and uncertainty principle are covered in the beginning of the course. Principles and applications of various spectroscopic techniques incorporating electronic, vibrational, rotational, and Raman spectroscopy are described in the following lectures.

CHM291 Analytical Chemistry I [분석화학 I]

The main purpose of the course is to provide students with a strong theoretical and practical grounding in the principles and practices of analytical chemistry, including classical and instrumental analytical techniques. This introductory course also covers the principles of spectrophotometry and mass spectrometry.

CHM301 Inorganic Chemistry Lab [무기화학실험]

This is a lab session of 3rd year inorganic chemistry courses, which covers basic synthetic techniques, and characterisations of inorganic compounds. The lab sessions provide basic knowledge and skills for simple reactions in inorganic chemistry.

CHM302 Physical/Analytical Chemistry Lab [물리분석화학실험]

This experimental course is designed to provide students a chance to experience up-to-date experimental physical chemistry instruments and experimentation as well as state-of-the art analytical instruments to characterise organic, inorganic, and biological molecules and materials.

CHM311 Synthetic Organic Chemistry [합성유기화학]

This course covers topics on the structure and reactivity of organic molecules with an emphasis on reaction mechanisms. Students will be introduced frontier molecular orbital theory and pericyclic reactions including Diels-Alder reaction, sigmatropic rearrangement, and elecrocyclization. Also, reactivity of various functional groups and stereochemistry of reactions will be discussed. This course recommends prerequisites of Organic Chemistry 1 and 2.

CHM313 Fundamentals of Energy Materials [에너지재료개론]

This course offers basic understandings and applications of the energy materials related to energy conversion and storage using organic and inorganic materials. It covers the roles of bonding defining the fundamental types of energy materials and structural defects, kinetics, and expands to in-depth understanding of electronic, magnetic materials, and metals and ceramics, glasses and polymers. Finally, this course focuses on the material selection and design for the solar cells, fuel cell, and batteries.

CHM321 Biochemistry I [생화학 I]

Our body is composed of various biological polymers such as protein, nucleic acid, lipid and glycan. These bio-polymers are composed of many monomer molecules such as amino acids, bases, fatty acids, and various sugar molecules. In this course of Biochemistry 1, students will learn basic biosynthetic mechanism of biopolymers by biological machinery. Biological polymers' structure and cellular functions will be discussed in this course, too. Because key mechanisms in this lecture will be discussed with organic chemistry terms, students are expected to have 2nd-year level knowledge of organic chemistry 1 and 2.

CHM322 Biochemistry II [생화학 II]

The second part of lecture covers signalling and metabolism of biological systems. Biosynthesis of carbohydrate, proteins, and DNAs will also be discussed. Recent advances in the convergence of biomolecules and nanotechnology will also be introduced.

CHM323 Medicinal Chemistry [의약화학]

This course covers structures and functions of drug targets including proteins, DNA, and RNA, and their interactions with small organic molecules. These interactions between macromolecules and small molecules serve as the basis for inhibition/activation of their biological functions. Students will also learn the concepts in phamacokinetics, pharmacodynamics, and drug metabolism. The basic processes involved in drug discovery from hit identification to clinical candidates will be covered with case studies on examples of life saving drugs. This course recommends prerequisites of organic chemistry and biochemistry.

CHM324 Spectroscopy in Organic Chemistry [유기분광학]

This course will provide the students with a fundamental understanding of the theory and practice of common spectroscopic techniques (NMR, IR, UV-vis, and MS) used in the identification of organic compounds. Special emphasis will be given in the application and interpretation of these analytical spectra. Students are expected to have taken ‘Organic Chemistry I’ and ‘Organic Chemistry II’.

CHM333 Physical Chemistry III [물리화학 III]

Statistical thermodynamics and kinetic theory are the two main topic s of the course. Derivation of the Boltzmann distribution is introduced in the beginning and followed by lectures on basic concepts of statistical thermodynamics such as ensemble, partition function and entropy. In the second half of the course, basic kinetic theory including reaction rate, collision, diffusion, and activated complex theory (Eyring equation) are covered.

CHM335 Quantum Chemistry [양자화학]

Chemistry is defined as “a science that deals with the composition, structure, and properties of substances and with the transformations that they undergo” (Merriam Webster Dictionary). This course will introduce molecular structure and the important spectroscopic and spectrometric tools for structure analysis of small and large molecules. The kinetics of chemical and physical transformations, as relevant to chemistry and biology, will be covered in the second part of the course. Modern experiments will be discussed to show capabilities and limits of current spectroscopic technologies.

CHM336 Chemical Thermodynamics [화학열역학]

Thermodynamics enables us to find an equilibrium phase of materials and to study its physical and chemical properties. This course is intended to study phase equilibria of various systems such as gases and condensed materials involving surfaces. Mainly focusing on practical problems, it can help develop one's confidence and ability to apply thermodynamics in novel situations.

CHM337 Computational Chemistry [전산화학]

Computational chemistry plays a very important role in chemical researches since it provides in-depth understanding of mysterious chemical properties of molecular systems. This course offersa basic understanding of the role of computational chemistry. Based on physical/chemical principles including quantum mechanics and classical mechanics, this course covers how to calculate electronic structures, spectroscopic properties, thermal properties, and chemical reactions in molecular systems, solid state systems, and biological systems with molecular modeling by using computers.

CHM351 Inorganic Chemistry I [무기화학 I]

The course is designed for undergraduate students who plan to major in chemistry and materials science and engineering. The objective of this course is to understand basic principles of modern inorganic chemistry. Topics covered in this course include atomic and molecular structures, molecular shape and symmetry, structure of solids, acid-base, oxidation-reduction, and molecular bonding.

CHM352 Inorganic Chemistry II [무기화학 II]

Electronics structures, spectroscopic and magnetic properties of the coordination compounds will be discussed based on the crystal field theory and molecular orbital theory. In addition to the reactions and properties of the coordination compounds, and the catalytic properties of the organometallic compounds also will be discussed.

CHM371 Introduction to Nanochemistry [나노화학개론]

This course is intended primarily as an introduction course to nano chemistry for undergraduate students. The objective is to understand basic concepts of nanoscience and nanotechnology from a chemical perspective and introduce general synthesis principles, characterization techniques, and potential technological applications of nanostructured materials. Such issues will be discussed in terms of presently important nano materials, including silica, magnetic, semiconducting, and carbon nanostructures.

CHM372 Introduction to Polymer Chemistry [고분자화학개론]

This course is designed for undergraduate students who are interested in synthetic and physical chemistry of molecules of high molecular weight. This introductory course covers basic concepts of polymer such as molecular weights and their distribution, synthetic chemistry of various polymerisations, behaviour of polymers in solution and bulk, and physical properties of synthetic macromolecules. Recent developments in synthetic chemistry, a convergence of synthetic and biopolymers, and the fascinating world of applications of polymers will also be introduced. Students are expected to have second-year level knowledge of organic and physical chemistry.

CHM391 Instrumental Analysis [기기분석]

This course introduces the principles of analytical instruments which are essential for the characterisation of various compounds and materials. The course provides students with the opportunity to learn how to operate them in laboratories. This course deals with many instruments for spectroscopic analysis (NMR, IR, UV-Vis, Raman), x-ray analysis (XRD, XRF), surface analysis (AFM, XPS, SIMS), thermal analysis (DSC, TGA), mass spectrometry, and electron microscopy.

CHM421 Introduction to Chemical Biology [화학생물학개론]

Chemical biology can be defined as a biological study with chemical approaches. In recent two decades, chemical biology has been expanded to make lots of fascinating discoveries in biological field and some approaches of chemical biology have been essential tools in some biological research field. In this course, we will learn and discuss about concepts, mechanisms and applications of newly developed chemical tools in chemical biology field from current chemical biology research topics such as biological surrogates for glyco-and lipid biology, total protein synthesis, unnatural amino acid polymerisation, biomimetic synthetic enzymes, acitivity-based proteomics, affinity-based inhibitor, protein tagging tools, fluorescent chemical probes. Students are expected to have third year level knowledge of organic chemistry, biochemistry, and cellular biology.

CHM422 Introduction to Supramolecular Chemistry [초분자화학개론]

Supramolecular chemistry involves the use of non covalent bonding interactions to self-assemble molecules into thermodynamically stable and well-defined structures. The course explores the field of supramolecular chemistry from molecules to nano materials. This course will provide students with an introduction to recent interesting research. The topics tp be covered include the types of non-covalent bonding, molecular recognition, the role of molecular recognition in biological systems, synthesis of new materials through supramolecular chemistry, applications for new nano materials. Students will be introduced to essential background concepts such as types of non covalent bonding and strategies for the design of supramolecular assemblies.

CHM431 Introduction to Molecular Spectroscopy [기초분자분광학]

This course is designed for undergraduate students who are interested in spectroscopy and experimental physical chemistry. In addition to basic concepts of spectroscopy, this advanced course covers cutting edge spectroscopy which is still under development such as 2D IR, optical force, correlated rotational alignment spectroscopy, and time-resolved electron microscopy and spectroscopy. Students are expected to have second-year levels knowledge of physical and quantum chemistry and spectroscopy.

CHM433 Solid State Physical Chemistry [고체물리화학]

Technologically important nanomaterials are hardly described by molecular theories. A theory dealing with extended systems is necessary to describe their electronic and structural properties. This course introduces basic knowledge of condensed matter physics to help understand the chemical properties. The main topics to be covered briefly are the lattice energy, band theory, optical properties, electron transport, and so on.

CHM451 Inorganic Materials Analysis [무기재료분석]

This course covers the principles of analytical instruments which are needed in the characterisation of organic and inorganic materials, and provides students with the opportunity to learn how to operate them in laboratories. This course deals with many instruments for spectroscopic analysis, x-ray analysis, surface analysis, thermal analysis, mass spectrometry, and electron microscopy.

CHM452 Organometallic Chemsitry [유기금속화학]

The focus of this course is on the synthesis, structure and bonding, properties and reactivity of main group organometallics (including Grignard reagents, organolithium reagents, organophosphorus compounds, etc), organotransition metal chemistry and organometallic catalysis. The course is of particular relevance for students interested in synthetic chemistry.

CHM453 Bioinorganic Chemistry [생무기화학]

This course covers fundamental principles of inorganic chemistry in the context of the role of metals in biological systems. Special emphasis is put on the role of metals in biological systems, and the connection between fundamental knowledge of biological processes with respect to metals, and their relation to commonly known phenomena such as diseases, pollution, alternative energies, evolution and industrial processes.

CHM454 Solid State Chemistry [고체화학]

This course focuses on the basic principles of solid state chemistry. Structural, chemical, and physical aspects of inorganic solids, such as ionic solids, metal, and molecular solids, will be discussed. The course explores the relationship between electronic structure, chemical bonding, and atomic order. It also investigates the characterization of atomic arrangements in crystalline and amorphous solids: metal, ceramics, semiconductors, and polymers. Topics include: symmetry, basic crystallography, crystal structure, bonding in solids, characterization technique (X-ray diffraction, microscopy, and spectroscopy) and crystal defects.

CHM455 Crytallography [결정학]

This course focuses on the basic principles of solid state chemistry. Structural, chemical, and physical aspects of inorganic solids, such as ionic solids, metal, and molecular solids, will be discussed. The course explores the relationship between electronic structure, chemical bonding, and atomic order. It also investigates the characterization of atomic arrangements in crystalline and amorphous solids:

metals, ceramics, semiconductors, and polymers. Topics include: symmetry, basic crystallography, crystal structure, bonding in solids, characterization techniques (X-ray diffraction, microscopy, and spectroscopy) and crystal defects.

CHM471 Block Copolymers [블록 코폴리머]

Block copolymers are increasingly attracting interest as well-defined architectural polymers. This course delivers fundamentals of synthetic and physical chemistry of block copolymers. Topics to be discusses involves modern controlled polymerisation techniques, phase behaviour of block copolymers, solution physical chemistry, and structure-function relationships. Application of block copolymers to biomedical sciences, pharmaceutics, and nano sciences will also be discussed.

CHM473 Nanomaterials Chemistry [나노재료화학]

This course introduces basic concepts of nanomaterials and nanochemistry and applications of basic concepts to modern materials for electronics, catalysis, and optics. Inorganic chemistry for synthesis and characterization of 2-D materials will also be covered.

CHM401~3 Special Topics in Chemisty I~III [화학특론 I~III]

In recent years nanoscience and nanotechnology have grown rapidly. Chemical science, in particular, presents a unique approach to building novel materials and devices with a molecular-scale precision. One can envision the advantages of nanoscale materials and devices in medicine, computing, scientific exploration, and electronics, where nanochemical science offers the promise of building objects atom by atom. This course reviews current developments in chemical science.

□ Mathematical Sciences (MTH)

MTH204 Linear Algebra [선형대수학]

More abstract treatment of linear algebra than Linear Algebra (MTH103). Tools such as matrices, vector spaces and linear transformations, bases and coordinates, eigenvalues and eigenvectors and their applications. Characteristic and minimal polynomial. Similarity transformations: Diagonalization and Jordan forms over arbitrary fields. Schur form and spectral theorem for normal matrices. Quadratic forms and Hermitian matrices: variational characterization of the eigenvalues, inertia theorems. Singular value decomposition, generalized inverse, projections, and applications. Positive matrices, Perron-Frobenius theorem. Markov chains and stochastic matrices. M-matrices. Structured matrices (Toeplitz, Hankel, Hessenberg). Matrices and optimization.

MTH230 Set Theory [집합론]

Set-theoretical paradoxes and means of avoiding them. Sets, relations, functions, order and well-order. Proof by transfinite induction and definitions by transfinite recursion. Cardinal and ordinal numbers and their arithmetic. Construction of the real numbers. Axiom of choice and its consequences.

MTH251 Mathematical Analysis I [해석학 I]

The real number system. Set theory. Topological properties of R^n, metric spaces. Numerical sequences and series, Continuity, connectedness, compactness. Differentiation and integration.

MTH252 Mathematical Analysis II [해석학 II]

Sequences and series of functions: Uniform convergence and continuity, Power series, special functions. Functions of several variables: Partial derivatives, Inverse function theorem, Implicit function theorem, transformation of multiple integrals. Integration of Differential forms.

MTH260 Elementary Number Theory [정수론]

Divisibility, congruences, numerical functions, theory of primes. Topics selected: Diophantine analysis, continued fractions, partitions, quadratic fields, asymptotic distributions, additive problems.

MTH271 Methods of Applied Mathematics [응용수학방법론]

Concise introductions to mathematical methods for problems formulated in science and engineering. Functions of a complex variable, Fourier analysis, calculus of variations, perturbation methods, special functions, dimension analysis, tensor analysis. Introduction to numerical methods with emphasis on algorithms, applications and computer implementation issues.

MTH281 Discrete Mathematics [이산수학]

This course introduces discrete objects, such as permutations, combinations, networks, and graphs. Topics include enumeration, partially ordered sets, generating functions, graphs, trees, and algorithms.

MTH302 Modern Algebra I [현대대수학 I]

Groups, homomorphisms, automorphisms, permutation groups. Rings, ideals and quotient rings, Euclidean rings, polynomial rings. Extension fields, roots of polynomials.

MTH303 Modern Algebra II [현대대수학 II]

Further topics on groups, rings; the Sylow Theorems and their applications to group theory; classical groups; abelian groups and modules over a principal ideal domain. Algebraic field extensions; splitting fields and Galois theory; construction and classification of finite fields.

MTH313 Complex Analysis I [복소해석학 I]

Complex numbers and complex functions. The algebra of complex numbers, fractional powers, Logarithm, power, exponential and trigonometric functions. Differentiation and the Cauchy-Riemann equations. Cauchy’s theorem and the Cauchy integral formula. Singularities, residues, Taylor series and Laurent series.

MTH314 Complex Analysis II [복소해석학 II]

Conformal mapping: Fractional Linear transformations. Riemann Mapping Theorem. Analytic continuation. Harmonic functions.Some advanced topics in complex analysis.

MTH315 Ordinary Differential Equations [상미분방정식론]

Existence and uniqueness of solutions, linear systems, regular singular points. Analytic systems, autonomous systems, Sturm-Liouville Theory.

MTH321 Numerical Analysis [수치해석학]

Polynomial interpolation, Polynomial approximation, Orthogonal polynomials and Chebyshev polynomials. Least-squares approximations. Numerical differentiation and integration. Numerical methods for solving initial and boundary value problems for ODEs. Direct and iterative methods for solving linear systems. Numerical solutions of Nonlinear system of equations.

MTH330 Introduction to Geometry [기하학 개론]

A critical examination of Euclid's Elements; ruler and compass constructions; connections with Galois theory; Hilbert's axioms for geometry, theory of areas, introduction of coordinates, non-Euclidean geometry, regular solids, projective geometry.

MTH331 Scientific Computing [과학계산]

Fundamental techniques in scientific computation with an introduction to the theory and software of the topics. Monte Carlo simulation. Numerical linear algebra. Numerical methods of ordinary and partial differential equations. Fourier and wavelet transform methods. Nonlinear equations. Numerical continuation methods. Optimization. Gas and Fluid dynamics.

MTH342 Probability [확률론]

Combinatorial analysis used in computing probabilities. The axioms of probability, conditional probability and independence of events. Discrete and continuous random variables. Joint, marginal, and conditional densities and expectations, moment generating function. Laws of large numbers. Binomial, Poisson, gamma, univariate, and bivariate normal distributions. Introduction to stochastic processes.

MTH343 Financial Mathematics [금융수학]

Review of random variables, expectation, variance, covariance and correlation. Binomial distribution. Properties of Normal random variables and the central limit theorem. Time value of money, compound interest rates and present value of future payments. Interest income. The equation of value. Annuities. The general loan schedule. Net present values. Comparison of investment projects Option pricing techniques in discrete and continuous time. Black-Scholes option pricing formula.

MTH344 Mathematical Statistics [수리통계학]

Probability and combinatorial methods. Discrete and continuos univariate and multivariate distributions. Expected values, moments. Estimation. Unbiased estimation. Maximum likelihood estimation. Confidence intervals. Tests of hypotheses. Likelihood ratio test. Nonparametric methods.

MTH351 General Topology [위상수학]

Set-theoretic preliminaries. Metric spaces, topological spaces, compactness, connectedness. Countability and separation axioms. Covering spaces and homotopy groups.

MTH361 Mathematical Modeling and Applications [수리모형방법론]

Formulation and analysis of mathematical models. Applications to physics, biology, economics, social sciences and other areas of science. Use of Mathematical and scientific software packages: Mathematica, Matlab, Maple, e.t.c.

MTH412 Dynamical Systems [동적 시스템]

This course provides tools to characterize qualitative properties of linear and nonlinear dynamical systems in both continuous and discrete time. The course covers stability analysis of differential equations, Hamiltonian systems, Pointcare mapping, and Reduction methods.

MTH413 Differential Geometry I [미분기하학 I]

The differential properties of curves and surfaces. Introduction to differential manifolds and Riemannian geometry. Second fundamental form and the Gauss map. Vector fields. Minimal surfaces. Isometries. Gauss Theorem and equations of compatibility. Parallel transport, Geodesics and Gauss Bonet theorem. The Exponential map.

MTH414 Differential Geometry II [미분기하학 II]

Plane curves: rotation index, isoperimetric inequality, Fenchel's theorem. Space curves: congruence, total curvature of a knot. Submanifolds of Euclidean spaces as level sets, Gauss map. Curves on a surface, geodesics. Gauss Lemma and a proof that geodesics minimise distance locally. Isometries and conformal maps.

MTH420 Fourier Analysis [푸리에 해석학]

Introduction to harmonic analysis and Fourier analysis methods, such as Calderon-Zygmund theory, Littlewood-Paley theory, and the theory of various function spaces, in particular Sobolev spaces. Some selected applications to ergodic theory, complex analysis, and geometric measure theory will be given.

MTH421 Introduction to Partial Differential Equations [편미분방정식개론]

Waves and Diffusions. Reflections and Sources. Boundary value problems. Fourier series. Harmonic functions. Green's Identities and Green's functions. Computation of solutions. Waves in space. Boundaries in the plane and in space. General eigenvalue problems. Distributions and Transforms. Nonlinear PDEs.

MTH432 Algebraic Topology [대수위상]

Fundamental group and covering spaces, simplicial and singular homology theory with applications, cohomology theory, duality theorem. Homotopy theory, fibrations, relations between homotopy and homology, obstruction theory, and topics from spectral sequences, cohomology operations, and characteristic classes.

MTH461 Stochastic Processes [확률과정론]

Exponential Distribution and Poisson Process. Markov Chains. Limiting Behavior of Markov Chains. The main limit theorem and stationary distributions, absorption probabilities. Renewal theory and its applications. Queueing theory. Reliability theory. Brownian Motion and Stationary Processes. Martingales. Structure of a Markov process: waiting times and jumps. Kolmogorov differential equations.

MTH480 Topics in Mathematics I [수학 특강 I]

This course is designed to discuss contemporary topics in Mathematics. Actual topics and cases will be selected by the instructor and may vary from term to term.

MTH481 Topics in Mathematics II [수학 특강 II]

This course is designed to discuss contemporary topics in Mathematics. Actual topics and cases will be selected by the instructor and may vary from term to term.

School of Business Administration

1. School Introduction

The School of Business Administration educates students both in technology and management to be creative global business leaders in today's dynamic economy.
The School offers academic courses on various business areas including Technology Management, Information Systems, Finance, International Business, Marketing and Entrepreneurship.

2. Undergraduate Programs

□ Track Introduction

1) Management (MGT)

Management field aims to provide education for the leaders in a highly globalized and diversified playing field with rapid technological and social changes.
GM track manor explores an organization's design and operations; an organization's economic, legal, ethical and sociopolitical environment; how an organization interacts with its environment in a creative and efficient way.

2) Finance & Accounting (FIA)

Students in Finance & Accounting are field trained for careers in domestic and international corporations and financial institutions as well as careers in academia.
Finance allows students to study the ways in which individuals, corporations, and other business organizations allocate resources and make financial decisions in capital markets. Courses in Finance include Financial Management, Investment Analysis, Money & Banking and Financial Engineering which cover various academic areas as well as practical techniques with both broad and specific perspectives.
Accounting helps managers to create and disseminate financial accounting information to communicate effectively with investors and capital market participants, and apply managerial accounting information internally to make more efficient financial and economic decisions. Courses in Accounting include Intermediate Accounting, Managerial Accounting, and Auditing which cover the principles and practices of accounting.

3) Entrepreneurship (EPS)

Entrepreneurship is related not only to the domain of independent new ventures, but also to the long-term viability of extant firms. Organizations are required to be entrepreneurial to survive in the era of globalization in the market and dramatic technological change.

Entrepreneurship allows students to understand the role of entrepreneurship in a fast changing business environment. This track is not only focusing on the issues for the new startups, but also emphasizing the issues for the existing companies. The goal of this track is designed to provide intellectual knowledge as well as real business experience.

※ Entrants who were selected as Entrepreneurship Talent Admission in 2015 must choose EPS track as a 2nd track.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1st Track	2nd Track	
MGT	Required	21	18	
	Elective	33	-	
FIA	Required	21	12	
	Elective	33	6	
EPS[1]	Required	-	12	
	Elective	-	6	

1) Students can choose Entrepreneurship track as a 2nd track only.
※ Impossible combination of interdisciplinary double major :
School of Management Engineering - School of Business Administration
※ Those students who chose both 1st and 2nd track from School of Business Administration must take all the required courses(12 courses) from both tracks and earn 36 credits. The rest 36 credits can be earned with any courses provided from School of Business Administration.

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
MGT	MTH203	Applied Linear Algebra	1-2
	MTH211	Statistics	1-2
FIA	MTH203	Applied Linear Algebra	1-2
	MTH211	Statistics	1-2

※ Complete based on 1TR

▶ Fundamentals required to Engineering field students when they choose Business administration field tracks as 2nd track

Course Title	MGT	FIA	EPS
Statistics	✔	✔	-
Economics	✔	✔	✔

3. Curriculum ※ Course opening semester is subject to be changed according to School's situation.

□ Management (MGT)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGT	MGT202	Organizational Behavior 조직행동론	3-3-0		1,2
	MGT204	Marketing Management 마케팅 관리	3-3-0		1,2
	MGT205	Financial Accounting 재무회계	3-3-0		1,2
	MGT207	Financial Management 재무관리	3-3-0		1,2
	MGT209	Operations Management 생산운영관리	3-3-0	Identical: MGE209	1
	MGT308	Strategic Management 경영전략	3-3-0		1,2
Total Credit			18		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGT	MGT201	Dynamics of IT Dynamics of IT	3-3-0		2
Total Credit			3		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGT	MGT101	Business Communication & Leadership 비즈니스 커뮤니케이션 & 리더십	3-3-0		1,2
	MGT203	International Business 국제경영학	3-3-0		-
	MGT206	Managerial Accounting 관리회계	3-3-0	Prerequisite: MGT205	2
	MGT210	Data Analysis & Decision Making 경영통계 분석	3-3-0	Prerequisite: MTH211	1,2
	MGT211	Microeconomics 미시경제학	3-3-0	Prerequisite: MGT106	2
	MGT212	Business Communication 비즈니스 커뮤니케이션	3-3-0		-
	MGT302	Human Resource Management 인사관리	3-3-0	Prerequisite: MGT202	1
	MGT303	Strategic Human Resource Management 전략적 인적자원 관리	3-3-0		2
	MGT304	Diversity Management 인력 다양성 관리	3-3-0		-
	MGT306	Business Ethics 기업경영 윤리	3-3-0		-
	MGT307	Legal Environment of Business 경영과 법률 환경	3-3-0		-
	MGT312	Macroeconomics 거시경제학	3-3-0	Prerequisite: MGT211	1
	MGT315	Econometrics 계량경제학	3-3-0	Prerequisite: MGT211	-
	MGT316	Industrial Organization 산업조직론	3-3-0	Prerequisite: MGT211	-
	MGT317	International Economics 국제경제학	3-3-0	Prerequisite: MGT312	2
	MGT330	Consumer Behavior 소비자행동	3-3-0	Prerequisite: MGT204	2
	MGT331	International Marketing 국제마케팅	3-3-0	Prerequisite: MGT204	2
	MGT332	Brand Management 브랜드관리론	3-3-0	Prerequisite: MGT330	-
	MGT361	Technology Management 기술 경영	3-3-0		-
	MGT362	Process & Quality Management 생산과 품질 관리	3-3-0	Prerequisite: MGT209 Identical: MGE362	1
	MGT363	Operations Research 계량경영학	3-3-0	Identical: MGE201	2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGT	MGT364	Database 데이터 베이스	3-3-0		1
	MGT366	Advanced Business Programming 고급 경영 프로그래밍	3-3-0	Prerequisite: ITP108	-
	MGT371	Service Science 서비스 사이언스	3-3-0	Prerequisite: MGT209 Identical: MGE308	2
	MGT372	Internet Business and Marketing 인터넷 비즈니스	3-3-0		2
	MGT373	Strategic Management of IT 정보기술과 경영전략	3-3-0	Prerequisite: MGT308, ISM201	-
	MGT374	Mobile Business 모바일 비즈니스	3-3-0		-
	MGT410	Special Topics in MGT Ⅰ MGT 특론 Ⅰ	3-3-0		-
	MGT411	Special Topics in MGT Ⅱ MGT 특론 Ⅱ	3-3-0		-
	MGT412	Special Topics in MGT Ⅲ MGT 특론 Ⅲ	3-3-0		-
	MGT413	Game Theory 게임 이론	3-3-0	Prerequisite: MGT211	-
	MGT414	Special Topics in MGT Ⅳ MGT 특론 Ⅳ	3-3-0		-
	MGT432	Marketing Research 마케팅 조사론	3-3-0	Prerequisite: MTH211, MGT204	2
	MGT433	Advertising Management 광고 관리론	3-3-0	Prerequisite: MGT204	-
	MGT434	Experimental Design with Applications in Marketing 마케팅실험설계	3-3-0	Prerequisite: MGT330	-
	MGT435	Case Studies in Marketing 마케팅사례연구	3-3-0		-
	MGT441	Global Business Strategy 글로벌경영전략	3-3-0		-
	MGT442	Case Studies in International Business 국제경영사례연구	3-3-0		-
	MGT463	Simulation 시뮬레이션	3-3-0	Prerequisite: MTH211	-
	MGT464	Stochastic Modeling & Applications 추계적 모델링 및 응용	3-3-0	Prerequisite: MTH211	-
	MGT465	System Analysis and Design 경영정보시스템분석 및 설계	3-3-0		-
	MGT471	Managing Innovation and Change 혁신과 변화의 관리	3-3-0		1
	MGT473	Entrepreneurship and Venture Management 창업과 벤처	3-3-0		1
	MGT474	Social Entrepreneurship 사회적 기업의 창업	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGT	MGT491	Independent Study 개별연구	3-3-0		-
	MGT492	Capstone Projects Ⅰ 캡스톤 디자인 Ⅰ	3-3-0		-
	MGT493	Capstone Projects Ⅱ 캡스톤 디자인 Ⅱ	3-3-0		-
FIA	FIA304	International Finance 국제재무관리	3-3-0	Prerequisite: MGT207	2
MTH	MTH342	Probability 확률론	3-3-0		2
	MTH343	Financial Mathematics 금융수학	3-3-0		1
	MTH461	Stochastic Processes 확률과정론	3-3-0		-
MGE	MGE303	Data Mining 데이터 마이닝	3-3-0		1
	MGE311	Quantitative Finance 계량재무론	3-3-0		1
	MGE405	Applied Programming for Management Engineering 경영공학프로그래밍	3-3-0	Prerequisite: ITP107	2
	MGE414	Time-series Analysis 시계열 분석	3-3-0		-
Total Credit			165		

□ Finance & Accounting (FIA)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
FIA	FIA301	Investments 투자론	3-3-0	Prerequisite: MTH211 Identical: MGE205	1,2
MGT	MGT205	Financial Accounting 재무회계	3-3-0		1,2
	MGT207	Financial Management 재무관리	3-3-0		1,2
	MGT211	Microeconomics 미시경제학	3-3-0	Prerequisite: MGT106	2
Total Credit			12		

▶ Required : 1TR / Elective : 2TR

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
FIA	FIA305	Corporate Finance 기업재무론	3-3-0	Prerequisite: MGT207	1
MGT	MGT206	Managerial Accounting 관리회계	3-3-0	Prerequisite: MGT205	2
	MGT312	Macroeconomics 거시경제학	3-3-0	Prerequisite: MGT211	1
Total Credit			9		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
FIA	FIA302	Money and Banking 금융시장론	3-3-0	Prerequisite: MGT207	-
	FIA303	Futures and Option 선물과 옵션	3-3-0	Prerequisite: MGT207 Identical: MGE306	2
	FIA304	International Finance 국제재무관리	3-3-0	Prerequisite: MGT207	2
	FIA321	Intermediate Accounting 1 중급회계 1	3-3-0	Prerequisite: MGT205	1
	FIA322	Intermediate Accounting 2 중급회계 2	3-3-0	Prerequisite: MGT205	2
	FIA401	Financial Engineering 금융공학	3-3-0	Prerequisite: MGT207 Identical: MGE411	2
	FIA402	Fixed Income Securities 채권투자	3-3-0	Prerequisite: MGT207	-
	FIA403	Derivatives Market 파생상품시장	3-3-0	Prerequisite: MGT207	-
	FIA404	Risk Management 리스크관리	3-3-0	Prerequisite: MGT207 Identical: MGE312	2
	FIA405	Corporate Valuation 기업가치평가	3-3-0	Prerequisite: MGT205, MGT207	-
	FIA407	Case Studies in Finance 재무사례연구	3-3-0	Prerequisite: MGT207	-
	FIA410	Special Topics in Finance I 재무특론 I	3-3-0		-
	FIA411	Special Topics in Finance II 재무특론 II	3-3-0		-
	FIA412	Special Topics in Accounting I 회계특론 I	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
FIA	FIA413	Special Topics in Accounting II 회계특론 II	3-3-0		-
	FIA414	Applied Investment Management 투자실무	3-3-0	Prerequisite: FIA301	-
	FIA415	Mergers and Acquisitions 기업 인수합병론	3-3-0	Prerequisite: MGT207	2
	FIA416	Corporate Governance 기업 지배구조론	3-3-0	Prerequisite: MGT207	-
	FIA417	Financial Markets and Trading 증권시장론	3-3-0	Prerequisite: MGT207	1
	FIA418	Venture Finance 벤처 파이낸스	3-3-0	Prerequisite: MGT207	1
	FIA421	Commercial Law 상법총론	3-3-0		-
	FIA441	Financial Statement Analysis 재무제표분석	3-3-0	Prerequisite: MGT205	-
	FIA442	Taxation 세무회계	3-3-0	Prerequisite: MGT205	1
	FIA443	Strategic Cost Management 원가관리전략	3-3-0	Prerequisite: MGT206	-
	FIA445	Auditing 감사학개론	3-3-0	Prerequisite: MGT205	-
	FIA492	Capstone Projects I 캡스톤 디자인 I	3-3-0		-
	FIA493	Capstone Projects II 캡스톤 디자인 II	3-3-0		-
MGT	MGT101	Business Communication & Leadership 비즈니스 커뮤니케이션 & 리더십	3-3-0		1,2
	MGT210	Data Analysis & Decision Making 경영통계 분석	3-3-0	Prerequisite: MTH211	1,2
	MGT306	Business Ethics 기업경영 윤리	3-3-0		-
	MGT307	Legal Environment of Business 경영과 법률 환경	3-3-0		-
	MGT315	Econometrics 계량경제학	3-3-0	Prerequisite: MGT211	-
	MGT316	Industrial Organization 산업조직론	3-3-0	Prerequisite: MGT211	-
	MGT317	International Economics 국제경제학	3-3-0	Prerequisite: MGT312	2
	MGT364	Database 데이터 베이스	3-3-0		1
	MGT413	Game Theory 게임 이론	3-3-0	Prerequisite: MGT211	-
	MGT473	Entrepreneurship and Venture Management 창업과 벤처	3-3-0		1
	MGT491	Independent Study 개별연구	3-3-0		-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MEN	MEN301	Numerical Analysis 수치해석	3-3-0		2
CSE	CSE462	Artificial Intelligence 인공지능	3-3-0	Prerequisite: CSE221	1
	CSE463	Machine Learning 기계 학습	3-3-0	Prerequisite: EE211, CSE331	2
MTH	MTH342	Probability 확률론	3-3-0		2
	MTH343	Financial Mathematics 금융수학	3-3-0		1
	MTH461	Stochastic Processes 확률과정론	3-3-0		-
MGE	MGE303	Data Mining 데이터 마이닝	3-3-0		1
	MGE311	Quantitative Finance 계량재무론	3-3-0		1
	MGE405	Applied Programming for Management Engineering 경영공학프로그래밍	3-3-0	Prerequisite: ITP107	2
	MGE412	Advanced Quantitative Finance 고급계량재무론	3-3-0	Prerequisite: MGE311 or MTH343	-
	MGE414	Time-series Analysis 시계열 분석	3-3-0		-
Total Credit			**147**		

□ Entrepreneurship (EPS)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGT	MGT205	Financial Accounting 재무회계	3-3-0		1,2
	MGT204	Marketing Management 마케팅 관리	3-3-0		1,2
	MGT308	Strategic Management 경영전략	3-3-0		1,2
	MGT473	Entrepreneurship and Venture Management 창업과 벤처	3-3-0		1
Total Credit			**12**		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
EPS	EPS491	Capstone Projects Ⅰ 캡스톤 디자인 Ⅰ	3-3-0		-
	EPS492	Capstone Projects Ⅱ 캡스톤 디자인 Ⅱ	3-3-0		-
MGT	MGT101	Business Communication & Leadership 비즈니스 커뮤니케이션 & 리더십	3-3-0		1,2
	MGT302	Human Resource Management 인사관리	3-3-0	Prerequisite: MGT202	1
	MGT303	Strategic Human Resource Management 전략적 인적자원 관리	3-3-0		2
	MGT330	Consumer Behavior 소비자행동	3-3-0	Prerequisite: MGT204	2
	MGT361	Technology Management 기술 경영	3-3-0		-
	MGT363	Operations Research 계량경영학	3-3-0	Identical: MGE201	2
	MGT364	Database 데이터 베이스	3-3-0		1
	MGT372	Internet Business and Marketing 인터넷 비즈니스	3-3-0		2
	MGT432	Marketing Research 마케팅 조사론	3-3-0	Prerequisite: MTH211, MGT204	2
	MGT465	System Analysis and Design 경영정보시스템분석 및 설계	3-3-0		-
	MGT471	Managing Innovation and Change 혁신과 변화의 관리	3-3-0		1
	MGT474	Social Entrepreneurship 사회적 기업의 창업	3-3-0		-
FIA	FIA401	Financial Engineering 금융공학	3-3-0	Prerequisite: MGT207 Identical: MGE411	2
	FIA418	Venture Finance 벤처 파이낸스	3-3-0	Prerequisite: MGT207	1
	FIA441	Financial Statement Analysis 재무제표분석	3-3-0	Prerequisite: MGT205	-
ID	IID232	3D CAD 3D CAD	3-2-2		2
	IID404	Product Service System Design 제품서비스시스템디자인	3-2-2		1
MGE	MGE303	Data Mining 데이터 마이닝	3-3-0		1
Total Credit			**60**		

4. History of Courses Change of 2017-2018

Category	2017		2018
MGT	<New>	⇨	MGT371 (Elective) Service Science 서비스 사이언스
	MGT209 (Required) Operations Management 생산관리	⇨	MGT209 (Required) Operations Management 생산운영관리
	MGT206 (1TR Required) Managerial Accounting 관리회계	⇨	MGT206 (Elective) Managerial Accounting 관리회계
	MGT210 (1TR Required) Data Analysis & Decision Making 경영통계분석	⇨	MGT210 (Elective) Data Analysis & Decision Making 경영통계분석
	MGT211 (1TR Required) Microeconomics 미시경제학	⇨	MGT211 (Elective) Microeconomics 미시경제학
FIA	FIA305 (Required) Corporate Finance 기업재무론	⇨	FIA305 (1TR Required) Corporate Finance 기업재무론
	FIA321 (1TR Required) Intermediate Accounting 1 중급회계 1	⇨	FIA321 (Elective) Intermediate Accounting 1 중급회계 1

5. Course Descriptions

□ Management (MGT)

MGT101 Business Communication & Leadership [비지니스 커뮤니케이션 & 리더십]

This course provides theoretical backgrounds and practical tools for effective management of organization and for improving leadership capability. The main topics include personality, motivation, leadership and team management, organizational design and culture, and organizational change, in both micro and macro perspectives. The purpose of this course is to help prepare students to assume increasingly responsible leadership roles in their personal, professional, and academic lives. As such, the course focuses not only on significant theories of leadership and their applicability to leaders of the past and present, but also includes substantial hands-on, experiential and learning opportunities in which leadership will be put into action.

MGT201 Dynamics of IT [Dynamics of IT]

This course introduces business and social applications of information technologies (IT). The main focus of the course is on introducing managerial insights into the strategic use of IT. Students will develop familiarity with the principles of information systems through the analysis of real-world business cases. At the end of the semester, students will be expected to understand technical and strategic foundations for the effective use of information systems in organizations and society

MGT202 Organizational Behavior [조직행동]

Organizational behavior is about the study and application of knowledge about how individual or group of people acts within organization. This course introduces the basic concepts, theories, models, and cases of behavioral phenomena such as personality, learning, motivation, group process, leadership, organization design and culture, and organizational change.

MGT203 International Business [국제경영]

Companies compete in the international markets with the globalized of world economy. This course in International Business enables students to be equipped with the ability to analyze global issues in economics and to cope well with the rapidly changing international business environment. With the combination of theories and realistic international business cases, students are prepared to understand and deal effectively with the international business issues.

MGT204 Marketing Management [마케팅 관리]

This course is an introduction to the theory and application of contemporary marketing. Marketing topics covered include customer needs, company skills, competition, collaborators, and context in marketing and product development (5Cs)and product, price, place, and, promotion (4Ps). The course combines cases, discussions, and theories to provide a mix of integrating concepts and hands-on problem solving.

MGT205 Financial Accounting [재무회계]

Financial Accounting examines basic concepts of accounting and provides a basic framework to understand the financial statement in users'point of view. This course also provides overview of basic financial statements such as balance sheets, income statement and cash flow statement for financial and accounting decision making.

MGT206 Managerial Accounting [관리회계]

This course covers the basic concepts and foundations for the management decision-making using accounting information and cost and benefit analysis. The topics include cost structure and cost concepts, strategic decision making, design of various costing systems, and performance measurement systems.

MGT207 Financial Management [재무관리]

This course introduces various issues in financial management. It provides the student with an introduction to the problems faced by corporate financial managers and investment bankers, and suggests methods for resolving the financial problems including capital structure and capital budgeting problems.

MGT209 Operations Management [생산운영관리]

Operations management is basically concerned with the production of quality goods and services, and how to make efficient and effective business operations. It involves subjects in the analysis of production planning, inventory and quality control, cost and performance analysis, and supply chain management.

MGT210 Data analysis & Decision Making [경영통계분석]

The main goal of this course is to understand statistical analysis of data and to apply to various management issues in forecasting and planning. The topics include the basic concept of probability and statistics with the application of practical cases.

MGT211 Microeconomics [미시경제학]

Microeconomics is concerned with the behaviors of individual consumers and businesses. This course provides an introduction to the analytical tools to understand how individuals and societies deal with the fundamental economic problem of scarcity. This course also provides discussions in applied fields such as environment economics, international trade, industrial organization, labor economics, and public finance.

MGT302 Human Resource Management [인사관리]

The purpose of this course is to provide undergraduate learners with a basic understanding of the concept, principles and techniques of human resource management. Content to be explored includes, but is not limited to, human resource planning and strategy, staffing (recruiting and selection), training, performance appraisal, compensation, employee relations, diversity, legal issues and contemporary issues.

Strategic Human Resource Management [전략적 인적자원 관리]

This course is designed to understand how companies can strategically manage human resources as a source of competitive advantage. This calls for a departure from a traditional view of HR as an administrative function to a view of HR as a strategic partner. Throughout this course, students will be able to apply the knowledge about strategic management to the functions and roles of human resource management. By integrating organizational strategy and HR practices, students can learn how the system of human resource management can be designed and implemented with the clear goal of contributing to the formulation and implementation of the organization’s competitive strategy.

MGT304 Diversity Management [인력 다양성 관리]

This course takes a multidisciplinary approach to the challenges encountered by individuals, groups, managers and organizations as they strive to deal with an increasingly diverse workforce. It aims to develop students'understanding and critical awareness of issues associated with managing a workforce characterized by diversity in age, gender, race, religion, disability, and sexual orientation. It will explore issues both conceptually and experientially and focus on problem solving so that students will improve their ability as a future employee or manager to address diversity issues in organizations.

MGT306 Business Ethics [기업경영윤리]

This course examines business ethics from both an organizational and managerial perspective. Students will examine the goal of business organizations, as well as individual conduct in business settings. Ethical reasoning and ethical leadership will guide students through debates on various topics such as: creating an ethical climate in an organization, honesty, affirmative action, environmental ethics, ethics in advertising and sales, financial management, personnel management, and the role of character and virtues in effective leadership.

MGT307 Legal Environment of Business [경영과 법률 환경]

The legal environment represents a significant segment of the decision-maker's landscape. This course provides an overview of laws and regulations as they pertain to the business atmosphere. Key topics include forms of business enterprise, international law, contracts, intellectual property, and financial reporting and disclosure regulations. Case analysis and ethical implications are discussed in each area.

MGT308 Strategic Management [경영전략]

This course introduces the basic concepts, process, and various skills and techniques of strategy formulation, implementation and evaluation. Practical cases of Korean and American corporations will be analyzed and discussed.

MGT312 Macroeconomics [거시경제학]

Macroeconomics is concerned with economic aggregates such as GDP, inflation and unemployment. This course provides an overview of macroeconomic issues such as the determination of output, employment, interest rates, and inflation. Policy issues and applications of basic models will be discussed with special reference to monetary and fiscal policy.

MGT315 Econometrics [계량경제학]

This course focuses on the application of statistical methods to the testing and estimation of economic relationships. After developing the theoretical constructs of classical least squares, students will learn how to treat common problems encountered when applying the ordinary least squares approach, including serial correlation, heteroscedasticity and multicollinearity.

MGT316 Industrial Organization [산업조직론]

Industrial organization is concerned with the workings of markets and industries, in particular the way firms compete with each other. Its emphasis is on the study of the firm strategies that are characteristic of market interaction: price competition, product positioning, advertising, research and development, and so forth.

MGT317 International Economics [국제경제학]

This course discusses topics in International Trade and International Macroeconomics. Theoretical analyses will be presented in lecture as a basis for discussions on various policy issues. The topics will include patterns of international trade and production; gains from trade; tariffs and other impediments to trade; foreign exchange markets; exchange rate determination theories; balance of payments; capital flows; financial crises; monetary/fiscal policy coordination in a global economy.

MGT330 Consumer Behaviors [소비자행동]

This course deals with issues related to the purchase and consumption by consumers, and how marketing managers make effective decisions using this information. It also focuses on understanding and predicting consumer behavior based on theories of consumer psychology and cognitive theory.

MGT331 International Marketing [국제마케팅]

This course introduces basic concepts and theories of marketing management of international business. It focuses on international marketing environment and opportunities, global marketing strategy, and overcoming the barriers in different economic environments.

MGT332 Brand Management [브랜드관리론]

The goal of this course is to understand how to create a comprehensive brand architecture that will provide strategic direction and develop brand building programs. Relevant theories, models, and tools for the making of brand decisions will be discussed.

MGT361 Technology Management [기술경영]

This course provides a strategic framework for managing technologies in businesses. As a basis, this course focuses on how technologies, technological structures, and systems affect organizations and the behaviors of their members. Then, this course aims to help students understand the complex co-evolution of technological innovation and identify new opportunities, business ecosystems, and decision-making execution within the business.

MGT362 Process & Quality Management [생산과 품질관리]

This course covers the approaches in quality improvement and implications in management responsibilities. Practical cases involving business processes will be analyzed and discussed in class.

MGT363 Operations Research [계량경영학]

This course is an introduction to the key aspects of operations research methodology. Students will model and solve a variety of problems using deterministic and stochastic operations research techniques. Topics include basic theory, modeling, the use of computer tools, and interpreting results.

MGT364 Database [데이터베이스]

This course deals with the fundamental concepts of current database systems. Specific topics will include data modeling, database system architecture, and query processing. The course also covers advanced issues such as concurrency controls and disaster recovery methods.

MGT366 Advanced Business Programming [고급 경영 프로그래밍]

This subject examines the principles, techniques and methodologies for the design of business software systems using visual programming tools and the object-oriented approach. This subject describes the concepts of inheritance, encapsulation, construction, access control and overloading. Students will be provided with both the framework and the building blocks with which they can define and implement objects of their own and use them in conjunction with a visual programming system.

MGT371 Service Science [서비스 사이언스]

Service systems in transportation, retail, healthcare, entertainment, hospitality, and other areas are configurations of people, information, organizations, and technologies that operate together for specific functions and values. The field of Service Science is emerging as the study of complex service systems, and involves methods and theories from a range of disciplines, including operations, industrial engineering, marketing, computer science, psychology, information systems, design, and more. Effective understanding of service systems often requires combining multiple methods to consider how interactions of people, technology, organizations, and information create value under various conditions. In this course, we will learn and apply concepts and methods in Service Science for service management and engineering.

MGT372 Internet Business and Marketing [인터넷 비지니스]

This course intends to introduce students to the concept and practice of e-business. The principal topics include the internet and mobile e-business, e-business models, architecture of web systems, and communications and networking.

MGT373 Strategic Management of IT [정보기술과 경영전략]

This course will focus on exploring and articulating the framework and methodology associated with the deployment of Information Technology to help formulate and execute business strategy.

MGT374 Mobile Business [모바일비지니스]

By taking a journey into the history of mobile technologies/services and their current trends, this course investigates how mobile technologies have transformed and will continue to transform the world. The course explores various mobile technologies, their business applications, successful and failed cases, and related issues such as mobile policy or convergence among wired, wireless, and broadcasting services.

MGT410 Special Topics in MGT I [MGT 특론 I]

This course is designed to discuss contemporary topics in General Management. Actual topics and cases will be selected by the instructor and may vary from term to term.

MGT411 Special Topics in MGT II [MGT 특론 II]

This course is designed to discuss contemporary topics in General Management. Actual topics and cases will be selected by the instructor and may vary from term to term.

MGT412 Special Topics in MGT III [MGT 특론 III]

This course is designed to discuss contemporary topics in General Management. Actual topics and cases will be selected by the instructor and may vary from term to term.

MGT413 Game Theory [게임이론]

Game theory studies an analytical approach to the study of strategic interaction. Students will learn the development of basic theory, including topics such as the Nash equilibrium, repeated games, credibility, and mixed strategies. Applications will include markets and competition, auction design, voting, and bargaining.

MGT414 Special Topics in MGT IV [MGT 특론 IV]

This course is designed to discuss contemporary topics in General Management. Actual topics and cases will be selected by the instructor and may vary from term to term.

MGT432 Marketing Research [마케팅조사론]

This course offers a study of the application of scientific methods to the definition and solution of marketing problems with attention to research design, sampling theory, methods of data collection and the use of statistical techniques in the data analysis. It concerns the use of marketing research as an aid in making marketing decisions. In particular, this course addresses how the information used to make marketing decisions is gathered and analyzed. Accordingly, this course is appropriate for both prospective users of research results and prospective marketing researchers.

MGT433 Advertising Management [광고관리론]

An analysis of marketing communications from business, social, economic, and political perspectives, this course provides an in-depth discussion of advertising and promotion as key tools in marketing new and established products. This course examines advertising planning and management, research, creative development, media selection, direct response, and advertising agencies. Emphasis is on new media

MGT434 Experimental Design with Applications in Marketing [마케팅실험설계]

This course teaches the principles of experimental design for the study of consumer behavior. Experiments may be administered through surveys and on the Internet as well as in laboratory settings. The goal of this course is to become familiar with experimental research techniques and data analysis. Specifically, we will discuss various experimental designs, how to manipulate independent variables and measure dependent variables, how to control for the influence of extraneous variables, and how to eliminate alternative hypotheses. Further, we will discuss the methods to statistically analyze data obtained from experimental research (e.g., analysis of variance, regression), and the specific problems that can occur when analyzing the experimental data.

MGT435 Case Studies in Marketing [마케팅사례연구]

This course helps students understand the subjects in Marketing, and gives opportunities to discuss the managerial and academic issues through practical cases in Marketing.

MGT441 Global Business Strategy [글로벌경영전략]

This course provides a theoretical framework for strategic management to gain sustainable competitive advantage over rivals for a long period. Using various business cases of multinational companies, this course allows students to obtain strategic mind and capabilities for strategic analysis that can readily be applicable to real international business.

MGT442 Case Studies in International Business [국제경영사례연구]

This course helps students understand the subjects in International Business within a globalized economy, and gives opportunities to discuss the managerial and academic issues through practical cases in International Business.

MGT463 Simulation [시뮬레이션]

This course deals with phenomena that are of a stochastic (rather than deterministic) nature: that is, some aspects of the system under study are subject to random variations. Systems with a stochastic component include a wide range of applications such as inventory, reliability, computer, communication, production, and transportation systems. This course provides a unified approach to the modeling, analysis and simulation of stochastic systems. Analytical tools include the Poisson process, Markov chains and queueing theory. In parallel to the mathematical models, we develop the concept of discrete event simulation.

MGT464 Stochastic Modeling & Applications [추계적 모델링 및 응용]

This course aims to help students understand the nature of stochastic systems and learn how to model and analyze such systems. The emphasis is on problem formulation, modeling techniques, and realistic applications. The majority of the class will focus on Markov models in discrete time.

MGT465 System Analysis and Design [경영정보 시스템분석 및 설계]

This course is designed to explore the functions and methods of information systems development from both a practical and theoretical perspective. Upon successful completion of the course, students should be able to analyze and design information systems in a real-world setting and to compare and choose intelligently from among methods, tools, and techniques of systems analysis and design.

MGT471 Managing Innovation and Change [혁신과 변화의 관리]

This course covers current issues and theories on the management of innovation and change in new and existing organizations. It introduces various perspectives that can help to explore how organizations emerge, innovate, adapt, and fail during the changes in their organizational environments. It prepares students to understand practical business cases and discuss the questions including: How do technical, market, and institutional changes offer opportunities and challenges to incumbent organizations? What are the major obstacles in change management and adaptation? How does ‘a gale of creative destruction’ present opportunities to entrepreneurs?

MGT473 Entrepreneurship and Venture Management [창업과 벤처]

This course is designed to help students understand the challenges and learn how to approach the process of creating and managing a new venture, which includes recognizing and analyzing an opportunity, mobilizing resources, financing a new venture, and managing growth. To achieve this goal, the course will introduce important concepts and cover a number of cases involving different entrepreneurial challenges and settings. It also serves as the capstone course for those pursing a degree in business management and entrepreneurship.

MGT474 Social Entrepreneurship [사회적 기업의 창업]

Social entrepreneurs combine the knowledge and skills used in traditional business, with a passionate commitment to having a meaningful and sustainable social impact. Rather thanthe relentless and selfish pursuit of personal enrichment through profit, social entrepreneurs apply their passion and skill to enrich the lives of people who are poor, sick or disenfranchised. The best social entrepreneurs find creative ways to help the disadvantaged help themselves, by building innovative and sustainable new -social enterprises that can be scaled to achieve significant social change.

MGT490 Interdisciplinary Project [창의시스템 구현]

This course is joined with other tracks for performing a term project through collaboration. Students are required to conceive a novel idea, which will be envisioned by designing and fabricating a product by using the best knowledge learned at an undergraduate level. Lastly, students will present their work in public for evaluation.

MGT491 Independent Study [개별연구]

This course is intended for students who wish to pursue a discipline in greater depth than possible through the regular curriculum. The course is designed to provide the student with an opportunity to expand current knowledge, develop or enhance necessary skills in a specific area of interest related to management.

MGT492 Capstone Projects I [캡스톤 디자인 I]

This capstone course offers each student the opportunity to develop a special project in his or her specific area of interest. This includes researching the topic, identifying an issue, developing a strategy and a workplan, establishing a timeline, and implementation of the work schedule. Students will also develop a plan for evaluation.

MGT493 Capstone Projects II [캡스톤 디자인 II]

This capstone course offers each student the opportunity to develop a special project in his or her specific area of interest. This includes researching the topic, identifying an issue, developing a strategy and a workplan, establishing a timeline, and implementation of the work schedule. Students will also develop a plan for evaluation.

FIA304 International Finance [국제재무관리]

This course deals with the financial issues of corporations and financial institutions in international markets. It covers foreign exchange markets, international stock and bond markets and other related issues in risk and returns.

□ Finance & Accounting (FIA)

FIA301 Investments [투자론]

The course in Investment Analysis introduces the students with conceptual framework in the theory and practice of financial investment decisions. The topics include portfolio theory, Capital Asset Pricing Model, market efficiency, and derivative securities pricing.

FIA302 Money and Banking [금융시장론]

The purpose of this course is to introduce the basic principles of money, credit, banking and to discuss the application of these principles to the issues of current financial policy. It also involves the practical influences of macroeconomic policy on the real sector of the economy and financial markets.

FIA303 Futures and Option [선물과 옵션]

This course covers some of the main topics in futures, options and other derivative securities. It provides a working knowledge of how derivatives are analyzed, and covers the financial derivative markets, trading strategies and valuation issues involving options and futures/forwards.

FIA304 International Finance [국제재무관리]

This course deals with the financial issues of corporations and financial institutions in international markets. It covers foreign exchange markets, international stock and bond markets and other related issues in risk and returns.

FIA305 Corporate Finance [기업재무론]

This course is an elective course for students taking finance/accounting department in School of Business Administration. We will initially focus on the institutional features of corporate financing and governance. Then, course deals with the theory of corporate financing such as capital budgeting and capital structure under perfect market conditions. After establishing this basic framework, we will incorporate various market imperfections, such as, taxes, bankruptcy costs, agency costs, and asymmetric information, into the analysis. The course “Financial anagement” is a prerequisite for students who are taking this course on advanced financial management contents. This course aims at understanding market efficiency hypothesis, capital structure, dividend policy and working capital management, which are based on fundamental financial theories including the present value model, capital budgeting, portfolio theory, CAPM and cost of capital. Moreover, this course will provide a simple introduction to corporate financial analysis, financial planning and derivatives.

FIA321 Intermediate Accounting I [중급회계1]

This course is an intensive study of the theories and practices of financial accounting. The primary goal of this course is to understand both current accounting standards and the conceptual framework that is the foundation of current accounting standards. Specifically, this course is designed to acquaint the student with current accounting theories and practices.

FIA322 Intermediate Accounting II [중급회계2]

While this course is similar to the Intermediate Accounting I course, its topics are more specific and complicated. It focuses on accounting for assets and liabilities, accounting standard processes and economic influence of accounting standards on stockholders.

FIA401 Financial Engineering [금융공학]

Financial Engineering is a cross-disciplinary field which covers mathematical and computational finance, statistics, and numerical methods that are useful for trading, hedging and investment decisions, as well as facilitating the risk management of those decisions.

FIA402 Fixed Income Securities [채권투자]

This course is designed to introduce fixed income markets including money markets and bond markets. Students are going to understand the time value of money and the relation between price and yield of the bond. The derivatives products underlain by money or bond such as swaps or options will be introduced as well. Most of explanations will be applied to practical market situations.

FIA403 Derivatives Market [파생상품 시장]

This course covers advanced topics in derivative security markets. The purpose of the course is to provide students with comprehensive theories in derivative securities and practical issues in complicated derivative markets. It includes the quantitative valuations, technical properties and applications, hedging and trading strategies of basic and exotic derivatives. Futures and Options (FIA303) is a prerequisite for this course.

FIA404 Risk Management [리스크 관리]

This course is designed to study effective ways of managing financial risks from the perspective of corporations and financial institutions. Major topics include ALM(Asset liability management), VaR, interest rate risk management, credit risk management, and exchange risk management. Other topics include practical cases and statistical tools for risk manage- ment. Finally, this course deals with theories and recent advances in structured products, interest and credit-related derivatives as a tool for risk management. Students are required to have a solid understanding of basics of futures, options and swaps.

FIA405 Corporate Valuation [기업가치 평가]

This course is an elective course for students taking finance/accounting department in School of Business Administration. This course will expose students to the primary equity research, analysis, and valuation techniques utilized by investment professionals. This course will cover several approaches to corporate valuation: discounted cash flow (DCF) valuation, relative valuation, contingent valuation. Security valuation could be best learned by doing valuation on his/her own with securities that are traded on the market. Thus, each student will carry out a term project which requires him/her to apply all types of valuation approach they learn during classes with team members.

FIA407 Case Studies in Finance [재무사례연구]

This course is designed to apply the theories of financial management to the practical business cases faced by corporations and financial institutions. Students will have opportunities to practice the problems of capital structure, capital budgeting, valuation of financial assets, and risk management.

FIA410 Special Topics in Finance I [Finance 특론 I]

This course is designed to discuss contemporary topics in accounting. Actual topics and cases will be selected by the instructor and may vary from term to term.

FIA411 Special Topics in Finance II [Finance 특론 II]

This course is designed to discuss contemporary topics in accounting. Actual topics and cases will be selected by the instructor and may vary from term to term.

FIA412 Special Topics in Accounting I [Accounting 특론 I]

This course is designed to discuss contemporary topics in accounting. Actual topics and cases will be selected by the instructor and may vary from term to term.

FIA413 Special Topics in Accounting II [Accounting 특론 II]

This course is designed to discuss contemporary topics in accounting. Actual topics and cases will be selected by the instructor and may vary from term to term.

FIA414 Applied Investment Management [투자실무]

This course is intended to provide students with working knowledge of applied investment management. Main topics include deciding on the optimal allocation problems, identifying multiple risk factors, assessing the performance, and quantifying the expected return and risk properties of investment opportunities. The course begins by how traditional optimal allocation problems should be modified under real situations such as short shale constraints, differences in lending and borrowing rates, or imposing maximum allocations on particular asset classes. This course also covers topics of investment in commodities and global equities for creating more diversified portfolios. The focus then turns to portfolio strategies and assesements. Portfolio strategies may include portable alpha and futures overlay strategy. The problems addressed are those of the managers of mutual funds, endowments, mutual funds, index funds, exchange-traded-funds(ETFs), and hedge funds.

FIA415 Mergers and Acquisitions [기업 인수합병론]

The course focuses on corporate governance and merger and acquisition. The corporate form, in contrast to other business form, frequently involves the separation of ownership and control of the assets of the business. The separation result in a number of conflicts of interest between managers and shareholders. In order to mitigate such conflicts of interest, corporate governance structure have been developed and implemented in corporations. This course will explore issues associated with corporate governance such as principal-agency relationship, board of directors, effective corporate governance, elements of a company's statement of corporate governance polices that investment analysts should assess, and the valuation implication of corporate governance. Merger adds value only if the two companies are worth more together than apart. The merger and acquisition part of this course covers why two companies could be worth more together and how to get the merge deal done. The specific topics include motivation behind M&A, various valuation methods for target company, post-merger value, the effect of price and payment method, the distribution of benefits in a merger

FIA416 Corporate Governance [기업 지배구조론]

Since the major corporate frauds in early 2000s, the need for better corporate governance practice becomes stronger. This course deals with the concepts and applications of corporate governance. The course contents include conflicts between principals and agents, incentive mechanism to alleviate it, various mechanisms to implement/supplement corporate governance (e.g., regulations, board of directors, institutional investors, analysts, and product market competition), interactions among different governance mechanisms, and potential conflict of interest among various stakeholders (e.g., creditors vs shareholders). In addition to lectures, students are required to participate in In-class discussion based on case studies and news articles.

FIA417 Financial Markets and Trading [증권시장론]

This course is an introductory level of market microstructure. Market microstructure is a sub-field of finance that is the study of trading mechanisms. Because most trading occurs during trading session and the market procedure and rules matter, this course deals with the trading protocols and the economic principle that shape them. Topics include how information is impouded in prices, avoidance of market failures, understanding market participants and the trading environment, market impact, market fragmentation and consolidation, high frequency trading, algorithm trading, exchanges. dark pools, ATS(Alternative Trading System), ECN(Electronic Communication Network) and regulations on the financial markets. Finally, this course also covers financial market regulations.

FIA418 Venture Finance [벤처파이낸스]

This course is how to finance and manage privately-held firms. Topics include private firm valuation issues, financing sources and methods, venture and private equity markets, and exit and outcomes for entrepreneurial and privately-held firms.

FIA421 Commercial Law [상법총론]

The course on Commercial Law aims to provide students with a firm understanding of the legal and regulatory mechanisms that govern companies and how they operate and function in a business environment. Through this course, students build up working knowledge of the procedural and substantive law governing key aspects of company formation, organization and control; management; finance; corporate rescue' and corporate insolvency.

FIA441 Financial Statement Analysis [재무제표분석]

The goal of this course is to develop skills essential to using financial information and accounting statements for capital market decisions. The course is designed to prepare students to interpret and analyze financial statements.

FIA442 Taxation [세무회계]

This course is designed to introduce basic concepts and theories of tax accounting. The course will focus primarily on corporate income tax laws and regulations and related corporate tax accounting issues. Other tax issues that corporations are facing in their tax accounting will be discussed as well in the class.

FIA443 Strategic Cost Management [원가관리 전략]

Explores critical issues facing accounting and financial managers in the current business environment. Topics include: introduction to state-of-the-art managerial accounting practices, in-depth understanding of cost management, product and service costing methods, performance evaluation and managerial compensation systems. Global and ethical issues are examined. Written assignments, case studies and team discussions comprise much of classroom interaction.

FIA445 Auditing [감사학 개론]

This course is designed to introduce basic concepts of financial audits, generally accepted auditing standards, key audit procedures and audit techniques. This course also covers audit quality, auditors' responsibilities, and other hot issues including regulatory systems over the audit profession.

FIA490 Interdisciplinary Project [창의시스템구현]

This course is joined with other track for performing a term project through collaboration. Students are required to conceive a novel idea, which will be envisioned by designing and fabricating a product by using the best knowledge learned at an undergraduate level. Lastly, students will present their work in public for evaluation.

FIA492 Capstone Projects I [캡스톤 디자인 I]

This capstone course offers each student the opportunity to develop a special project in his or her specific area of interest. This includes researching the topic, identifying an issue, developing a strategy and a workplan, establishing a timeline, and implementation of the work schedule. Students will also develop a plan for evaluation.

FIA493 Capstone Projects II [캡스톤 디자인 II]

This capstone course offers each student the opportunity to develop a special project in his or her specific area of interest. This includes researching the topic, identifying an issue, developing a strategy and a workplan, establishing a timeline, and implementation of the work schedule. Students will also develop a plan for evaluation.

School of Management Engineering

1. School Introduction

The School of Management Engineering is dedicated to creating and disseminating advanced knowledge to plan and operate business strategies of corporations. Our teaching and research emphasize synthetic, interdisciplinary, and practical approaches by linking engineering, science, and management disciplines. We are currently playing the leading role in a wide array of areas including manufacturing, technology management, and financial engineering. Students are encouraged to be involved in a variety of academic and industry projects and to cultivate a global mindset.

2. Undergraduate Programs

□ Track Introduction

1) Management Engineering (MGE)

Students in Management Engineering track are educated and trained to identify, synthesize, and analyze large-scale and complex problems in both public and private sectors as well as to prepare for more in-depth research activities in the graduate school. To this end, we provide a comprehensive collection of interdisciplinary courses mainly related to industrial engineering and financial engineering. Students are expected to build up the capability to direct and harmonize a whole system of strategic, administrative and technical elements.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)		
		Interdisciplinary Major		Remark
		1st Track	2nd Track	
MGE	Required	30	9	
	Elective	24	9	

※ Impossible combination of interdisciplinary double major :
School of Management Engineering - School of Business Administration

□ Fundamental Course for each track

▶ Required Mathematics Course for Each Track

Track	Course No.	Required Mathematics course	Semester
MGE	MTH211	Statistics	2-1
	MTH203	Applied Linear Algebra	1-2

※ Complete based on 1TR
※ Engineering field students who entered in 2009 should take 'Calculus (or I), Applied Linear Algebra, Differential Equations, Statistics' in total 12 credits.

▶ Fundamentals required by another School students when they choose School of Management Engineering track as 2^{nd} track

Course Title	MGE
Statistics	✔

▶ Required Experimental Course

Track	Required Courses
MGE	MGE450 Project Lab.

※ Complete based on 1TR

3. Curriculum ※ Course opening semester is subject to be changed according to School’s situation.

□ Management Engineering (MGE)

▶ Required

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGE	MGE201	Operations Research Ⅰ* 계량경영학 Ⅰ*	3-3-0	Identical: MGT363	2
	MGE205	Investments*** 투자론***	3-3-0	Prerequisite: MTH211 Identical: FIA301	1,2

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGE	MGE209	Operations Management* 생산운영관리*	3-3-0	Identical: MGT209	1
	MGE303	Data Mining*** 데이터 마이닝***	3-3-0		1
	MGE305	Operations Research Ⅱ* 계량경영학 Ⅱ*	3-3-0	Prerequisite: MGE209, MGE201	1
	MGE306	Derivatives** 파생상품**	3-3-0	Prerequisite: MGT207 Identical: FIA303	2
	MGE311	Quantitative Finance** 계량재무론**	3-3-0		1
	MGE312	Quantitative Risk Management** 정량적 리스크 관리**	3-3-0	Prerequisite: MGT207 Identical: FIA404	2
	MGE404	Business Process Management* 프로세스 관리*	3-3-0		1
	MGE405	Applied Programming for Management Engineering*** 경영공학프로그래밍***	3-3-0	Prerequisite: ITP107	2
	MGE411	Financial Engineering and Trading Management** 금융공학 및 트레이딩 관리**	3-3-0	Prerequisite: MGT207 Identical: FIA401	1
	MGE450	Project Lab.*** 프로젝트 랩***	3-1-4		1
MGT	MGT207	Financial Management*** 재무관리***	3-3-0		1,2
	MGT361	Technology Management* 기술 경영*	3-3-0		-
	MGT364	Database 데이터 베이스	3-3-0		1
Total Credit			45		

▶ Elective

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGE	MGE304	ME Methodology* 경영공학 방법론*	3-3-0		2
	MGE308	Serice Science* 서비스 사이언스*	3-3-0	Prerequisite: MGE209 Identical: MGT371	2
	MGE362	Quality Management* 품질관리*	3-3-0	Prerequisite: MGT209 Identical: MGT362	1
	MGE412	Advanced Quantitative Finance* 고급계량재무론*	3-3-0	Prerequisite: MGE311 or MTH343	-
	MGE413	Fixed Income Analysis 이자율상품 분석	3-3-0	Prerequisite: MGT207	-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
MGE	MGE414	Time-series Analysis*** 시계열 분석***	3-3-0		-
	MGE470	Special Topics in MGE Ⅰ MGE 특론 Ⅰ	3-3-0		-
	MGE471	Special Topics in MGE Ⅱ MGE 특론 Ⅱ	3-3-0		-
	MGE472	Special Topics in MGE Ⅲ MGE 특론 Ⅲ	3-3-0		-
MAE	MEN301	Numerical Analysis 수치해석	3-3-0		2
SDC	SDC202	Computational Tools for Engineers 공학전산기법	3-3-0		2
	SDC304	Manufacturing System Design & Simulation 생산시스템설계 및 시뮬레이션	3-3-0		2
CSE	CSE232	Discrete Mathematics 이산수학	3-3-0		1,2
	CSE462	Artificial Intelligence 인공지능	3-3-0	Prerequisite: CSE221	1
	CSE463	Machine Learning 기계 학습	3-3-0	Prerequisite: EE211, CSE331	2
MTH	MTH201	Differential Equations 미분방정식	3-3-0	Prerequisite: MTH111	1,2
	MTH251	Mathematical Analysis Ⅰ 해석학 Ⅰ	3-3-0		1
	MTH321	Numerical Analysis 수치해석학	3-3-0		2
	MTH333	Scientific Computing 과학계산	3-3-0		-
	MTH342	Probability 확률론	3-3-0		2
	MTH361	Mathematical Modeling and Applications 수리모형방법론	3-3-0		1
	MTH421	Introduction to Partial Differential Equations 편미분방정식개론	3-3-0	Prerequisite: MTH201	1
MGT	MGT106	Economics 경제원론	3-3-0		1
	MGT205	Financial Accounting** 재무회계**	3-3-0		1,2
	MGT211	Microeconomics** 미시경제학**	3-3-0	Prerequisite: MGT106	2
	MGT308	Strategic Management*** 경영전략***	3-3-0		1,2
	MGT312	Macroeconomics*** 거시경제학***	3-3-0	Prerequisite: MGT211	1
	MGT315	Econometrics 계량경제학	3-3-0	Prerequisite: MGT211	-

Track	Course No.	Course Title	Cred.-Lect.-Exp.	Remarks	Semester
FIA	FIA304	International Finance** 국제재무관리**	3-3-0	Prerequisite: MGT207	2
	FIA305	Corporate Finance** 기업재무론**	3-3-0	Prerequisite: MGT207	1
	FIA417	Financial Markets and Trading** 증권시장론**	3-3-0	Prerequisite: MGT207	1
Total Credit			93		

* Industrial engineering focused
** Financial engineering focused
*** Both
※ Management Engineering Track Curriculum consist of Required Group and Elective Group. Students are required to fulfill the minimum credit requirements by taking courses from Required Group. Required Group offers 14 Lecture courses and 1 Experimental course (Total 45 credits) which is excessive for the minimum graduation requirement (1st track: 30, 2nd track: 9). The students can choose course from among the Required Group course list based on their individual academic and research interest. It is mandatory to enroll in 1 Experimental course for 1st Track students. If students choose more required courses than the minimum requirements, then the required courses in excess can be counted as elective courses. Vice versa, i.e., use elective courses to fulfill the required courses minimum requirements, is not allowed.

4. History of Courses Change of 2017–2018

Category	2017		2018
MGE	<New>	⇨	MGE308 (Elective) Service Science 서비스 사이언스
	MGE209 (Required) Operations Management 생산관리	⇨	MGE209 (Required) Operations Management 생산운영관리

5. Course Descriptions

□ Management Engineering (MGE)

MGE201 Operations Research Ⅰ [계량경영학 Ⅰ]

This course is an introduction to the key aspects of operations research methodology. Students will model and solve a variety of problems using deterministic and stochastic operations research techniques. Topics include basic theory, modeling, the use of computer tools, and interpreting results.

MGE205 Investments [투자론]

The course objective is to introduce the theory and practice of investments from the point of view of

an investment/portfolio manager. We will begin with a review of asset classes, financial history, and preferences for risk. Next, we will have a brief review of statistics and finance and we will review matrix algebra. We will then apply these tools to examine the trade-off between risk and return and to develop and implement Modern Portfolio Theory. The major topics covered will include the Capital Asset Pricing Model (CAPM), Markowitz optimization, performance evaluation, market efficiency, and Arbitrage Pricing Theory (APT). The last portion of the course will be devoted to fixed income securities including interest rates, bond valuation, and bond immunization.
The course is primarily conducted in the lecture/discussion format. Throughout the course, our focus will be on applying analytical tools to solve multi-step financial problems. Just knowing how to plug numbers into formulas or memorizing problems will not be sufficient for a passing grade in this course. In addition, there will be a reasonable amount of material that you will be responsible for that we will not have time to cover in class. Hopefully, most of this will be more information oriented rather than problem solving. Note that there are many variations to the basic problems and concepts that we cannot cover in class, so it is very important to understand how to apply the concepts.

MGE209 Operations Management [생산운영관리]

Operations management is basically concerned with the production of quality goods and services, and how to make efficient and effective business operations. It involves subjects in the analysis of production planning, inventory and quality control, cost and performance analysis, and supply chain management.

MGE303 Data Mining [데이터마이닝]

Data mining is comprised techniques from statistics, AI, and computer science. It is applied not only to conventional engineering and science problems, but also to various business areas such as manufacturing, marketing and finance. This course introduces basic data mining problems (clustering, classification, and association analysis) and the respective algorithms and techniques. In addition, students will learn about actual business problems, goals, and the environment in which data mining is applied. Cases in various areas will be studied. Students are strongly encouraged to identify and solve real world business problems using data mining techniques so that they improve their relevance to human interface design.

MGE304 Management Engineering Methodology [경영공학 방법론]

Management engineering links engineering, science, and management to plan and operate management strategy of corporations. This course will cover a variety of models and methods in the field of management engineering, ranging from qualitative frameworks to quantitative techniques. Students are expected to develop the capability to synthesize engineering technology and management strategy.

MGE305 Operations Research Ⅱ [계량경영학 Ⅱ]

Operations Research II is the second of a two-course sequence that introduces students to models commonly used in the analysis of complex decision-making problems. Modeling approaches and fundamental solution methodologies will be emphasized. This course covers a variety of ways in which deterministic and stochastic models in Operations Research can be used and applied to solve practical problems. Topics for this course include nonlinear and integer programming, dynamic programming, Markov decision processes, and queueing theory.

MGE306 Derivatives [파생상품]

This course covers main topics in futures, options and other derivatives securities. It provides a working knowledge of how derivatives are analyzed and/or valued, and covers the derivatives market structures, trading strategies and valuation issues involving derivatives contracts. Covered topics may include hedging commodity price risk, structuring protected equity notes, managing interest rate risk exposures, swapping fixed for floating interest rate payments, and managing currency risk exposures.

MGE308 Service Science [서비스 사이언스]

Service systems in transportation, retail, healthcare, entertainment, hospitality, and other areas are configurations of people, information, organizations, and technologies that operate together for specific functions and values. The field of Service Science is emerging as the study of complex service systems, and involves methods and theories from a range of disciplines, including operations, industrial engineering, marketing, computer science, psychology, information systems, design, and more. Effective understanding of service systems often requires combining multiple methods to consider how interactions of people, technology, organizations, and information create value under various conditions. In this course, we will learn and apply concepts and methods in Service Science for service management and engineering.

MGE311 Quantitative Finance [계량재무론]

In this course, we will review of basic probability theory with random variables, expectation, variance and covariance, the properties of normal distribution and the central limit theorem. Students are going to understand the asset dynamics models and bond, forward/future, option pricing.

MGE312 Quantitative Risk Management [정량적 리스크 관리]

This course is designed to study effective ways of managing financial risks from the perspective of corporations and financial institutions. Major topics include ALM(Asset liability management), VaR, interest rate risk management, credit risk management, and exchange risk management. Other topics include practical cases and statistical tools for risk manage- ment. Finally, this course deals with theories and recent advances in structured products, interest and credit-related derivatives as a tool for risk management. Students are required to have a solid understanding of basics of futures, options and swaps.

MGE362 Quality Management [품질관리]

The objective of this course is to teach various methods that can be used for improving the quality of products and processes. Topics for this course are quality system requirements, designed experiments, process capability analysis, measurement capability, statistical process control, and acceptance sampling plans.

MGE404 Business Process Management [프로세스 관리]

Business processes are ubiquitous in modern organizations and their execution is increasingly supported by advanced information systems, which make available a large amount data related to their design and execution. The first part of this course focuses on the typical phases of business process management in an organisation, that is, business process identification, business process modelling (using BPMN 2.0), and business process analysis and improvement. The second part focuses on process mining, that is, a state of the art technique to extract knowledge about business processes, e.g., process models, from the logs of the IT systems supporting their execution.

MGE405 Applied Programming for Management Engineering [경영공학프로그래밍]

This courses focuses on Python as a programming language and covers basic and advanced topics related to algorithm design and data management. The first part of the course focuses on fundamental data structures (e.g., stacks, queues, trees, heaps) and algorithms (e.g., recursion, sorting) for programming. In the second part, the course looks at advanced data structures, such as graphs, and advanced aspects related to data acquisition and processing, e.g., natural language and text processing or tracking and processing of live Twitter streams. The objective of the course is to give students the ability to design advanced algorithms for acquiring, storing and processing effectively data regardless of the application domain

MGE411 Financial Engineering and Trading Management [금융공학 및 트레이딩 관리]

This course is for the student who is interested in modeling the financial derivatives trading. The general quantitative finance will be presented excluding mathematical proofs. All the theoretic explanation will be implemented with the Microsoft Excel for the practical uses during the class.

MGE412 Advanced Quantitative Finance [고급계량재무론]

In this course, we will learn about the stochastic process on the continuous time line and the theoretical approaches for finding financial derivatives values. This course will mainly focus on understanding main properties on Brownian motion and the derivative pricing theory with a Black-Scholes_Merton approach and a probabilistic approach. This course will focus mainly on the theory but examines some estimation methods as well empirical evidence.

MGE413 Fixed Income Analysis [이자율 상품 분석]

This course is designed to introduce the fixed income market. Students are going to understand the time value of money and the relation between price and yield. The derivatives products underlain by money or bond such as swaps or options will be introduced as well. Most of explanations will be applied to practical market situations.

MGE414 Time-series Analysis [시계열 분석]

This course introduces regression analysis and applications to investment models. Principal components and multivariate analysis. Likelihood inference and Bayesian methods. Financial time series. Estimation and modeling of volatilities. Statistical methods for portfolio management.

MGE450 Project Lab. [프로젝트 랩]

Students and strategic partners from industry will work in project teams and undertake management engineering industrial projects. The teams must aim to disseminate completed project outcomes to industry. The progress of each project will be reviewed based on formal presentations

MGE470 Special Topics in MGE Ⅰ [MGE 특론Ⅰ]

This course is designed to discuss contemporary topics in Management Engineering. Actual topics and cases will be selected by the instructor and may vary from term to term.

MGE471 Special Topics in MGE Ⅱ [MGE 특론Ⅱ]

This course is designed to discuss contemporary topics in Management Engineering. Actual topics and cases will be selected by the instructor and may vary from term to term.

MGE472 Special Topics in MGE Ⅲ [MGE 특론 Ⅲ]

This course is designed to discuss contemporary topics in Management Engineering. Actual topics and cases will be selected by the instructor and may vary from term to term.

Graduate

Graduate
Contents

Credit Requirement for Each Department

Department	Major	Credit Total credit(Course credit/Research Credit)		
		Master's Program	Doctoral Program	Combined Master's-Doctoral Program
Electrical Engineering	Electrical Engineering	28(21/7)	60(18/42)	60(36/24)
Computer Science and Engineering	Computer Science and Engineering	28(21/7)	60(18/42)	60(36/24)
Mechanical Engineering	Mechanical Engineering	28(18/10)	60(18/42)	60(30/30)
Nuclear Engineering	Nuclear Engineering	28(18/10)	60(24/36)	60(33/27)
Materials Science Engineering	Materials Science Engineering	28(15/13)	60(12/48)	60(24/36)
Biological Sciences	Biological Sciences	28(21/7)	60 (At least15 /At least17)	60 (At least30 /At least24)
Biomedical Engineering	Biomedical Engineering	28(21/7)	60 (At least12 /At least20)	60 (At least30 /At least24)
Human Factors Engineering	Human Factors Engineering	28(18/10)	60(18/42)	60(30/30)
Urban and Environmental Engineering	Environmental Science and Engineering	28(24/4)	60(18/42)	60(36/24)
	Urban Infrastructure Engineering			
	Disaster Management Engineering			
	Convergence of Science and Arts			
Energy Engineering	Energy Engineering	28(15/13)	60(15/45)	60(24/36)
	Battery Science and Technology			
Chemical Engineering	Chemical Engineering	28(15/13)	60(12/48)	60(21/39)
Chemistry	Chemistry	28(15/13)	60 (At least12 /At least20)	60 (At least21 /At least33)
Physics	Physics	28(21/7)	60(15/45)	60(33/27)
Mathematical Sciences	Mathematical Sciences	28(24/4)	60(24/36)	60(36/24)
Management Engineering	Management Engineering	28(24/4)	60(24/36)	60(36/24)

Degree conferred for Each Department

Department	Degree	
	M.S.	Ph.D.
Electrical Engineering	Master of Science in Electrical Engineering	Doctor of Philosophy in Electrical Engineering
Computer Science and Engineering	Master of Science in Computer Science and Engineering	Doctor of Philosophy in Computer Science and Engineering
Mechanical Engineering	Master of Science in Mechanical Engineering	Doctor of Philosophy in Mechanical Engineering
Nuclear Engineering	Master of Science in Nuclear Engineering	Doctor of Philosophy in Nuclear Engineering
Materials Science Engineering	Master of Science in Materials Science Engineering	Doctor of Philosophy in Materials Science Engineering
Biological Sciences	Master of Science in Biological Sciences	Doctor of Philosophy in Biological Sciences
Biomedical Engineering	Master of Science in Biomedical Engineering	Doctor of Philosophy in Biomedical Engineering
Human Factors Engineering	Master of Science in Human Factors Engineering	Doctor of Philosophy in Human Factors Engineering
Urban and Environmental Engineering	Master of Science in Environmental Science and Engineering	Doctor of Philosophy in Environmental Science and Engineering
	Master of Science in Urban Infrastructure Engineering	Doctor of Philosophy in Urban Infrastructure Engineering
	Master of Science in Disaster Management Engineering	Doctor of Philosophy in Disaster Management Engineering
	Master of Science in Convergence of Science and Arts	Doctor of Philosophy in Convergence of Science and Arts
Energy Engineering	Master of Science in Energy Engineering	Doctor of Philosophy in Energy Engineering
	Master of Science in Battery Science and Technology	Doctor of Philosophy in Battery Science and Technology
Chemical Engineering	Master of Science in Chemical Engineering	Doctor of Philosophy in Chemical Engineering
Chemistry	Master of Science in Chemistry	Doctor of Philosophy in Chemistry
Physics	Master of Science in Physics	Doctor of Philosophy in Physics
Mathematical Sciences	Master of Science in Mathematical Sciences	Doctor of Philosophy in Mathematical Sciences
Management Engineering	Master of Science in Management Engineering	Doctor of Philosophy in Management Engineering

Department of Electrical Engineering

□ Electrical Engineering [EE]

Electrical Engineering (EE) is the field of study that deals with everything from solid-state devices and designing integrated circuits to developing information, communication and control systems. Over 22 faculty members are committed to the EE program while actively contributing in various research groups - Image Processing and Computer Vision Research Group, Information & Networks Research Group, Semiconductor Device &Circuit Design Research Group, EM &Wireless Power Transfer Research Group. The EE program is firmly committed to sustaining excellence in traditional areas of strength while venturing into areas of opportunity. Research and education in the EE program includes the area of Communication, Control, Signal Processing; Analog, Digital, RF and Power Circuit Design; Power Electronics and Systems; Electronic Devices and Materials; and Photonics.

• Communication, Control, & Signal Processing

The Communication, Control, and Signal Processing area focuses on research and development of IT convergence systems that are capable of enriching the future human society with pleasant, secure, convenient, and socially connected living environments. The broad range of IT technologies covered by this track is cohesively merged together to reap the new benefits in the ubiquitous information society driven by the digital convergence. The research areas in Communication, Control, and Signal Processing include cutting-edge future IT technologies and convergence systems such as wireless communications, channel coding for communication systems, wireless and mobile networking, human-friendly intelligent robotic systems, decision and control system, image and video processing, computer vision, 3D visual processing, machine learning, medical image processing, and future smart home systems.

• Analog, Digital, RF & Power Circuit Design

The Analog, Digital, RF, & Power Circuit Design area focuses on a vital area of electrical engineering represented by the core technology needed in implementing consumer electronics, automotive IT, communication systems and biomedical systems. Research in analog and RF circuit design circuits includes high-speed analog-digital converters, RF and wireless communication ICs, sensor network devices, RFID, antenna design, automotive IT and e-health sensors. Research in VLSI digital circuits includes low-power and high-performance microprocessor and mixed signal circuits including CAD (computer-aided design), physical design, and design for testing and manufacturability, next generation semiconductor devices, packaging, and power/signal integrity. Research in power circuit design includes power converters, power interface systems, and power conditioning for various applications such as renewable energy, EVs, and smart grid.

• Electronic & Photonic Devices

The Electronic & Photonic Devices area focuses on research and development of next-generation semiconductor electronic devices and photonic/plasmonic devices covering most of the electromagnetic wave spectrum including microwave, THz, mid-/near-infrared and visible light. Research in electronic devices focuses on nanoscale non-planar CMOS devices, multi-level logic/memory devices, flexible devices, neuromorphic devices, and high-performance THz detectors/emitters, which is a part of the cooperative research effort aiming at developing electronic brain and THz sensing systems for security, safety, and medical applications. Research in photonic/plasmonic devices focuses on photonic waveguide devices which constitute photonic integrated-circuits used for optical interconnects and optical sensors, plasmonics in which a variety of peculiar optical phenomena related to light-matter interaction in metal or metal/dielectric interfaces are studied, and metamaterials with novel properties which cannot be observed from materials existing in nature.

□ Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 21 credits	at least 7 credits (at least 1 credit for ECE Graduate Seminar, at least 6 credits for Master’s Research)
Doctoral Program	at least 60 credits	at least 18 credits	at least 42 credits (at least 2 credits for ECE Graduate Seminar, at least 40 credits for Doctoral Research)
Combined Master's-Doctoral Program	at least 60 credits	at least 36 credits	at least 24 credits (at least 3 credits for ECE Graduate Seminar, at least 21 credits for Doctoral Research)

Curriculum

▶ Electrical Engineering [EE]

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Required	ECE590	Research	ECE Graduate Seminar	ECE 대학원 세미나	1-1-0	EE211, EE311	X
	ECE690		Master's Research	석사논문연구	가변학점		
	ECE890		Doctoral Research	박사논문연구	가변학점		
Elective	EE506	Lecture	Introduction to Optimization	최적화 이론	3-3-0	EE533	O
	CSE512		Graph Theory	그래프 이론	3-3-0		O
	EE530		Image Processing	영상처리	3-3-0	EE211, EE311	
	EE531		Intelligent Systems	지능형시스템	3-3-0	EE211, EE311	
	EE532		Linear System Theory	선형시스템이론	3-3-0	EE211, EE311, EE313	
	EE533		Advanced Linear Algebra	고급선형대수학	3-3-0	EE211, EE311	
	EE534		Modern Digital Communication Theory	디지털 통신 이론	3-3-0	EE412	
	EE535		Robotics	로봇공학	3-3-0	EE211, EE311, EE313	
	EE536		3D Visual Processing	3차원 영상처리	3-3-0	EE211, EE311	O
	EE537		Audio Engineering	오디오 공학	3-3-0	EE411	
	EE538		Data Communication Networks	데이터 통신망	3-3-0	EE211	O
	EE539		Advanced Control Techniques	최신제어기법	3-3-0	EE313	
	EE540		Stochastic Optimization	스토캐스틱 최적화	3-3-0	EE211	
	EE541		Modern Probability Theory and Stochastic Processes	확률신호론	3-3-0	EE211, EE311	
	EE542		Introduction to Medical Image Processing	의료영상처리의 기초	3-3-0	EE311	O
	EE543		Computer Vision	컴퓨터 비전	3-3-0	EE211, EE311	O
	EE550		Electric Machines and Drives	전기기기 및 제어	3-3-0	EE231	
	EE551		Analog Filters	아날로그 필터	3-3-0	EE301	
	EE552		Operational Amplifier Design	연산증폭기 설계	3-3-0	EE301	
	EE553		Digital Integrated Circuits	디지탈 집적회로	3-3-0	EE301	O
	EE554		Electronic Packaging Design	전자패키징설계	3-3-0	EE231	

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	EE555	Lecture	Advanced Power Electronics	고급 전력전자 공학	3-3-0	EE231, EE301, EE404	
	EE556		Antenna Engineering	안테나 공학	3-3-0	EE231, EE204	
	EE557		Data Converter Circuits	데이터 변환기 회로	3-3-0	EE301	
	EE558		Advanced Analog IC Design	고급 아날로그 IC 디자인	3-3-0	EE301, EE302	
	EE559		Wireless IC Design	무선 IC 디자인	3-3-0	EE301, EE302	
	EE560		Power Systems	전력 시스템	3-3-0	EE301, EE313	
	EE571		Advanced Electromagnetics	고급전자기학	3-3-0	EE231, EE204	
	EE572		Numerical methods in Electromagnetics	전자기장수치해석	3-3-0	EE231, EE204	O
	EE575		Modern RF Engineering	현대초고주파공학	3-3-0	EE231, EE204	O
	EE576		Advanced Photonics	고급 광자학	3-3-0	EE231, EE204	
	EE577		Microelectronics Lab	전자소자실험	3-1-4	EE331	
	EE578		Advanced Semiconductor Device Engineering	고급 반도체소자 공학	3-3-0		
	EE580		Automotive Elective System Design	융합전자시스템설계	3-3-0	EE404	
	EE581		Automotive Electronics Ⅰ	자동차 반도체 설계 Ⅰ	3-3-0	EE404	
	EE582		Automotive Electronics Ⅱ	자동차 반도체 설계 Ⅱ	3-3-0	EE404	
	EE630		Special Topics in Communication, Control, and Signal Processing Ⅰ	통신,제어 및 신호처리 특수토픽 Ⅰ	3-3-0		
	EE631		Special Topics in Communication, Control, and Signal Processing Ⅱ	통신,제어 및 신호처리 특수토픽 Ⅱ	3-3-0		
	EE632		Special Topics in Communication, Control, and Signal Processing Ⅲ	통신,제어 및 신호처리 특수토픽 Ⅲ	3-3-0		
	EE633		Special Topics in Communication, Control, and Signal Processing Ⅳ	통신,제어 및 신호처리 특수토픽 Ⅳ	3-3-0		
	EE634		Special Topics in Communication, Control, and Signal Processing Ⅴ	통신,제어 및 신호처리 특수토픽 Ⅴ	3-3-0		
	EE635		Special Topics in Electronic Design and Applications Ⅰ	전자회로 설계및 응용 특수토픽 Ⅰ	3-3-0		
	EE636		Special Topics in Electronic Design and Applications Ⅱ	전자회로 설계및 응용 특수토픽 Ⅱ	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	EE637	Lecture	Special Topics in Electronic Design and Applications III	전자회로 설계및 응용 특수토픽 III	3-3-0		
	EE638		Special Topics in Electronic Design and Applications IV	전자회로 설계및 응용 특수토픽 IV	3-3-0		
	EE639		Special Topics in Electronic Design and Applications V	전자회로 설계및 응용 특수토픽 V	3-3-0		
	EE640		Special Topics in Device Physics I	소자물리 특수토픽 I	3-3-0		
	EE641		Special Topics in Device Physics II	소자물리 특수토픽 II	3-3-0		
	EE731		Information Theory	정보이론	3-3-0	EE211, EE311, EE312, EE541	
	EE732		Advance Digital Signal Processing	고급디지털 신호처리	3-3-0	EE211, EE311, EE411, EE541	
	EE733		Optimal Control Theory	최적 제어 이론	3-3-0	EE211, EE311, EE532	
	EE734		Estimation & Decision Theory	추론 및 의사결정 이론	3-3-0	EE211, EE311, EE411, EE541	
	EE735		Pattern Recognition	패턴 인식	3-3-0	EE211, EE311, EE541	O
	EE736		Channel Coding Theory	채널코딩 이론	3-3-0	EE211, EE311, EE312, EE541	
	EE737		Data Compression	데이터 압축	3-3-0	EE211, EE311, EE541	
	EE738		Advanced Wireless Communication Theory	고급 무선 통신 이론	3-3-0	EE412, EE534	
	EE752		Advanced Integrated System Design	아날로그 시스템 디자인	3-3-0	EE301, EE302	
	EE753		Advanced Digital IC Design	고급 디지털 회로 설계	3-3-0	EE201, EE301	O
	EE754		Low Noise Electronic System Design	저잡음 전자시스템 디자인	3-3-0	EE301, EE302	
	EE755		Frequency Synthesizers	주파수 발생기 이론	3-3-0	EE301, EE302	
	EE756		Electronic Oscillators	전자 발진기 이론	3-3-0	EE301, EE302	
	EE759		Intelligent Power Interface	지능형 전력 인터페이스	3-3-0	EE404, EE555	

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	EE772	Lecture	Nanoscale Electronic Devices	나노전자소자	3-3-0	PHY315	O
	EE773		Compound Semiconductor Devices	화합물 반도체 소자	3-3-0	PHY315	O
	EE774		Plasma in Device Manufacturing	플라즈마공정	3-3-0	EE231, PHY204	O
	EE775		Electromagnetic compatibility	전자파 적합성	3-3-0		O
	EE778		Electronic Carrier Transport Physics	전하 수송 물리	3-3-0		O
	EE782		Nanophotonics	나노광자학	3-3-0		O
	EE830		Advanced Topics in Communication, Control, and Signal Processing Ⅰ	통신,제어 및 신호처리 고급토픽 Ⅰ	3-3-0		
	EE831		Advanced Topics in Communication, Control, and Signal Processing Ⅱ	통신,제어 및 신호처리 고급토픽 Ⅱ	3-3-0		
	EE832		Advanced Topics in Communication, Control, and Signal Processing Ⅲ	통신,제어 및 신호처리 고급토픽 Ⅲ	3-3-0		
	EE833		Advanced Topics in Communication, Control, and Signal Processing Ⅳ	통신,제어 및 신호처리 고급토픽 Ⅳ	3-3-0		
	EE834		Advanced Topics in Communication, Control, and Signal Processing Ⅴ	통신,제어 및 신호처리 고급토픽Ⅴ	3-3-0		
	EE835		Advanced Topics in Electronic Design and Applications Ⅰ	전자회로 설계및 응용 고급토픽 Ⅰ	3-3-0		
	EE836		Advanced Topics in Electronic Design and Applications Ⅱ	전자회로 설계및 응용 고급토픽 Ⅱ	3-3-0		
	EE837		Advanced Topics in Electronic Design and Applications Ⅲ	전자회로 설계및 응용 고급토픽 Ⅲ	3-3-0		
	EE838		Advanced Topics in Electronic Design and Applications Ⅳ	전자회로 설계및 응용 고급토픽 Ⅳ	3-3-0		
	EE839		Advanced Topics in Electronic Design and Applications Ⅴ	전자회로 설계및 응용 고급토픽 Ⅴ	3-3-0		
	EE840		Advanced Topics in Device Physics Ⅰ	소자물리 고급토픽 Ⅰ	3-3-0		
	EE841		Advanced Topics in Device Physics Ⅱ	소자물리 고급토픽 Ⅱ	3-3-0		
	PHY503		Electrodynamics Ⅰ	전기역학 Ⅰ	3-3-0		
	PHY505		Quantum Mechanics Ⅰ	양자역학 Ⅰ	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	PHY561	Lecture	Plasma Physics	플라즈마 물리	3-3-0	EE231, PHY203, PHY204	
	PHY723		Interface Physics of Electronic Devices	전자소자 계면물리	3-3-0	EE331	O
	PHY761		Physics of Vacuum Electron Devices	진공 전자소자 물리	3-3-0		O
	PHY763		Laser-Plasma Physics	레이저-플라즈마 물리	3-3-0	PHY427	
	PHY765		Nuclear Fusion Engineering	핵융합 공학	3-3-0		O
	ECS527		Organic Electronics	유기일렉트로닉스	3-3-0		

Description

ECE590 ECE Graduate Seminar ECE [대학원 세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D level by invited talks of the experts in various related scientific or engineering fields, and also possibly by presentations of the students in the course to exchange their own ideas and updated information for creative and fine-tuned achievements.

ECE690 Master's Research [석사논문연구]

This course is related to the student's graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

ECE890 Doctoral Research [박사논문연구]

This course is related to the student's graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

EE506 Introduction to Optimization [최적화 이론]

This course introduces basic optimization theory and methods, with applications in systems and control. The course will cover constrained and unconstrained optimization, linear programming, convex analysis, various algorithms and search methods for optimization, and their analysis. Examples from various engineering applications are given. Prerequisite of linear algebra and calculus of several variables.

CSE512 Graph Theory [그래프 이론]

This course studies the theories of graphs that are useful in solving problems in computer science/engineering especially in networking, communication, and database. This course also focuses on how to apply the theories of graphs to practical problems and how to implement the solution techniques using computer languages. The major topics to be covered include matchings, factors, connectivity, coloring, and cycles of various types of graphs.

EE530 Image Processing [영상처리]

This course introduces mathematical representations of continuous and digital images, basic coding schemes and formats, picture enhancement, models of image degradation and restoration, segmentation, and pattern recognition.

EE531 Intelligent Systems [지능형시스템]

Intelligent Systems are studied with particular attentions to CI(Computational Intelligence)-based design techniques and their applications in uncertain/ambiguous environments. Topics includes fuzzy logic, artificial neural networks, evolutionary computation, support vector machine, swarm intelligence, immune systems with their real-life applications for automation system control and data/information processing including gesture and facial expression recognition.

EE532 Linear System Theory [선형시스템이론]

This course provides basic system theory for various engineering problems; solution of the linear system, equilibrium points and linearization, natural and forced response of state equations, system equivalence and Jordan form, BIBO stability, controllability and duality, control-theoretic concepts.

EE533 Advanced Linear Algebra [고급선형대수학]

This course extends the undergraduate linear algebra and focus on vector spaces, dual vector spaces, eigenvalues and eigen vectors, Positive definiteness, Jordan form, linear transformations (e.g., orthogonal and unitary transformations), matrix decompositions (e.g., QR and singular value decompositions), least square approximation and linear programming.

EE534 Modern Digital Communication Theory [디지털 통신 이론]

This course covers digital transmission of information over the channels using modern communication technologies. The topics include source coding, channel coding, digital modulation, decision theory, fundamental limits in coding and modulation, capacity and throughput analysis, and wireless channel model.

EE535 Robotics [로봇공학]

This course introduces advanced topics in robot control methods such as servo mechanism design, man machine interface, teleoperation, force control, and stereo vision.

EE536 3D Visual Processing [3차원 영상처리]

This course is offered to graduate students and introduces the researches in 3D Visual Processing. Topics include 3D data acquisition, 3D modeling, 3D data compression and transmission, 3D image processing, 3D rendering and visualization, and 3D display.

EE537 Audio Engineering [오디오 공학]

This course studies concepts of acoustics and electroacoustic modeling for the analysis and design of microphones, loudspeakers, and crossover networks. Methods of analysis and design of audio power amplifiers are also covered.

EE538 Data Communication Networks [데이터 통신망]

This course covers general connection methods of data networks and data communication architectures. The topics are: data link control (e.g., error correction, framing), message delay analysis (e.g., Markov processes, queuing), network delay analysis (e.g., Kleinrock independence, throughput analysis), and multiple access networks (e.g., ALOHA, carrier sensing).

EE539 Advanced Control Techniques [최신제어기법]

Based on mathematical foundations, this course concerns advanced control methods such as adaptive control, robust control, predictive control, fuzzy control, etc.

EE540 Stochastic Optimization [스토캐스틱 최적화]

This course is an introductory course for optimization of stochastic systems via mathematical modeling. The topics may include linear programming (e.g., simplex method, interior point method), convex optimization, dynamic programming (e.g., shortest path algorithm, infinite horizon problems, average cost optimization), and Markov decision process.

EE541 Modern Probability Theory and Stochastic Processes [확률신호론]

This course covers probability theories such as probability measure, random variable, distribution, expectation, Markov chains, renewal theory and queuing theory, and stochastic processes such as Poisson process, random walks and Brown motion.

EE542 Introduction to Medical Image Processing [의료 영상 처리의 기초]

Principles of modern medical imaging systems. For each modality the basic physics is described, leading to a mathematical systems model of the imager. Then, image reconstruction algorithm for each system will be derived. Modalities covered include radiography, x-ray computed tomography (CT), MRI, and ultra-sound.

EE543 Computer Vision [컴퓨터 비전] (equivalent to CSE543)

This course aims at learning how to extract valuable information from visual scenes using computers. Topics may include the basic theories for capturing images by cameras, human visual perception, filtering, edge detection, segmentation, stereo, motion analysis, feature extraction, and object recognition.

EE550 Electric Machines and Drives [전기기기 및 제어]

Electric machine is an essential component in modern electric power applications such as electric vehicles, renewable energy generation, robotics, and industrial electronics. This course introduces the basic background of electric machines and drives, including the electromechanical energy conversion, steady-state and dynamic operations, control of AC and DC machines. As advanced topics, electromagnetic analysis and design of electric machines are also covered.

EE551 Analog Filters [아날로그 필터]

This course is an introduction to the theory, design techniques, and applications of analog passive, active, and switched-capacitor filters.

EE552 Operational Amplifier Design [연산증폭기 설계]

This course studies analysis and design techniques for the utilization of integrated circuit operational amplifiers for applications in electronic systems.

EE553 Digital Integrated Circuits [디지털 집적회로]

This course studies analysis and design of MOS digital integrated circuit families necessary for Very Large Scale Integrated (VLSI) circuits and their applications in modern electronic systems. This course introduces full-custom (or semi-custom) integrated circuit design with help of several EDA tools (e.g., schematic and layout design, parasitic extraction, and DRC/LVS, etc). This course is highly project-oriented.

EE554 Electronic Packaging Design [전자패키징설계]

The electronic packaging in real-world applications is compromised by artifacts of the analog and digital circuit design, IC package, and printed circuit boards. This course gives engineers the necessary skills in the circuit and electromagnetic designs to ensure signal quality between a driver and a receiver and electromagnetic compatibility.

EE555 Advanced Power Electronics [고급 전력전자 공학]

The objective of this course is to study and discuss the recent technology of power electronics. Main topics will cover topology of new dc-dc converter, resonant converters, bidirectional converters, and PFCs. In addition, new control scheme for power electronics and hot applications such as smart gird, renewable energy, EV, and DC distribution/transmission will be treated.

EE556 Antenna Engineering [안테나 공학]

This course is designed for understanding the fundamental theory of antennas used in various wireless applications. The course covers electromagnetic radiation theory, small antennas, array antennas, resonant antennas, broadband antennas, aperture antennas, and antenna synthesis theory. Practical aspects for antenna designs are also considered.

EE557 Data Converter Circuits [데이터 변환기 회로]

Data converters are essential circuits to provide data conversions between analog signals and digital signals. Various ADC(Analog-to-Digital Converter) and DAC(Digital-to-Analog Converter) circuits and their recent technology trends are covered.

EE558 Advanced Analog IC Design [고급 아날로그 IC디자인]

A progression from the Analog Integrated Circuits course, this course covers advanced and state-of-the-art design of analog circuits using CMOS and bipolar technology with emphasis on practical implementation and examples.

EE559 Wireless IC Design [무선IC 디자인]

Wireless system specifications are translated to architectures and building blocks compatible with silicon technology. The course focuses on the analysis and design of these blocks.

EE560 Power Systems [전력시스템]

This course introduces the fundamentals of electric power systems, which covers power generation, transmission, and operation analysis. Topics include three-phase power analysis, transmission line modeling, distributions systems, power flow analysis, and grid stability. The effects of recent developments, such as renewable energy and distributed resources will also be discussed.

EE571 Advanced Electromagnetics [고급전자기학]

In this course we provide the student with the basic knowledge of electrodynamics, which are necessary to understand the advanced electrodynamics. The electrostatics, magnetostatics, boundary value problems, Maxwell equations, and wave propagations are covered.

EE572 Numerical methods in Electromagnetics [전자기장수치해석]

This course introduces popular numerical techniques for simulating electromagnetic fields: the finite difference method, the finite element method and the method of moments. To assess the accuracy of numerical methods, von Neumann stability analysis, convergence analysis and dispersion analysis are used. As applications, we develop numerical codes for simulating scattering and antenna design.

EE575 Modern RF Engineering [현대초고주파공학]

This course covers from the fundamentals of RF/microwave engineering to applications of RF/microwave devices based on in-depth knowledge of microwave components. The emerging millimeter, submillieter, and THz technology will be also introduced. Basic principles of RF oscillators, amplifiers, and passive components, and circuits will be introduced. Modern usage of RF/microwave/millimeter-wave components will be broadly covered.

EE576 Advanced Photonics [고급 광자학]

This course intends to provide knowledge for a research in the field of photonics. It covers a few fundamental and advanced topics related to photonics, especially integrated waveguide based photonics. The topics include: electromagnetic waves in anisotropic media, Gaussian beam propagation, resonance, coupled-mode theory, nonlinear optical effect, and optical modulation.

EE577 Microelectronics Lab [전자소자실험]

This course supplies students hands-on experiences on semiconductor device fabrication processes (oxidation, chemical cleaning/etching, lithography, diffusion, metalization) by actually making planar diodes and transistors on a silicon wafer in cleanroom environment. Students also learn about the methodologies of characterizing the fabricated devices.

EE578 Advanced Semiconductor Device Engineering [고급 반도체소자 공학]

The main purpose of this course is to teach the basic knowledges of semiconductor governing equations such as Poisson's equation and continuity equations, and carrier transport equations on the numerical TCAD (technology computer-aided design) platform. In addition the course teaches discretization methods and how to solve nonlinear algebraic equations.

EE580 Automotive Elective System Design [융합전자시스템설계]

This course aims to convey a knowledge of Implementation of integrated circuit of IT convergence system and latest research trend. In this semester, extra focus will be given to the following topics: IT convergence system research, Sensor technology for IT convergence systems, Processor technology for IT convergence systems, Integrated circuit implementation of IT convergence system.

EE581 Automotive Electronics I [자동차 반도체 설계 I]

The aim of this course is to introduce the architecture of automotive ECU (Electronic Control Units) along with its system components, design requirements and real applications in automotive electronic industry. The underlying physics and its characteristics of semiconductor devices such as power MOSFET would be covered. Also, BCDMOS fabrication technologies, circuit design and implementation would be covered.

EE582 Automotive Electronics II [자동차 반도체 설계 II]

The aim of this course is to cover the system architecture and key circuit design blocks of automotive IVN (In-Vehicle Network) such as CAN/CAN-FD, LIN, PSI-5, and SENT protocol. This course will carry out the real circuit design implementation of CAN and LIN function along with other key function blocks. Also, this will cover the requirement of the functional safety or so called ISO26262 from actual design perspective.

EE630~ECE634 Special Topics in Communication, Control, and Signal Processing I~V [통신,제어 및 신호처리 특수토픽 I~V]

This course introduces new research topics in the field of Communication, Control, and Signal Processing I~V.

EE635~ECE639 Special Topics in Electronic Design and Applications I~V [전자회로 설계및 응용 특수토픽 I~V]

This course introduces new research topics in the field of Electronic Design and Applications I~V.

EE640 Special Topics in Device Physics I [소자물리 특수토픽 I]

This course introduces new research topics in the field of Device Physics I.

EE641 Special Topics in Device Physics II [소자물리 특수토픽 II]

This course introduces new research topics in the field of Device Physics II.

EE731 Information Theory [정보이론]

This course introduces information theory which is a base for efficient data storage, compression, and transmission in communications. The topics include entropy, channel capacity, source coding theorems, channel coding theorems, and rate-distortion theory.

EE732 Advance Digital Signal Processing [고급디지털 신호처리]

This course introduces advanced signal processing methods. Topics include statistical and deterministic least square filters design, adaptive filtering, applications in beam-forming and spectral estimation.

EE733 Optimal Control Theory [최적 제어 이론]

This course introduces optimal control theory, including calculus of variations, the maximum principle, and dynamic programming for linear-quadratic control, differential games, and H-infinity control synthesis.

EE734 Estimation & Decision Theory [추론 및 의사결정 이론]

This course introduces estimation and decision theory applied to random processes and signals in noise: Bayesian, maximum likelihood, and least squares estimation; the Kalman filter; maximum likelihood and maximum a posteriori detection, and detection systems with learning features.

EE735 Pattern Recognition [패턴 인식]

This course introduces pattern recognition systems and their components. Topics include decision theories and classification, discriminant functions, supervised and unsupervised training, clustering, feature extraction and dimensional reduction, sequential and hierarchical classification, applications of training, feature extraction, and decision rules to engineering problems.

EE736 Channel Coding Theory [채널코딩 이론]

This course introduces basic error-correcting codes by which channel errors in communications can be detected or corrected. The topics include introductory coding theory, basic algebra for linear codes, and encoding/decoding of cyclic codes, BCH and Reed-Solomon codes, convolutional codes, and Turbo codes.

EE737 Data Compression [데이터 압축]

This course introduces various theories and tools to efficiently store and transmit source data. Topics cover quantization theory, rate-distortion theory, lossless and lossy compression methods, and their practical applications to multimedia data compressions including speech and image.

EE738 Advanced Wireless Communication Theory [고급 무선 통신 이론]

This course covers the fundamentals of wireless communication underpinning the advances in leading-edge wireless technologies. The emphasis is on theory and algorithms for the most salient concepts including multi-input multi-output (MIMO) and OFDMA/CDMA and forefronts of commercialized systems such as WiFi and LTE-A.

EE752 Advanced Integrated System Design [아날로그 시스템 디자인]

Students will study the design of analog systems using CMOS and bipolar technology. A higher level of design for analog and digital systems is presented. Practical examples for communication microsystems are presented.

EE753 Advanced Digital IC Design [고급 디지털 회로 설계]

This course aims to convey a knowledge of application-specific integrated-circuit (ASIC) implementation. Emphasis is on the VLSI circuits and chip-level metrics such as power, area, speed and reliability; along with design automation techniques and methodologies (logic synthesis, physical design, design for testability, physical verification). In this semester, extra focus will be given to the following topics: RTL to tape-out using leading-edge EDA tool, and low-power System-on-Chip (SoC) design techniques.

EE754 Low Noise Electronic System Design [저잡음 전자시스템 디자인]

This course is a study of the sources of noise found in electronic instrumentation. It teaches the recognition of sources of noise and the design techniques to achieve noise reduction.

EE755 Frequency Synthesizers [주파수 발생기 이론]

Frequency synthesizers generate many discrete RF frequencies from one reference frequency. General synthesizers, digital PLL, direct digital, and hybrid synthesizers are covered.

EE756 Electronic Oscillators [전자 발진기 이론]

Starting from non-linear differential equations, this course presents a systematic approach to the design of electronic oscillators. Design of negative resistance and feedback oscillators is discussed. CAD techniques are employed.

EE759 Intelligent Power Interface [지능형 전력 인터페이스]

This course is a lecture for graduate students, especially in Ph.D. course, who are choosing a track in the school of ECE, especially the EE track. It is composed of three-hour lecture as a single course; however, this course requires partially organized student seminars for specific topics of Intelligent Power Interface such as resonant converters. It is designed to give graduate students

(Ph.D. or M.S. graduate students who already took prerequisite lectures of Power Electronics) both the advanced principles and practical knowledge of power electronics, especially, practical design considerations of power converters and resonant converters for high power conversion efficiency.

EE772 Nanoscale Electronic Devices [나노전자소자]

This course is intended to introduce the fundamental scientific principles and technologies of nano-scale electronic devices. We will start with discussing the basic and key concepts of semiconductor device physics, and then applying those concepts for several conventional electronic devices such as p-n junction, bipolar transistor, Schottky diode, and MOSFET. Finally, we will extend our scope to the new types of nanoscale devices that are currently under extensive research and development as candidates to overcome the limitation of current planar CMOS and flash memories, such as 3D structure transistors (dual-, tri-gate), CNT and nanowire applications, MRAM, FRAM and spintronics, etc.

EE773 Compound Semiconductor Devices [화합물 반도체 소자]

This course covers the material properties of III-V compound semiconductor and device fabrication process technologies including epitaxy, doping, and etching, bandgap engineering. Also, several important applications of compound semiconductor such as HEMT will be discussed in depth.

EE774 Plasma in Device Manufacturing [플라즈마 공정]

Plasma is widely used for contemporary materials processing. In this course, the plasma processing of semiconductors and other electronic devices are introduced.

EE775 Electromagnetic compatibility [전자파 적합성]

With a boom of mobile and wearable devices, electromagnetic compatibility problems are becoming increasingly critical due to the decreasing form factor of the systems. This course covers the fundamental theories and necessary skills in the circuit and electromagnetic designs with respect to modeling and analysis of electromagnetic interference (EMI), electromagnetic immunity, electromagnetic susceptibility (EMS), and electrostatic discharge (ESD) issues on system-level, PCB-level, package-level, and IC-chip-level.

EE778 Electronic Carrier Transport Physics [전하 수송 물리]

The purpose of this course is to extend knowledge to the advanced electronic carrier transport physics, which include conductance from transmission function, Green's functions, tunneling and Non-equilibrium Green's function (NEGF) formalism.

EE782 Nanophotonics [나노광자학]

This course intends to provide and discuss advanced knowledge of nanophotonics. It covers a few current topics related to nanophotonics. The topics include: surface-plasmon polariton, plasmonic waveguides, plasmonic waveguide devices, nanophotonic devices like photonic crystals.

EE830~ECE834 Advanced Topics in Communication, Control, and Signal Processing I~Ⅴ [통신,제어 및 신호처리 고급토픽 I~Ⅴ]

This course introduces advanced research topics in the field of Communication, Control, and Signal Processing I~V.

EE835~ECE839 Advanced Topics in Electronic Design and Applications I~Ⅴ [전자회로 설계및 응용 고급토픽 I~Ⅴ]

This course introduces advanced research topics in the field of Electronic Design and Applications I~V.

EE840 Advanced Topics in Device Physics I [소자물리 고급토픽 I]

This course introduces advanced research topics in the field of Device Physics I.

EE841 Advanced Topics in Device Physics I [소자물리 고급토픽 II]

This course introduces advanced research topics in the field of Device Physics II.

PHY503 Electrodynamics I [전기역학 I]

In this course we provide the student with the basic knowledge of electrodynamics, which are necessary to understand the advanced electrodynamics. The electrostatics, magnetostatics, boundary value problems, Maxwell equations, and wave propagations are covered.

PHY505 Quantum Mechanics I [양자역학 I]

This course is intended to improve our understanding of the basic principles and theoretical schemes of quantum mechanics by revisiting the topics covered in undergraduate quantum mechanics with more systematic and advanced mathematical formalism. The basic assumptions, Dirac notation, Hilbert space, Schrodinger equation, harmonic oscillator, angular momentum, spin and identical particles will be discussed.

PHY561 Plasma Physics [플라즈마 물리]

In this intermediate level course of plasma physics, basic frameworks are discussed for understanding of waves in plasmas, diffusion, collisions and energy absorption, MHD model, nonlinear theories of plasma sheath and shock waves etc. The prerequisite is the undergraduate plasma and beam physics or similar topics.

PHY723 Interface Physics of Electronic Devices [전자소자 계면물리]

The interfaces between different materials in an electronic device take crucial roles in determining the functionality and efficiency of the device. This course introduces the basic physics of various interface phenomena occurring in electronic devices, and also the experimental methods characterizing them as well. Particularly, it discusses the electronic band structure and charge/spin transport (lateral, vertical) at interfaces, and their relations to the operational mechanisms of various actual electronic devices.

PHY761 Physics of Vacuum Electron Devices [진공 전자소자 물리]

This course covers basic principles of vacuum electron devices. The electron beam formation, beam-wave interaction, and application of vacuum electron devices are the main topics of this course. The modern vacuum electron devices such as micro-vacuum electronics, and THz frequency sources will be discussed. Students are required to take pre-requisites for this course.

PHY763 Laser-Plasma Physics [레이저-플라즈마 물리]

This course is composed of two parts. Before the midterm, diverse subjects of laser-plasma interactions including the scattering, energy absorption by Bremsstrahlung, particle acceleration, nuclear fusion, terahertz generation, wakefield, and other nonlinear interactions are briefly introduced. After the midterm, specialized lectures are given on the laser-plasma-based particle acceleration and its numerical simulation.

PHY765 Nuclear Fusion Engineering [핵융합 공학]

This course intends to cover basic principles of nuclear fusion and broad knowledge of the current technology in the world. Physics of fusion plasmas and beam-wave interaction are the main themes of the course. Students are required to take pre-requisites for this course.

ECS527 Organic Electronics [유기일렉트로닉스]

This course will cover the basic concepts, mechanisms, and special issues in organic electronics. Based on understanding of the basic properties of inorganic semiconductors, this course will focus on the applications using organic semiconductors such as organic light-emitting diodes, organic solar cells, and organic field-effect transistors.

Department of Computer Science and Engineering

□ Computer Science and Engineering [CSE]

Computer Science and Engineering (CSE) is the field of study that blends principles, theories, and applications of computer technologies that improve access to information. It encompasses computer programming, theoretical computer science, operating systems, databases, computer architecture, artificial intelligence, computer graphics, and human computer interaction just to name a few. Computer science and engineering is not just about how to write computer programs or how to use them, but it tries to tackle the fundamental question - how and what computation can be efficiently automated and implemented.

• Artificial Intelligence

Can machines think? Many pioneers in computer science have investigated this question at some point during their lifetimes. In fact, long before the dawn of computing, people have been fascinated by the possibility of building machines that can think like humans. Artificial Intelligence (AI) is a branch of computer science dedicated to the creation of machines with intelligence. At UNIST, we aim to study all aspects of intelligent machines and build intelligent systems for all kinds of applications. Our research topics include the architecture of intelligent agents, gameplaying programs, knowledge representation and automated reasoning, planning and acting in the real world, machine learning, natural language processing, computer vision and robotics

• Computer Systems & Network

Today's information systems are connected through wired/wireless communications with each other. The fundamental challenges in this area are how to build networked computer systems, and how to design scalable, predictable, reliable, trustable, and yet cost-effective systems, in both hardware and software. Advances in this area are critical to meet the exploding demands of tomorrow's applications arising in other sciences and engineering as well as in our daily lives. UNIST research in this area includes computer architecture, embedded systems, parallel and distributed computing, real-time systems, operating system virtualization, mobile computing, the Internet computing, and ubiquitous computing.

• Graphics and Visualization

"A picture is worth a thousand words." This is still valid in the big data era where heterogeneous data are flooded. Graphics and visualization research focuses on developing novel algorithms and interactive techniques to represent, understand, and manipulate visual information from scientific, industry, and personal data. This research area is inherently interdisciplinary and requires close collaboration across various fields in computer science, including computer graphics, computational geometry, scientific and information visualization, computer vision, image processing, and human-computer interaction. This research will address many practical needs in entertainment, medicine, finance, internet, and domain sciences.

- **Theoretical Computer Science**

Computer science and engineering does not always involve computers. It is as if music is not just about creating musical instruments or how to play them. In fact, computer science problems have been investigated even before modern computers were built. This field focuses on analysis of algorithms, data structures, computational complexity theory, computational biology, computational geometry, information theory, cryptography, algebra, automata theory, and more mathematical aspects of computation.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 21 credits	at least 7 credits (at least 1 credit for ECE Graduate Seminar, at least 6 credits for Master's Research)
Doctoral Program	at least 60 credits	at least 18 credits	at least 42 credits (at least 2 credits for ECE Graduate Seminar, at least 40 credits for Doctoral Research)
Combined Master's-Doctoral Program	at least 60 credits	at least 36 credits	at least 24 credits (at least 3 credits for ECE Graduate Seminar, at least 21 credits for Doctoral Research)

Curriculum

▶ Computer Science and Engineering [CSE]

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Required	ECE590	Research	ECE Graduate Seminar	ECE 대학원 세미나	1-1-0	EE211, EE311	X
	ECE690		Master's Research	석사논문연구	가변학점		
	ECE890		Doctoral Research	박사논문연구	가변학점		
Elective	EE506	Lecture	Introduction to Optimization	최적화 이론	3-3-0	EE533	O
	CSE507		Probabilistic Graph Models	확률 그래프 모델	3-3-0		
	CSE508		Automated Planning and Decision Making	자동 플래닝 및 의사 결정	3-3-0		
	CSE509		Mobile Networks	모바일 네트워크	3-3-0		
	CSE510		System Software	시스템소프트웨어	3-3-0		
	CSE511		Advanced Computer Architecture	고급 컴퓨터 구조	3-3-0	CSE301	O
	CSE512		Graph Theory	그래프 이론	3-3-0		
	CSE513		Formal Languages and Automata	형식언어 및 오토마타	3-3-0		
	CSE514		Advanced Operating Systems	고급 운영체제	3-3-0		
	CSE515		Algorithm Design	알고리즘 디자인	3-3-0		
	CSE516		Compiler Design	컴파일러 디자인	3-3-0	CSE211, CSE221	
	CSE517		Distributed Systems	분산시스템	3-3-0	CSE221, CSE311	
	CSE518		Modern Cryptography	현대암호학	3-3-0	CSE232	
	CSE519		Massively Parallel Programming	대규모 병렬처리 프로그래밍	3-3-0		
	CSE520		Computational Geometry	계산 기하학	3-3-0		
	CSE521		Intelligent Agents and Electronic Marketplace	지능 에이전트와 전자 상거래	3-3-0		
	CSE522		Data Visualization	데이터 가시화	3-3-0		
	CSE523		Human Computer Interaction	인간 컴퓨터 상호작용	3-3-0		O
	CSE524		Software Engineering	소프트웨어 공학	3-3-0		
	CSE525		Parallel Computing	병렬 컴퓨팅	3-3-0		O
	CSE526		Programming Language Design	프로그래밍 언어 설계	3-3-0		
	CSE527		Embedded System Design	내장형 시스템 설계	3-3-0		O
	CSE528		Cloud Computing	클라우드 컴퓨팅	3-3-0		
	CSE529		Autonomous Robots	자율 로봇	3-3-0		O
	CSE530		Algorithms and Complexity	알고리즘과 계산복잡도	3-3-0		
	CSE539		Advanced Computer Networks	고급 컴퓨터 네트워크	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	CSE543	Lecture	Computer Vision	컴퓨터 비전	3-3-0	EE211, EE311	O
	CSE544		Advanced Machine Learning	고급 기계학습	3-3-0		
	CSE610		Special Topics in Computer Engineering I	컴퓨터공학 스페셜 토픽 I	3-3-0		
	CSE611		Special Topics in Computer Engineering II	컴퓨터공학 스페셜 토픽 II	3-3-0		
	CSE612		Special Topics in Computer Engineering III	컴퓨터공학 스페셜 토픽III	3-3-0		
	CSE613		Special Topics in Computer Engineering Ⅳ	컴퓨터공학 스페셜 토픽 Ⅳ	3-3-0		
	CSE614		Special Topics in Computer Engineering Ⅴ	컴퓨터공학 스페셜 토픽 Ⅴ	3-3-0		
	CSE710		Natural Language Processing	자연언어처리	3-3-0		
	CSE714		Artificial Intelligence	고급인공지능	3-3-0		
	CSE715		Advanced Computer Graphics	고급 컴퓨터 그래픽스	3-3-0		
	CSE716		Advanced Database	고급데이터베이스	3-3-0		
	CSE717		Computational Complexity	계산복잡도 이론	3-3-0	CSE513	
	CSE719		Information Retrieval	정보 검색	3-3-0		
	CSE721		Bioinformatics	바이오 인포매틱스	3-3-0		
	CSE722		Discrete Stochastic Processes	이산 확률 프로세스	3-3-0		
	CSE810		Advanced Topics in Computer Engineering I	컴퓨터공학 고급 토픽 I	3-3-0		
	CSE811		Advanced Topics in Computer Engineering II	컴퓨터공학 고급 토픽 II	3-3-0		
	CSE812		Advanced Topics in Computer Engineering III	컴퓨터공학 고급 토픽 III	3-3-0		
	CSE813		Advanced Topics in Computer Engineering Ⅳ	컴퓨터공학 고급 토픽 Ⅳ	3-3-0		
	CSE814		Advanced Topics in Computer Engineering Ⅴ	컴퓨터공학 고급 토픽 Ⅴ	3-3-0		

Description

ECE590 ECE Graduate Seminar ECE [대학원 세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D level by invited talks of the experts in various related scientific or engineering fields, and also possibly by presentations of the students in the course to exchange their own ideas and updated information for creative and fine-tuned achievements.

ECE690 Master's Research [석사논문연구]

This course is related to the student's graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

ECE890 Doctoral Research [박사논문연구]

This course is related to the student's graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

EE506 Introduction to Optimization [최적화 이론]

This course introduces basic optimization theory and methods, with applications in systems and control. The course will cover constrained and unconstrained optimization, linear programming, various algorithms and search methods for optimization, and their analysis. Examples from various engineering applications are given. Prerequisite of linear algebra and calculus of several variables.

CSE507 Probabilistic Graphical Models [확률 그래프 모델]

This course studies a class of graphical models that represent joint probability distributions of random variables. The topics include conditional dependence of random variables, statistical inference, message passing algorithm, Nash equilibrium, (Non-)cooperative game, Bayesian network, Conditional Random Fields.

CSE508 Automated Planning and Decision Making [자동 플래닝 및 의사 결정]

Planning is a fundamental ability for intelligent agents to act successfully in an environment.
Automated planning has been an active area of research in artificial intelligence for over three decades. Planning techniques have been applied in a number of domains including robotics, process planning, web-based information gathering, and spacecraft mission control. This course aims to introduce the basic algorithms and techniques in AI planning research, with an overview of a wide variety of planning paradigms and applications.

CSE509 Mobile Networks [모바일 네트워크]

This course provides the fundamental concepts and algorithms in mobile networks involving cellular networks, mobile ad-hoc networks, and opportunistic networks. The topics covered in this course include naming, routing and transport layer protocols designed and optimized for mobile networks.

CSE510 System Software [시스템소프트웨어]

This course introduces fundamental principles behind diverse system software such as linker, loader, debugger, performance profiler and virtualization hypervisor.

CSE511 Advanced Computer Architecture [고급 컴퓨터 구조]

This course provides the in-depth understanding of the design issues of processors, memory hierarchy, data bus architectures, and storage technologies.

CSE512 Graph Theory [그래프 이론]

This course studies the theories of graphs that are useful in solving problems in computer science/engineering especially in networking, communication, and database. This course also focuses on how to apply the theories of graphs to practical problems and how to implement the solution techniques using computer languages. The major topics to be covered include matchings, factors, connectivity, coloring, and cycles of various types of graphs.

CSE513 Formal Languages and Automata [형식언어 및 오토마타]

This course introduces the theory of formal languages and automata. Finite automata, regular expression, context-free grammar, pushdown automata, turing machine and computability will be covered in this course.

CSE514 Advanced Operating Systems [고급 운영체제]

This course is to introduce the core concepts in operating systems and distributed systems, and study recent research topics on computer systems. This course will cover topics including classic systems, large scale systems, multicore systems, and fault tolerance.

CSE515 Algorithm Design [알고리즘 디자인]

This course provides the practical design and analysis techniques of algorithms. Parallel programming, linear programming, dynamic programming, approximation programming, randomization, amortized analysis, probabilistic analysis, and other advanced algorithm concepts will be dealt with in this course.

CSE516 Compiler Design [컴파일러 디자인]

Through this course, students study basic rules and implementation considerations in implementing a programming language. More details on grammar checks for program syntax, implementation optimization, relations between programming languages and compilers, the role of interpreters, run-time systems, and semantically accurate expressions are also covered.

CSE517 Distributed Systems [분산시스템]

This course studies the key design principles of distributed systems, which are collections of independent networked computers that function as single coherent systems. Covered topics include communication protocols, processes and threads, naming, synchronization, consistency and replication, and fault tolerance. This course also examines some specific real-world distributed systems case studies, ranging from the Internet to file systems. Class discussion is based on readings from the textbooks and research papers.

CSE518 Modern Cryptography [현대암호학]

This is an introductory course on cryptography, covering fundamental cryptographic notions including pseudorandom generators, symmetric-key encryption, message authentication codes, public-key encryption, and digital signatures. Special emphasis is given to rigorous definition and provable security.

CSE519 Massively Parallel Programming [대규모 병렬처리 프로그래밍]

This course introduces state-of-the-art programming techniques for massively parallel computing systems, such as graphics processing units (GPU). The course covers basic parallel programming theories and several programming APIs such as NVIDIA CUDA, OpenCL, and MPI.

CSE520 Computational Geometry [계산 기하학]

Computational geometry studies efficient algorithms and data structures for solving large scale geometry problems. The topics to be covered include computational complexity, convex hull, line segment intersection, Delaunay triangulation, Voronoi diagram, Euclidean shortest path, mesh generation, and so on. The main goal of the course is to make students familiar with the fundamental data structures for geometric objects and train them to develop the efficient data structures. The knowledge and insight about algorithms and data structures gained from this course can be applied to various computer science research - database management systems, distributed systems, geographic information systems, computer graphics, etc.

CSE521 Intelligent Agents and Electronic Marketplaces [지능 에이전트와 전자 상거래]

An intelligent agent is an Artificial Intelligence program that situates in a simulated or physical environment and operates on behalf of a user to achieve certain goals or maximize a performance measure. This course provides a board introduction to the design of intelligent agents, with emphasis on agents in electronic markets. We will also cover computational and game-theoretic topics related to the foundations of electronic marketplaces. Topics include agent architectures and modeling, game theoretic analysis of multiagent systems, automated mechanism design, auction and exchange design, computational social choice, incentive-compatibility, privacy in mechanism design, negotiation and bargaining, reputation systems, prediction markets, advertising markets, and electricity markets.

CSE522 Data Visualization [데이터 가시화]

In this class, we will learn introductory visualization algorithms and data structures frequently used in scientific and information visualization research. The class will cover basic data representation, scalar and vector visualization, image and volume visualization, and information visualization. We will also cover widely used image processing and visualization libraries, such as ITK and VTK.

CSE523 Human Computer Interaction [인간 컴퓨터 상호작용]

This course introduces the concepts of Human-Computer Interaction (HCI) that enables computer scientists to design systems that consider human factors. In this course, students will learn what are the good and bad design from the perspective of users, and analytic and empirical evaluation methods.

CSE524 Software Engineering [소프트웨어 공학]

Software engineering is a sub field of computer science that studies how to analyze and understand software requirements, how to build cost-effective designs and solutions to the problems, and how to manage project teams. In this course, students will learn foundational skills for high-quality graphical user interface prototyping and development based on the underlying software architectures and modern software prototyping toolkits.

CSE525 Parallel Computing [병렬 컴퓨팅]

Parallel computing enables many computations to be carried out concurrently on parallel platforms ranging from multi-core architectures to high-performance clusters. This course introduces parallel architectures, parallel algorithms, parallel programming models and libraries (Pthreads, MPI, PVM, OpenMP), scalability, locking protocols, data localization, and the theoretical models for parallel computation.

CSE526 Programming Language Design [프로그래밍 언어 설계]

This course introduces concepts of the design of high-level programming languages. It includes various programming language features, structural operational semantics, denotational semantics, logic semantics, algebraic implementation of data types, attribute grammar formalism, and axiomatic semantics.

CSE527 Embedded System Design [내장형 시스템 설계]

This course will introduce the fundamentals of embedded system design. Students are required to design and implement an application for an embedded systems platform, and to investigate performance tuning.

CSE528 Cloud Computing [클라우드 컴퓨팅]

This course is to understand key concepts and techniques of cloud computing and virtualization, which is the core technology for cloud computing. This course will cover interesting topics including x86 virtualization, virtual machine management techniques, cloud resource management and optimization, big data analysis on cloud, and high performance computing on cloud.

CSE529 Autonomous Robots [자율 로봇]

Robotics is a topic in artificial intelligence which focuses on the physical aspect of intelligence. A machine that can interact successfully with our physical world is an important incarnation of an intelligent agent. In this course, we will introduce some basic algorithms for robotic research. Topics include, but are not limited to: motion control (PID control), observers and tracking (Kalman filters), localization (particle filters, SLAM), vision (segmentation and object detection), walking (zero-moment point), action and sensor modeling (STRIPS planning, optimization of humanoid walk), path planning (Rapidly-exploring Random Trees), behavior architectures (subsumption architecture), multi-robot coordination (multi-robot patrolling), reinforcement learning (Q-learning, multi-armed bandit), multi-robot interaction (socially intelligent robots), applications (autonomous vehicles), and social implications (Isaac Asimov's "Three laws of Robotics").

CSE530 Algorithms and Complexity [알고리즘과 계산복잡도]

This course gives basic introduction to algorithms and complexity. The topics covered are: review of asymptotic notations, elementary data structures and graph algorithms, dynamic programming, maximum flow, linear programming, Turing machine formalism, the classes P and NP, NP-completeness and reduction, and probabilistic algorithms.

CSE539 Advanced Computer Networks [고급 컴퓨터 네트워크]

This course provides in-depth understanding on the design and implementation of computer and communication networks. It covers a variety of analytical techniques to understand system performance, and advanced networking technologies for performance improvement in wired and wireless environment.

CSE543 Computer Vision [컴퓨터 비전] (equivalent to EE543)

This course aims at learning how to extract valuable information from visual scenes using computers. Topics may include the basic theories for capturing images by cameras, human visual perception, filtering, edge detection, segmentation, stereo, motion analysis, feature extraction, and object recognition.

CSE544 Advanced Machine Learning [고급 기계학습]

The goal of Machine Learning is to build intelligent system that can adapt behaviors based on their experience. This course will study the theory ad application of machine learning methods in graduate level. The main body of the course will cover computational learning theory and various recently developed machine learning methods. The methods includes supervised/unsupervised learning, on-line learning method, Bayesian inference, Support Vector Machine (SVM), Deep Networks and Conditional Random Fields.

CSE610 Special Topics in Computer Engineering I [컴퓨터공학 스페셜 토픽 I]

This course introduces new research topics in the field of Computer Engineering I

CSE611 Special Topics in Computer Engineering II [컴퓨터공학 스페셜 토픽 II]

This course introduces new research topics in the field of Computer Engineering

CSE612 Special Topics in Computer Engineering III [컴퓨터공학 스페셜 토픽 III]

This course introduces new research topics in the field of Computer Engineering

CSE613 Special Topics in Computer Engineering Ⅳ [컴퓨터공학 스페셜 토픽 Ⅳ]

This course introduces new research topics in the field of Computer Engineering

CSE614 Special Topics in Computer Engineering Ⅳ [컴퓨터공학 스페셜 토픽 Ⅳ]

This course introduces new research topics in the field of Computer Engineering

CSE710 Natural Language Processing [자연언어처리]

This course introduces the theory and techniques to process natural language with computer systems.

CSE714 Artificial Intelligence [고급인공지능]

This course provides diverse techniques for designing intelligent decision-making machines. The topics covered in this course are machine learning, expert systems, neural networks, game theory, operations research, and heuristic algorithms.

CSE715 Advanced Computer Graphics [고급 컴퓨터 그래픽스]

This course is an advanced course on the state-of-the-art 3D computer graphics theories and applications. The course will review recent computer graphics and visualization research articles about 3D modeling, rendering, image processing, and volume graphics.

CSE716 Advanced Database [고급데이터베이스]

This course covers database management system design principles and techniques. Possible topics include internal design of DBMS, indexing, query optimization, parallel databases, distributed databases, geographic information systems, data intensive computing, and big data processing. In the first half of the course, we will review internal design of DBMS. In the second half, we will read milestone papers in DB history as well as the state-of-the-art papers mainly focusing on emerging technologies.

CSE717 Computational Complexity [계산복잡도 이론]

Computational complexity theory studies how much resource (time or memory, for example) is required to solve a given computational problem. Topics covered in this class includes time complexity, space complexity, randomized computation, quantum computation, and interactive proofs.

CSE719 Information Retrieval [정보 검색]

This course introduces theory and design of text-based information retrieval systems. It discusses the models and methodologies used in information retrieval systems, statistical characteristics, representation of information, clustering algorithms, collaborative filtering, automatic text categorization, etc.

CSE721 BioInformatics [바이오 인포매틱스]

Bioinformatics studies methods for storing, retrieving, and analyzing biological data, such as protein sequence, structure, and genetic interactions. It deals with various computer science fields including algorithms, databases, information systems, artificial intelligence, data mining, image processing, and discrete mathematics.

CSE722 Discrete Stochastic Processes [이산 확률 프로세스]

The objective of this class is to help students develop the understanding necessary to apply stochastic models to a variety of problems in engineering, science and operations research. The course contains many examples and case studies designed to build insight into the structure of stochastic processes and their impact on real systems, especially in the broad area of communication and networking.

CSE810 Advanced Topics in Computer Engineering I [컴퓨터공학 고급 토픽 I]

This course introduces advanced research topics in the field of Computer Engineering I

CSE811 Advanced Topics in Computer Engineering II [컴퓨터공학 고급 토픽 II]

This course introduces advanced research topics in the field of Computer Engineering II

CSE812 Advanced Topics in Computer Engineering III [컴퓨터공학 고급 토픽 III]

This course introduces advanced research topics in the field of Computer Engineering III

CSE813 Advanced Topics in Computer Engineering Ⅳ [컴퓨터공학 고급 토픽 Ⅳ]

This course introduces advanced research topics in the field of Computer Engineering Ⅳ

CSE814 Advanced Topics in Computer Engineering Ⅴ [컴퓨터공학 고급 토픽 Ⅴ]

This course introduces advanced research topics in the field of Computer Engineering Ⅴ

Department of Mechanical Engineering

Mechanical Engineering [MEN]

Mechanical Engineering deals with numerous systems and has a variety of important applications such as automobiles, aircraft, ships, home appliances, electronic devices, power plants and so on. The mechanical systems and the fundamental science and technology of mechanical engineering have made dramatic advances and high impacts on the global economies and the standard of living. In the track of mechanical engineering, students are educated and trained to learn the underlying principles of mechanical engineering and to apply the knowledge to real-world examples and case studies hands-on. Disciplines include thermodynamics, fluid mechanics, solid mechanics, dynamics, machine design, advanced materials processing, laser-assisted manufacturing, micro/nano machining, MEMS, biomedical products, controls and mechatronics, acoustics, tribology and so on.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 18 credits	at least 10 credits
Doctoral Program	at least 60 credits	at least 18 credits	at least 42 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 30 credits	at least 30 credits

Curriculum

▶ Mechanical Engineering [MEN]

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Required	MEN590	Research	The Seminars	세미나	1-1-0		
	MEN690		Master's Research	석사논문연구	Value of credit		
	MEN890		Doctoral Research	박사논문연구	Value of credit		
Elective	MEN500	Lecture	Advanced Numerical Methods	수치해석특론	3-3-0		
	MEN501		Continuum Mechanics	연속체역학	3-3-0		
	MEN502		Advanced Mechanical Engineering Analysis	기계공학해석특론	3-3-0		
	MEN510		Advanced Thermodynamics	열역학특론	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	MEN511	Lecture	Advanced Heat Transfer	열전달특론	3-3-0		
	MEN512		Advanced Combustion	연소특론	3-3-0		O
	MEN513		Convection Heat Transfer	대류열전달	3-3-0	MEN310	
	MEN520		Advanced Fluid Mechanics	유체역학특론	3-3-0		
	MEN521		Microfluidics and Nanofluidics	미세유체역학	3-3-0		O
	MEN522		Computational Thermofluid Engineering	전산열유체공학	3-3-0		
	MEN523		Advanced Therofluid Measurement	열유동 계측특론	3-3-0		O
	MEN524		Aerosol Technology	에어로졸특론	3-3-0		O
	MEN525		Turbulence	난류특론	3-3-0		
	MEN530		Advanced Solid Mechanics	고체역학특론	3-3-0		
	MEN531		Finite Element Method	유한요소법특론	3-3-0		O
	MEN532		Mechanics of Composites	복합재역학특론	3-3-0	MEN432	
	MEN535		Computational Nanomechanics	전산나노역학	3-3-0		O
	MEN551		Computer-Aided Design	전산기원용설계	3-3-0		O
	MEN552		Manufacturing Processes and Systems	생산공정 및 시스템	3-3-0		
	MEN553		Manufacturing and Process Engineering	생산공학특론	3-3-0		
	MEN554		Machine Tool Analysis and Control	공작기계 해석 및 제어	3-3-0		
	MEN556		Laser Material Interaction and Processing I	레이저 재료 상호작용 및 가공 I	3-3-0		O
	MEN557		Polymer and Composite Manufacturing	고분자 및 복합재료 제조공정	3-3-0		
	MEN558		Advanced MEMS	MEMS특론	3-3-0		O
	MEN559		Bio MEMS	바이오MEMS	3-3-0		O
	MEN560		Unconventional Nanomanufacturing	비전통적 나노가공기술	3-3-0		O
	MEN570		Advanced Dynamics	동역학특론	3-3-0		
	MEN571		Robotics	로봇공학	3-3-0		O
	MEN572		Nonlinear Systems	비선형 시스템	3-3-0		
	MEN573		Advanced Control Systems I	고급제어 I	3-3-0		O
	MEN574		Real-Time Applications of Control Systems	제어 시스템 구현	3-3-0		O
	MEN575		Electromechanical dynamics	전자기기 동력학	3-3-0		O
	MEN656		Laser Material Interaction and Processing II	레이저 재료 상호작용 및 가공II	3-3-0		O
	MEN732		Failure Analysis and Design for Reliability	파괴해석과 신뢰성 설계	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	MEN733	Lecture	Mechanics of Polymer Solids and Fluids	고분자역학	3-3-0		
	MEN734		Scanning Probe Microscopy	주사 탐침 현미경	3-3-0		
	MEN735		Bioinspired Technology	생체모사공학	3-3-0		O
	MEN755		Net Shape Manufacturing	소성가공	3-3-0		
	MEN772		Advanced Analytic Kinematics	해석기구학특론	3-3-0		
	MEN773		Advanced Control Systems II	고급제어 II	3-3-0		O
	MEN774		System Identification and Adaptive Control	시스템식별 및 적응제어	3-3-0		O
	MEN791		Special Topic I	기계공학특론 I	3-3-0		
	MEN792		Special Topic II	기계공학특론 II	3-3-0		
	MEN793		Special Topic III	기계공학특론 III	3-3-0		
	MEN794		Special Topic IV	기계공학특론 IV	3-3-0		
	MEN795		Special Topic V	기계공학특론 V	3-3-0		
	MEN796		Special Topic VI	기계공학특론 VI	3-3-0		
	MEN797		Special Topic VII	기계공학특론 VII	3-3-0		
	MEN796		Special Topic VIII	기계공학특론 VIII	3-1-4		
	MEN797		Special Topic IX	기계공학특론 IX	3-1-4		

Description

MEN500 Advanced Numerical Methods (수치해석특론)

This course focuses on the modern computational and mathematical techniques needed for solving engineering problems. In this course, numerical methods for solving sets of nonlinear algebraic equations, ordinary differential equations, and differential-algebraic (DAE) systems are covered. The use of these techniques will be demonstrated.

MEN501 Continuum Mechanics (연속체역학)

This is a core course for graduate study in Mechanical Engineering. This course provides knowledge of the fundamental, comprehensive concepts of the mechanics of continua, including tensors, rigorous definitions of stress and strain, laws of thermodynamics for a continuum, and fundamentals of behavior of solids and fluids.

MEN502 Advanced Mechanical Engineering Analysis (기계공학해석특론)

This course introduces application of mathematical methods to the description and analysis of systems in mechanical engineering.

MEN510 Advanced Thermodynamics (열역학특론)

This course reviews the fundamentals of macroscopic thermodynamics and then introduces statistical thermodynamics that describes thermodynamic phenomena and analyzes them from the standpoint of microscopic quantities. Topics include the basic principles of thermodynamics, classical kinetic theory, the fundamentals of quantum mechanics, Bose-Einstein and Fermi-Dirac quantum statistics, partition functions, and the Schrodinger equation for the modes of translation, rotation, vibration, etc. Various application methods enabling the estimation of thermodynamic properties will be studied.

MEN511 Advanced Heat Transfer (열전달특론)

This course reviews the fundamentals of heat transfer and then studies more profound convective heat transfer and radiation. It further discusses the cooling system using nanofluids, applications of heat transfer to biomedical devices, micro-/nano heat transfer system, and semiconductor cooling using electrokinetics and mass transfer.

MEN512 Advanced Combustion (연소특론)

This course covers chemical thermodynamics, chemical kinetics, oxidation mechanism of fuels, environment combustion such as NOx and soot, and conservation equations for reacting flows. Based on the basic knowledge, the characteristics of premixed flames, nonpremixed flames, and ignition/extinction of flames, and turbulent combustion and modeling will be discussed.

MEN513 Convection Heat Transfer (대류열전달)

The objectives of this course is to gain in-depth knowledge of a heat transfer mode accompanied by fluid motion, namely, the convection heat transfer. In addition, this course aims to obtain deeper understanding of analytic approaches and approximate procedures for closed-form solutions. The contents of this course include analysis of laminar/turbulent forced/natural convection phenomena and velocity/temperature distribution in boundary layers; external and internal flows; and analytic/numerical methods for predicting the heat transfer coefficients for various related engineering systems.

MEN520 Advanced Fluid Mechanics (유체역학특론)

This course teaches mathematical and physical foundations of fluid mechanics. The first part of the course is a brief review of tensor analysis, followed by rigorous derivations of continuity equation, momentum equation, and energy equation for Newtonian fluids. After that, topics such as low Reynolds number flows, laminar flows, turbulent flows, boundary layers, vorticity dynamics, and irrotational flows are covered with practical examples.

MEN521 Microfluidics and Nanofluidics (미세유체역학)

Microfluidics and nanofluidics is the study of how fluids behave at the micro and even nano scale. This course is aimed primarily at graduate students in science and engineering who have some background in or are interested in learning more about microfluidics. In this course not only do we study the basic physics such as low Reynolds number fluid mechanics, electrokinetics and heat and mass transfer, but we also discuss how physical phenomena are implemented in microfluidic devices. We further discuss microfabrication techniques necessary for building bio-compatible microfluidic devices and organic, biological samples such as DNA, protein and cells.

MEN522 Computational Thermofluid Engineering (전산열유체공학)

This course introduces basic methods to solve fluid mechanics problems, heat flow problems, and coupled fluid-flow & heat-flow problems using the techniques of Computational Fluid Dynamics (CFD). A focus is placed on incompressible fluid flows and accompanying heat flows, and students will deepen their understanding by writing CFD programs through homework assignments and course projects.

MEN523 Advanced Thermofluid Measurement (열유동계측특론)

In this course, we are able to widen and deepen our understanding of thermofluid measurement methods based on the fundamentals of heat transfer and fluid mechanics. We will learn how to measure flow fields and temperature fields by using the principles of PIV (particle image velocimetry) and a hotwire method. We will also learn how to use LabVIEW and other measurement equipment.

MEN524 Aerosol Technology (에어로졸특론)

The objective of this class is to understand fundamental knowledge of gasborne particles (aerosols) and their physical/chemical/thermal/optical/electric properties. Also, the generation, collection, and measurement of aerosols will be covered along with the basic concepts and applications of biological aerosols (bioaerosols).

MEN525 Turbulence (난류특론)

In this class, we will study a basic turbulence theory for understanding of viscous, incompressible turbulent flow. The topics include: 1) Introduction to turbulence, 2) Governing equations and turbulent flows, 3) Statistical description of turbulence, 4) Kinematics and dynamics of homogeneous turbulence, 5) Spectral dynamics of turbulence, 6) Boundary-free shear flows, 7) Wall-bounded shear flows and 8) New research trends in wall turbulence.

MEN530 Advanced Solid Mechanics (고체역학특론)

In this course, we will gain the ability to solve general solid mechanics problems, by defining the stress and strain based on the tensor theory and by understanding the governing equations such as equilibrium, constitutive, and compatibility equations between stress and strain. In addition, the special problems and their theoretical solutions in solid mechanics will be introduced.

MEN531 Finite Element Method (유한요소법특론)

In this course, the theory and formulation behind finite element method will be introduced. To gain hands-on experience of finite element method, practical applications in engineering will be covered.

MEN532 Mechanics of Composites (복합재역학특론)

This course will introduce students to the fundamental mechanics of composite (more than one phase) solids. The topics will include effective stiffness properties of composites, constitutive description of laminated plates, and laminated plate theory. Other advanced topics such as nonlinear theory of generally laminated plates, governing equations in the Von Karman sense, laminated plates with moderately large deflections, post-buckling and nonlinear vibration of laminated plates, and failure theories and experimental results for laminates will also be discussed.

MEN535 Computational Nanomechanics (전산나노역학)

In this course, classical molecular dynamics and quantum simulation methods will be discussed in detail as general computational tools to explore nanomaterials and nanosystems. For this, basic characteristics of nanomaterials and numerical algorithmswill be introduced. Through a numerical project, we will broaden our understanding of nanomaterials and nanomechanics.

MEN551 Computer-Aided Design (전산기원용설계)

This course introduces fundamentals of CAD, including geometric and solid modeling, parametric representations, features, and human-machine interactions. Applications to design, analysis, and manufacturing will be covered.

MEN552 Manufacturing Processes and Systems (생산공정 및 시스템)

To provide graduate students with an integrated treatment of the analysis of traditional and non-traditional manufacturing processes, their selection and planning, within an economic framework, this course will cover materials processing analysis and selection, manufacturing systems design and economic analysis.

MEN553 Manufacturing and Process Engineering (생산공학특론)

This course introduces the basic design techniques of various manufacturing tools, including cutting tools, forming dies, inspection gages, jigs and fixtures. The course also covers the fundamental planning principles and techniques of manufacturing processes, including routing planning and operations design. Through term projects performed in teams, students integrate the fundamental principles into solving practical manufacturing process problems within an economic framework.

MEN554 Machine Tool Analysis and Control (공작기계 해석 및 제어)

To develop an advanced understanding of machining processes in the context of machinery, mechanics, dynamics, monitoring techniques, and control strategies. In this course, mechanics and dynamics of machining, machine tool components and structures, sensors and controls of machine tools, machine process planning and optimization will be covered.

MEN556 Laser Material Interaction and Processing I (레이저 재료 상호작용 및 가공 I)

In this course, students learn the basic principles of lasers and various interaction mechanisms in laser material interaction. Based on this basic knowledge, students will also learn various areas of laser materials processing. Topics include laser interaction with various materials (such as metals, semiconductors, dielectrics, and biological tissues), laser cutting, laser drilling, laser welding, laser heat treatment, laser cladding, and laser micromachining.

MEN557 Polymer and Composite Manufacturing (고분자 및 복합재료 제조공정)

This course is designed to expose graduate students to a variety of processing methods for polymers and polymer-matrix composites. Polymer processing methods include injection molding, extrusion, fiber spinning, filament winding, etc. for both thermoplastic and thermosetting polymers. Topics in polymer-matrix composites include not only traditional fiber-reinforced composites, but also design, manufacturing, characterization, and application of such cutting-edge material systems as high-temperature, multifunctional composites and nanocomposites. Integral components to this course are modeling- and simulation-based material property prediction and cost (or affordability) analysis, which will enable students to design and manufacture polymers and polymer-matrix composites within an economic framework.

MEN558 Advanced MEMS (MEMS특론)

MEMS/NEMS technologies are adopted in a variety of mechanical, electronic devices and sensors. This course introduces principles of conventional microfabrication techniques and, working principles and design rules for MEMS device fabrication. It also includes applications and some case studies of MEMS devices. MEMS is a typical interdisciplinary research area so that the application of this course is expected to be extended to research areas such as electronic engineering, biochemistry, chemistry, physics, medical science and etc.

MEN559 Bio MEMS (바이오 MEMS)

This course organizes its contents along a bottom-up biological pathway made by nature so that we will discuss the impacts made by innovative bioMEMS/NEMS technologies on the development of biology: genomics, proteomics, metabolomics, signaling pathway modulation, and tissue and artificial organ engineering. Not only we will learn/review general biology and bioMEMS but also we will discuss what engineers can build for biologists/scientists and what they require us to develop.

MEN560 Unconventional Nanomanufacturing (비전통적나노가공기술)

This course introduces unconventional nano/microscale manufacturing and fabrication techniques as well as their unique applications. Fundamental ideas, technical trends and interesting recent works will be covered.

MEN570 Advanced Dynamics (동역학특론)

This course will cover the following: kinematics and kinetics of plane and three-dimensional motion, Coriolis acceleration, general methods of linear and angular momentum, central force motion, gyrodynamics, generalized coordinates, and Lagrange's equations. Prerequisite skills are a basic knowledge of fundamental calculus and differential equations

MEN571 Robotics (로봇공학)

This course aims at teaching students basic mathematical and computational tools for modeling and analysis of robotic systems. Students will learn to identify, model, analyze, design, and simulate robotic systems, including their kinematics, dynamic responses, and control. In addition, students will gain an understanding of sensory and mechanical components integrated within a robotic system.

MEN572 Advanced Control Systems II (고급제어 I)

Input-output and state space representation of linear time-invariant continuous and discrete time dynamic systems. Design and analysis of single and multi-variable feedback control systems in time and frequency domain. Controllability, observability, and stability. System modelling and identification. State observer. Linear Quadratic Optimal Control.

MEN573 Real-Time Applications of Control Systems (제어 시스템 구현)

Mini and micro computers, operating in real time, have become ubiquitous components in engineering systems. The purpose of this course is to build competence in the engineering use of such systems through lectures stressing small computer structure, programming, and output/input operation, and through laboratory work with mini and micro computer systems.

MEN574 Nonlinear Systems (비선형 시스템)

Introduction to nonlinear phenomena: multiple equilibria, limit cycles, bifurcations, complex dynamical behavior. Planar dynamical systems, analysis using phase plane technique. Describing fuction. Input-output analyssi and stablitity. Lyapunov stability theory. feedback linearization.

MEN575 Electromechanical dynamics (전자기기 동력학)

Electromagneic theory, Lumped electromechanical elements, Circuit theory, Energy conversion, Riotating machines, Lumped-parameter electromechanical dynamics

MEN590 The Seminars (세미나)

The purpose of this course is to extend knowledge of the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

MEN656 Laser Material Interaction and Processing II (레이저 재료 상호작용 및 가공 II)

In this course, students learn the basic principles of lasers and various interaction mechanisms in laser material interaction. Based on this basic knowledge, students will also learn various areas of laser materials processing. Topics include laser interaction with various materials (such as metals, semiconductors, dielectrics, and biological tissues), laser cutting, laser drilling, laser welding, laser heat treatment, laser cladding, and laser micromachining.

MEN690 Master's Research (석사논문연구)

This course is related to the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

MEN732 Failure Analysis and Design for Reliability (파괴해석과 신뢰성 설계)

This course introduces various mathematical and experimental techniques employed for failure analysis, provides knowledge of fundamental physics of material and structure failure, and provide the knowledge needed to apply these concepts to design for reliability. Through term projects, students integrate fundamental principles and techniques.

MEN733 Mechanics of Polymer Solids and Fluids (고분자역학)

This course deals with continuum mechanics of solids and fluids, mechanics of deformation of anisotropic polymers, anisotropy and critical failures, such as yield, fracture and fatigue, non-Newtonian viscous and viscoelastic behavior of polymer fluids. Students will study the mechanics-based foundations for developing structure-property relations in polymer and learn constitutive models.

MEN734 Scanning Probe Microscopy (주사탐침현미경)

In variety of research areas, SPMs (scanning probe microscopes) work as a powerful research tool capable of providing spatially/temporally resolved diverse surface properties through the tip apex or micro/nanoelectrode integrated near/at the tip apex. This course provides fundamentals of diverse kinds of SPMs and applications of specific SPMs in details.

MEN735 Bioinspired Technology (생체모사공학)

Elucidating the underlying principles of natural systems will enable us to develop more reliable, efficient and environment-friendly biomimetic systems with advanced performances. This course is focused on the study of mechanics of macro/micro/nanoscale components in nature using fundamental principles of mechanical engineering, and apply them to the development of bio-inspired functional structures, devices and systems with innovative multiscale manufacturing techniques.

MEN755 Net Shape Manufacturing (소성가공)

This course focuses on the manufacturing of discrete parts to net or near net dimensions by stamping, forging, machining, and tube hydroforming.

MEN772 Advanced Analytic Kinematics (해석기구학특론)

A machine is a combination of resistant bodies so arranged to transmit motion and forces. The device to transmit forces or modify motion is called a mechanism. The basic element of any machinery consists of various mechanisms, in the most cases of 2-D(dimensional) mechanisms. In this advanced lecture series, 3-D linkage mechanisms will be dealt with analytical methods. Understanding analyses methods of a mechanism is important procedure in designing a machine.

And due to dynamic nature of the mechanism, the analysis or synthesis will be carried via computer, and it is known as one of the major application areas of CAD(Computer Aided Design). However, an analytical method, which produces the exact solution, belongs to the research domain. The Directional Cosine Matrix Method developed by the instructor will be discussed.

MEN773 Advanced Control Systems II (고급제어 II)

Stochastic State Estimation (Kalman filter), Linear Quadratic Gaussian Problem, Loop Transfer Recovery, Feedforward/preview control, Repetitive Control, Analysis and synthesis techniques for multi-input (MIMO) control systems.

MEN774 System Identification and Adaptive Control (시스템식별 및 적응제어)

Probability Theory, Parametric Time-domain Methods, Non-Parametric Frequency-Domain Methods, Stability Analysis of Adaptive Systems, Model Reference Adaptive Control, Self-tuning Regulators, Advanced topics on System Identification and Adaptive Control.

MEN791~797 Special Topics in Mechanical Engineering I ~Ⅸ (기계공학 특론 I ~Ⅸ)

In this course, special topics in mechanical engineering are discussed based on the knowledge of the principles of solid mechanics, dynamics, thermodynamics, fluid mechanics, heat transfer, manufacturing process, system design, and power system engineering. Topics may include machine design, advanced materials processing, laser-assisted manufacturing, micro/nano machining, MEMS, biomedical products, controls and mechatronics, acoustics and dynamics, tribology, heat problems in microchips and light emitting diodes, wind power, blood flow, micro/nanofluidics, heat exchanger design in nuclear power plants, and combustion in engines.

MEN890 Doctoral Research (박사논문연구)

This course is related to the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

Department of Nuclear Engineering

Nuclear Engineering [NUE]

Department of Nuclear Engineering includes the advancement of safety measures in operating nuclear power plants, the development of fourth generation (Gen-IV) reactors including ultra-long cycle fast reactor (UCFR), small and medium-sized nuclear reactors. For these, the research is focused into nuclear fuel design (metallic fuel, coated fuel, ceramic fuel, and fuel cycle), reactor design including neutron transport and diffusion, and reactor core simulator, cladding and structural materials in advanced nuclear energy systems, design of advanced nuclear systems, nuclear safety systems and engineered features, advanced liquid metal transportation for fast reactors and nuclear fusion reactors, advanced nuclear radiation protection and detections, nanofluids and nanocomposites for advanced nuclear coolants and nuclear fuel. Furthermore, included are UniST Advanced Research Reactor (USTAR), avanced safety systems and molten core cooling systems for I-Power reactor, spent fuel storage, liquid metal MHD generation, accelerator physics, neutron science, nuclear data, and fundamentals of nuclear fusion for the future energy development.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 18 credits	at least 10 credits
Doctoral Program	at least 60 credits	at least 24 credits	at least 36 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 33 credits	at least 27 credits

Curriculum

▶ Nuclear Engineering [NUE]

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Required	NUE590	Research	The Seminars	세미나	1-1-0		
	NUE600	Lecture	Research Trends in Nuclear Engineering I	원자력공학 연구 동향 I	3-3-0		
	NUE690	Research	Master's Research	석사논문연구	Value of Credit		
	NUE890		Doctoral Research	박사논문연구	Value of Credit		
Elective	NUE501	Lecture	Structural Mechanics in Energy Systems	에너지 시스템 구조 역학	3-3-0		O
	NUE502		Engineering of Nuclear Energy System	원자력 시스템 공학 특론	3-3-0		
	NUE503		Special Topics in Structural Materials in Energy Systems	에너지 구조 재료 공학 특론	3-3-0		
	NUE504		Advanced Energy Conversion	에너지 변환 공학 특론	3-3-0		
	NUE505		Modeling and Simulation in Energy System	에너지 전산 모사	3-3-0		
	NUE507		Nuclear Reactor Dynamics	원자로 동력학	3-3-0		
	NUE510		Nuclear Reactor Core Design and Engineering	원자로심설계공학	3-3-0		
	NUE511		Nuclear Fuel Engineering	핵연료 공학	3-3-0		
	NUE512		Radiation Measurement System Ⅰ	방사선계측 Ⅰ	3-3-0		
	NUE513		Nuclear Reactor Core Analysis Ⅰ	원자로심해석 Ⅰ	3-3-0		
	NUE514		Nuclear Reactor Core Analysis Ⅱ	원자로심해석 Ⅱ	3-3-0		
	NUE515		Liquid Metal Magnetohydrodynamics I	액체금속 자기유체역학 I	3-3-0		
	NUE516		Nuclear Fuel Design and Performance Analysis	핵연료설계 및 성능 분석	3-3-0		O
	NUE517		Nuclear Reactor Theory	원자로 이론	3-3-0		
	NUE519		Nuclear Safety	원자력 안전	3-3-0		
	NUE520		Nuclear Safety System Design and Lab	원전안전계통 설계실습	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	NUE521	Lecture	Liquid Metal Magnetohydrodynamics II	액체금속 자기유체역학 II	3-3-0		
	NUE522		Special Topics on Advanced Nuclear Design Engineering	첨단 원자력 설계 공학 특론	3-3-0		O
	NUE523		Nuclear Safety and Convergence Technology	원자력 안전 및 융합 기술	3-3-0		O
	NUE524		Radiation Measurement System II	방사선 계측 II	3-3-0		
	NUE525		Spent Nuclear Fuel Engineering	사용후핵연료공학	3-3-0		
	NUE527		Nuclear Material Safeguards and Non-Proliferation	핵물질 안전조치와 핵비확산	3-3-0		
	NUE528		Nuclear Fuel Performance Experiment and Modeling	핵연료성능 실험 및 모델링	3-3-0		
	NUE529		Radiation Materials Engineering I	방사선재료공학 I	3-3-0		
	NUE530		Radiation Materials Engineering II	방사선재료공학 II	3-3-0	NUE529	
	NUE531		Probabilistic Safety Assessment	확률론적안전성평가	3-3-0		
	NUE532		Application of Probabilistic Safety Assessment	확률론적안전성평가 응용	3-3-0	NUE531	
	NUE533		Nuclear Safety Policy	원자력 안전정책	3-3-0		
	NUE619		Special topics in Nuclear Engineering I	원자력공학특론 I	3-3-0		
	NUE629		Special topics in Nuclear Engineering II	원자력공학특론 II	3-3-0		
	NUE639		Special topics in Nuclear Engineering Ⅲ	원자력공학특론 Ⅲ	3-3-0		
	NUE649		Special Topics in Nuclear Engineering Ⅵ	원자력공학특론 Ⅵ	3-3-0		
	NUE659		Special Topics in Nuclear Engineering Ⅶ	원자력공학특론 Ⅶ	3-3-0		
Elective (Ph.D.)	NUE719		Special topics in Nuclear Engineering Ⅳ	원자력공학특론 Ⅳ	3-3-0		
	NUE729		Special topics in Nuclear Engineering Ⅴ	원자력공학특론 Ⅴ	3-3-0		
Elective	NUE790	Research	Research Trends in Nuclear Energy II	원자력공학 연구 동향 II	2-2-0		

Description

NUE501 Structural Mechanics in Energy Systems [에너지 시스템 구조 역학]

Structural components in energy systems, their functional purposes, operating conditions, and mechanical/structural design requirements. Combines mechanics techniques with models of material behavior to determine adequacy of component design. Considerations include mechanical loading, brittle fracture, inelastic behavior, elevated temperatures, neutron irradiation, vibrations and seismic effects.

NUE502 Engineering of Nuclear Energy System [원자력 시스템 공학 특론]

This course covers the advanced topics in engineering principles of nuclear reactors, emphasizing power reactors. Specific topics include power plant thermodynamics, reactor heat generation and removal (single-phase as well as two-phase coolant flow and heat transfer). It also discusses engineering considerations in reactor design.

NUE503 Special Topics in Structural Materials in Energy Systems [에너지 구조 재료 공학 특론]

Applies thermodynamics and kinetics of electrode reactions to aqueous corrosion of metals and alloys. Application of advanced computational and modeling techniques to evaluation of materials selection and susceptibility of metal/alloy systems to environmental degradation in aqueous systems. Discusses materials degradation problems in various energy system including nuclear.

NUE504 Advanced Energy Conversion [에너지 변환 공학 특론]

Introduces basic background, terminology, and fundamentals of energy conversion. Discusses current and emerging technologies for production of thermal, mechanical, and electrical energy. Topics include fossil and nuclear fuels, solar energy, wind turbines, fuel and solar cells.

NUE505 Modeling and Simulation in Energy System [에너지 전산 모사]

Concepts of computer modeling and simulation in materials science and engineering. Uses techniques and software for simulation, data analysis and visualization. Continuum, mesoscale, atomistic and quantum methods used to study fundamental and applied problems in physics, chemistry, materials science, mechanics, engineering, and biology. Examples drawn from the disciplines above are used to understand or characterize complex structures and materials, and complement experimental observations.

NUE507 Reactor Dynamics [원자로 동역학]

This course covers the time-dependent behaviour of nuclear reactors and the under-lying governing equations and their mathematical solutions. The delayed neutron, which makes nuclear reactor controllable, is investigated and derivation, validity, and solution of the point reactor equation are studied. Principles of the reactivity measurement and the reactivity feedback effects are also investigated. In addition, the general space-time-dependent reactor dynamics is studied.

NUE510 Nuclear Reactor Core Design and Engineering [원자로심설계공학]

The purpose of this course "Nuclear Reactor Core Design and Engineering" is to provide students with basic insight into nuclear reactor core design and engineering for use of nuclear energy as a safe and economical energy source. This course is designed to study nuclear fuel, nuclear design, thermal/hydraulic design, safety analysis, and nuclear fuel cycle economics. This course will also cover special topics such as reactor core design criteria, core design requirements, core design procedure, technical specifications, and nuclear power plant licensing.

NUE511 Nuclear Fuel Engineering [핵연료 공학]

This course covers the materials and structure, characteristics and basic in-reactor performance of the fuels used in PWR, BWR, CANDU, fast reactors, research reactor and small and medium size reactors. It will also introduce, for PWR UO2 fuel, the basic requirements, fuel safety and design criteria, the basics of fuel rod design and fuel assembly design, important fuel performance modelling. It will also cover the basics of the design/analysis computer codes which are used in PWR UO2 fuel design. Finally fuel fabrication processes of the PWR UO2 fuel will be introduced.

NUE512 Radiation Measurement Systems I [방사선 계측 I]

This course covers the principle of the radiation instruments. It deals with the counting and measurement mechanism for the ionizing radiation such as alpha, beta, gamma and neutron. It introduces radiation spectrometry, radioactivity analysis, calibration, measurement statistics including measurement uncertainty.

NUE513 Nuclear Reactor Core Analysis I [원자로심해석 I]

This class will study computational methods for nuclear engineering applications. Focus will be on the theory behind numerical methods for solving the partial differential equations encountered in nuclear reactor analysis. We will investigate various spatial discretization techniques, as well as the methods used to solve large, sparse systems of linear and nonlinear equations. Lectures will cover the various conservation laws for mass, energy, and momentum and the methods used to discretize the applicable elliptical and parabolic equations. Linear solution methods will include direct, iterative (e.g. SOR, etc.), and semi-iterative (e.g. Krylov, etc.) techniques, with special attention given to methods that lend themselves to high performance computing. Newton-Krylov methods will be introduced for solving nonlinear systems of equations.

NUE514 Nuclear Reactor Core Analysis II [원자로심해석 II]

This class will study computational methods for nuclear engineering applications. Focus will be on the theory behind numerical methods for solving the partial differential equations encountered in nuclear reactor analysis. We will investigate various spatial discretization techniques, as well as the methods used to solve large, sparse systems of linear and nonlinear equations. Lectures will cover the various conservation laws for mass, energy, and momentum and the methods used to discretize the applicable elliptical and parabolic equations. Linear solution methods will include direct, iterative (e.g.

SOR, etc.), and semi-iterative (e.g. Krylov, etc.) techniques, with special attention given to methods that lend themselves to high performance computing. Newton-Krylov methods will be introduced for solving nonlinear systems of equations.

NUE515 Liquid Metal Magnetohydrodynamics I [액체금속 자기유체역학 I]

This course covers the magnetohydrodynamic (MHD) characteristic of the liquid metal used in fast reactor, nuclear fusion reactor and accelerator. Instructor will include Lorents' force produced in the liquid metal with the high electrical conductivity such as sodium, gallium, lead and mercury, flow characteristic, pressure drop under the magnetic field. The students will study the property of the electromagnetic pump for the liquid metal transportation and the liquid metal MHD electricity generation system.

NUE516 Nuclear Fuel Design and Performance Analysis [핵연료설계 및 성능 분석]

This course intends to provide the students with practical knowledge and experience for the design and analysis of the LWR UO2 fuel. It will first discuss the backgrounds and the derivation of the fuel safety and design criteria, design and analysis method, and licensing requirements for LWR UO2 fuel. The design models and actual measurement data on irradiation performances of the important in-reactor fuel performances, which includes fission gas release, densification and swelling, restructuring, fuel thermal conductivity change during irradiation, high burnup effects, cladding corrosion, cladding creep, pellet-cladding interaction, etc. will be discussed and compared. Practical examples of fuel rod design and fuel assembly design will be introduced and the practices with fuel design/analysis computer codes will be given.

NUE517 Nuclear Reactor Theory [원자로 이론]

The understanding of neutron behaviour in the nuclear reactor is very important for the design of new nuclear reactors and the safe operation of existing nuclear reactors. This course covers methodologies of neutron flux calculations, diffusion and slowing down theory, flux separation, material buckling, resonance absorption, Doppler effect, 2-group and multi-group theories, and reactivity balances for design and operation. There will be an introduction to reactor kinetics, delayed neutrons, point reactor kinetics, transient behavior, load changes, reactivity feedback, and safety implications.

NUE519 Nuclear Safety [원자력 안전]

The purpose of nuclear safety is to prevent the release of radioactive materials during events and accidents. This course covers the actions taken to prevent nuclear and radiation accidents or to limit their consequences. To date, there have been five serious accidents (core damage) in the world since 1970 (one at Three Mile Island in 1979; one at Chernobyl in 1986; and three at Fukushima-Daiichi in 2011), corresponding to the beginning of the operation of generation II reactors. Based on experiences of the accidents, the course discuss the safety culture as one relatively prevalent notion about nuclear safety.

NUE520 Nuclear Safety System Design and Lab [원전 안전 계통 설계실습]

This course covers the principles of design of the nuclear safety systems. The three primary objectives of nuclear reactor safety systems are to shut down the reactor, maintain it in a shutdown condition, and prevent the release of radioactive material during events and accidents. These objectives are accomplished using a variety of equipment, which is part of different systems, of which each performs specific functions. The students will participate in field-oriented design and practice programs.

NUE521 Liquid Metal Magnetohydrodynamics II [액체금속 자기유체역학 II]

This course is focused on the unbounded flow known as Rayleigh-Stokes flow, flow transition and magnetohydrodynamic (MHD) stability, which is characterized by a control parameter such as Reynolds or Rayleigh number and Hartman number, of the liquid metal flow in the externally-driven magnetic field. MHD turbulent flow is approached mathematically by using mean field theory and its local property is discussed for the different orientation of geometry, direction of magnetic field, and velocity. Also, the attention is focused on the solution of simple examples of magnetoconvective flows.

NUE522 Special Topics on Advanced Nuclear Design Engineering [첨단 원자력 설계 공학 특론]

This course will cover various aspects of nuclear reactor design: nuclear reactor core design including neutronics and thermal-hydraulics, spent fuel analysis, fuel cycle, and fast spectrum reactor system analysis as well as thermal system. Students will study the reactor design concepts and practice the design procedures using computer codes.

NUE523 Nuclear Safety and Convergence Technology [원자력 안전 및 융합 기술]

Safety feature of a nuclear reactor that does not require operator actions or electronic feedback in order to shut down safely in the event of a particular type of emergency (usually overheating resulting from a loss of coolant or loss of coolant flow) can be advanced using convergence technology, e.g. nuclear and nano-technologies and nuclear and ICT. After the Fukushima accidents, the multi-physics concepts based on thermal-hydraulics and materials sciences are becoming key factors to enhance nuclear safety. The area can be coupled by Information technology. The course will cover the multiphysics-based safety principles and introduce convergence technologies in recent trends.

NUE524 Radiation Measurement Systems II [방사선 계측 II]

This course covers the principle of the radiation instruments. It deals with the counting and measurement mechanism for the ionizing radiation such as alpha, beta, gamma and neutron. It introduces radiation spectrometry, radioactivity analysis, calibration, measurement statistics including measurement uncertainty.

NUE525 Spent Nuclear Fuel Engineering [사용후핵연료공학]

This course covers fundamentals, practices, and issues of spent nuclear fuel management from in-core behavior, on-site pools, interim storages, transportation, partitioning, transmutation, and disposal. Among these topics, major focus will be given for partitioning, transmutation, and disposal. Through this course, students will be prepared to research one of the most difficult challenges we are facing in nuclear power based on solid understanding.

NUE526 Chemistry of Actinide and Fission Product [악티나이트화학]

This course covers thermodynamics and kinetics of actinide and fission products in chemical and electrochemical reactions. In particular, lanthanide in fission products is a major element group from nuclear fission based on the double hump curve of fission yield. Actinide such as U, Pu, Am, Cm, Th and lanthanide such as La, Ce, Nd, Eu have similar characteristics because their valence shell electrons are being added to f orbitals. However, they need to be separated each other for recycling since some lanthanide isotopes are strong neutron absorbers. Students will learn how to separate actinide from lanthanide in a proliferation-resistant way.

NUE527 Nuclear Material Safeguards and Non-Proliferation [핵물질 안전조치와 핵비확산]

This course aims to thoroughly cover the fundamental aspects of nuclear material safeguards and non-proliferation for graduate students seeking professional career in these fields. Specific contents and topics of this course include the following: fundamental components of fuel cycle; histories of nuclear weapon development, IAEA, and NPT, measurement systems for Nuclear Material Accountancy (NMA), basis for material protection, control, and accounting systems, political and technological issues of nuclear proliferation, Proliferation Resistance (PR) of nuclear fuel cycle, safeguards system, Containment and Surveillance (C/S), and Physical Protection (PP).

NUE528 Nuclear Fuel Performance Experiments and Modeling [핵연료 성능 실험 및 모델링]

This course introduces experimental methodologies and underlying scientific principles commonly utilized for nuclear fuel research. The metallurgical and thermophysical characterization of radioactive materials such as uranium and thorium is essential to model and predict nuclear fuel performance. However, still wide empty space exists in the material property database due to unavoidable hardship associating with the kind of experiments. Systematic approach for specimen preparation is also seldom found in open literatures. This subject will provide an initial breakthrough for beginning nuclear fuel engineers.

NUE529 Radiation Materials Engineering I [방사선 재료 공학 I]

This course provides basic theoretical understanding on radiation interactions with materials; such as, radiation damage event, atom displacement, damage cascade, point defect formation and diffusion, defect reaction rate theory. Material degradation under extreme radiation environment, such as inside nuclear reactor core, has significant impacts on nuclear materials performance and life expectancy, however the development of this particular branch of materials science and engineering started less than a century ago. Hence, current theoretical approaches are often incomprehensive. This course will cover up-to-date experimental and theoretical approaches have been made on the issues and a renowned simulation program, Stopping and Range of Ions in Matter (SRIM).

NUE530 Radiation Materials Engineering II [방사선 재료 공학 II]

This course covers physical and mechanical effects of radiation damage, such as, radiation-induced segregation, irradiation-induced voids and bubbles, phase stability under irradiation, irradiation hardening/creep/growth. Ion beam irradiation, a cost- and time-effective experimental method frequently utilized for expedited simulation of radiation damage, will also be introduced with interrelated usage of SRIM simulation which is an essential supplementary tool for data analysis.

NUE531 Probabilistic Safety Assessment [확률론적안전성평가]

This course provides the fundamentals of probabilistic safety assessment (PSA) for quantitative evaluation of a nuclear power plant safety. This course will cover the topics for PSA such as modelling methods and tools, reliability data, common cause failures, and quantification result analysis. In addition, students will get skilled to develop a PSA model through review of a nuclear power plant PSA model and a term project.

NUE532 Application of Probabilistic Safety Assessment [확률론적안전성평가 응용]

This course covers emerging issues and applications of probabilistic safety assessment. Methods of risk model development and their quantification with software tools are included. Students will develop probabilistic safety assessment models for various initiating events and quantify the risk.

NUE533 Nuclear Safety Policy [원자력 안전정책]

This course is designed to investigate various policy issues and legislative direction on nuclear safety, provide discussions with other students, researchers, and professors. Through this course, the students will have opportunities to extend his/her knowledge in the future direction of nuclear energy safety research. In accordance with the policy on energy conversion, this course covers to study nuclear safety enhancement through free and in-depth discussions and exchange their ideas on various policy issues and legislative direction on nuclear safety.

NUE590 The Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

NUE600 Research Trends in Nuclear Engineering I [원자력공학 연구동향 I]

This course is designed to investigate recent trends in Nuclear energy fields and provide discussions with other students, researchers, and professors.

NUE619 Special topics in Nuclear Engineering I [원자력공학특론 I]

This course covers the special field of nuclear engineering such as nuclear battery, nuclear propulsion and space applications which are not covered by the given courses. The content can be variable and will be chosen by the instructor.

NUE629 Special topics in Nuclear Engineering II [원자력공학특론 II]

This course covers the special field of nuclear engineering such as nuclear safety, probabilistic safety assessment and creative nuclear research reactor which are not covered by the given courses. The content can be variable and will be chosen by the instructor.

NUE639 Special topics in Nuclear Engineering III [원자력공학특론 III]

This course covers the special field of nuclear engineering such as nuclear safety, probabilistic safety assessment and creative nuclear research reactor which are not covered by the given courses. The content can be variable and will be chosen by the instructor.

NUE649 Special topics in Nuclear Engineering VI [원자력공학특론 VI]

This course covers the special field of nuclear engineering such as nuclear safety, probabilistic safety assessment and creative nuclear research reactor which are not covered by the given courses. The content can be variable and will be chosen by the instructor.

NUE659 Special topics in Nuclear Engineering VII [원자력공학특론 VII]

This course covers the special field of nuclear engineering such as nuclear safety, probabilistic safety assessment and creative nuclear research reactor which are not covered by the given courses. The content can be variable and will be chosen by the instructor.

NUE690 Master's Research [석사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

NUE719 Special topics in Nuclear Engineering IV [원자력공학특론 IV]

This course covers the special field of nuclear engineering such as nuclear fuel cycle, radiation safety, radioactive waste, decontamination and dismantling which are not covered by the given courses. The content can be variable and will be chosen by the instructor.

NUE729 Special topics in Nuclear Engineering V [원자력공학특론 V]

This course covers the special field of nuclear engineering such as nuclear fuel cycle, radiation safety, radioactive waste, decontamination and dismantling which are not covered by the given courses. The content can be variable and will be chosen by the instructor.

NUE790 Research Trends in Nuclear Engineering II [원자력공학 연구동향 II]

This course is designed to investigate recent trends in Nuclear energy fields and provide discussions with other students, researchers, and professors. Through this course, the students will have opportunities to extend his/her knowledge in Nuclear energy fields. Also students and professors can exchange their own ideas.

NUE890 Doctoral Research [박사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation

Department of Materials Science Engineering

Materials Science Engineering[MSE]

The graduate department in Materials Science Engineering pursues the frontiers of modern materials science and engineering through education and research. We focus on various materials such as metals, ceramics, semiconductors, polymers and hybrid materials at both macroscopic and microscopic scale. Our mission in education is to help graduate students to seek solutions to current issues in MSE, so that eventually they can be creative leaders who can convert scientific ideas into changes in the real world. Our missions in research are to develop new materials and to generate new knowledge through theoretical and experimental investigation on them.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 15 credits	at least 13 credits
Doctoral Program	at least 60 credits	at least 12 credits	at least 48 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 24 credits	at least 36 credits

* For the Doctoral, Combined Master's-Doctoral course, the degree requirements above apply to students who have entered since 2018.
** For students entered before 2018, refer to previous degree requirements.

Curriculum

▶ Materials Science Engineering [MSE]

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Convergence
Required	MSE590	Research	The Seminars	세미나	1-1-0	
	MSE690		Master's Research	석사논문연구	1~3	
	MSE890		Doctoral Research	박사논문연구	3~9	
Elective	MSE501	Lecture	Advanced Thin Film Technology	박막공학특론	3-3-0	O
	MSE502		Nanoscale Surface Analysis	나노표면분석	3-3-0	
	MSE505		Advanced Thermodynmaics of Materials	고급열역학	3-3-0	
	MSE511		Nano Mechanics	나노역학	3-3-0	O
	MSE512		Advanced Ferrous Metals and Alloys	철강소재특론	3-3-0	
	MSE531		Light Emitting Diodes	LED공학개론	3-3-0	O
	MSE532		Dielectric Ceramics: From Fundamentals to Applications	유전체공학	3-3-0	
	MSE550		Semiconductor Physics and Devices	반도체 물성과 소자	3-3-0	
	MSE551		Surface and Interface Sciences	표면 및 계면과학	3-3-0	O
	MSE552		Characterization, Microstructure and Anisotropy of Materials	재료의 집합조직 및 이방성	3-3-0	
	MSE553		Electrochemical methods: fundamental science and applications	전기화학법: 기초과학 및 응용	3-3-0	O
	MSE571		Organic Optoelectric Materials and Devices	유기광전자재료 및 디바이스	3-3-0	
	MSE572		Carbon Nano Materials	탄소나노소재특론	3-3-0	
	MSE573		Materials for Biomedical Applications	생명공학재료	3-3-0	O
	MSE580		Polymer Structures and Properties	고분자구조 및 물성	3-3-0	
	MSE601		Synchrotron Radiation	방사광가속기 응용	3-3-0	
	MSE611		Advanced Light Metals and Alloys	경량금속소재특론	3-3-0	
	MSE612		Alloy Design	합금설계	3-3-0	
	MSE631		Electronic Properties of Materials	재료의 전자기적성질	3-3-0	

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Convergence
Elective	MSE681	Lecture	Special Topics on Materials Science Engineering Ⅰ	신소재공학특론 Ⅰ	3-3-0	
	MSE682		Special Topics on Materials Science Engineering Ⅱ	신소재공학특론 Ⅱ	3-3-0	
	MSE683		Special Topics on Materials Science Engineering Ⅲ	신소재공학특론 Ⅲ	3-3-0	
	MSE684		Special Topics on Materials Science Engineering Ⅳ	신소재공학특론 Ⅳ	3-3-0	
	MSE685		Special Topics on Materials Science Engineering Ⅴ	신소재공학특론 Ⅴ	3-3-0	
	MSE686		Special Topics on Materials Science Engineering Ⅵ	신소재공학특론 Ⅵ	3-3-0	
	MSE687		Special Topics on Materials Science Engineering Ⅶ	신소재공학특론 Ⅶ	3-3-0	
	MSE688		Special Topics on Materials Science Engineering Ⅷ	신소재공학특론 Ⅷ	3-3-0	
	MSE711		Advanced Metallic Materials	금속신소재특론	3-3-0	
	MSE712		Metallic Materials Processing and Lab	금속재료 공정 및 실습	3-3-0	
	MSE731		Advanced Magnetic Materials	자성재료특론	3-3-0	
	MSE732		Advanced Electric Ceramics	전자세라믹스특론	3-3-0	
	MSE753		Nano Convergent Energy Devices	나노융합에너지소자	3-3-0	
	MSE754		Advanced Semiconductor Devices	고급반도체소자론	3-3-0	
	MSE755		Introduction to Spintronics	스핀트로닉스 개론	3-3-0	O
	MSE756		Advanced Optical Materials and Devices	고급 광학소재 및 소자	3-3-0	O
	MSE757		The Physics of Nanoelectronics	나노소자 물리	3-3-0	O
	MSE771		Special Topics on flexible Electronic Materials	플렉시블 전자소재특론	3-3-0	
	MSE772		Advanced Polymer Physics	고급 고분자 물리학	3-3-0	
	MSE851		Advanced Transmission Electron Microscopy	전자현미경학특론	3-3-0	
	MSE852		Quantum Analysis and Modeling	양자해석 및 설계	3-3-0	

※ Undergraduate Seniors can register following courses : "MSE511 Nano Mechanics", "MSE550 Semiconductor Physics and Devices", "MSE551 Surface and Interface Sciences", "MSE571 Organic Optoelectric Materials and Devices", "MSE572 Carbon Nano Materials", "MSE611 Advanced Light Metals and Alloys", “MSE681~688 Special Topics on Materials Science Engineering I~VIII(Only if the instructor approves)”

Description

MSE501 Advanced Thin Film Technology (박막공학특론)

The need for thin films is now increasing as the electronic devices become small, light and integrated. In addition, fabrication of thin films from bulk materials is necessary to maximize their performance. Therefore, in this course we study the basic principles and techniques for the fabrication of thin films, the characterization methods and the applications of thin films.

MSE502 Nanoscale Surface Analysis (나노표면분석)

This course provides the fundamental principles of scanning tunneling microscopy (STM), scanning tunneling spectroscopy (STS), and related technique. The topic will also cover the application of STM and recent STM works on th nanoscale materials systems.

MSE505 Advanced Thermodynmaics of Materials (고급열역학)

This course is focused on the understanding of material properties and fundamental phenomena related to material processes. It covers phase equilibrium, calculation of heat capacitance, and the relation between free energy and phase diagram, etc.

MSE511 Nano Mechanics (나노역학)

This course covers mechanical behavior of materials at the nano-scale. While mechanical properties of materials have been known to be independent of size at the bulk-scale, mechanical behavior of materials at the nano-scale strongly depends on size. This course covers synthesis and characterization methods of nano-materials, and experimental approaches to measure and analyze mechanical behavior of materials at the nano-scale.

MSE512 Advanced Ferrous Metals and Alloys (철강소재특론)

This course aims to understand the microstructure and mechanical properties of ferrous metals and alloys, which are being used in a variety of industrial fields. The phase transformation phenomena we will cover in this course include TRIP and martensitic transformations. The relationship between microstructure and deformation behavior in the ferrous materials will also be discussed.

MSE531 Light Emitting Diodes (LED공학개론)

Technical progress in the field of light-emitting diodes has been breathtaking during the last few decades. State-of-the art LEDs are small, rugged, reliable, bright, and efficient. In contrast to many other light sources, LEDs have the potential of converting electricity to light with near-unity efficiency. This course will review the electrical and optical fundamentals of LEDs as well as advanced device structures. Recent technological breakthroughs and several application areas of LEDs including illumination and communication will also be discussed.

MSE532 Dielectric Ceramics: From Fundamentals to Applications [유전체공학]

Dielectrics have been widely utilized for wherever a steady electrical input is required for any given electronics. The most widely used dielectric materials are all ferroelectric materials with a perovskite structure. Here, one should note that ferroelectricity is a subgroup of pyroelectricity, the supergroup of which is piezoelectricity that is again a subgroup of dielectricity. This means that to properly understand the state-of-the art of dielectricity, one should go through the hierarchical correlations among the properties that ferroelectric materials have. Dielectricity based on ferroelectricity, which is one of the most interesting physical phenomena, will be introduced and discussed in this course. This lecture aims primarily at providing an extensive overview on the state-of-the-art in ferroelectric-based materials from fundamentals to applications, followed by in-depth discussion on the remaining challenges and future directions for the researchers of next generation.

MSE550 Semiconductor Physics and Devices (반도체 물성과 소자)

This course is designed to provide professional understanding in the current (and future) device physics. The basics of semiconductor devices will be reviewed and the detailed phenomenological study on transistor, metal-semiconductor contact, PN junction, MOS capacitor, and JFET etc. will be offered.

MSE551 Surface and Interface Sciences (표면 및 계면과학)

This course concentrates on the surface property of solid matter, especially on metals and semiconductors. Various materials properties, such as physical, chemical, electrical and mechanical properties depend on the surface phase and its treatment. These novel properties of surfaces can be used to develop structural and functional materials.

MSE552 Characterization, Microstructure and Anisotropy of Materials (재료의 집합조직 및 이방성)

The purpose of this course is to mainly acquaint the student with texture, microstructure and anisotropy of aggregates of crystalline solids, i.e., polycrystals. The specific areas of learning include the mathematical basis for crystallographic (preferred) orientation (pole figures, inverse pole figures, ODF, and etc), grain boundary anisotropy (interface texture by misorientation distribution and grain boundary character/energy distributions), texture measuring methods (EBSD and X-ray), the effect of texture on elastic and plastic anisotropy in polycrystals, and image analysis and extraction of 3D information.

MSE553 Electrochemical methods: fundamental science and applications (전기화학법: 기초과학 및 응용)

The fields of electrochemistry and electroanalytical chemistry have evolved substantially in this few decades. The understanding of the fundamental sciences played crucial roles in wide electrochemical research and advanced technology development. This course is designed to provide fundamental electrochemistry and introduce various electrochemical processes and methods. Basic principles of physics and chemistry, overview of electrode processes, thermodynamics, charge transfers and interfacial reactions will be covered and discussed.

MSE571 Organic Optoelectric Materials and Devices (유기광전자재료 및 디바이스)

This course will provide the characteristics of electro-optic organic materials, such as conjugated polymers, liquid crystals, and devices will be reviewed and discussed. Their applications for organic optoelectronics such as organic LEDs, solar cells and laser diodes will be explained.

MSE572 Carbon Nano Materials (탄소나노소재특론)

This course will deal with the thermal, mechanical, physical, electronic, chemical properties of carbon nano materials such as fullerene, nanotube, graphene and so on. The related applications and analysis of carbon allotropes will also be covered.

MSE573 Materials for Biomedical Applications (생명공학재료)

Various types of materials are widely used in all areas of biomedical applications('biomaterials'). The main objectives of this course are (1) to provide the students with an understanding of the fundamental principles and language associated with current biomaterials research and issues associated with biomedical applications, (2) to train students to read the research literature with critical understanding. Topics to be covered include polymeric materials (hydrogels, fibers, elastomers), ceramics, metals and their alloys, biomedical applications, and biological interactions and response with materials. Due to the highly interdisciplinary nature, students with broad interest in many facets of science and engineering are encouraged to join.

MSE580 Polymer Structures and Properties (고분자구조 및 물성)

This course presents the physical properties of polymers, such as the chain confirmation, fluctuation, entanglements, etc. The macroscopic properties of polymeric materials are dramatically influenced by these changes in their microscopic state. Macromolecules beyond the simple polymers such as membranes, gels, polyelectrolytes and biopolymers and the formation of block copolymer nanostructures will also be studied.

MSE590 The Seminars (세미나)

The purpose of this course is to extend knowledge of the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

MSE601 Synchrotron Radiation (방사광가속기 응용)

This course is intended to provide an introduction to the physics and applications of synchrotron radiation. The relevant basic principles such as radiation, scattering, wave propagation, diffraction, and coherence will be reviewed and a broad range of phenomena and applications of synchrotron radiation including soft x-ray microscopy, spectromicroscopy, and soft x-ray laser will be covered.

MSE611 Advanced Light Metals and Alloys (경량금속소재특론)

This course aims to understand the microstructure and mechanical properties of light metals and alloys, which include aluminum, magnesium, titanium, and their alloys. Solidification, recrystallization, and precipitation phenomena will be covered in this course. The relationship between microstructure and deformation behavior in the non-ferrous materials will also be discussed.

MSE612 Alloy Design (합금설계)

This class will cover the theoretical fundamentals of metallic alloy design, utilization methods of thermodynamic database and commercial softwares, alloy fabrication, and characterization of the microstructure and mechanical properties of designed alloys.

MSE631 Electronic Properties of Materials (재료의 전자기적성질)

This class discusses the origin of electrical, magnetic and optical properties of materials, with a focus on the acquisition of quantum mechanical tools. It begins with an analysis of the properties of materials, presentation of the postulates of quantum mechanics, and close examination of the hydrogen atom, simple molecules and bonds. The course continues with the free electron model, elemental kinetic theory of thermal and electrical transport, band theory, and semiconductor physics and its applications.

MSE681 Special Topics on Materials Science Engineering Ⅰ (신소재공학특론Ⅰ)

This course covers cutting-edge technologies with applications in materials science and engineering, especially on advanced structural materials, multifunctional metallic composites, characterizations of materials at the nano-scale. This content is changeable depending on the instructor.

MSE682 Special Topics on Materials Science EngineeringⅡ (신소재공학특론Ⅱ)

This course covers cutting-edge technologies with applications in materials science and engineering, especially on polymer nanocomposites, electronics, spintronics, and organic/inorganic optical materials. This content is changeable depending on the instructor.

MSE683 Special Topics on Materials Science Engineering Ⅲ (신소재공학특론Ⅲ)

This course covers cutting-edge technologies with applications in materials science and engineering, especially on graphene, low-dimensional crystals, optoelectronic materials, and nano devices. This content is changeable depending on the instructor.

MSE684 Special Topics on Materials Science Engineering Ⅳ (신소재공학특론 Ⅳ)

This course covers cutting-edge technologies with applications in materials science and engineering, especially on graphene, low-dimensional crystals, optoelectronic materials, and nano devices. This content is changeable depending on instructor.

MSE685Special Topics on Materials Science Engineering Ⅴ (신소재공학특론 Ⅴ)

This course covers cutting-edge technologies with applications in materials science and engineering, especially on graphene, low-dimensional crystals, optoelectronic materials, and nano devices. This content is changeable depending on the instructor.

MSE686 Special Topics on Materials Science Engineering Ⅵ (신소재공학특론 Ⅵ)

This course covers cutting-edge technologies with applications in materials science and engineering, especially on graphene, low-dimensional crystals, optoelectronic materials, and nano devices. This content is changeable depending on the instructor.

MSE687 Special Topics on Materials Science Engineering Ⅶ (신소재공학특론 Ⅶ)

This course covers cutting-edge technologies with applications in materials science and engineering, especially on graphene, low-dimensional crystals, optoelectronic materials, and nano devices. This content is changeable depending on the instructor.

MSE688 Special Topics on Materials Science Engineering ⅧI (신소재공학특론 ⅧI)

This course covers cutting-edge technologies with applications in materials science and engineering, especially on graphene, low-dimensional crystals, optoelectronic materials, and nano devices. This content is changeable depending on the instructor.

MSE690 Master's Research (석사논문연구)

This course is related to the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

MSE711 Advanced Metallic Materials (금속신소재특론)

This course deals with metallic materials widely studied recently in materials science and engineering and further expands to the understanding of relationships of processing, properties and mechanisms. While conventional metallic materials focus on structural materials at bulk scale, more discussion is placed on various metallic materials at multi-scales with various applications.

MSE712 Metallic Materials Processing and Lab (금속재료 공정 및 실습)

The objective of this course is to understand the fundamental concepts of processing technologies for metallic materials as well as to experience a variety of processing techniques with emphasis on their effects on the microstructure, texture, and mechanical properties of metallic alloys applied. The processing techniques will include rolling, extrusion, forging, and other severe plastic deformation processes such as equal channel angular pressing, accumulative roll bonding, high pressure torsion, and etc.

MSE731 Advanced Magnetic Materials (자성재료특론)

The study of magnetism and its intricacy with electricity runs in parallel with the technological drive to find new functional materials and their applications to the electronics, such as spintronics. This course aims to provide review of microscopic and macroscopic properties magnetic materials and the subjects of intense research activities in magnetism. Topics include isolated magnetic moments, environmental effects, their mutual interactions which lead to phase transitions, Further discussion on order and broken symmetry will be provided. The class will also review intense modern research areas, such as spintronics and nanomagnetism.

MSE732 Advanced Electric Ceramics (전자세라믹스특론)

This course will offer the basic understanding on dielectric properties of current transport mechanisms in thin insulating films which is (or will be) used in semiconductor memory and logic devices. The basics of memory devices will be reviewed and the detailed phenomenological study on the dielectric properties and leakage current properties of high-dielectric thin film will be offered.

MSE753 Nano Convergent Energy Devices (나노융합에너지소자특론)

This course provides the fundamental understandings of optoelectronic properties of nanomaterial. The energy related topics of nanomaterials such as LED, fuel cell, solar cell will be discussed in this lecture.

MSE757 The Physics of Nanoelectronics (나노소자 물리)

Advances in nanotechnology have allowed physicists and engineers to miniaturize electronic structures to the limit where finite-size related phenomena start to impact their properties. This course deal with such phenomena and models made for their description. This course will start from the semiclassical description of nonequilibrium effects, details of the scattering theory used for quantum transport calculations, and explains the main interference effects. It will also describe how fluctuations and correlations affect transport through nano structures.

MSE754 Advanced Semiconductor Devices (고급반도체소자론)

This class will cover basic operation principles of Si or compound semiconductor devices including field-effect transistor, light-emitting diode, laser diode, solar cell, and nanoelectronics. Especially, this class will help graduate students grasp state-of-the-art research trends through case study and invited talks on specific semiconductor devices.

MSE755 Introduction to Spintronics (스핀트로닉스 개론)

Spintronics, or spin electronics, involves the study of active control and manipulation of spin degrees of freedom in solid-state systems. The primary focus is on the basic physical principles underlying the generation of carrier spin polarization, spin dynamics, and spin polarized transport in semiconductors and metals. Spin transport differs from charge transport in that spin is a non-conserved quantity in solids due to spin-orbit and hyperfine coupling. This rapidly evolving research field now undergoes second phase due to a number of new phenomena involving spin-orbit coupling. This courses aims to provide review of recent progresses with the emphasis on projected applications.

MSE756 Advanced Optical Materials and Devices (고급광학소재 및 소자)

Over the last few decades, we have witnessed revolutionary developments in photonics technology, such as optical fiber communication, optical disc storage, lasers, LEDs, solar cells, etc. This photonics revolution has brought enormous beneficial impacts to society. In this course, students will learn about optical materials and devices used in various photonic applications. Eventually, students are expected to understand photonics industries and appreciate the role of photonics in the future society.

MSE771 Special Topics on Flexible Electronic Materials (플렉시블 전자소재특론)

Low cost roll-to-roll manufacturing process for flexible electronics and other applications are increasingly drawing attention as emerging technology platform for device fabrication. This course covers fundamental understanding of flexible conductive and semiconductor materials and their device applications to organic light-emitting devices, organic solar cells and organic thin film transistors. Further discussion on deposition processes, interfacial engineering and functional coatings will be discussed. The course will also go over the patterning techniques such as embossing and self-aligned imprint lithography, transfer technologies, digital fabrication, and printed electronics.

MSE772 Advanced Polymer Physics (고급 고분자 물리학)

Polymer is one of the most used materials in current daily life. The understanding of chemical structure of polymers and correlation with the physical behavior such as molecular dynamics, rheology, thermal and mechanical properties are essential to fully utilize their potentials. The main background of this course is providing in-depth study of sciences associated with polymer physics. This lecture is to help graduate student understand the theoretical backgrounds of polymer physics and their behavior (structure-property relationship) so as to take advantage of the course in their researches.

MSE851 Advanced Transmission Electron Microscopy (전자현미경특론)

The need for micro- and nano-structure characterizations is now increasing as both the structural and electronic materials become smaller and smaller. In this course we study the advanced principles and techniques for modern transmission electron microscopy including 1) Imaging theory and experiments in high resolution electron microscopy, 2) Nano-diffraction and convergent beam electron diffraction, 3) X-ray energy dispersive spectroscopy, 4) electron energy loss spectroscopy and 5) simulations etc. Details of this lecture may be modified later.

MSE852 Quantum Analysis and Modeling (양자해석 및 설계)

In this course, we will discuss quantum calculation methods such as DFT and HF. To understand the characteristics of nanomaterials using quantum simulations, the theoretical backgrounds and the basic concept of algorithm will be introduced. Some basic explanation of quantum physics and solid-state physics will be briefly introduced for engineers who are not familiar with quantum mechanics

MSE890 Doctoral Research (박사논문연구)

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

Department of Biological Sciences

Biological Sciences [BIO]

The graduate department of Biological Sciences offers interdisciplinary research training based on fundamental understandings on living organisms and applied knowledge to medical science in order to improve quality of life. The department provides a world-class research environment for biological and medical sciences, such as a state-of-art animal research center, Olympus biomed imaging center, stem cell research center, and cancer research center. This department aims to produce young, brilliant, and creative scientific minds, with world-class renown, by educating them so they are fully equipped and familiar with the basic knowledge of biological and medical sciences as well as cutting-edge research technologies in the state-of-the-art facilities provided by UNIST.

Credit Requirement

Program	Total Credits	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 21 credits	at least 7 credits
Doctoral Program	at least 60 credits	at least 15 credits	at least 17 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 30 credits	at least 24 credits

Curriculum

▶ Biological Sciences

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Prerequisite	Convergence	Remark
Required	BIO690	Research	Master's Research	석사논문연구	Value of Credit			
	BIO890		Doctoral Research	박사논문연구	Value of Credit			
	BIO590		Seminar	세미나	1-1-0			
Elective	BIO501	Lecture	Advanced Biochemistry	고급생화학	3-3-0			Core Subject
	BIO502		Advanced Molecular Biology	고급분자생물학	3-3-0			Core Subject
	BIO503		Advanced Cell Biology	고급세포생물학	3-3-0			Core Subject
	BIO504		Stem Cell Engineering	줄기세포공학	3-3-0			
	BIO505		Cancer Biology	암생물학	3-3-0			
	BIO506		Biochemistry of Diseases	질환생화학	3-3-0			
	BIO507		Biomolecular Network	생분자네트워크	3-3-0			
	BIO508		Structural Biology	구조생물학	3-3-0			
	BIO509		Protein Engineering	단백질공학	3-3-0			
	BIO510		Current topics in metabolism and cancer biology	최신 대사학 및 암생물학 특론	3-3-0			
	BIO601		Protein Crystallography	단백질결정학	3-3-0			
	BIO602		Signal Transduction in Cells	세포신호전달학	3-3-0			
	BIO603		Current topics in Immunology I	면역학특론 I	3-3-0			
	BIO604		Neurobiology	신경생물학	3-3-0			
	BIO605		Biomaterial and Nanobiotechnology	생체재료와 나노바이오 테크놀로지	3-3-0			
	BIO606		Analytical Chemistry of Biomolecules	생물분자분석특론	3-3-0			
	BIO607		Advanced Microbial Physiology	고급미생물생리학	3-3-0			
	BIO608		Advanced Endocrinology and Metabolism	고급 내분비 및 대사학	3-3-0			
	BIO701		Molecular Physiology	분자생리학	3-3-0			

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Prerequisite	Convergence	Remark
Elective	BIO702	Lecture	Current Topics in Immunology II	면역학특론 II	3-3-0			
	BIO703		Topics in Genome Data Analysis	유전체데이터분석특론	3-3-0			
	BIO704		Current Topics of Biomedical Research	의생명과학특론	3-3-0			
	BIO705		Mitochondria Biology	미토콘드리아생물학	3-3-0			
	BIO706		Statistical Genetics	통계유전학	3-3-0			
	BIO707		Advanced Structural Biology	구조생물학특론	3-3-0			
	BIO708		Current Topics in Protein Engineering	최신단백질공학특론	3-3-0			
	BIO709		Current Topics in Cellular Physiology	최신세포생리학특론	3-3-0			
	BIO710		Current Topics in Developmental Biology	최신발생생물학특론	3-3-0			
	BIO711		Current Topics in Molecular Medicine	최신분자의학특론	3-3-0			
	BIO712		Current Topics in Stem Cell Biology	최신줄기세포공학특론	3-3-0			
	BIO713		Patho-biotechnology	병리-바이오테크놀로지	3-3-0			
	BIO801		Special Lectures in Biological Sciences A	최신생명과학특론A	3-3-0			
	BIO802		Special Lectures in Biological Sciences B	최신생명과학특론B	3-3-0			
	BIO803		Special Lectures in Biological Sciences C	최신생명과학특론C	3-3-0			
	BIO804		Special Lectures in Biological Sciences D	최신생명과학특론D	3-3-0			
	BIO805		Special Lectures in Biological Sciences E	최신생명과학특론E	3-3-0			
	BIO806		Special Lectures in Biological Sciences F	최신생명과학특론F	3-3-0			
	BIO807		Special Lectures in Biological Sciences G	최신생명과학특론G	3-3-0			
	BIO808		Special Lectures in Biological Sciences H	최신생명과학특론H	3-3-0			
	BIO809		Special Lectures in Biological Sciences I	최신생명과학특론I	3-3-0			
	BIO810		Special Lectures in Biological Sciences J	최신생명과학특론J	3-3-0			

Description

BIO501 Advanced Biochemistry [고급생화학]

This is an intensive course in Biochemistry. Beside lectures, graduate students will also be trained to criticize and interpret experimental data on various biochemistry topics by presenting recent research papers published in top-quality journals.

BIO502 Advanced Molecular Biology [고급분자생물학]

This course will cover the molecular biological aspects of a variety of biological phenomena, such as genetic structure and regulation of gene expression in prokaryotic and eukaryotic organisms; mechanisms of gene action and gene/enzyme relationships; biochemical manipulation and characterization of genetic macromolecules. A series of presentations and discussions on recent research achievements in molecular biology will equip graduate students with up-to-date knowledge and techniques in the field of advanced molecular biology, which will improve their performance as an independent researcher.

BIO503 Advanced Cell Biology [고급세포생물학]

This is an intensive course of Cell Biology. In addition to lectures, graduate students will also be trained to criticize and interpret experimental data on various cell biology topics including up-to-date research achievements on cancer biology as well as the stem cell field.

BIO504 Stem Cell Engineering [줄기세포공학]

Stem cells have the remarkable potential to develop into many different cell types in the body during early life and growth. Given their unique regenerative abilities, stem cells offer new potentials for treating diseases such as diabetes, neural and heart disease. Research on stem cells continues to advance knowledge about how an organism develops from a single cell and how healthy cells replace damaged cells in adult organisms. Stem cell research is one of the most fascinating areas of contemporary biology. One of UNIST’s core research programs is Stem Cell Research. The class in this core program is focused on understanding the pluripotency of mouse and human embryonic stem cells.

BIO505 Cancer Biology [암생물학]

This course provides students with knowledge of the fundamental principles of the molecular and cellular biology of cancer cells. Students will learn the nature of cancer, the role of growth factors, cellular oncogenes, tumor suppressor genes, angiogenesis, metastasis, and signal transduction mechanisms in tumor formation. Principles of anticancer drug action and many aspects of immunology, neurobiology, developmental biology related to cancer will be discussed.

BIO506 Biochemistry of Diseases [질환생화학]

This course applies basic biochemistry and analytical chemistry to medical diagnosis, treatment and management. It provides a sound, objective basis on which to gauge the extent of a clinical disorder, the biochemical consequences of a particular disease process, and the response to therapy.

BIO507 Biomolecular Network [생분자네트워크]

This course will introduce complex biomolecular interaction networks for example, metabolic networks, regulatory networks and signaling networks. General and specific aspects of cellular signaling pathways and their function in the regulation of cellular processes will be covered.

BIO508 Structural Biology [구조생물학]

This course will introduce molecular structure of biological macromoloecules, especially proteins and nucleic acids. This course will cover major methods to determine the three-dimensional structure of protein, how the structures are closely related with their functions. Practical aspect also will be covered.

BIO509 Protein Engineering [단백질공학]

This advanced course will cover the broad aspects of proteins, including protein folding, structures, dynamics and functions. Particular focuses will be protein-protein interactions, protein structure-function or/and dynamics-function relationships, and protein macromolecular complexes. Various analytical methods, including spectroscopic and spectrometric tools, and the perspectives on biomedical and industrial applications of engineered proteins will also be discussed.

BIO 510 Current topics in metabolism and cancer biology [최신 대사학 및 암생물학 특론]

This course will review current research and publications related to metabolism and related cancer cell biology. Students will be able to understand current topics in the filed of metabolism-related cancer biology easily through a series of presentations and discussions.

BIO601 Protein Crystallography [단백질결정학]

X-ray crystallography is one of the powerful methods to solve the protein three-dimensional structure at atomic level resolution. The main objective of this lecture is to introduce the fundamental principles and techniques of protein X-ray crystallography. The lecture will include macromolecule crystallization method, basic mathematics for crystallography, diffraction theory, data collection, model building and refinement, graphic visualization and structural analysis. Practical aspects of crystallography will be also covered in the class.

BIO602 Signal Transduction in Cells [세포신호전달학]

All aspects of signal transduction pathways will be introduced. A series of lectures on cell division and its mechanisms following extracellular signals in both healthy subjects and disease conditions will be given. In particular, deteriorated signal transduction pathways, due to aging, will be discussed through a series of presentations on recent research findings.

BIO603 Current topics in Immunology Ⅰ [면역학특론Ⅰ]

A series of presentations and discussions on recent research achievements published in top-notch immunology journaLS will equip graduate students with up-to-date knowledge and techniques in the field of immunology, which improve their performance as independent researchers.

BIO604 Neurobiology [신경생물학]

This course is intended to introduce graduate students to a broad survey of the basic concepts of neuroscience. The course is organized into a series of modules discussing levels of neurobiological functions that range from molecular through behavioral and cognitive processes, and covering topics such as the action potential, molecular mechanisms of synaptic release, neurotransmitters, sensory and motor processing, emotion, cognition and various neurological disorders.

BIO605 Biomaterial and Nanobiotechnology [생체재료와 나노바이오테크놀로지]

This course will review current developments of nanobiotechnology utilizing biomaterials such as nucleic acids, proteins, and carbohydrates and their impacts on nanotechnology, biomedical research, and industry. This course particularly focuses on learning how to utilize biomaterials for nanotechnology and biomedical research and what kinds of important techniques are used to study biomimetic nanobiotechnology.

BIO606 Analytical Chemistry of Biomolecules [생물분자분석특론]

This course will deal with the characterization and analysis of biomolecules, such as nucleic acids, carbohydrates, and proteins in depth. This course will particularly focus on the fundamental understanding of various types of analytical tools, including electrochemical, chromatographic, spectroscopic, and spectrometric methods, to study the structures and functions of biomolecules. Instrumental details will also be discussed.

BIO607 Advanced Microbial Physiology [고급미생물생리학]

This class will look into the inner workings of microbial growth and metabolism. Emphasis will be given to the study of transport systems, metabolic balances (redox/mass/energy), metabolic flux analysis, genetic regulation and the effects of environmental stimuli on the gene expression patterns, with a general focus on bioproduction and whole-cell biosensor systems.

BIO608 Advanced Endocrinology and Metabolism [고급 내분비 및 대사학]

Westernized societies are confronting an epidemic surge in the incidence of obesity and its attendant co-morbidities. Foremost among these is type 2 diabetes, which is projected to reach a global incidence of 300 million cases by the year 2020. The major goal of this lecture is to provide how obesity and metabolic diseases can be caused and what is the best way to manage the metabolic disorders. For this, this lecture encourages interactions between basic and translational researches. Accordingly, this lecture will concentrate on signaling and regulation of endocrinology in animal systems and in man. Also, this class will provide current insights how mammalian cells can operate their own cellular metabolism and these metabolic pathways can result in systemic metabolism.

BIO701 Molecular Physiology [분자생리학]

The primary goal of this course is to develop understanding of the principles of the physiological processes at the molecular level. This course will provide a timely summary of the molecular and cellular mechanisms underlying physiological processes. The structure-function relationship among signaling biomolecules will be discussed.

BIO702 Current Topics in ImmunologyⅡ [면역학특론Ⅱ]

This is an advanced immunology class where immune systems in health and diseases will be discussed. Students will also learn about developments and functions of various immune cells as well as experimental technologies used in immunology. Mainly, current immunological research topics will be discussed.

BIO703 Topics in Genome Data Analysis [유전체데이터분석특론]

This course covers various data analysis methods for genome data including multivariate analysis, machine learning and graph algorithms. Applications for microarray and next generation sequence data are included.

BIO704 Current Topics of Biomedical Research [의생명과학특론]

This course is designed to cover the state-of-the-are technologies and future directions in the field of biomedical engineering. Special interests are focused on artificial tissues to replace that of human and diagnostic devices for medical applications.

BIO705 Mitochondria Biology [미트콘드리아생물학]

With the recent renaissance in mitochondrial biology and increasing recognition of their role in many important human diseases, this course will provide a timely summary of the current state-of-the-art mitochondrial research. This class covers structure and function of mitochondria, dynamics of mitochondria, and the biochemistry of oxidative stress and mitochondrial cell signaling. Mitochondrial implications of important human diseases such as neurodegeneration, cancer, aging, heart attack, and stroke will be discussed.

BIO706 Statistical Genetics [통계유전학]

This course covers topics in evolution and population genetics as well as related statistical methods

BIO707 Advanced Structural Biology [구조생물학특론]

This course will generally elucidate the cellular biophysical function of the proteins. The lecture will focus on biophysical activities such as the cell cycle, epigenetics, DNA metabolism, vesicular trafficking, cytoskeleton, signal transduction and membrane biology, in terms of protein structure. The lecture will also cover how to develop and design small molecules for specific diseases (cancer, neurodegenerative disease, etc) that were caused by malfunctions of these proteins.

BIO708 Current Topics in Protein Engineering [최신단백질공학특론]

This course is intended to introduce the principles and techniques of protein engineering to develop novel tools which help understand from protein functions to diverse diseases in molecular and cellular level. A series of techniques including chemical and light inducible protein modifications will be discussed. Students will be able to understand the up-to-date protein engineering and develop new tools and improve their performance in their research fields.

BIO709 Current Topics in Cellular Physiology [최신세포생리학특론]

This course is planned to introduce the principles and techniques of cellular physiology. Students will participate in a series of presentations and discussions which help them understand the field of cellular physiology and apply experimental techniques/technologies to their research.

BIO710 Current Topics in Developmental Biology [최신발생생물학특론]

In this course, students will review recent literature in cell and developmental biology. Students must be actively involved in discussion and also have to exchange their opinion. The topics and literature can be selected by students or instructor.

BIO711 Current Topics in molecular medicine [최신분자의학특론]

Molecular and cellular mechanism underlying a variety of common diseases such as diabetes, hypertension, and atherosclerosis is being uncovered at a breath-taking pace. This course is designed to keep up with the progress by reviewing up-to-date literature. Critical review of the literature will be achieved by free exchange of questions and ideas.

BIO712 Current Topics in Stem Cell Biology [최신줄기세포공학특론]

This course will review current research and publications related to stem cell biology.
Students will be able to understand current topic in stem cell biology easily through a series of presentations and discussions.

BIO713 Patho-biotechnology [병리-바이오테크놀로지]

This course introduces the idea of patho-biotechnology, which is defined in this context as the use of pathogenic processes, virulence factors or other effectors to biotechnological applications. As a relatively new field of science, the topics covered will be both novel and creative, spanning from bacterial ghosts as vaccines to the application of bacteria with cancer treatments and as vehicles for RNAi delivery.

BIO801-810 Special Lectures in Biological Sciences A-J [최신생명과학특론 A-J]

This course is designed to introduce the current trends and the state-of the-art states of various research areas in life sciences. To keep the flexibility of the course, the topics and the instructors will be changed every semesters.

BIO590 The Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

BIO690 Master's Research [석사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

BIO890 Doctoral Research [박사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

Department of Biomedical Engineering

Biomedical Engineering[BME]

The graduate program of biomedical engineering offers multidisciplinary research and education at the intersection of engineering, medicine, and the biological sciences to improve health and quality of life and to solve global crises related to energy and the environment. Research in the graduate program of biomedical engineering focuses on the application of engineering principles to design and manipulate biological systems as well as to analyze and understand biological phenomena contributing to the leading-edge technologies. This graduate program also offers a number of pertinent courses providing the students with the know-how and practical experience needed, through in-depth discussions and laboratory experiments. Education in the biomedical engineering graduate program leads the students to become leading researchers and experts within their area as well as creative leaders for both academia and industry.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 21 credits	at least 7 credits
Doctoral Program	at least 60 credits	at least 12 credits	at least 20 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 30 credits	at least 24 credits

Curriculum

▶ Biomedical Engineering[BME]

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Convergence	Remark
Required	BME590	Research	Seminar	세미나	1-1-0		
	BME690		Master's Research	석사논문연구	Value of Credit		
	BME890		Doctoral Research	박사논문연구	Value of Credit		
Elective	BIO501	Lecture	Advanced Biochemistry	고급생화학	3-3-0		Core Subject
	BIO502		Advanced Molecular Biology	고급분자생물학	3-3-0		Core Subject
	BIO503		Advanced Cell Biology	고급세포생물학	3-3-0		Core Subject
	BME501		Biology and Micro/Nanotechnology	생물학과 마이크로/나노공학	3-3-0		Core Subject
	BME502		Advanced Biomedical Engineering	고급생명공학	3-3-0		Core Subject
	BME503		Multiscale Imaging	첨단분광학 및 영상학	3-3-0		Core Subject
	BME504		Animal Cell Biotechnology	동물세포공학	3-3-0		
	BME505		Methods in OMICS experiment	오믹스 실험 방법론	3-3-0		Core Subject
	BME508		Engineering Physiology	공학생리학	3-3-0		Core Subject
	BME509		Advanced Biomedical Optics	의광학개론	3-3-0		
	BME510		Quantitative Systems Biology	정량적시스템생물학	3-3-0		Core Subject
	BME602		Biofabrication	바이오 가공	3-3-0		
	BME603		Advanced Proteomics	고급 단백질체학	3-3-0		
	BME605		Quantitative Analysis for Biomedical Images	의생명영상의 정량적분석	3-3-0		
	BME606		Biomedical Research with Model Organisms	모델 동물을 이용한 생명공학 연구	3-3-0		
	BME608		Light-tissue interaction	광-조직 상호작용	3-3-0		
	BME609		Wave optics	파동광학	3-3-0		
	BME610		Cancer Genomics	암유전체학	3-3-0		
	BME700		Technical Writing in English	영어논문작성법	3-3-0		
	BME704		Spatial Aspects of Magnetic Resonance	공간자기공명학	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Convergence	Remark
Elective	BME705	Lecture	Single molecule Biophysics	단분자 생물물리학	3-3-0		
	BME706		Frontiers of Biomedical Engineering	최신의생명공학특론	3-3-0		
	BME707		Inventions and Patents	발명과특허	3-3-0		
	BME708		OMICS Special Program	오믹스 특론	3-3-0		
	BME709		Geromics	노화체학	3-3-0		
	BME801		Special Lectures in Biomedical Engineering A	최신생명공학특론A	3-3-0		
	BME802		Special Lectures in Biomedical Engineering B	최신생명공학특론B	3-3-0		
	BME803		Special Lectures in Biomedical Engineering C	최신생명공학특론C	3-3-0		
	BME804		Special Lectures in Biomedical Engineering D	최신생명공학특론D	3-3-0		
	BME805		Special Lectures in Biomedical Engineering E	최신생명공학특론E	3-3-0		
	BME806		Special Lectures in Biomedical Engineering F	최신생명공학특론F	3-3-0		
	BME807		Special Lectures in Biomedical Engineering G	최신생명공학특론G	3-3-0		
	BME808		Special Lectures in Biomedical Engineering H	최신생명공학특론H	3-3-0		
	BME809		Special Lectures in Biomedical Engineering I	최신생명공학특론I	3-3-0		
	BME810		Special Lectures in Biomedical Engineering J	최신생명공학특론J	3-3-0		

□ Description

BIO501 Advanced Biochemistry [고급생화학]

This is an intensive course in Biochemistry. Beside lectures, graduate students will also be trained to criticize and interpret experimental data on various biochemistry topics by presenting recent research papers published in top-quality journals.

BIO502 Advanced Molecular Biology [고급분자생물학]

This course will cover the molecular biological aspects of a variety of biological phenomena, such as genetic structure and regulation of gene expression in prokaryotic and eukaryotic organisms; mechanisms of gene action and gene/enzyme relationships; biochemical manipulation and characterization of genetic macromolecules. A series of presentations and discussions on recent research achievements in molecular biology will equip graduate students with up-to-date knowledge and techniques in the field of advanced molecular biology, which will improve their performance as an independent researcher.

BIO503 Advanced Cell Biology [고급세포생물학]

This is an intensive course of Cell Biology. In addition to lectures, graduate students will also be trained to criticize and interpret experimental data on various cell biology topics including up-to-date research achievements on cancer biology as well as the stem cell field.

BME501 Biology and Micro/Nanotechnology [생물학과 마이크로/나노공학]

This course will review fabrication techniques(e.g. micropatterning of surfaces, soft lithography, BioMEMS) and examples of microfluidic chemical analytical systems through lectures and discussion of current literature. Students will learn how to make a device and operate it, how to do group discussions(oral presentation) and how to do a critical review(writing).

BME502 Advanced Biomedical Engineering [고급생명공학]

In general, advanced bioengineering can be defined as the application of engineering concepts and tools to the broad field of biomedical and biochemical engineering. The course covers the basic application of biology and biochemistry to tissue engineering, bioMEMS, bioimaging technology, fermentation engineering, metabolic engineering, and systems biotechnology.

BME503 Multiscale Imaging [첨단분광학 및 영상학]

A series of lectures provides basic principles of molecular spectroscopy and biomedical imaging methods. Emphasis is laid on infrared(IR) spectroscopy and nuclear magnetic resonance(NMR) spectroscopy and imaging. Topics include FT-IR, 2DIR, FT-NMR, 2D-NMR, MRI, and other frequently used spectroscopic techniques such as pump-probe spectroscopy and flourescence resonance energy transfer(FRET).

BME504 Animal Cell Biotechnology [동물세포공학]

The culture of animal cells is one of the major aspects of science which serves as a foundation for most of our recent discoveries. The aim of this course is to provide knowledge about techniques and applications of animal cell culture to biotechnology. This course will cover from methodology of animal cell culture; sterile technique, culture of primary cell, generation of immortalized cells, stem cell culture, tissue culture, organotypic culture, 3D culture, to specialized applications; model system, gene therapy, drug screening, transplantation, and production of therapeutics. It will provide graduate students in the various fields of science and technology with a better understanding of animal cell culture and aid to apply these techniques to their own research.

BME505 Methods in OMICS experiment [오믹스 실험방법론]

The goals of this class are 1) basic introduction to the information on DNA, RNA and protein, 2) experimental and computational methods to decipher those information in large scale, such as genomics, transcriptomics, epigenomics, proteomics, metabolomics, and 3) implementation techniques for those methods. We will also discuss recent research articles related to those topics.

BME508 Engineering Physiology [공학생리학]

This is introductory course designed for graduate Biomedical Engineering students. This course mainly covers how to apply knowledge of mathematics and engineering to human physiology. Initial lectures will focus on the review of human anatomy and physiology. Subsequently, the role of fundamental physiological principles will be illustrated in specific organ systems through more detailed discussions of the muscular, nervous, sensory, cardiovascular and respiratory systems. At last, these concepts will be quantitatively analyzed by engineering model and simulation. In order to follow the course contents, students should be comfortable with the use ordinary differential equations and linear system analysis.

BME509 Advanced Biomedical Optics [의광학개론]

This course aims to introduce fundamentals and frontier topics of biomedical optics to mainly graduate students as well as high-level undergraduate students. The course covers an overview of fundamental optics, light-matters interactions, and the principle of optical sensors and imaging systems. This course will also provide an overview of emerging technologies and research trends in biomedical optics for solving current challenges in biology and medicine.

BME510 Quantitative Systems Biology [정량적시스템생물학]

This course outlines the systemic approach in which the life phenomena are viewed as an information processing and a material-energy transport at a cellular level. We review, on a firmly quantitative and molecular basis, the DNA replication, Central Dogma, and regulatory mechanisms that a cell utilizes to cope with the constantly changing environment. The course aims to provide the conceptual tools for scientists and engineers, particularly working in the fields of interdisciplinary bioscience and biotechnology. Throughout the course, theoreticians will be guided to critically appreciate current experimental methods and experimentalists to discriminate the quality of modelling or computational studies. The target audience includes graduates and higher undergraduates with the training background in biology or in physics, engineering, computer science.

BME602 Biofabrication [바이오 가공]

MEMS/NEMS technologies are adopted in a variety of mechanical, electronic devices and bio-sensors. This course introduces basic principles of conventional microfabrication techniques for MEMS device fabrication and includes their applications and some case studies. MEMS is a typical interdisciplinary research area so that the application of this course is expected to be extended to the research areas such as electronic engineering, biochemistry, chemistry, physics, medical science and etc.

BME603 Advanced Proteomics [고급 단백질체학]

Mass spectrometry-based proteomics is widely used to elucidate the function of proteins in living cells. Recently this technology has been improved significantly so it can be used to study “more than protein identification”, like absolute protein quantification, protein complexes, protein-RNA binding, and post-translational modification. However, because its data is not easy to interpret, compared to sequencing data, its application is hindered in spite of its power to survey more than thousand of proteins at once. The goal of this class is to learn basic knowledge to understand MS/MS proteomics data, to understand research articles with MS/MS proteomics data. We will discuss recent research and review articles related to various topics in proteomics, from the basic concept of mass spectrometry to the data analysis. We will also have computational practice sessions for actual data analysis.

BME606 Biomedical Research with Model Organism [모델동물을 이용한 생명공학 연구]

A model organism is an essential component in biomedical research; we have revealed novel gene function in the regulatory networks and signalling pathways by perturbing genes in a model organism, and interpreted its role in human health based on the gene homology through evolution. Also, we have used model organism to develop novel technology in many fields of biomedical research, such as genomics, bio-imaging, and bio-device. Each model organism has its own characteristics, so it is important to understand them to choose right model for your own research. For example, yeast is good to study cell cycle but it is not obvious to cell-cell communication in heterogeneous environment; mouse is good to study many phenotypes related to human diseases, such as physiology and organ development, but it is not easy to use in large-scale population genetics. This class will discuss about recent research and review articles utilized various model organisms, to understand the pros and cons of each system.

BME605 Quantitative Analysis for Biomedical Images [의생명영상의 정량적분석]

Fundamental image signal processing with particular emphasis on problems in biomedical research and clinical medicine. Emphasis on quantitative image handling of MRI, PET and optical image data. Topic will include data acquisition, imaging, filtering, feature extraction, pattern recognition and modeling.

BME608 Light-tissue interaction [광-조직 상호작용]

The objective of this course is to provide fundamentals and frontier topics of laser applications in biomedical field. This course will cover the basic principles of laser and laser-tissue interaction and furthermore discuss practical applications in various clinical environments.

BME609 Wave optics [파동광학]

This course provides basic principles of optics and current state-of-the-art imaging technique. Emphasis is laid on the wave properties of light. Description of the propagation of light based of Fourier optics and understanding a microscope in terms of Fourier optics will constitute the basis. Principles of holography as well as statistical properties of light to describe coherence will also be discussed.

BME610 Cancer Genomics [암유전체학]

This course will provide a general overview on cancer genomics and review a variety of key research papers in the field of cancer genomics. Each participant of the class will be required to prepare an overview of one or two papers for general discussion.

BME700 Technical Writing in English [영어논문작성법]

This course is designed to improve English writing skills for graduate students. It provides opportunity to do critical review of research articles as well as to practice technical writing in English. Students write a review article or their own research papers throughout the course.

BME704 Spatial Aspects of Magnetic Resonance [공간자기공명학]

This course provides detailed classical and quantum description of NMR theory. Emphasis is on spatial aspects of magnetic resonance, including discussions of basic image reconstruction, image contrast, diffusion and flow measurements, and hardware design considerations. Exposure to laboratory NMR spectroscopic and imaging equipment is included.

BME705 Single molecule Biophysics [단분자 생물물리학]

The goal of this course is to understand the relationship between the structure and function of biomolecules and to develop solid knowledge of current research and technical development. In addition, this course covers biological regulations by the modifications of protein such as phosphorylation, glycosylation, methylation and proteolytic activation.

BME706 Frontiers of Biomedical Engineering [최신의생명공학특론]

This course discusses recent research trends in biomedical engineering, specifically, interdisciplinary research examples such as biochips or lab-on-a-chips for analysis of nucleic acids, proteins, and cells in molecular or cell level. Proposal writing and oral presentation are also required.

BME707 Inventions and Patents [발명과특허]

Students can learn how to think creatively and how to make inventions. Students can practice creative thinking, claim analysis, and writing patent specifications by using case studies or their own projects.

BME708 OMICS Special Program [오믹스 특론]

Omics is a new name for biology and biotechnology. It has many -omics subfields such as genomics and proteomics.

1. Whatislife,information,andtheuniverse? (as information processing objects) Introduction to the course.
2. What is Sequencing in Genomics and Omics?(as an approach of understanding life) Sequencing
3. What is genome and proteome? 4. What is the meaning of interactome?

BME709 Geromics [노화체학]

Geromics is a new name for biological gerontology.
It aims to provide critical and independently acquired knowledge and methods on how to cure aging. (It is based on SELF: self evaluating and learning framework)
It covers: 1.What is aging? 2.What is omics methodologies? 3.Current anti-aging and rejuvenation approaches

BME801-810 Special Lectures in Biomedical Engineering A-J [최신생명공학특론A-J]

This course is designed to introduce the current trends and the state-of the-art states of new biomedical diagnostics and therapeutics, green energy, and bioremediation. To keep the flexibility of the course, the topics and the instructors will be changed every semesters.

BME590 The Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

BME690 Master's Research [석사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

BME890 Doctoral Research [박사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

Department of Human Factors Engineering

Human Factors Engineering [HFE]

The department of Human Factors Engineering (HFE) focuses on understanding human capabilities, limitations, and behaviors and how this can be applied to the design and development of innovative products, processes and systems. The curriculum of HFE is structured to provide students with deep knowledge and practical skills in human factors engineering and applied statistics. Specific foci include: physical/cognitive ergonomics, human-computer interaction (HCI), human behavior modeling, and human centered design. The knowledge and skills gained through studying Human Factors Engineering can be applied to a wide range of products and systems including human-machine interfaces, healthcare products/systems, and transportation systems.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 18 credits	at least 10 credits
Doctoral Program	at least 60 credits	at least 18 credits	at least 42 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 30 credits	at least 30 credits

Curriculum

▶ Human Factors Engineering [HFE]

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre requisite	Convergence
Elective	HFE504	Experimental	Master Graduation Project	석사졸업과제	2-0-4		O
	HFE590	Research	The Seminars	세미나	1-1-0		O
	HFE690		Master's Research	석사논문연구	Value of Credit		
	HFE890		Doctoral Research	박사논문연구	Value of Credit		
	HFE540	Lecture	Human Factors Research Design	인간공학연구설계	3-3-0		
	HFE542		Advanced Multivariate Methods & Data Mining	고등다변량기법과 데이터마이닝	3-3-0		
	HFE543		Human Performance in Transportation System	교통시스템과 인간수행력	3-3-0		
	HFE550		Occupational Biomechanics	작업 생체 역학	3-3-0		
	HFE558		Human Information Processing	인간정보처리	3-3-0		
	HFE740		Special Topics in HFE 1	인간공학 특론 1	3-3-0		
	HFE741		Special Topics in HFE 2	인간공학 특론 2	3-3-0		
	HFE742		Special Topics in HFE 3	인간공학 특론 3	3-3-0		
	HFE743		Special Topics in HFE 4	인간공학 특론 4	3-3-0		
	HFE745		Techniques and Methodologies in Ergonomics 1	인간공학기법과 방법론 1	3-3-0		
	HFE746		Techniques and Methodologies in Ergonomics 2	인간공학기법과 방법론 2	3-3-0		
	HFE747		Techniques and Methodologies in Ergonomics 3	인간공학기법과 방법론 3	3-3-0		
	HFE748		Techniques and Methodologies in Ergonomics 4	인간공학기법과 방법론 4	3-3-0		
	HFE560		Color Science	색채과학	3-3-0		
	HFE561		Psychophysics	정신물리학	3-3-0		
	HFE562		Cross-media color reproduction	크로스미디어컬러 리프로덕션	3-3-0		
	HFE701		Advanced Topics in High Touch	하이터치 고등논제	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre requisite	Convergence
Elective	HFE761	Lecture	Human Vision	인간시각	3-3-0		
	HFE762		Advanced Color Science	고급색채과학	3-3-0		
	HFE790		Research Practicum in Human Factors	인간공학 연구주제	3-3-0		
	HFE552		Human-Computer Interaction	인간과 컴퓨터 상호작용	3-3-0		
	HFE900		Special Topics in DHE 1	DHE 특론 1	1-1-0		O
	HFE901		Special Topics in DHE 2	DHE 특론 2	3-3-0		O
	HFE910		Interaction Deign	인터렉션 디자인	3-2-2		
	HFE911		Human-Centered design	인간중심 디자인	3-3-0		
	HFE912		Contextual design	컨텍스츄얼 디자인	3-3-0		

Description

HFE504 Master Graduation Project [석사졸업과제]

This course is offered for Master Students who take Practice-Oriented Masters Program aiming at fostering competent design engineers who have Integrated perspective, creative problem-solving knowledge and skills and business mind. Students define a problem and deliver a practical solution using various methods and techniques coming from design, engineering, business and so forth. Students in Practice-oriented Masters Program should take this course for two semesters in a row. Patent application, award wining, outcome transfer into a business or publication of research outcome is expected.

HFE590 The Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

HFE690 Master's Research [석사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

HFE890 Doctoral Research [박사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

HFE540 Human Factors Research Design [인간공학연구설계]

Procedures for conducting and analyzing human factors and ergonomics experiments, including fundamentals of research, design alternatives, fitting and testing statistical models, and data interpretation and presentations. Primary focus on linear regression (simple and multiple) and analysis of variance (single and multiple factor) will be explored in depth.

HFE542 Advanced Multivariate Methods & Data Mining [고등다변량기법과 데이터마이닝]

This course explores advanced multivariate and data mining methods. Primacy will be given to the analysis of multivariate distributions, location and dispersion problems for one and two samples, multivariate analysis of variance, linear models, repeated measurements, inference for dispersion and association parameters, principal components, discriminant and cluster analysis, and simultaneous inference.

HFE543 Human Performance in Transportation Systems [교통시스템과 인간수행력]

The principles objectives of this course are to explore: 1) the basic principles of human performance, human error, and human behavior applied to transportation systems, 2) the principles of transportation systems design for human performance improvements, 3) the principles and practices of empirical evaluation of human, vehicular, and infrastructure interaction.

HFE550 Occupational Biomechanics [작업 생체 역학]

This course explores the modeling, analysis, and evaluation of industrial workplaces with emphasis on the physical demands placed on and the capabilities of workers. Topics covered include: physiology, anthropometry, bioinstrumentation, and biomechanics. Students will learn and apply a range of contemporary analytical and assessment methods.

HFE558 Human Information Processing [인간정보처리]

An examination of human information reception, information processing, and skilled performance capabilities and limitations in human-machine systems with an emphasis on models and techniques, including psychophysics, signal detection theory, information theory, supervisory control, and decision theory.

HFE740,741,742,743 Special Topics in Human Factors 1,2,3,4 [인공공학 특론 1,2,3,4]

This course consists of students-led seminars on contemporary topics in Human Factors.

HFE745,746,747,748 Techniques and Methodologies in Ergonomics [인간공학기법과 방법론 1, 2, 3, 4]

This course reviews contemporary techniques and methodologies used in Cognitive and Physical Ergonomics, most of which will be presented by students rather than by the instructor.

HFE560 Color Science [색채과학]

This course covers the principles of color science. Components include human visual system, CIE colorimetry, color measuring instruments, psychophysical scaling methods, models for color difference and color appearance, color order systems. It aims to equip students with thorough understanding of the principles of color science to be able to apply these for solving industrial problems.

HFE561 Psychophysics [정신물리학]

Psychophysics is the scientific discipline about the relation between physical stimulus and human sensation. This course focuses on the psychophysical experimental methods and data analysis for human visual perception researches.

HFE562 Cross-media color reproduction [크로스미디어컬러리프로덕션]

Color signal control methods such as device characterization and gamut mapping are introduced to reproduce the same colors on the various imaging devices.

HFE701 Advanced Topics in High Touch [하이터치 고등논제]

In this course, basic and advanced topics in high touch design will be discussed. Students are required to apply the high touch design process for their term project.

HFE761 Human Vision [인간시각]

The process of human visual perception starting from the retina to the visual cortex is studied along with various adaptation process.

HFE762 Advanced Color Science [고급색채과학]

This course introduces the latest researches on color science & engineering field conducted at the related international standard organization such as the International Commission on Illumination (CIE) or International Electrotechnical Commission (IEC).

HFE790 Research Practicum in Human Factors [인간공학 연구주제]

This course is intended to provide PhD students with a practical research experience in the area of cognitive or physical ergonomics area by planning and conducting a research project. Final outcome of this course is a journal submission ready manuscript.

HFE552 Human-Computer Interaction [인간과 컴퓨터 상호작용]

This graduate course on HCI focuses on the design, development, and evaluation of human-computer interfaces. Lecture material reviews key concepts in usability, user-centered design and styles and types of interaction. These latter topics are in the are research focused - introducing and framing current research areas in HCI and showing a set of recent research outcomes. Assessment will be a series of projects in which small teams (ideally pairs) will use advanced prototyping tools (e.g. Axure, MIT AppInventor, Arduino) to create interactive human-computer interfaces on web, mobile and physical computing platforms.

HFE900, 901 Special Topics in DHE 1,2 [DHE 특론 1, 2]

These courses consist of special topics covering contemporary issues, methods and perspectives in Design and Human Engineering.

HFE910 Interaction Deign [인터렉션 디자인]

The students in this class will learn ways to design and implement a highly-finished interactive prototype, specifically they will learn physical computing and programming skills for the implementation of their interactive product ideas. Students will learn systematic ways to generate novel and creative interactive product ideas by planning the concrete technologies to be used in their products and the hardware designs for implementation; and they will go through the iterative prototyping process of the concepts they have generated in order to complete their interactive prototypes that can be used in the real world. During the learning process, students will discuss ways to plan concrete technologies to be used in their products and the hardware designs for implementation based on their design concepts. They will have periodic discussions with the instructor about ways to improve their design concepts and to apply technologies from the perspective of design and interaction design research.

HFE911 Human-Centered Design [인간중심 디자인]

This course treats knowledge and insights from the human sciences as far as this contributes to our understanding of the way we (mis)use products, are aesthetically pleased or emotionally touched by them through our various sense modalities (touch, sound, vision), experience (dis)comfort, risk or safety in use, and learn to operate products in (in)appropriate ways. Connections will thus be revealed between the way our various systems work and the way we understand, use, and (emotionally) experience products. The course is built on a few themes and for each theme relevant literature will be selected and shared.

HFE912 Contextual Design [컨텍스츄얼 디자인]

Students in this course will learn about how to use empirical method to gather data about people's social and cultural contexts. At the end of this class, students should be able to design a study that allows them to take a question and answer it using appropriate data collection and analysis techniques. Techniques will include how to interview people, including designing questions that allow people to provide you with information, observing humans doing various tasks and activities to learn about how they interact with computers. For each technique, students will learn what types of question it can answer, how to go about using it, and how does it influence their study design.

Department of Urban and Environmental Engineering

□ Urban and Environmental Engineering [UEE]

Environmental pollution and climate change caused by industrialization and urbanization are directly related to the survival of human society. With no surprise, studies on these issues are gaining in importance. Urban and environmental engineering is an interdisciplinary research field focusing on environmental protection and sustainable urban development with ultimately aiming toward the improvement of human welfare. In this department, students will study advanced courses represented by three programs:

1) Environmental Science and Engineering (ESE)

The program is an inter-disciplinary major to understand the environmental issues on global and regional scales including climate change. Enrolled students research the science- and engineering-based methodologies to reconstruct the past, monitor the present, and predict the future of the Earth system on various temporal and spatial scales, based on the integrated knowledge of atmospheric, oceanic, and earth sciences. The program also aims to develop state-of-the-art engineering technologies to achieve those scientific goals.

2) Urban Infrastructure Engineering (UIE)

The program contributes to developing smart green cities on our planet's future, through consistent research on principles essential to create the built environment desired for fertile human life and on never-ending problems confronted during the process. It includes interdisciplinary pursues in the field of civil engineering and urban planning.

3) Disaster Management Engineering (DME)

The DME program pursues interdisciplinary education and research in collaboration with researchers in urban/civil engineering, environmental engineering, earth/environmental science, and disaster management to mitigate the impact of unexpected disasters. It focuses on natural hazard prediction, sustainable and resilient infrastructure, disaster risk reduction/prevention, disaster mitigation and preparedness, disaster response and recovery, and disaster risk management policy. This program also provides educational opportunities for the next generation of disaster researchers and professionals.

4) Convergence of Science and Arts (CSA)

Idea of Education Major ‘Convergence of Science and Arts’ emerges from questions on definition of science, based on our experiences with single research tool and other convergence studies. Those studies share similarity in methodology procedures towards final conceptual knowledge, including observation, analysis, synthesis, and concept making. With this being in mind, problems and issues with which we are facing now can be observed as either object or subject, represented as some images followed by analysis, and integrated into a conceptual knowledge, with helps of causality and contingency with occurrence probability, which employs scientific and/or liberal arts methodologies. There might be controversy whether liberal arts can be categorized into science, but, may share methodologies to some extents with science, especially procedures prior to final conceptual knowledge making. Integrating and converging science desires to work with liberal arts as there are similarities as well as identity-based differences in methods and products to be made. For example, with regard to water/energy problems and issues under climate change era, it is almost impossible to extract strong concepts and/or knowledge, from isolated scientific division, as almost all the problems and issues are associated directly or indirectly with variables of human being, especially under social system. Without comments of liberal arts, it is not easy to lead to a strong and clear knowledge with problems and issues of many different problems as most of those are connected to human through public perception, policy, regulation, ethics, morality, culture, and many other variables. With these, the education major is launched.

☐ Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 24 credits	at least 4 credits
Doctoral Program	at least 60 credits	at least 18 credits	at least 42 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 36 credits	at least 24 credits

Curriculum

▶ Urban and Environmental Engineering

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre requisite	Convergence
Required	UEE690	Research	Master's Research	석사논문연구	Value of Credit		X
	UEE890		Doctoral Research	박사논문연구	Value of Credit		X
	CSA511 /AHS111	Lecture	Understanding Arts*	예술의 이해*	3-3-0		O
	CSA521		Scientific Methodology*	과학기술방법론*	3-3-0		O
Elective	ENV590	Research	The Seminars	세미나	1-1-0		X
	ENV501	Lecture	Advanced Environmental Engineering	환경공학특론	3-3-0		X
	ENV503		Environmental Organic Chemistry	환경유기화학	3-3-0		X
	ENV505		Wastewater Microbiology	폐수미생물학	3-3-0		X
	ENV506		Waste Management	폐기물관리	3-3-0		X
	ENV601		Wastewater Treatment and Process Design	수처리공정설계	3-3-0		X
	ENV604		Aquatic Chemistry	수질화학	3-3-0		X
	ENV605		Chemistry for Environmental Engineering and Science	환경화학개론	3-3-0		X
	ENV607		Environmental Colloid Surface Chemistry	환경콜로이드표면화학	3-3-0		X
	ENV608		Bioprocess Modeling and Control	생물공정모델링 및 공정제어	3-3-0		X
	ENV701		Environmental Photochemistry	환경광화학	3-3-0		X
	ENV702		Environmental Nanotechnology	환경나노기술	3-3-0		O
	ENV703		Introduction to Advanced Oxidation Technology	고도산화기술개론	3-3-0		X
	ENV704		Physical and Chemical Treatment Processes	물리화학적 수처리 공정 특론	3-3-0		O
	ENV705		Movement and Fate of Organic Contaminants in Water	수계 유기오염물질 거동	3-3-0		X
	ENV706		Introduction to Membrane Technology to Water/Wastewater Treatment	수처리/폐수처리 분리막 개론	3-3-0		X
	ENV707		Environmental Biotechnology	환경생명공학기술	3-3-0		X
	ENV802		Special Topics for Environmental Engineers I	환경문제특수해석 I	3-3-0		X

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre requisite	Convergence
Elective	ENV803	Lecture	Special Topics for Environmental Engineers II	환경문제특수해석 II	3-3-0		X
	ENV804		Biosensors	바이오센서	3-3-0		X
	ENV805		Special Topics for Environmental Engineers III	환경문제특수해석 III	3-3-0		X
	ENV806		Special Topics for Environmental Engineers IV	환경문제특수해석 IV	3-3-0		X
	ENV807		Special Topics for Environmental Engineers V	환경문제특수해석 V	3-3-0		X
	ENV808		Special Topics for Environmental Engineers	환경과학공학 특론	3-3-0		O
	EES590	Research	The Seminars1	세미나1	1-1-0		X
	EES591		The Seminars2	세미나2	1-1-0		X
	EES501	Lecture	Technical Writing and presentation skills for environmental scientists	환경과학자를 위한 글쓰기와 프레젠테이션 기술	3-3-0		X
	EES502		Introduction to Environmental Analysis	환경분석개론	3-3-0	CHE103 NCS201 ESE201	X
	EES503		Advanced Atmospheric Dynamics I	고급대기역학 I	3-3-0		X
	EES504		Mass Spectrometry	질량분석학	3-3-0	NCS201	X
	EES505		Tropical Meteorology	열대기상학	3-3-0		X
	EES601		Atmospheric Physics	대기물리	3-3-0		X
	EES602		Gas Hydrates and Climate Change	가스 하이드레이트와 기후변화	3-3-0		O
	EES603		Advanced Atmospheric Dynamics II	고급대기역학 II	3-3-0		X
	EES604		Analysis and Monitoring of Organic Pollutants	유기오염물질 분석 및 모니터링	3-3-0	CHE103, NCS201	X
	EES605		Air Pollution Management	대기오염관리	3-3-0		X
	EES651		Remote Sensing of the Environment	환경원격탐사	3-3-0	ESE305	O
	EES701		Climate-Environment Modeling	기후환경 모델링	3-3-0		X
	EES801		Special Course on Climate Change	기후변화 특강	3-3-0		X
	EES803		Current Topics in Carbon Dioxide Capture and Storage	이산화탄소 회수 및 저장 특론	3-3-0		X
	EES810		Special Topics in Earth and Environmental Sciences I	지구환경과학 특강 I	3-3-0		X
	EES811		Special Topics in Earth and Environmental Sciences II	지구환경과학 특강 II	3-3-0		X

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre requisite	Convergence
Elective	EES812	Lecture	Special Topics in Earth and Environmental Sciences Ⅲ	지구환경과학 특강 Ⅲ	3-3-0		X
	EES813		Special Topics in Earth and Environmental Sciences IV	지구환경과학 특강 IV	3-3-0		X
	EES814		Special Topics in Earth and Environmental Sciences V	지구환경과학 특강 V	3-3-0		X
	EES851		Advanced Modeling Techniques for GIScience Applications	GIScience 응용을 위한 고급 모델링 기법	3-3-0	ESE305	X
	UIE590	Research	Seminar	세미나	1-1-0		X
	UIE501	Lecture	Continuum Mechanics	연속체역학	3-3-0		X
	UIE502		Structural Dynamics	구조동역학	3-3-0		X
	UIE503		Earthquake Resistant Design	내진설계론	3-3-0		O
	UIE504		Low-carbon Concrete	저탄소 콘크리트 공학	3-3-0		X
	UIE505		Research Methods for Urban Studies	도시연구방법론	3-3-0		X
	UIE506		Urban form and spatial structure	도시형태 및 공간구조	3-3-0		X
	UIE507		Finite Element Method	유한요소법	3-3-0		X
	UIE509		Urban Design Workshop	도시설계워크샵	3-3-0		X
	UIE510		Advanced Engineering Mathematics	고급공학수학	3-3-0		X
	UIE601		Prestressed Concrete	프리스트레스트 콘크리트	3-3-0		X
	UIE602		Crack Analysis in Concrete	콘크리트 균열해석	3-3-0		X
	UIE603		Time-Dependent Properties of Concrete	콘크리트 시간의존적 특성	3-3-0		X
	UIE605		Real Estate Development and Investment	부동산 개발 및 투자	3-3-0		X
	UIE701		Stability of Structures	구조안정론	3-3-0		O
	UIE702		Nonlinear Finite Element Analysis	비선형 유한요소해석	3-3-0		X
	UIE704		Concrete Micro-characterization	콘크리트 미세구조분석	3-1-4		X
	UIE706		Urban Regeneration	도시재생	3-3-0		X
	UIE707		Theory of Planning	계획이론	3-3-0		X
	UIE708		Planning for Housing	도시주택론	3-3-0		X
	UIE802		Rheology of Concrete	콘크리트 레올로지	3-2-2		X
	UIE804		Urban Modeling and Simulation	도시 시뮬레이션	3-3-0		X

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre requisite	Convergence
Elective	UIE810	Lecture	Special Topics in Urban Infrastructure Engineering Ⅰ	도시기반시설공학특론 Ⅰ	3-3-0		X
	UIE811		Special Topics in Urban Infrastructure Engineering II	도시기반시설공학특론 II	3-3-0		X
	UIE812		Special Topics in Urban Infrastructure Engineering Ⅲ	도시기반시설공학특론 Ⅲ	3-3-0		X
	UIE813		Special Topics in Urban Infrastructure Engineering Ⅳ	도시기반시설공학특론 Ⅳ	3-3-0		X
	UIE814		Special Topics in Urban Infrastructure Engineering Ⅴ	도시기반시설공학특론 Ⅴ	3-3-0		X
	DME590	Research	Seminar	세미나	1-1-0		X
	DME502	Lecture	Structural Reliability	구조신뢰성	3-3-0	DME311	O
	DME503		Disaster Response and Recovery	재난대응 및 복구	3-3-0		X
	DME504		Surface Hydrology	지표수문학	3-3-0	ESE332	X
	DME505		Disaster Mitigation and Preparedness	재난완화 및 대비	3-3-0		X
	DME506		Numerical Weather Prediction	수치 예보	3-3-0		O
	DME507		Climate and Air Pollution : Integrated Approach	기후와 대기환경 : 통합적 접근	3-3-0		X
	DME508		Introduction to Safety Design	안전디자인 개론	3-3-0		X
	DME509		Geotechnical Earthquake Engineering	지반지진공학	3-3-0		X
	DME601		Disaster Planning and Policy	재난계획 및 정책	3-3-0		O
	DME602		Earthquake Engineering	지진공학	3-3-0	UIE502	X
	DME603		Wind Engineering	풍공학	3-3-0	UIE502	X
	DME604		Reliability of Infrastructure Systems	사회기반시설시스템의 신뢰성	3-3-0	DME502	X
	DME701		Disaster Theory and Practice	재난이론과 응용	3-3-0		X
	DME702		Advanced Numerical Modeling for Weather	고급기상수치모델링	3-3-0	DME421	X
	DME703		Random Vibrations	불규칙진동론	3-3-0	UIE502	X
	DME704		Smart Structures	스마트구조	3-2-2	UIE502	X
	DME705		Micro-meteorology and Environment	환경미기상학	3-3-0		X
	DME801		Special Topics in Disaster Management Engineering I	재난관리공학특론 I	3-3-0		X
	DME802		Special Topics in Disaster Management Engineering II	재난관리공학특론 II	3-3-0		X
	DME803		Special Topics in Disaster Management Engineering III	재난관리공학특론 III	3-3-0		X

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre requisite	Convergence
Elective	DME804	Lecture	Special Topics in Disaster Management Engineering IV	재난관리공학특론 IV	3-3-0		X
	DME805		Special Topics in Disaster Management Engineering V	재난관리공학특론 V	3-3-0		X
	CSA501		Introduction to Convergence Environmental Technologies	융합환경기술개론	3-3-0		O
	CSA561 /AHS161		Introduction to Philosophy	철학개론	3-3-0		O
	CSA590	Research	Convergence in Science and Arts Seminars I	과학예술융합 세미나 I	1-1-0		O
	CSA591		Convergence in Science and Arts Seminars II	과학예술융합 세미나 II	1-1-0		O
	CSA611 /AHS211	Lecture	Design Thinking	디자인 씽킹	3-3-0		O
	CSA661 /AHS261		Contemporary Philosophy	현대철학	3-3-0		O
	CSA710 /AHS310		Topics in Arts	예술특강	3-3-0		O
	CSA711		Special Topics in Science and Arts I	과학예술특론 I	3-1-4		O
	CSA712		Special Topics in Science and Arts II	과학예술특론 II	3-1-4		O
	CSA713		Special Topics in Science and Arts III	과학예술특론 III	3-1-4		O
	CSA714		Special Topics in Science and Arts IV	과학예술특론 IV	3-1-4		O
	CSA715		Special Topics in Science and Arts V	과학예술특론 V	3-1-4		O
	CSA716		Special Topics in Science and Arts VI	과학예술특론 VI	3-1-4		O
	CSA717		Special Topics in Science and Arts VII	과학예술특론 VII	3-1-4		O
	CSA718		Special Topics in Science and Arts VIII	과학예술특론 VIII	3-1-4		O
	CSA719		Special Topics in Science and Arts IX	과학예술특론 IX	3-1-4		O
	CSA720		Special Topics in Science and Arts X	과학예술특론 X	3-1-4		O
	CSA760 /AHS360		Topics in Philosophy	철학특강	3-3-0		O

* Those related to Environmental Science in ESE program and enrolled in 2013 should take the seminars1(EES590) and the seminars2(EES591).
* Understanding Arts(CSA511/AHS111), and Scientific Methodology(CSA521) are required only for students who are majoring CSA.

Description

UEE690 Master's Research [석사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

UEE890 Doctoral Research [박사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

ENV501 Advanced Environmental Engineering [환경공학특론]

For graduate students whose major was not environmental engineering, the history of environmental engineering and major disciplines will be introduced.

ENV503 Environmental Organic Chemistry [환경유기화학]

This course focuses on environmental factors that determine the fate of organic chemicals in natural and engineered systems. The knowledge learned from this course is useful to quantitatively assessing the environmental behaviour of organic chemicals.

ENV505 Wastewater Microbiology [폐수미생물학]

The goal of this course is to gain a fundamental understanding of microorganisms and their roles in wastewater environments.

ENV506 Waste Management [폐기물관리]

This course will introduce waste classification, physico-chemical properties, instrumental analysis, waste source, collection and recycling, remediation and treatment and life cycle assessments (LCA).

ENV601 Wastewater Treatment and Process Design [수처리공정설계]

The purpose of this course is to study basic principles of chemical, physical and biological treatment facilities and to design the unit operations and processes of water and wastewater treatment.

ENV604 Aquatic Chemistry [수질화학]

Basic concepts and chemical principles of water chemistry will be introduced, emphasizing the application of the principles to solve the specific chemical problems in aqueous environment, pollution control and purification technology.

ENV605 Chemistry for Environmental Engineering and Science [환경화학개론]

The purpose of this course is to bring into focus some aspects of chemistry which are valuable for solving environmental problems and lay a background of understanding in the area of specialized quantitative analysis, commonly referred to as water and wastewater analysis.

ENV607 Environmental Colloid Surface Chemistry [환경콜로이드표면화학]

This course covers two major areas: (1) various surface chemistry areas including hydrous oxide-water interface, electric double layer theory, adsorption mechanisms, and particle-particle interaction, (2) colloid hydrodynamics including basic motion equations, motion of single and two interacting colloids in water.

ENV608 Bioprocess Modeling and Control [생물공정모델링 및 공정제어]

This course aims to provide students with fundamental knowledge of bioprocess operation and control with particular emphasis on environmental treatment systems. Different biokinetic models and their applications in process control are discussed.

ENV701 Environmental Photochemistry [환경광화학]

The objective of this course is to understand the basic concepts and principles of photochemistry and to gain insight into its implication in environment and the applications in environmental technologies.

ENV702 Environmental Nanotechnology [환경나노기술]

This course introduces the recent research trends about environmental nanotechnologies and also covers the environmental impact of engineered nanoparticles.

ENV703 Introduction to Advanced Oxidation Technology [고도산화기술개론]

This course provides basic concepts and principles of advanced oxidation technologies for environmental remediation which include ozonation, Fenton systems and photocatalytic processes.

ENV704 Physical and Chemical Treatment Processes [물리화학적 수처리 공정 특론]

This course introduce the fundamentals of physical/chemical treatment processes and will help students learn how to design the processes.

ENV705 Movement and Fate of Organic Contaminants in Water [수계 유기오염물질 거동]

This course covers basic principles on the transport of organic chemicals in surface waters and ground-waters. including their sorption, mass transfer, advection, dispersion, etc.

ENV706 Introduction to Membrane Technology to Water/Wastewater Treatment [수처리/폐수처리 분리막 개론]

Fundamental principles of membrane technology with focus on microfiltration, ultrafiltration, nanofiltration and reverse osmosis. Emphasis is on polymer chemistry, synthesis, modification, characterization and degradation of membranes and then application of the membranes to solve problems in aquatic systems.

ENV707 Environmental Biotechnology [환경생명공학기술]

This course introduces applications of biotechnologies and molecular techniques today in environmental engineering with particular emphasis on biological pollutant removal processes.

ENV802 Special Topics for Environmental Engineers I [환경문제특수해석 I]

In this class we will examine the causes of environmental pollution in the spheres of water, atmosphere, waste, noise and vibration; focus on the effect and prevention counterplan and a comprehensive management plan for prevention of environmental pollution.

ENV803 Special Topics for Environmental Engineers II [환경문제특수해석 II]

In this class we will examine the causes of environmental pollution in the spheres of water, atmosphere, waste, noise and vibration; focus on the effect and prevention counterplan and a comprehensive management plan for prevention of environmental pollution.

ENV804 Biosensors [바이오센서]

Biosensors are tools utilizing at least one biological component, such as DNA, RNA, protein, whole cell, etc., which is used to detect and report on the presence of specific chemicals or groups of chemicals. As such, this class will cover topics related with biosenors, including their classes, development, fabrication, validation and current use in a variety of applications, especially in toxicity sensing.

ENV805 Special Topics for Environmental Engineers III [환경문제특수해석 III]

In this class we will examine the causes of environmental pollution in the spheres of water, atmosphere, waste, noise and vibration; focus on the effect and prevention counterplan and a comprehensive management plan for prevention of environmental pollution.

ENV806 Special Topics for Environmental Engineers IV [환경문제특수해석 IV]

In this class we will examine the causes of environmental pollution in the spheres of water, atmosphere, waste, noise and vibration; focus on the effect and prevention counterplan and a comprehensive management plan for prevention of environmental pollution.

ENV807 Special Topics for Environmental Engineers V [환경문제특수해석 V]

In this class we will examine the causes of environmental pollution in the spheres of water, atmosphere, waste, noise and vibration; focus on the effect and prevention counterplan and a comprehensive management plan for prevention of environmental pollution.

ENV808 Special Topics in Environmental Science and Engineering [환경과학공학 특론]

This course covers interdisciplinary topics on environmental science and engineering including environmental pollution and control, environmental analysis, climate change, and earth science.

ENV590 The Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

EES501 Technical writing and presentation skills for environmental scientists [환경과학자를 위한 글쓰기와 프레젠테이션 기술]

This course will address practical methods for technical writing (journal articles) and presentation. Students learn more efficient and successful ways to prepare their own manuscript to be submitted to an international refereed journal.

EES502 Introduction to environmental analysis [환경분석개론]

This course introduces sampling, pretreatment, and instrumental analysis for organic pollutants and heavy metals. The main contents are transport of pollutants, water analysis (major and trace constituents), analysis of solids and waste, atmospheric analysis (gases and particulates), and ultra-trace analysis.

EES503 Advanced Atmospheric Dynamics I [고급대기역학 I]

The course covers fundamentals of geophysical fluid dynamics, which consists of five small topics. We first provide a brief introduction to fluid dynamics and the basic equations of motion. Then, the effects of stratification and rotation is introduced to discuss fundamental topics such as the primitive equations and the Boussinesq equations. Also, we introduce the shallow water equations that forms the simplest expression of many of the principles of geophysical fluid dynamics. We then discuss vorticity and potential vorticity. Finally, we derive simplified equation sets for large-scale flows, e.g. the quasi-geostrophic equations.

EES504 Mass Spectrometry [질량분석학]

This course will introduce the principle and types of mass spectrometry, which has been widely used for trace-level analysis of organic pollutants. The interpretation of mass spectrum and applications for dioxin analysis will be also introduced.

EES505 Tropical Meteorology [열대기상학]

Atmospheric motion in the tropics is distinguished from that in extratropics in physical and dynamical aspects. The content includes the observed characteristics of tropical atmosphere, characteristics of tropical dynamics, tropical waves, and thermodynamic aspects of tropical atmosphere. The lecture is followed by tropical phenomena of El Nino-Southern Oscillation, Intraseasonal Oscillation, Monsoon, and Tropical Cyclone. This course is intended for early graduate or undergraduate students.

EES601 Atmospheric Physics [대기물리]

Atmospheric physics is applied to study the details of weather and climate, which includes the processes of radiation, cloud physics, convection, and turbulence. Moreover, understanding of the interaction between aerosol and cloud microphysics is gaining its importance recently for its uncertain role in the global warming. The course will cover these processes and their theoretical backgrounds based upon physics.

EES602 Gas Hydrates and Climate Change [가스 하이드레이트와 기후변화]

This course presents the basic understanding and concepts of gas hydrates and their impacts on climate change. This course also covers exploration and production of natural gas hydrates, gas hydrate-based carbon dioxide capture and storage methods, and other novel technologies relating to gas hydrates.

EES603 Advanced Atmospheric Dynamics II [고급대기역학 II]

The course is composed of two main topics: i) instabilities and wave-mean flow interaction, ii) large-scale atmospheric circulation. In the first half, we cover barotropic and baroclinic instability and how the waves and instabilities affect the mean flow in which they propagate. In the second half, we are mostly concerned with the dynamics of the Hadley and Ferrel Cells and mid-latitude circulation.

EES604 Analysis and Monitoring of Organic Pollutants [유기오염물질 분석 및 모니터링]

This course will focus on multimedia sampling, extraction, cleanup and instrumental analysis for environmental monitoring of organic pollutants.

EES605 Air Pollution Management [대기오염관리]

This course presents information about the general topic of air pollution and its control, and also covers the design procedures of various air pollution control.

EES651 Remote Sensing of the Environment [환경원격탐사]

This course investigates diverse applications of remote sensing as well as advanced digital image processing techniques for each application. This course covers understanding of various remote sensing systems (e.g. hyperspectral, LiDAR), their applications (e.g. vegetation, water) and advanced digital image processing techniques (e.g. object-based, texture-based, machine learning). Several interactive digital image processing systems (e.g., ENVI, ERDAS IMAGINE, ArcGIS, and/or MATLAB) are used by the students to analyze satellite and airborne-acquired remotely sensed image data.

EES701 Climate–Environment Modeling [기후환경 모델링]

The global climate model has been extensively used for medium-range weather forecasts, seasonal prediction, global atmospheric and oceanic reanalyses, and climate change predictions due to the increased greenhouse gases. This course introduces state-of-the-art modeling technologies that construct the model, including numerical approximations for the dynamical part, and the representations of physical parts related with sub-grid scale radiation, condensation, boundary-layer turbulence, and the treatments of land surface. The students will experiment and produce the actual simulation outputs by testing the community model opened in public.

EES801 Special Course on Climate Change [기후변화 특강]

This is a special course designed for motivating and fostering creative and interdisciplinary research models targeting on climate change. For a comprehensive understanding on the climate change, the class will review important highlights from the recent assessment reports from the Intergovernmental Panel on Climate Change (IPCC). The class will be asked to develop their own research projects during the course.

EES803 Current Topics in Carbon Dioxide Capture and Storage [이산화탄소 회수 및 저장 특론]

This course is intended to introduce recent technologies on carbon dioxide capture and storage developed and being developed for mitigating global warming.

EES810 Special Topics in Earth and Environmental Sciences Ⅰ [지구환경과학 특강 Ⅰ]

We study the current hot topics in Earth and Environmental Sciences.

EES811 Special Topics in Earth and Environmental Sciences Ⅱ [지구환경과학 특강 Ⅱ]

We study the current hot topics in Earth and Environmental Sciences.

EES812 Special Topics in Earth and Environmental Sciences Ⅲ [지구환경과학 특강 Ⅲ]

We study the current hot topics in Earth and Environmental Sciences.

EES813 Special Topics in Earth and Environmental Sciences Ⅳ [지구환경과학 특강 Ⅳ]

We study the current hot topics in Earth and Environmental Sciences.

EES814 Special Topics in Earth and Environmental Sciences Ⅴ [지구환경과학 특강 Ⅴ]

We study the current hot topics in Earth and Environmental Sciences.

EES851 Advanced Modeling Techniques for GIScience Applications GIScience [응용을 위한 고급 모델링 기법]

This course introduces advanced modeling techniques that have recently been used in GIScience applications. The techniques include machine learning approaches for both classification and regression such as decision/regression trees, random forest, support vector machines/regression, artificial neural networks, artificial immune networks, and genetic algorithms. The students will analyze GIScience data using several interactive software tools (e.g., MATLAB, ArcGIS, LP360, and ERDAS Imagine).

EES590 The Seminars1 [세미나1]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

EES591 The Seminars2 [세미나2]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

UIE501 Continuum Mechanics [연속체역학]

This course is concerned with idealization of continuous materials that can be a solid or a fluid. In lectures, we deal with tensor expression, definition of stress and strain in 3 dimensional space, and developing constitutive equations.

UIE502 Structural Dynamics [구조동역학]

The dynamic response of structures and structural components to transient loads and ground excitations is discussed for single and multi degree-of-freedom systems, including discussions for response spectrum concepts, simple inelastic structural systems, systems with distributed mass and flexibility, and fundamentals of experimental structural dynamics.

UIE503 Earthquake Resistant Design [내진설계론]

The course topics include the behavior, design, and assessment of indeterminate reinforced concrete and steel structures subjected to gravity, wind, seismic, and blast loads. Primary emphasis will be given to the introduction of available design methods for two-way slab systems, and the earthquake-resistant design of beam-column frames, slab-column frames, and shear walls.

UIE504 Low Carbon Concrete [저탄소 콘크리트 공학]

Portland cement concrete is highly economical and versatile construction building material; however, manufacture of portland cement is responsible for at least 5~8% of total worldwide man-made CO2 emission because one ton of portland cement production generates 0.9 ton of CO2. Development of new alternative binder with extremely low carbon emission to replace the portland cement in concrete production has been an urgent goal in academia and industries to build up sustainable future urban society. This course presents the state-of-art technology and research methodologies in the low carbon concrete.

UIE505 Research Methods for Urban Studies [도시연구방법론]

Quantitative analysis of data used in urban planning research. Particular emphasis on Inferential statistics through multinomial regressions, forecasting, categorical data analysis, and spatial data analysis.

UIE506 Urban form and spatial structure [도시형태 및 공간구조]

This course is about the analysis of urban form, pattern, and process. Historical exploration of how cities are patterned empirical evidence of the contemporary spatial development of metropolitan areas Industrial, residential and commercial location.

UIE507 Finite Element Methods [유한요소법]

The topics of this course include the theory and application of finite element methods stiffness matrices for triangular, quadrilateral, and isoparametric elements two- and three-dimensional elements; algorithms necessary for the assembly and solution; direct stress and plate bending problems for static, nonlinear buckling and dynamic load conditions; and displacement, hybrid, and mixed formulations.

UIE509 Urban Design Workshop [도시설계워크샵]

Examines urban design theory and principles, and evaluates the built environment in a studio-based setting. Working in teams, students become immersed in real work examples and propose design interventions for specific places, including socially diverse neighborhoods in small cities and major metropolitan urban centers.

UIE510 Advanced Engineering Mathematics [고급공학수학]

This course covers the basics of graduate-level applied mathematics for students majoring in engineering. Topics include complex variables, integral transformations, and partial differential equations.

UIE601 Prestressed Concrete [프리스트레스트 콘크리트]

This course discusses the strength, behavior, and design of prestressed concrete members and structures subjected to flexure, shear, and torsion, with special emphasis on pre-tensioned, precast construction. Unbonded post-tensioned members and composite prestressed beams are also introduced. The course materials also cover the evaluation of prestress losses, short-term and long-term deflections, bond between strand and concrete, and anchorage zone cracking and reinforcement.

UIE602 Crack Analysis in Concrete [콘크리트 균열해석]

Concrete structures are full of cracks. Their failure involves stable growth of large cracking zones and the formation of large fractures before the maximum load is reached. This course reviews the mechanism and analytical techniques for the cracking, which includes fracture mechanics of concrete and nonlinear mechanics of reinforced concrete.

UIE603 Time–Dependent Properties of Concrete [콘크리트 시간의존적 특성]

Creep refers to long-term deformation, usually for several years in the case of concrete, when a material is under constant load. Even within short time, large amount of creep is observed at early age of concrete, which sometimes causes a problem on the construction of high-rise buildings and piers. In the period, shrinkage is accompanied and affects the dimensional stability of early-age concrete. Thermal deformation due to heat and its transfer of hydration is also an important time-dependent property to be considered for the safety and serviceability of concrete structures.

UIE605 Real Estate Development and Investment [부동산 개발 및 투자]

The dynamics of real property development from the developer's perspective covering market research, government relations, site planning, financing, investment analysis, construction and project management, and marketing.

UIE701 Stability of Structures [구조안정론]

This course introduces principle theories and applications of structural stability that is essential in modern design of steel structures. A wide variety of stability problems are provided including elastic/inelastic buckling of bar and frames, torsional buckling, lateral buckling of beams, and buckling of rings, arches and thin plates.

UIE702 Nonlinear Finite Element Analysis [비선형 유한요소해석]

This course provides a comprehensive description of nonlinear finite element analysis for solid mechanics. It aimed to understand various approaches and difficulties inherent in nonlinear analysis as follows: Lagrangian and arbitrary Lagrangian-Eulerian formulation, explicit or implicit time integration methods, and handling nonlinear constitutive laws and structural stability.

UIE704 Concrete Micro-characterization [콘크리트 미세구조분석]

This course covers two promising structural concretes: fiber reinforced concrete (FRC) and geopolymer concrete. This course discusses various topics on these two materials from practical view for commercial use to in-depth research topics. All students are required to perform experimental research on these two materials using the following materials characterization techniques: X-ray diffractioin and Scanning Electron Microscope (SEM) and to turn in the research term-papers at the end of quarter.

UIE706 Urban Regeneration [도시재생]

Analyzes how economic, social, physical conditions of central cities can be improved through large-scale urban-planning efforts Understand the process of neighborhood revitalization and the main planning issues for the process.

UIE707 Theory of Planning [계획이론]

The logic of planning as a professional activity and Construction of methodologies for evaluating various theories of planning. Critical overview of current process theories leading students to develop a personal philosophy applicable to their work as planners.

UIE708 Planning for Housing [도시주택론]

The role of housing in urban planning supply and demand of the housing market and analysis of public policies for housing as they affect special consumer groups (the poor, the elderly, and the minorities).

UIE802 Rheology of Concrete [콘크리트 레올로지]

Concrete experience solidification from fluid. Its rheological properties before setting of concrete are critical for casting and construction of concrete structures. This course reviews fundamentals of fluid mechanics and rheology of unset concrete.

UIE803 Regional Economic Modeling [지역경제 모델링]

Examines the theories and limitations of input-output models, sources and weaknesses of the data, and validity of economic impact studies. Students are expected to complete a regional impact study with a sound knowledge of the inherent theoretical and data issues.

UIE804 Urban Modeling and Simulation [도시 시뮬레이션]

Urban modeling and simulation is an essential analytic technique for scenario planning. This course addresses two popular urban modeling and simulation techniques: space syntax and agent-based simulation model. After successfully completing this course, the students will be able to understand the modeling process and apply the techniques to analyze urban planning and design issues.

UIE810 Special Topics in Urban Infrastructure Engineering Ⅰ [도시기반시설공학특론 Ⅰ]

This course introduces new research topics in urban infrastructure engineering.

UIE811 Special Topics in Urban Infrastructure Engineering Ⅱ [도시기반시설공학특론 Ⅱ]

This course introduces new research topics in urban infrastructure engineering.

UIE812 Special Topics in Urban Infrastructure Engineering Ⅲ [도시기반시설공학특론 Ⅲ]

This course introduces new research topics in urban infrastructure engineering.

UIE813 Special Topics in Urban Infrastructure Engineering Ⅳ [도시기반시설공학특론 Ⅳ]

This course introduces new research topics in urban infrastructure engineering.

UIE814 Special Topics in Urban Infrastructure Engineering Ⅴ [도시기반시설공학특론 Ⅴ]

This course introduces new research topics in urban infrastructure engineering.

UIE590 Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

DME502 Structural Reliability [구조신뢰성]

The aim of this course is to offer a comprehensive review of reliability analysis methods and their applications to civil and structural engineering problems. In this course, students will learn several probabilistic approaches for structural reliability assessment including first- and second-order reliability methods, system reliability methods and sampling-based methods. As a final project, each student will be asked to model his/her own structural reliability problem and to solve it using one of the reliability analysis methods covered in this course.

DME503 Disaster Response and Recovery [재난대응 및 복구]

This course examines the theory and practice of response and recovery, including response variance and effectiveness. This course provides knowledge on immediate and long-term aspects of management of the post-impact phase of a disaster. The aim is to generate understanding of specific actions that should be taken during the post-impact stage of a disaster to facilitate its effective management.

DME504 Surface Hydrology [지표수문학]

This course is concerned with descriptive and quantitative hydrology dealing with the distribution, circulation, and storage of water on the earth's surface. Topics cover principles of hydrologic processes, advanced methods of analysis and their applications to water resource problems including the management of water resource facilities and flood control.

DME505 Disaster Mitigation and Preparedness [재난완화 및 대비]

This course discuss the variety of actions taken by individuals, households, businesses, communities, and governments to both prepare for the impact of disasters and offer realistic strategies to mitigate the adverse consequences of disasters. This course will explore hazard mitigation and preparedness procedures, programs, and planning through case studies.

DME506 Numerical Weather Prediction [수치 예보]

This course introduces the basics concept of numerical modeling for weather prediction and provides student with the relevant numerical methods (e.g., grid and spectral methods). In addition, students study how to apply numerical methods to practical researches such as weather forecast.

DME507 Climate and Air Pollution: Integrated Approach [기후와 대기환경: 통합적 접근]

This course focuses on the inter-impact between climate and air pollution. Especially, students will study the impact of the air pollution on climate adaptation and mitigation through co-benefit and trade-off effect.

DME508 Introduction to Safety Design [안전디자인 개론]

Safe city design is based on four lines of specialized branches: 1)traffic safety-Traffic calming is a measure to slow down traffic flows, 2)fire prevention-to establish evacuation routes and to make people and fire fighters move faster, 3)crime prevention-surveillance and access control, 4)Disaster prevention & mitigation. The four lines of design philosophy have contradictory characteristics. This course will provide the basic knowledge of traffic safety, fire prevention, crime prevention, and disaster prevention & mitigation. Finally, this course will find a “Comprehensive Safety Design Model” that are creative and harmonious design principle.

DME509 Geotechnical Earthquake Engineering [지반지진공학]

This course introduces fundamental concepts of earthquake engineering related to geotechnical problems, principles of earthquake, wave propagation, dynamic soil properties, liquefaction and seismic design of various geotechnical structures. This course begins with an introduction to seismology and tectonics, and continues with discussion on deterministic and probabilistic seismic hazard analyses, as well as site response analysis. In addition, the responses of various geotechnical structures such as foundations, retaining structures, and slopes subject to earthquake loading are discussed.

DME601 Disaster Planning and Policy [재난계획 및 정책]

This course provides knowledge to appreciate the need for integrating disaster risk reduction aspects in development policy, planning and implementation. The purpose is to equip students with the skills to identify the linkages between disasters and development, and understand the formulation and application of appropriate development planning policies integrating disaster risk reduction. This course includes reviews and critiques actual plans and engages students in components of effective disaster planning within and across various jurisdictions.

DME602 Earthquake Engineering [지진공학]

The first part of this course will focus on hazard analysis with emphasis on earthquake. The concepts necessary to understand, classify, and analyze an earthquake. The following concepts will be presented: the nature, power, and source of an earthquake, the wave propagation theory from the source to the site of interest, the characterization of a ground motion through different intensity measures, Probabilistic Seismic Hazard Analysis (PSHA). The second part of this course will involve earthquake design. The calculation of the demand and capacity of a structure subject to earthquake load will be studied. The common foundations at the base of each seismic design code will be explained. The different analyses available to assess the structural response of a structure will be explained: response spectrum method, pushover analysis, non-linear time history analysis.

DME603 Wind Engineering [풍공학]

Earthquake is the major concern in the design of low and medium rise buildings but wind dominates the design process of tall buildings and long-span bridges. The scope of this course is to teach the fundamentals of wind engineering and the design criteria for wind load. The students will learn how to predict the wind hazard at the location of the structure given the surrounding environment and how to compute the wind load given the properties of the hazard and the shape of the structure. Phenomena such as buffeting, vortex shedding, galloping and flutter will be explained in detail. Wind is treated with an equivalent static load in low medium rise buildings but for tall building and long-span bridges dynamic analysis must be used.

DME604 Reliability of Infrastructure Systems [사회기반시설시스템의 신뢰성]

This course will present the different methods used to estimate: the vulnerability of individual components and the reliability of entire civil infrastructures systems including distributed systems and complex systems. Examples of distributed systems are highway networks, power grids, water distribution systems. Examples of complex systems are nuclear power plants, dams, and chemical plants. Special consideration will be given to event tree analysis and fault tree analysis for complex systems, and Monte Carlo simulation for distributed systems.

DME701 Disaster Theory and Practice [재난이론과 응용]

This course reviews the theoretical assumptions and foundation of disaster management from the interpersonal, small group, organization and societal levels.

DME702 Advanced Numerical Modeling for Weather [고급기상수치모델링]

This course provides students with advanced techniques of the atmospheric numerical modeling such as objective analysis, data assimilation, physics parameterizations and boundary condition improvement.

DME703 Random Vibrations [불규칙진동론]

This course introduces probabilistic methods and applications to describe structural behavior under stochastic dynamic loads. Both time and frequency domain analyses to extract meaningful information from random signals are discussed. Theoretical and computer-aided approaches for data processing and analysis are covered.

DME704 Smart Structures [스마트구조]

This course introduces the basics of smart structure technologies and their applications to civil infrastructural systems. It covers smart materials, sensors, sensing, monitoring, assessment, retrofit, and control. Theoretical and experimental studies are conducted.

DME705 Micro-meteorology and Environment [환경미기상학]

The objective of this course is to understands the physical and dynamical characteristics of the atmospheric planetary boundary layer and the structure of local air circulation near the earth surface. Also students will learn how to apply the micro-meteorological knowledge onto the atmospheric environment problems.

DME801 Special Topics in Disaster Management Engineering Ⅰ [재난관리공학특론 I]

This course introduces new research topics in disaster management engineering.

DME802 Special Topics in Disaster Management Engineering Ⅱ [재난관리공학특론 II]

This course introduces new research topics in disaster management engineering.

DME803 Special Topics in Disaster Management Engineering Ⅲ [재난관리공학특론 III]

This course introduces new research topics in disaster management engineering.

DME804 Special Topics in Disaster Management Engineering Ⅳ [재난관리공학특론 IV]

This course introduces new research topics in disaster management engineering.

DME805 Special Topics in Disaster Management Engineering Ⅴ [재난관리공학특론 V]

This course introduces new research topics in disaster management engineering.

DME590 Seminar [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and find-tuned achievements through the Seminars.

CSA501 Introduction to Convergence Environmental Technolgies [융합환경기술개론]

The history and major disciplines of environmental engineering will be introduced for graduate students from different academic backgrounds. The goal of this course is to help students acquire a basic understanding of environmental engineering applications essential for convergence efforts.

CSA511/AHS111 Understanding Arts [예술의 이해]

This course introduces students to the use of arts and design to develop fresh approaches to creating new content in the arts, humanities, and technologies. Students explore diverse themes and topics in the contemporary arts, digital humanities, and product prototyping to create novel media objects or compositions through teamwork. Readings include a selection of classic and contemporary critical cultural texts from the arts and design.

CSA521 Scientific Methodology [과학기술방법론]

This course is on both scientific knowledge and artistic abstract, and also on the filosopia of convergence of science and arts. It encompasses fundamental observation procedures of nature, more detailed methodologies for knowledges and abstract, and underlying philosophy of the methods taken in this issue.

CSA561/AHS161: Introduction to Philosophy [철학 개론]

In this course we shall examine various philosophical views at the preliminary level. The aim of the course is to provide the students with a general introduction to seminal questions in philosophy, to lead them to engage in deep thinking and reflections on important matters in life, and to enable them to make their own arguments on a given issue in a critical and reasonable fashion.

CSA590 Convergence of Science and Arts Seminars I [과학예술융합 세미나 I]

The purpose of this course is to extend knowledge to the state-of-the-art R&D activities integrating science and arts in various fields. Students will be encouraged to share their ideas and thoughts to cultivate their ability of creative thinking.

CSA591 Convergence of Science and Arts Seminars II [과학예술융합 세미나 II]

The purpose of this course is to extend knowledge to the state-of-the-art R&D activities integrating science and arts in various fields. Students will be encouraged to share their ideas and thoughts to cultivate their ability of creative thinking.

CSA611/AHS211 Design Thinking [디자인 씽킹]

This class is a critical study over creative industry in contemporary art and design to make students familiar with basic perceptual concepts as well as two-dimensional and three-dimensional visual concepts. It moves into a more sophisticated problem-solving environment in which structure, organization, composition, proportion, scale will be emphasized. Proportional systems and ratios, Gestalt phenomena, scale relationships and design thinking problem-solving methodologies are some of the specific concepts that will be covered.

CSA661/AHS261 Contemporary Philosophy [현대 철학]

This course deals with the central issues of contemporary philosophy. We will discuss in depth at least one of the main branches in philosophy such as metaphysics, logic, ethics, philosophy of science, and philosophy of mind. Since the issues covered in contemporary philosophy are diverse, the specific contents of the course may vary. There are no prerequisites for this course.

CSA710/AHS310 Topics in Arts [예술 특강 (with Subtitle)]

This course focuses on a special topic in the field of arts. The particular contents of this course will be chosen by the instructor each semester when it is offered.

CSA711~CSA720 Special Topics in Science and Arts I~X [과학예술특론 I~X]

It is the project based class which is designed to tell students into contributing to necessary activitie to solve existing problems of community where we live. Students are asked to design the methodologies of classes to work on project(s), from strategic plannings to working realities. Students may solve the problem which they also select in scientific, artistic, or multidisciplinary ways. Classes are to be held on the sites which all the activities happen: laboratory, studio, working place, and even in-between those. Students are subject to submit their reports with flexible formats and to exhibit those as either scientist, engineer, philosopher, or artist, at the end of the semester.

CSA760/AHS360 Topics in Philosophy [철학특강 (with Subtitle)]

This course focuses on a special topic in the field of philosophy. The particular contents of this course will be chosen by the instructor each semester when it is offered.

Department of Energy Engineering

Energy Engineering [ENE]

Department of Energy Engineering provides exciting and unique undergraduate and graduate programs that deal with energy production, energy conversion, energy storage, and energy efficiency, alternative energy technologies from a basic concept to practical technology. We combine courses from chemistry, electrochemistry, polymer, ceramics, physics, and materials engineering to create a strong knowledge base essential to success in energy-related areas. Students have the opportunity to take courses and research focused on specific energy research subjects that includes solar cell, fuel cell, battery, and other energy-related devices and materials. Along with research activities in our department, our students will be well-prepared for career focused on energy science and engineering and creatively apply their knowledge to confront the global challenges of energy supply and demand.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 15 credits	at least 13 credits
Doctoral Program	at least 60 credits	at least 15 credits	at least 45 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 24 credits	at least 36 credits

Curriculum

▶ Energy Engineering

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Required	ENE590	Research	The Seminars	세미나	1-1-0		
	ENE690		Master's Research	석사논문연구	Value of Credit		
	ENE890		Doctoral Research	박사논문연구	Value of Credit		
Elective (Ph.D.)	ENE719	Lecture	Special topics on Energy Conversion and Storage I	에너지 변환 및 저장 I	3-3-0		
	ENE729		Special topics on Energy Conversion and Storage II	에너지 변환 및 저장 II	3-3-0		
Elective	ENE619		Energy Engineering I	에너지공학 특론 I	3-3-0		
	ENE629		Energy Engineering II	에너지공학 특론 II	3-3-0		
	ENE639		Energy Engineering III	에너지공학 특론 III	3-3-0		
	ENE600		Research Trends in Green Energy I	친환경에너지연구동향 I	3-3-0		
	ENE790	Research	Research Trends in Green Energy II	친환경에너지연구동향 II	2-2-0		
	BST511	Lecture	Special Topics on Solid State Chemistry	고체화학특론	3-3-0		
	BST512		Nanomaterials for Lithium-ion Batteries	이차전지 나노재료	3-3-0		O
	BST513		Renewable Energy Device and System	친환경 에너지 디바이스 및 시스템	3-3-0		O
	BST514		Membrane Technology	멤브레인 테크놀로지	3-3-0		
	BST521		X-ray Powder Diffraction	X-선 분말 결정	3-3-0		
	BST522		Nanostructured Electrodes for Lithium-ion Batteries I	리튬이온전지를 위한 전극물질 I	3-3-0		
	BST523		Surface and Thin Film Analysis	표면 및 박막 분석	3-3-0		
	BST531		Electrodes for Lithium-ion Batteries II	리튬이온전지를 위한 전극물질 II	3-3-0		
	BST532		Electrolytes for Lithium-ion Natteries	전해액	3-3-0		
	BST533		Applied Electrochemistry	응용전기화학	3-3-0		
	BST534		Special Topics on Battery Science and Technology I	배터리과학 및 기술 특론 I	3-3-0		
	BST535		Special Topics on Battery Science and Technology II	배터리과학 및 기술 특론 II	3-3-0		
	BST536		Special Topics on Battery Science and Technology III	배터리과학 및 기술 특론 III	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	BST537	Lecture	Special Topics on Battery Science and Technology IV	배터리과학 및 기술 특론 IV	3-3-0		
	BST538		Special Topics on Battery Science and Technology V	배터리과학 및 기술 특론 V	3-3-0		
	BST539		Electrochemical System Design and Applications	전기화학시스템 아키텍처 설계 및 응용	3-3-0		
	ENE511		Solid State Chemistry	고급 고체화학	3-3-0		
	ECS512		Advanced Electrochemistry	고급 전기화학	3-3-0		
	ENE513		Special Topics on Solar Cells	태양전지 특론	3-3-0		O
	ECS514		Advanced Inorganic Chemistry	고급 무기화학	3-3-0		
	ENE515		Special Topics on Solar Energy	태양에너지 특론	3-3-0		O
	ECS522		Electrochemical Energy Conversion & Storage	전기화학적 에너지변환 및 저장	3-3-0		O
	ECS524		Special Topics on Fuel Cells	연료전지 특론	3-3-0		O
	ECS526		Advanced Organic Spectroscopy	고급 유기분광학	3-3-0		
	ENE527		Organic Electronics	유기 일렉트로닉스	3-3-0		O
	ECS531		Advanced Organic Chemistry	고급 유기화학	3-3-0		
	ENE532		Advance Materials Analysis	고급 재료분석	3-3-0		
	ENE533		Principles of Device Physics	소자물리	3-3-0		O
	ECS581		Special Topics on Energy Materials I	에너지재료 특론 I	3-3-0		
	ECS582		Special Topics on Energy Materials II	에너지재료 특론 II	3-3-0		
	ECS583		Special Topics on Energy Materials III	에너지재료 특론 III	3-3-0		
	ECS584		Special Topics on Energy Materials IV	에너지재료 특론 IV	3-3-0		
	ECS585		Special Topics on Energy Materials V	에너지재료 특론 V	3-3-0		
	ECS611		Advanced Polymer Materials	고급 고분자재료	3-3-0		O
	ECS612		Nanostructures and Nanomaterials	나노공학	3-3-0		
	ENE613		Advanced Quantum Physics I	고급 양자물리학 I	3-3-0		
	ENE614		Nanochemistry	나노화학	3-3-0		
	ECS615		Carbon-based Nanomaterials	탄소기반 나노재료 특론	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	ECS621	Lecture	Fundamental of the Advanced Fuel Cells	고급 연료전지	3-3-0		
	ECS622		Crystallography	결정학	3-3-0		
	ECS623		Advanced Quantum Physics II	고급 양자물리학 II	3-3-0		
	ECS631		Materials for Organic Electronics	유기전자재료	3-3-0		O
	BST515		Nanomaterials for Energy Storage	에너지 저장용 나노재료	3-3-0		O
	ECS633		Special Topics on Electronic Materials	전자재료 특론	3-3-0		O
	ECS634		Lithography	리소그래피 특론	3-3-0		O
	ECS635		Nano thin films	나노박막 특론	3-3-0		

Description

ENE590 The Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

ENE690 Master's Research [석사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

ENE890 Doctoral Research [박사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

ENE719 Special topics on energy conversion and storage I [에너지변환 및 저장 I]

This course helps you investigate recent trends in energy conversion research and its storage. The conversion includes solar cells, hydrogen generation, fuel cells, and the storage includes secondary ion batteries and hydrogen storage. Brief introduction and future prospect will be discussed.

ENE729 Special topics on energy conversion and storage II [에너지변환 및 저장 II]

This course is designed as a extended subject of special topics on energy conversion and storage. Thus, this course helps you build your individual research skills and rounded expertise in energy conversion and storage.

ENE619 Energy engineering I [에너지공학 특론 I]

In Li-ion batteries, irreversible reactions are dependent upon the species of the surface, and thus, different surface of materials induces different irreversible reactions, resulting in different battery performances. Therefore, in this point of view, it is necessary to attain a comprehensive understanding of the roles of surface chemistry because it is a very important factor in improving the performance of lithium ion batteries. This course thus provide the various roles and fundamentals of surface chemistry in cathode and anode materials for lithium ion batteries.

ENE629 Energy engineering II [에너지공학 특론 II]

This course is designed to investigate recent trends in energy engineering fields and provide discussions with other students, researchers, and professors. Through this course, the students will have opportunities to extend his/her knowledge in the area of energy engineering such as rechargeable batteries, solar cells, fuel cells as well as energy materials.

ENE639 Energy engineering III [에너지공학 특론 III]

This course covers the basic knowledges related to solar cells, batteries, fuel cells. In addition, it includes discussion sections with students and professor for some special topics. From this course, the students will extend their knowledge concerning energy engineering.

ENE600 Research Trends in Green Energy I [친환경에너지연구동향 I]

This course is designed to investigate recent trends in green energy fields and provide discussions with other students, researchers, and professors. Through this course, the students will have opportunities to extend his/her knowledge in green energy fields. Also students and professors can exchange their own ideas.

ENE790 Research Trends in Green Energy II [친환경에너지연구동향 II]

This course is designed to investigate recent trends in green energy fields and provide discussions with other students, researchers, and professors. Through this course, the students will have opportunities to extend his/her knowledge in green energy fields. Also students and professors can exchange their own ideas.

※ Sit in on class for ENE600 with 2 research credits

BST511 Special topics on Solid State Chemistry [고체화학특론]

This course explores the basic principles of solid state chemistry and its application to engineering systems. The course explores the relationship between electronic structure, chemical bonding, and atomic order. It also investigates the characterization of atomic arrangements in crystalline and amorphous solids: metals, ceramics, semiconductors, and polymers. Topics covered include crystal structure, electrical & ionic conductivity, electrochemistry, chemical kinetics, diffusion, synthesis method, and phase diagrams. Examples are drawn from energy generation and storage devices such as batteries, fuel cells, and superconductors.

BST512 Nanomaterials for lithium-ion batteries [이차전지 나노재료]

This course will investigate the selected topics from areas of current research in materials chemistry. Particularly, the advanced nanotechnologies in electrode materials and battery systems of the Li-ion cells, will be discussed. Topics include: Nanoparticles synthesis, sol-gel process, mesoporous materials, advanced concepts in materials chemistry, and recent technology updates for anode and cathode materials in terms of energy density and safety.

BST513 Renewable Energy Device and System [친환경 에너지 디바이스 및 시스템]

This course is designed to learn the system and design of energy conversion/storage devices for renewable energy sources. Students will first learn the fundamental principles of the various renewable energy options including kinetic, solar, and chemicals. Next, the course will provide students with a review of the thermodynamic concepts behind energy constant and energy transfer via an energy conversion device. Finally, this course will tie together concepts of renewable energy sources and thermodynamics teaching students about design elements for energy conversion and storage devices, in which renewable energy sources are converted and stored. After taking this course, the students will be familiar with the economic and societal impact of renewable energy systems, and be able to participate in the design or selection of renewable energy systems.

BST514 Membrane Technology [멤브레인 테크놀로지]

Membranes are considered a core component of various energy storage and conversion systems such as rechargeable batteries (including supercapacitors and redox-flow batteries) and fuel cells. In this lecture, basic principles, structure/properties, and future development direction of the membranes will be explored in terms of on their application fields. In addition, transport phenomena via the membranes will be comprehensively discussed and correlated with electrochemical characteristics of their final applications.

BST521 X-ray powder diffraction [X-선 분말 결정]

This course covers the fundamentals of solid state chemistry including crystallography and principles of XRD analysis to characterize the crystal structure of powders, at the beginning of the semester. A training course for the Rietveld method using the GSAS program will follow.

BST522 Nanostructured electrodes for lithium-ion batteries I [리튬이온전지를 위한 전극물질 I]

This course will cover the latest developments, challenges, and perspectives of nanostructured electrodes for lithium-ion batteries. Compared to bulk electrode materials, the synthesis, electrochemical properties, advantages/disadvantages of nanostructured electrodes will be described. Moreover, the outlook for future-generation batteries will be discussed.

BST523 Surface and thin film analysis [표면 및 박막 분석]

Materials analysis is based on the measurement of particles (e.g. electrons, ions) and radiation (e.g. X-ray) that emerge from a solid that is irradiated by photons, electrons, or heavy particles. This class focuses on the physics underlying the techniques used to analyze the surface region of materials. The various techniques including RBS, XPS, AES, XRD, XAS (XANES & EXAFS), and etc will be covered.

BST531 Nanostructured electrodes for lithium-ion batteries II [리튬이온전지를 위한 전극물질 II]

This course will cover the history of electrode materials for lithium batteries including lithium-ion batteries and lithium-air batteries. Primary batteries, various secondary batteries, and their applications will be discussed. In addition, the latest development and perspectives of these electrode materials will be described.

BST532 Electrolytes for lithium-ion batteries [전해액]

This course is designed for students who plan to major in advanced organic materials for energy storage devices. In this lecture, chemical and electrochemical properties of electrolytes including important principles and facts will be covered. This course deals with the recent development of organic materials including liquid/polymer electrolytes and binders for electrodes, and interfacial phenomena between electrodes and electrolytes. Also, it covers synthesis of advanced organic materials and instrumental analysis.

BST533 Applied electrochemistry [응용전기화학]

This course will cover various applications in electrochemistry. After briefing on basic concepts of fundamentals of electrochemistry, various electrochemical methods in energy storage/conversion devices will be discussed. Papers will be used for in-depth study in the applications.

BST534-538 Special Topics on Battery Science and Technology I-V [배터리과학 및 기술 특론 I-V]

In this lecture, we will be exploring advanced topics in Battery Science and Technology research: Next generation rechargeable batteries, Membrane technology, Electrolytes, all solid-state batteries, Nanostructured electrode materials.

BST539 Electrochemical System Design and Applications [전기화학시스템 아키텍처 설계 및 응용]

In order to understand electrochemical system design, lithium ion full cell architecture design, material selection for full cell design, manufacturing process and control, and get insight / power for future battery design

ENE511 Solid State Chemistry [고급 고체화학]

In this lecture, we will be exploring physical, chemical and electrical properties of many major scientific advances in inorganic materials, including a high temperature superconductor (YBCO), a new form of carbon, C60 (fullerenes), the commercial development of rechargeable batteries, and fuel cells. We will also examine their application to real engineering systems.

ECS512 Advanced Electrochemistry [고급 전기화학]

This course covers the fundamentals of electrochemistry including thermodynamics and electrode kinetics, as well as mathematical techniques necessary to tackle electrochemical problems, at the beginning of the semester. Detailed discussions of various electrochemical techniques and applications are then followed.

ENE513 Special Topics on Solar Cells [태양전지 특론]

This course provides a fundamental understanding of the functioning of solar cells. The discussion includes the solar cell structures, various types of cells, their theoretic parts, and analysis tools. In addition to the various kinds of solar cells, PCS system and markets for solar cells will be provided. Presentations on each type of solar cell is required for the course.

ECS514 Advanced Inorganic Chemistry [고급 무기화학]

Experimental methods and characterization tools for coordination compounds, organometallics, quantum dot, and metal nanomaterials will be introduced. The practical application of these inorganic materials will also be introduced.

ENE515 Special Topics on Solar Energy [태양에너지 특론]

The course is intended for students who have interest in alternate energy sources as a contributor to sustainability. This course covers global energy needs, environmental impacts, solar energy basics, and current trends in photovoltaic energy engineering, solar cell material science. It will be mainly focused on fundamentals of solar energy, and solar energy conversion by solar photovoltaic (PV) technology. In addition, solar chemical, and solar thermal technology will slightly be touched. At the end of the course the students should be able to: Understand the factors that influence the use of solar radiation as an energy source; know the various active and passive technologies that are available for collecting solar energy.

Specific topics to be covered include

1) A review of solar energy: sunlight properties, the solar radiation and spectrum, blackbody radiation, air mass etc.
2) fundamental PV physics, band structure and Fermi level in semiconductors, pn-junctions, diode models, photon interactions with semiconductors, theoretical cell efficiency, multijunction devices, the Shockley-Queisser limit.
3) Emerging solar cells: DSSC, quantum dot-based solar cells, organic photovoltaics, Perovskite solar cells etc.

ECS522 Electrochemical Energy Conversion & Storage [전기화학적 에너지변환 및 저장]

This course (EECS) covers from basic electrochemistry to electrochemistry-based energy devices. Based on the understanding of electrochemistry, graduates and seniors learn the principles and the state-of-the-art technologies of energy devices including batteries, fuel cells, electrochemical capacitors and biofuel cells.

ECS524 Special Topics on Fuel Cells [연료전지 특론]

This class covers the various topics for fuel cells. It focuses on thermodynamics, kinetics, mass transport, modeling and measurement of cell performance.

ECS526 Advanced Organic Spectroscopy [고급 유기분광학]

This course deals with the principle and application of modern spectroscopy by organic chemists. It focuses on the use of instrumental methods in assigning structures with organic molecules, which covers ultra-violet/visible (UV-Vis), infrared(IR), nuclear magnetic resonance (NMR) specroscopy, and mass (MS) spectometry. Both the basic theory and practical applications of these methods are discussed.

ENE527 Organic Electronics [유기 일렉트로닉스]

This course will cover the basic concepts, mechanisms, and special issues in organic electronics. Based on understanding of the basic properties of inorganic semiconductors, this course will focus on the applications using organic semiconductors such as organic light-emitting diodes, organic solar cells, and organic field-effect transistors.

ECS531 Advanced Organic Chemistry [고급 유기화학]

This course will introduce the advanced organic reactions used for the organic synthesis, including general alkylation, carbonyl addition/condensation reactions, nucleophilic substitution for functional group interconversion, electrophilic addition, redox reactions, cycloadditions, and organometallic reactions. We will also cover about the physical organic chemistry to probe the mechanism of the related reactions. The general objective of this course is to provide the solid foundation of organic synthesis and to nurture the integration of organic synthesis knowledge into the respective research fields.

ENE532 Advanced Materials Analysis [고급 재료분석]

This course covers the principles of analytical instruments which are needed in the characterization of organic and inorganic materials, and provides students with the opportunity to learn how to operate them in laboratories. This course deals with many integuments for spectroscopic analysis (NMR, FTIR, Raman, UV/VIS), x-ray analysis (XRD, XRF), surface analysis (AFM, XPS, SIMS), thermal analysis (DSC, TGA), Mass spectrometry, and electron microscopy (SEM, TEM).

ENE533 Principles of Device Physics [소자물리]

The purpose of this course is to provide a basis for understanding the characteristics and operations of semiconductor devices by bringing together quantum mechanics, quantum theory of solids, semiconductor material physics, and semiconductor device physics, which are essential to the understanding of both the modern and future electronic devices. Topics include semiconductor device fundamentals, equilibrium and non-equilibrium statistical mechanics, band structures, density of states, carrier dynamics and transport phenomena, PN junctions, metal-semiconductor junctions, field effect transistors, MOSFETS, optoelectronic devices etc.

ECS581-585 Special Topics on Energy Materials I-V [에너지재료 특론 I-V]

In this lecture, we will be exploring recent trends in Energy Conversion and Storage Research. The challenges and state-of-the-art technologies on Energy Materials will be discussed.

ECS611 Advanced Polymer Materials [고급 고분자재료]

Polymers are very important materials for daily life to advanced technologies. This course will briefly deal polymer concepts for students who have not taken polymer course(s) before. Then, specialty polymers for opto-electronic and energy conversion and storage applications are discussed in details.

ECS612 Nanostructures and Nanomaterials [나노공학]

This course deals with small structures or small sized materials. A nanometer is one billionth of a meter. Small features permit more functionality in a given space. Nanotechnology is nanostructure design, synthesis, and applications. During the class, synthesis, analysis, and applications of nanostructured materials will be covered.

ENE613 Advanced Quantum Physics I [고급 양자물리학 I]

This course covers quantum mechanics at the beginning graduate level. Undergraduate physics courses, including electro-magnetism, quantum mechanics are prerequisite for this course. Theoretical foundations of quantum mechanics are gently introduced in comparison with classical physics. Mathematical tools for Hamiltonian mechanics also covered in relation with the structure of quantum mechanics. All students who wants to take the course should consult with the Lecture for the appropriateness of the course content.

ENE614 Nanochemistry [나노화학]

This course presents concepts of nanochemistry in various nanosciences and nanotechnologies. Topics include synthetic methods of nanomaterials, fabrication methods of nanostructures, and analytical methods of nanostructured materials. This course is designed for graduate students with backgrounds in chemistry, physics, and material science.

ECS615 Carbon-based Nanomaterials [탄소기반 나노재료 특론]

Carbon-based nanomaterials have attracted significant attention due to those unique and tunable properties. This course will introduce recent advances in carbon-based nanomaterials such as fullerene, carbon nanotube, and graphene, as well as carbon-based nanodevices.

ECS621 Fundamental of the Advanced Fuel Cells [고급 연료전지]

This lecture will provide the knowledge of components, characterization, and application in fuel cells, such as proton exchange membrane (PEM), Phosphoric fuel cells, Molten Carbonate fuel cells, and Solid Oxide fuel cells. It also delivers the scientific information for their characterizations via ceramic engineering and solid state electrochemistry.

ECS622 Crystallography [결정학]

The basic group theory which deals with molecular structure and symmetry will be discussed. The properties of crystals, X-rays and the interaction between the crystal and X-ray will be covered. The theory of the molecular structure determination by X-ray diffraction will be discussed and the single-crystal structure determination will be practiced using a real data set obtained via a diffratometer.

ECS623 Advanced Quantum Physics II [고급 양자물리학 II]

This course aims to give more practical experience with Quantum Mechanics. Concept of angular momentum, identical particle, perturbation theory, and scattering theory will be introduced. At the later part of the course, the relativistic Quantum mechanics is shortly introduced. Theories of solid states physics and electronic structures are also introduced. All students who wants to take the course should consult with the Lecture for the appropriateness of the course content.

ECS631 Materials for Organic Electronics [유기전자재료]

This course will cover the molecular design and engineering of organic materials for electronic, optical, and electrochemical applications such as organic light-emitting diodes (OLED), organic field-effect transistors (OFETs), and organic solar cell (OSC). The general routes for their synthesis will also be introduced.

BST515 Nanomaterials for Energy Storage [에너지 저장용 나노재료]

This course will deliver the synthetic methods and characterization of nanomaterials for energy storage. Using different synthetic methods, the dimension of energy storage materials can be varied and their storage capabilities are also changed. Thus, this course will focus on the synthetic methods of the storage materials, and discuss about the optimization of the synthetic conditions of the materials using various methods.

ECS633 Special Topics on Electronic Materials [전자재료 특론]

This course will deliver the principle and applications of electronic materials. This is an advanced course that covers the overall principles of the materials which take part in modern industries. This course consists of two parts; one is to understand the basic principles of the materials, based on the atomic bonding nature. The other is to provide the deep knowledge on the device applications of electronic materials, such as semiconductors, electrochemical materials (Li-ion, solar, fuel cells), and magnetic materials. The other part is to review the synthetic methods of the electronic materials to help understand recent advances in electronic materials.

ECS634 Lithography [리소그래피 특론]

Lithography is one of most important tools towards energy-related materials. This course covers the fundamental theory of several lithography techniques and the applications of the structures fabricated from each technique.

ECS635 Nano Thin Films [나노박막 특론]

This course aims to provide the basic principles and applications of nanoscale thin films composed of inorganic and organic materials. In addition, understanding the relevant characterization tools will be discussed in detail. This course is designed for graduate students with backgrounds in chemistry, physics, and material science.

Department of Chemical Engineering

Chemical Engineering [ACE]

Department of Chemical Engineering at UNIST is aiming to be a world-leader. Regarded as one of the finest institutions in Korea, this department provides its graduate students with a state-of-the-art research environment and facilities. We are focusing on the application of Chemical engineering to a variety of specific areas, including energy and the environment, catalysis, reaction engineering, systems and process design, nanotechnology, polymers and colloids and biotechnology. It is a multi-scale engineering department in which students can learn about the creative design of new Chemicals, materials, processes and systems by translating molecular level information into novel engineering principles. Faculty members are involved in cutting-edge research programs that encompasses all areas of Chemical engineering: Nanoscience, Materials Science, Catalysis, Electronic Materials and Devices, Colloidal Science and Chemical Engineering. The graduate students and post doctoral researchers will have access to state-of-the-art facilities on campus, such as the UCRF and Chemical Sciences Facility.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 15 credits	at least 13 credits
Doctoral Program	at least 60 credits	at least 12 credits	at least 48 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 21 credits	at least 39 credits

Curriculum

▶ Chemical Engineering

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Remarks	Convergence
Required	ACE590	Research	The Seminars I	세미나	1-1-0		
	ACE690		Master's Research	석사논문연구	Value of Credit		
	ACE890		Doctoral Research	박사논문연구	Value of Credit		
Elective	ACE503	Lecture	Advanced Organic Chemistry	고급유기화학	3-3-0		
	ACE504		Molecular Thermodynamics	분자열역학	3-3-0		
	ACE505		Advanced Transport Phenomena	고급전달현상	3-3-0		
	ACE507		Introduction to Polymer Physics and Rheology	기초 고분자물리 및 레올로지	3-3-0		
	ACE508		Advanced Nanoscience and Nanotechnology	고급나노과학기술	3-3-0		O
	ACE509		Colloids and Interfaces	콜로이드와 계면	3-3-0		
	ACE510		Renewable Energy Engineering	신재생에너지공학	3-3-0		
	ACE601		Advanced Process Control	고급공정제어	3-3-0		
	ACE602		Semiconductor Processing	반도체공정	3-3-0		O
	ACE603		Catalysis	촉매	3-3-0		
	ACE604		Organic Electronics Materials	유기전자재료	3-3-0		O
	ACE605		Statistical Mechanics and Molecular Simulation	통계역학 및 분자모사	3-3-0		O
	ACE606		Advanced Physics for Nanomaterials	나노재료물리	3-3-0		O
	ACE607		Polymer Structures and Properties	고분자구조 및 물성	3-3-0		
	ACE608		Special Topics in Metabolic Engineering	대사공학특론	3-3-0		O
	ACE609		Current Topics of Synthetic Biology	합성생물학특론	3-3-0		
	ACE610		Advanced Enzyme Engineering	고급효소공학	3-3-0		O
	ACE611		Current Topics of Bioseparation Technology	고급생물분리공정	3-3-0		O
	ACE612		Advanced Biochemical Engineering	생물공학특론	3-3-0		
	ACE702		Nanolithography	나노리소그래피	3-3-0		O
	ACE703		Advanced Organic Nanomaterials	고급유기나노재료	3-3-0		O

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Remarks	Convergence
Elective	ACE704	Lecture	Printed Electronics	인쇄전자	3-3-0		O
	ACE705		Special Topics in Chemical and Energy Materials	화학 및 에너지 재료 특론	3-3-0		O
	ACE706		Synthetic organic chemistry	합성유기화학	3-3-0		
	ACE707		Biorefinery	바이오리파이너리	3-3-0		
	ACE708		Current Trends of Surface Chemistry and Catalysis	최신 표면 화학 및 촉매	3-3-0		O
	ACE709		Catalysis for Energy Conversion	에너지 변환 촉매	3-3-0		
	ACE801		Special Lectures in Applied Chemistry A	최신응용화학특론 A	3-3-0		
	ACE802		Special Lectures in Applied Chemistry B	최신응용화학특론 B	3-3-0		
	ACE803		Special Lectures in Applied Chemistry C	최신응용화학특론 C	3-3-0		
	ACE804		Special Lectures in Applied Chemistry D	최신응용화학특론 D	3-3-0		
	ACE805		Special Lectures in Applied Chemistry E	최신응용화학특론 E	3-3-0		
	ACE806		Special Lectures in Applied Chemistry F	최신응용화학특론 F	3-3-0		
	ACE807		Special Lectures in Applied Chemistry G	최신응용화학특론 G	3-3-0		
	ACE808		Special Lectures in Applied Chemistry H	최신응용화학특론 H	3-3-0		
	ACE809		Special Lectures in Applied Chemistry I	최신응용화학특론 I	3-3-0		
	ACE810		Special Lectures in Applied Chemistry J	최신응용화학특론 J	3-3-0		

Description

ACE590 The Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

ACE503 Advanced Organic Chemistry [고급유기화학]

The goal of synthetic chemistry is to construct target molecules from available starting materials and reagents in recognizing the various structural units, which are called synthons. The course includes conformational, synthetic and functional group analyses based on reterosynthetic approach.

ACE504 Molecular Thermodynamics [분자열역학]

This course offers in-depth understanding of thermodynamics based on molecular physics and statistical mechanics together with classical macroscopic thermodynamics. This combination enables us to calculate a variety of thermodynamic properties quantitatively and to systematically analyze many apparently complex thermodynamic phenomena occurring in mixtures.

ACE505 Advanced Transport Phenomena [고급전달현상]

This course provides advanced level of understanding on the transport phenomena (momentum, heat, and mass transfer) from an unified viewpoint. It covers not only the conventional macroscopic approach but also rigorous microscopic approach based on statistical mechanics, which is useful in dealing with a variety of real problems.

ACE507 Introduction to Polymer Physics and Rheology [기초 고분자물리 및 레올로지]

This course covers the general physical behaviors of polymeric materials under equilibrium and nonequilibrium (flowing) conditions, with a particular emphasis on rheological properties of polymers. Statistical analysis will also be taken into account in order to get insight into the structural and thermodynamical properties intrinsic to polymers. Basis knowledge of transport phenomena is prerequisite.

ACE508 Advanced Nanoscience and Nanotechnology [고급나노과학기술]

This course is intended primarily as an advanced course in nanoscience and nanotechnology. This course introduces the principles of science and technologies that underlie nanoscience and nanotechnology, and presents a review of recent literature in this area.

ACE509 Colloids and Interfaces [콜로이드와 계면]

Basic forces and interactions between atoms, molecules, small particles and extended surfaces in solution and in colloidal systems: Van der Waals, electrostatic, hydrophobic, solvation, H-bonding. Introduction to colloidal systems: particles, micelles, polymers, etc. Surfaces: wetting, contact angles, surface tension, etc.

ACE510 Renewable Energy Engineering [신재생에너지공학]

This course first provides students a basic knowledge and understanding of renewable energy processes. And special lectures about water photoelectrolysis for solar hydrogen production will be followed. Finally, there will be individual presentation (not a group) on renewable energy by students.

ACE601 Advanced Process Control [고급공정제어]

This course provides in-depth understanding of the ways in which chemical engineers make decisions and balance constraints to come up with new processes and products. Students will learn material and energy balances as tools to achieve workable, economical, and safe chemical processes and products.

ACE602 Semiconductor Processing [반도체공정]

This course offers the understanding of the semiconductor chemical processes and the basis required for designing semiconductor chemical processes. This course covers oxidation, diffusion, ion implantation, chemical vapor deposition, photolithography, metallization, and all of the silicon processing.

ACE603 Catalysis [촉매]

This course is intended primarily as an introduction course to catalysis for graduate students. The objective of this course is to understand basic principles of catalytic phenomena. Topics covered include preparation and characterizations of catalysts, correlation between the structure of catalysts and their activity, catalytic reaction kinetics and mechanism, and properties and working principles of metal, metal oxides, acid-base, and homogeneous catalysts.

ACE604 Organic Electronics Materials [유기전자재료]

The course covers molecular design and synthesis, charge generation and charge transport mechanisms, and the structure-property relationship of organic electronic materials including organic semiconductors, polymeric electronic materials, carbon nanomaterials, dielectrics, and dopants. In addition, this course aims at an in-depth understanding of the fabrication methods, operation principles, performance optimization approaches of organic electronic devices such as organic field-effect transistors (OFETs), organic light-emitting diodes (OLEDs), organic solar cells, sensors, and nano-devices.

ACE605 Statistical Mechanics and Molecular Simulation [통계역학 및 분자모사]

This course focuses on the fundamentals of classical/quantum statistical mechanics and their applications in a wide variety of research subjects. In this course, we also deal with the basics of molecular simulations in conjunction with statistical mechanics, followed by their practical applications to physical systems and phenomena. Basic knowledge of thermodynamics is prerequisite.

ACE606 Advanced Physics for Nanomaterials [나노재료물리]

This course is about the electronic properties of nano-materials and contains lectures about scattering, transport in metals, phonons and superconductivity. The goal of the course is twofold: to present modern concepts of the electronic properties of the nano-materials, and to develop the ability to understand scientific papers.

ACE607 Polymer Structures and Properties [고분자구조 및 물성]

This course will look into the microstructures and properties of polymeric materials, thereby aiming at an in-depth understanding of the structure-property relationship. This class is designed to deliver basic knowledge and skills for molecular design and the synthesis of novel polymeric materials with desired physical or chemical properties. In addition, theoretical methodologies and experimental analysis tools for the investigation of macromolecular structures and their properties will also be introduced.

ACE608 Special Topics in Metabolic Engineering [대사공학특론]

Starting from Central Dogma, we will take quantitative approach to the regulation of gene expression in natural and engineered genetic circuits, which will be integrated into the control of cellular growth and metabolism. Both theory and experiment majors from either biochemical engineering or physical sciences are welcome. Working knowledge of thermodynamics and/or physical chemistry and a basic command of introductory molecular biology is desirable but not essential.

ACE609 Current Topics of Synthetic Biology [합성생물학특론]

A series of presentation and discussions on recent research achievements in synthetic biology will equip graduate students with up-to-date knowledge and techniques in the field of synthetic biology, which improve their performance as an independent researcher.

ACE610 Advanced Enzyme Engineering [고급효소공학]

This course will introduce the recent achievements and trends in biocatalysis field. Although biocatalysis is a synthesis of chemistry, biology, chemical engineering, but most students enter this field with limited knowledge. So this course seeks to fill the gap between the research front and the area beyond basic courses.

ACE611 Current Topics of Bioseparation Technology [고급생물분리공정]

Currently various kinds of bio-products such as proteins, bulk metabolites, and fine chemicals are being produced through biological process. However, the commercialization of these bio-products are heavily dependent on the successful bioseparation process. Some parts of conventional separation process commonly used in chemical process can be directly applied, but various unique separation process for protein and cellular metabolites are required. In this course, the latest and practical separation process will be discussed to design the optimum separation process for bio-products depending on the characteristics of bio-products.

ACE612 Advanced Biochemical Engineering [생물공학특론]

Advanced Biochemical Engineering course is designed to provide core bioprocess engineering principles at graduate level. Graduate students having background in biological sciences such as microbiology, biochemistry, molecular biology while seeking for the career as biochemical engineer will benefit greatly from this course. Lectures will include physical processes (such as fluid flow, mixing, mass transfer and unit operations) and reactions and reactors (such as homogeneous and heterogeneous reactions and reactor engineering), with emphasis on biological systems.

ACE702 Nanolithography [나노리소그래피]

This course offers the understanding of the basic principles in top-down methods in semiconductor processing and also bottom-up methods in manipulating nanoparticles, nanotubes, and nanowires for the fabrication of nanostructures and nanoscale patterns.

ACE703 Advanced Organic Nanomaterials [고급유기나노재료]

This course is designed to introduce fabrication methods of nanostructured functional organic materials and their applications. Fabrication methods of organic nanomaterials with various morphologies based on self-assembly and template synthesis of small molecules and polymers are covered, and their state-of-the-art applications in optoelectronic devices, energy devices, drug delivery, and biomimic materials are also introduced.

ACE704 Printed Electronics [인쇄전자]

Electronic device manufacturing is poised to undergo a renaissance through the utilization of relatively low-cost, high-speed printing technologies. Over the last several years, the development of new materials and technologies such as printable organic semiconductors, inkjet systems and lower cost, robust flexible substrates, have made the manufacture of electronic and display devices by high speed printing in commercial environments possible. This revolutionary shift in A1 manufacturing philosophy will enable significant cost reductions in existing products, will allow manufacturers to expand current products into new markets and will also foster the development of entirely new, products and technologies such as smart packaging solutions, flexible displays and RFID tags. This course covers the state-of-the-art printing technologies, materials considerations and implementation challenges that are shaping the future of the electronics industry. The program offers the opportunity to obtain an expert start in the Printed Electronics field, to get an update, or to open up exciting new opportunities.

ACE705 Special Topics in Chemical and Energy Materials [화학 및 에너지 재료 특론]

This course will introduce recent development of materials for applications in chemical and energy engineering. The students will learn the fundamental chemical and physical properties of polymers and inorganic materials required in applications in green energy process, catalysis, batteries, solar cells, and electronic devices.

ACE706 Synthetic Organic Chemistry [합성유기화학]

Students will learn about the fundamentals of synthetic organic chemistry including arrow pushing, molecular orbitals, reaction mechanisms of nucleophilic reaction, electrophilic reaction, migration, metal-catalyzed reactions.

Objective: Introduction to synthetic methods and organic reaction mechanisms.

ACE707 Biorefinery [바이오리파이너리]

This course provides a detailed overview of different biorefinery concepts and deals with how different types of biomass resources can serve as feedstock for the production of biofuels, chemicals, and raw materials.

ACE708 Current Trends of Surface Chemistry and Catalysis [최신 표면 화학 및 촉매]

The new course is created to provide valuable information of recent technologies for the development of next generation nanocatalysts, as well as to understand classical surface science and the technology of industrial catalysts. In particular, synthetic methods of nanoparticles and mesoporous materials for nanocatalysts and several reaction studies will be introduced by demonstrating how the structures of nanostructures affect catalytic performance.

ACE709 Catalysis for Energy Conversion [에너지 변환 촉매]

This class covers fundamental aspects of energy conversion devices, including fuel cells and electrolyzers, and of catalysis for energy conversion reactions in these devices. The first half of this class deals with basic electrochemical engineering in fuel cells and electrolyzers, such as thermodynamics, kinetics, and transport phenomena. The second half provides fundamental aspects and recent advances in catalysts for oxygen reduction, hydrogen evolution, and oxygen evolution reactions.

ACE801–810 Special Lectures in Applied Chemistry A–J [최신응용화학특론 A–J]

This course is designed to introduce the current trends and the state-of the-art states of nanotechnologies, biotechnologies and Chemistry-related technologies. To keep the flexibility of the course, the topics and the instructors will be changed every semesters.

Department of Chemistry

☐ Chemistry [CHM]

Chemistry is a central science that seeks to understand the interactions between atoms and molecules coupled with their applications. The Department of Chemistry at UNIST provides opportunities for students to obtain a deep fundamental knowledge in the field of chemistry including its sub-disciplines. In addition, students are encouraged to engage in research as such experiences are considered to be an essential educational tool. Research projects that utilize state-of-the-art facilities under the mentorship of world-class researchers are available to all students and set in collaborative environments. The primary goal of the department is to educate the next-generation of chemists and to provide them with the technical and leadership skills sets needed to contribute to society and to humankind.

☐ Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 15 credits	at least 13 credits
Doctoral Program	at least 60 credits	at least 12 credits	at least 20 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 21 credits	at least 33 credits

Curriculum

Chemistry

Course is	Course No.	Classi-fication	Course Title (Eng)	Course Title (Kor)	Cred.-Lect.-Exp.	Remarks	Prere-quisite	Convergence
Required	CHM590	Research	Seminar	세미나	1-1-0			
	CHM690		Master's Research	석사논문연구	Value of Credit			
	CHM890		Doctoral Research	박사논문연구	Value of Credit			
Elective	CHM511	Lecture	Advanced Organic Chemistry	고급유기화학	3-3-0	Core Subject		
	CHM521		Frontiers in Chemical Biology	고급화학생물학	3-3-0	Core Subject		
	CHM522		Supramolecular Chemistry	초분자화학	3-3-0	*CHM422		
	CHM531		Introduction to Molecular Spectroscopy	기초분자분광학	3-3-0	*CHM431		
	CHM532		Statistical Mechanics	통계역학	3-3-0	Core Subject		
	CHM534		Materials for Organic Electronics	유기전자재료	3-3-0	Core Subject		
	CHM535		Physical Organic Chemistry	물리유기화학	3-3-0	Core Subject		
	CHM541		Inorganic Materials Analysis	무기재료분석	3-3-0	Core Subject *CHM451		
	CHM542		Advanced Quantum Chemistry	고급양자화학	3-3-0	Core Subject		
	CHM552		Organometallic Chemistry	유기금속화학	3-3-0	Core Subject *CHM452		
	CHM553		Bioinorganic Chemistry	생무기화학	3-3-0	Core Subject *CHM453		
	CHM554		Solid State Chemistry	고체화학	3-3-0	*CHM454		
	CHM555		Crystallography	결정학	3-3-0			
	CHM561		Advanced Inorganic Chemistry	고급무기화학	3-3-0	Core Subject		
	CHM572		Advanced Polymer Chemistry	고급고분자화학	3-3-0	Core Subject		
	CHM582		Nanochemistry	나노화학	3-3-0	Core Subject		
	CHM622		Nanomedicine	나노의학	3-3-0			
	CHM624		Advanced Protein Chemistry	고급단백질화학	3-3-0			
	CHM643		Molecular Spectroscopy	분자분광학	3-3-0	Core Subject		

Course is	Course No.	Classi-fication	Course Title (Eng)	Course Title (Kor)	Cred.-Lect.-Exp.	Remarks	Prere-quisite	Converg ence
Elective	CHM644	Lecture	Chemical Kinetics	반응속도론	3-3-0			
	CHM645		Chemical Physics	화학물리학	3-3-0			
	CHM646		Molecular Physics	분자물리학	3-3-0			
	CHM651		Inorganic Supramolecules/Metal-Organic Frameworks	무기초분자 및 금속유기 얼개	3-3-0			
	CHM681		Advanced Instrumental Analysis	고급기기분석	3-3-0			
	CHM682		Organic Chemistry for Materials	재료유기화학	3-3-0			
	CHM810		Special Topics in Organic Chemistry I	유기화학특론1	3-3-0			
	CHM811		Special Topics in Organic Chemistry II	유기화학특론2	3-3-0			
	CHM812		Special Topics in Biochemistry and Chemical Biology	생화학/화학생물학특론	3-3-0			
	CHM813		Special Topics in Organic Materials Chemistry	유기재료화학특론	3-3-0			
	CHM831		Special Topics in Physical Chemistry	물리화학특론	3-3-0			
	CHM832		Special Topics in Chemical Physics	화학물리학특론	3-3-0			
	CHM833		Special Topics in Theoretical Chemistry	이론화학특론	3-3-0			
	CHM834		Special Topics in Computational Chemistry	계산화학특론	3-3-0			
	CHM851		Special Topics in Inorganic Chemistry I	무기화학특론 I	3-3-0			
	CHM852		Special Topics in Inorganic Chemistry II	무기화학특론 II	3-3-0			
	CHM871		Special Topics in Polymer Chemistry	고분자화학특론	3-3-0			
	CHM872		Special Topics in Polymer Physics	고분자물리특론	3-3-0			
	CHM873		Special Topics in Materials Chemistry	재료화학특론	3-3-0			
	CHM874		Special Topics in Nanoscience	나노과학특론	3-3-0			
	CHM875		Special Topics in Interdisciplinary Research on Carbon Materials	탄소재료연구특론	3-3-0			

Courses marked with an asterisk (*) are designed for both advanced undergraduate students and first-year graduate students. These courses may be taken for either undergraduate or graduate credit.

Description

CHM511 Advanced Organic Chemistry [고급유기화학]

The goal of synthetic Chemistry is to construct target molecules from available starting materials and reagents in recognizing the various structural units, which are called synthons. The course includes conformational, synthetic and functional group analyses based on reterosynthetic approach.

CHM521 Frontiers in Chemical Biology [고급화학생물학]

Chemical biology can be defined as a biological study with chemical approaches. In recent two Department of Chemistry Graduate decades, chemical biology has been expanded to make lots of fascinating discoveries in biological field and some approaches of chemical biology have been essential tools in some biological research field. In this course, we will learn and discuss about concepts, mechanisms and applications of newly developed chemical tools in chemical biology field from current chemical biology research topics such as biological surrogates for glyco-and lipid biology, total protein synthesis, unnatural amino acid polymerisation, biomimetic synthetic enzymes, acitivity-based proteomics, affinity-based inhibitor, protein tagging tools, fluorescent chemical probes. Students are expected to have third year level knowledge of organic chemistry, biochemistry, and cellular biology.

CHM522 Supramolecular Chemistry [초분자화학]

Supramolecular chemistry involves the use of non covalent bonding interactions to self-assemble molecules into thermodynamically stable and well-defined structures. The course explores the field of supramolecular chemistry from molecules to nano materials. This course will provide students with an introduction to recent interesting research. The topics tp be covered include the types of non-covalent bonding, molecular recognition, the role of molecular recognition in biological systems, synthesis of new materials through supramolecular chemistry, applications for new nano materials. Students will be introduced to essential background concepts such as types of non covalent bonding and strategies for the design of supramolecular assemblies.

CHM531 Introduction to Molecular Spectroscopy [기초분자분광학]

This course is designed for students who study in spectroscopy and experimental physical chemistry. In addition to basic concepts of spectroscopy, this advanced course covers cutting edge spectroscopy which is still under development such as 2D IR, optical force, correlated rotational alignment spectroscopy, and time-resolved electron microscopy and spectroscopy. Students are expected to have second-year levels knowledge of physical and quantum chemistry and spectroscopy.

CHM532 Statistical Mechanics [통계역학]

This course covers the equilibrium properties of matter. The central issue of thermodynamics regards the determination of the equilibrium state that eventually results after removal of internal constraints in a closed, composite system. Statistical mechanics regards the interaction between the particles composing a bulk sample, and predicts the equilibrium properties of the system that result from these interactions, exactly solvable or requiring approximations or numerical analysis.

CHM534 Materials for Organic Electronics [유기전자재료]

This course introduces the comprehensive principles of organic materials applied in organic solar cells, especially for bulk-heterojunction solar cells and dye-sensitized solar cells. Not only each device structures but design strategy of materials are also introduced. Through this course, students will solidify and expand their understanding to organic solar cells.

CHM535 Physical Organic Chemistry [물리유기화학]

This course is designed for students who study in organic chemistry and physical chemistry. Physical organic chemistry mainly concerns the interrelationships between structure and reactivity in organic molecules. The course will discuss organic chemistry using tools of physical chemistry such as chemical equilibrium, chemical kinetics, thermodynamics, and quantum chemistry.

CHM541 Inorganic Materials Analysis [무기재료분석]

This course covers the principles of analytical instruments which are needed in the characterisation of organic and inorganic materials, and provides students with the opportunity to learn how to operate them in laboratories. This course deals with many instruments for spectroscopic analysis, x-ray analysis, surface analysis, thermal analysis, mass spectrometry, and electron microscopy.

CHM542 Advanced Quantum Chemistry [고급양자화학]

This course provides an introduction to methods of quantum mechanics, including Schrodinger equation and its solutions as applied to simple physical problems, elementary approximate methods, and scattering theory.

CHM552 Organometallic Chemistry [유기금속화학]

The focus of this course is on the synthesis, structure and bonding, properties and reactivity of main group organometallics (including Grignard reagents, organolithium reagents, organophosphorus compounds, etc), organotransition metal chemistry and organometallic catalysis. The course is of particular relevance for students interested in synthetic chemistry.

CHM553 Bioinorganic Chemistry [생무기화학]

This course covers fundamental principles of inorganic chemistry in the context of the role of metals in biological systems. Special emphasis is put on the role of metals in biological systems, and the connection between fundamental knowledge of biological processes with respect to metals, and their relation to commonly known phenomena such as diseases, pollution, alternative energies, evolution and industrial processes.

CHM554 Solid State Chemistry [고체화학]

This course focuses on the basic principles of solid state chemistry. Structural, chemical, and physical aspects of inorganic solids, such as ionic solids, metal, and molecular solids, will be discussed. The course explores the relationship between electronic structure, chemical bonding, and atomic order. It Department of Chemistry Graduate also investigates the characterization of atomic arrangements in crystalline and amorphous solids: metal, ceramics, semiconductors, and polymers. Topics include: symmetry, basic crystallography, crystal structure, bonding in solids, characterization technique (X-ray diffraction, microscopy, and spectroscopy) and crystal defects.

CHM555 Crystallography [결정학]

He basic group theory which deals with molecular structure and symmetry will be discussed. The properties of crystals, X-rays, and the interaction between the crystal and X-ray will be covered. The theory of the molecular structure determination by X-ray diffraction will be discussed and the single-crystal structure determination will be practiced using a real data set obtained via a diffractometer.

CHM561 Advanced Inorganic Chemistry [고급무기화학]

Experimental methods and characterization tools for coordination compounds, organometallics, quantum dot, and metal nanomaterials will be introduced. The practical application of these inorganic materials will also be introduced.

CHM572 Advanced Polymer Chemistry [고급고분자화학]

This course will provide advanced level topics in Polymer Chemistry including an introduction to Polymer Chemistry. The course is designed to deliver graduate students a comprehensive understanding of the Chemistry of polymer synthesis and the modern synthetic chemistry and strategy for polymers, block copolymers, and architectural polymers. Recent advances in organic and inorganic/organometallic chemistry will be applied to synthetic polymer chemistry.

CHM582 Nanochemistry [나노화학]

This course aims to give basic concepts of nanoscience and nanotechnology. Topics in this course include introduction of various nanomaterials, fabrication methods of nanostructures, physicochemical properties of nanomaterials, and recent trends in nanoscience and nanotechnology. This course is designed for graduate students with backgrounds in chemistry, physics, and materials science.

CHM622 Nanomedicine [나노의학]

This course is intended primarily as an introduction course to the applications of nanoscience in medicine and biomedical fields. Nanosystems that can be used as drug delivery vehicles, cell-culture platforms, and therapeutic molecules and systems will be discussed.

CHM624 Advanced Protein Chemistry [고급단백질화학]

This course presents a review of recent protein chemistry centered on post-translational modification of proteins and their use in signal transduction and metabolism.

CHM643 Molecular Spectroscopy [분자분광학]

This course provides the basic principles of interaction of light and matter and their application n spectroscopy of atoms and molecules. In this course, covered will be how to describe absorption and emission of light by atoms and molecules, and how to characterize atomic and molecular states and molecular behavior by spectroscopy.

CHM644 Chemical Kinetics [반응속도론]

The main goal of this course is to deliver the principles of reaction kinetics and catalysis. Topics covered will include the laws and theories governing rates of chemical reactions and reaction mechanisms in the gas phase, in soluion, and at the solid-liquid interface. Emphasis is placed on modern experimental approaches to study kinetics in complex chemical and biochemical/biophysical systems.

CHM645 Chemical Physics [화학물리학]

Chemical physics is a subdiscipline of chemistry and physics that investigates physicochemical phenomena using techniques from atomic and molecular physics and condensed matter physics. This course is designed to deliver physical approaches to chemical problems and to discuss recent issues in chemical physics.

CHM646 Molecular Physics [분자물리학]

This course continues the study of the applications of quantum mechanics and quantum chemistry. The course covers selected topics in chemical and molecular physics with emphasis on experimentally observed phenomena, including atomic and molecular spectra, scattering of atoms and molecules, atom and molecule optics, and manipulation of molecular rotational and translational motions.

CHM651 Inorganic Supramolecules/Metal-Organic Frameworks [무기초분자 및 금속유기 얼개]

This course covers the basics of supramolecular chemistry of inorganic molecules and complexes, which yield highly ordered regular materials having precisely defined porous/crystalline structures. The course will discuss about the chemistry of metal-organic frameworks; synthesis, structures, and properties. Applications of these highly interesting materials will be also discussed.

CHM681 Advanced Instrumental Analysis [고급기기분석]

The course is designed to deliver theories and practices of modern instrumental analysis for nanoscience, Chemistry, Biology, and Chemical engineering. The lectures will cover (1) Theories for Department of Chemistry Graduate modern instrumental analysis, (2) NMR Spectroscopy, (3) Absorption Spectroscopy, (4) Surface Analysis, (5) Electron Microscopy, (6) Scanning Tunneling Microscopy and Atomic Force Microscopy, (7) Recent examples of modern instrumental analysis.

CHM682 Organic Chemistry for Materials [재료유기화학]

The course discusses organic chemistry and its application to materials science. Synthetic organic chemistry has widely adopted to synthesize molecules that play a crucial role in modern materials such as optoelectronic materials and biomedical materials. This course will discuss a few useful organic reactions and materials for modern materials.

CHM810–875 Special Topics in Chemistry [화학특론]

This course is designed to introduce the current trends and the state-of the-art states of nanotechnologies, biotechnologies and chemistry-related technologies. To keep the flexibility of the course, the topics and the instructors will be changed every semesters.

CHM590 Seminar [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the seminars.

CHM690 Master's Research [석사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

CHM890 Doctoral Research [박사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

Department of Physics

Physics [PHY]

Physics forms a fundamental knowledge system on nature and a framework of 'thinking' for almost every other contemporary science and technology. The physics department at UNIST aims to perform cutting-edge fundamental research in the field of physical sciences and to provide ground basis for the development of next generation technologies. The department focuses on the three main research areas including plasma and beam physics, quantum materials and optical physics, and soft matter and biological physics. The department provides graduate students with the deepest level of courses in physics and educates them to become world-leading physicists.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 21 credits	at least 7 credits
Doctoral Program	at least 60 credits	at least 15 credits	at least 45 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 33 credits	at least 27 credits

Curriculum

▶ Physics [PHY]

Course is	Course No.	Classi-fication	Course Title (Eng)	Course Title (Kor)	Cred.-Lect.-Exp.	Prerequisite	Convergence
Required	PHY501	Lecture	Classical Mechanics I	고전역학 I	3-3-0		
	PHY503		Electrodynamics I	전기역학 I	3-3-0		
	PHY505		Quantum Mechanics I	양자역학 I	3-3-0		
	PHY507		Statistical Mechanics	통계역학	3-3-0		
	PHY590	Research	The Seminars	세미나	1-1-0		
	PHY690		Master's Research	석사논문연구	Value of Credit		
	PHY890		Doctoral Research	박사논문연구	Value of Credit		
Elective	PHY500	Lecture	Advanced Mathematical Physics	고급수리물리	3-3-0		
	PHY502		Classical Mechanics II	고전역학 II	3-3-0		
	PHY504		Electrodynamics II	전기역학 II	3-3-0		
	PHY506		Quantum Mechanics II	양자역학 II	3-3-0		
	PHY511		Elementary High Energy Physics	고에너지물리개론	3-3-0		
	PHY521		Condensed Matter Physics I	응집물질물리 I	3-3-0		
	PHY522		Condensed Matter Physics II	응집물질물리 II	3-3-0		
	PHY541		Computational Physics	전산물리	3-3-0		
	PHY551		Introductory Astrophysics	천체물리개론	3-3-0		
	PHY552		General Relativity and Cosmology	일반상대론 및 우주론	3-3-0		
	PHY561		Plasma Physics	플라즈마 물리	3-3-0	EE231 PHY203 /204	
	PHY562		Advanced Plasma Physics	고급 플라즈마 물리	3-3-0		
	PHY564		Accelerator Physics	가속기물리	3-3-0		
	PHY571		Experimental Methods in Applied Physics	응용물리 실험기법	3-3-0		
	PHY681		Special Topics in Condensed Matter Physics	고체물리특론	3-3-0		
	PHY682		Special Topics in Plasma and Beam Physics	플라즈마 및 빔물리 특론	3-3-0		
	PHY683		Special Topics in Biophysics	생체물리특론	3-3-0		

Course is	Course No.	Classi-fication	Course Title (Eng)	Course Title (Kor)	Cred.-Lect.-Exp.	Prerequisite	Convergence
Elective	PHY684	Lecture	Special Topics in Theoretical Physics	이론물리특론	3-3-0		
	PHY685		Special Topics in Astrophysics and Cosmology	천체물리 및 우주론 특론	3-3-0		
	PHY686		Special Topics in High Energy Physics	고에너지물리특론	3-3-0		
	PHY687		Special Topics in Atomic, Molecular and Optical Physics	원자분자광물리특론	3-3-0		
	PHY688		Special Topics in Computational Physics	전산물리특론	3-3-0		
	PHY689		Special Topics in Soft Matter Physics	연성물질물리특론	3-3-0		
	PHY711		Quantum Field Theory I	양자장론 I	3-3-0		
	PHY712		Quantum Field Theory II	양자장론 II	3-3-0		
	PHY723		Interface Physics of Electronic Devices	전자소자 계면물리	3-3-0	EE331	O
	PHY731		Phase Transition and Critical Phenomena	상전이와 임계현상	3-3-0		
	PHY761		Physics of Vacuum Electron Devices	진공 전자소자물리	3-3-0		O
	PHY763		Laser-Plasma Physics	레이저-플라즈마 물리	3-3-0	PHY427	
	PHY765		Nuclear Fusion Engineering	핵융합공학	3-3-0		O
	PHY881		Advanced Topics in Theoretical Physics	이론물리 고등논제	3-3-0		
	PHY882		Advanced Topics in Experimental Physics	실험물리 고등논제	3-3-0		

☐ Description

PHY500 Advanced Mathematical Phycis [고급수리물리]

This course covers mathematical methods for application to problems in physics or engineering. General overview of differential equation, linear algebra, complex variable, some examples for special functions, and variational method will be introduced. Undergraduate courses of the electromagnetism and quantum mechanics are recommended prerequisite but not mandatory.

PHY501 Classical Mechanics I [고전역학 I]

This course covers various aspects of the Newtonian mechanics using high level mathematical techniques. The subjects include kinematics, angular motion, gravity, oscillations and motions of rigid bodies. Formalism using Lagrangians and Hamiltonians are introduced via calculus of variation, and its connection to quantum mechanics and relativity is discussed.

PHY502 Classical Mechanics II [고전역학 II]

This course is continuation of Classical Mechanics I, intended to deepen the basic concepts of Lagrangian and Hamiltonian formulations for continuous systems and fields. Canonical transformation and Hamiltonian-Jacobi theory are also introduced. Relativistic systems are also discussed in depth.

PHY503 Electrodynamics I [전기역학 I]

In this course we provide the student with the basic knowledge of electrodynamics, which are necessary to understand the advanced electrodynamics. The electrostatics, magnetostatics, boundary value problems, Maxwell equations, and wave propagations are covered.

PHY504 Electrodynamics II [전기역학 II]

Students study the radiation by charged particles and its interaction with materials. The Lienard-Wiechert Potential, Synchrotron radiation, Reflection, Transmission, Absorption of the electromagnetic wave to materials are covered.

PHY505 Quantum Mechanics I [양자역학 I]

This course is intended to improve our understanding of the basic principles and theoretical schemes of quantum mechanics by revisiting the topics covered in undergraduate quantum mechanics with more systematic and advanced mathematical formalism. The basic assumptions, Dirac notation, Hilbert space, Schrodinger equation, harmonic oscillator, angular momentum, spin and identical particles will be discussed.

PHY506 Quantum Mechanics II [양자역학 II]

This course deals with perturbation theory, variational method, scattering theory, quantum statistical mechanics, etc. which are essential to explain many physical phenomena occurring actually in nature.

PHY507 Statistical Mechanics [통계역학]

This course provides the fundamental principles of many-body systems in terms of their physical properties such as heat, free energy, entropy, etc. The power of statistical mechanics lies on its ability to predict statistical behavior of many molecules and the corresponding macroscopic material property changes, including phase transition between gas, liquid, and solid.

PHY511 Elementary High Energy Physics [고에너지물리개론]

This course introduces various mathematical tools and theoretical frameworks for understanding modern high energy physics and field theories. The current status of standard model including Quantum Electrodynamics, Strong and electroweak interactions, group theory, symmetry are introduced and students will learn a basic method of performing Feynman integrals.

PHY521 Condensed Matter Physics I [응집물질물리 I]

This course introduces the most important concepts of modern condensed matter physics at the

Department of Physics Graduate beginning graduate level. It aims to provide a range of solid-state phenomena that can be understood within an independent particle description. Topics include crystal structure, lattice dynamics, reciprocal space, phonons, solid-state thermodynamics, free and nearly free electron models, kinetic theory and transport, energy band theory, semiconductors physics and devices.

PHY522 Condensed Matter Physics II [응집물질물리 II]

This course deals with collective effects in solids arising from interactions between constituents.
Topics include electron-electron and electron-phonon interactions, screening, band structure effects, Landau Fermi liquid theory. magnetism in metals and insulators, superconductivity; occurrence, phenomenology, and microscopic theory.

PHY541 Computational Physics [전산물리]

The goal of this course is to let the students taste diverse contemporary methodologies used in solving physical problems by computers. In the first part of the course, basic computational techniques of root-finding, spectral analysis, differential equations, etc. are covered. In the second part, various numerical methods used in on-going research problems are explained on an introductory level. The subjects will be some from particle-in-cell simulations, molecular dynamics simulations, Monte-Carlo methods, the first principle calculations, fluid dynamics, genetic algorithms, Boltzmann equations, numerical renormalization, and others depending on the lecturer's choices.

PHY551 Introductory Astrophysics [천체물리개론]

This course aims to teach the introductory phenomenological astrophysics, including galaxies, supernova, black hole, super-dense astrophysical objects, gamma ray burst, gravitational wave detection, and related subjects.

PHY552 General Relativity and Cosmology [일반상대론 및 우주론]

This course aims to teach special relativity, general relativity, big bang cosmology, dark matter, dark energy, and related subjects at the introductory theoretical level.

PHY561 Plasma Physics [플라즈마 물리]

In this intermediate level course of plasma physics, basic frameworks are discoursed for understanding of waves in plasmas, diffusion, collisions and energy absorption, MHD model, nonlinear theories of plasma sheath and shock waves etc. The prerequisite is the undergraduate plasma and beam physics or similar topics.

PHY571 Experimental Methods in Applied Physics [응용물리 실험기법]

The main objective of this course is to provide students with the principles and applications of the experimental methods that are commonly used in the fields of Physics and Applied Physics. The student will demonstrate understanding of the experimental methods covered in this course by giving a presentation on the scientific applications of the methods.

PHY681 Special Topics in Condensed Matter Physics [고체물리 특론]

The main purpose of this course is to teach various special topics in condensed matter physics and discuss up to date theoretical and experimental results with students.

PHY682 Special Topics in Plasma and Beam Physics [플라즈마 및 빔물리 특론]

The main purpose of this course is to teach various special topics in plasma and beam physics and discuss up to date theoretical and experimental results with students.

PHY683 Special Topics in Biophysics [생체물리 특론]

The main purpose of this course is to teach various special topics in biophysics and discuss up to date theoretical and experimental results with students.

PHY684 Special Topics in Theoretical Physics [이론물리 특론]

The main purpose of this course is to teach various special topics in theoretical physics and discuss up to date theoretical and experimental results with students.

PHY685 Special Topics in Astrophysics and Cosmology [천체물리 및 우주론 특론]

The main purpose of this course is to teach various special topics in astrophysics and cosmology and discuss up to date theoretical and experimental results with students.

PHY686 Special Topics in High Energy Physics [고에너지물리 특론]

The main purpose of this course is to teach various special topics in high energy physics and discuss up to date theoretical and experimental results with students.

PHY687 Special Topics in Atomic, Molecular and Optical Physics [원자분자광물리 특론]

The main purpose of this course is to teach various special topics in atomic, molecular and optical physics and discuss up to date theoretical and experimental results with students.

PHY688 Special Topics in Computational Physics [전산물리 특론]

The main purpose of this course is to teach various special topics in computational physics and discuss up to date theoretical and experimental results with students.

PHY689 Special Topics in Soft Matter Physics [연성물질물리 특론]

Soft matter is a class of materials which include polymers, colloids, surfactants, granular particles, and liquid crystals. The properties of soft matter are complex, but they can be understood in terms of physics. In this course, students will learn advanced topics in soft matter physics. Additionally, selected topic for the term project will be given to each student depending on his/her interests.

PHY711 Quantum Field Theory I [양자장론 I]

This course covers the basics of relativistic quantum field theory. Starting from the Lagrangian formulation of classical fields and the standard method of field quantization, the free quantum fields, method of perturbative approach and Feynman rules are developed. Symmetries and conservations laws are duscussed and the interaction of scalar field and QED are formulated. Higher order diagram, self energy and renormalization are briefly covered.

PHY712 Quantum Field Theory II [양자장론 II]

This course further develops the formulation of relativistic quantum field theory. It covering the path Department of Physics Graduate integral approach to field theory, additional topics in QED, symmetry breaking, non-abelian gauge theories, the renormalization group, electroweak unification, QCD and non-perturbative methods.

PHY723 Interface Physics of Electronic Devices [전자소자 계면물리]

The interfaces between different materials in an electronic device take crucial roles in determining the functionality and efficiency of the device. This course introduces the basic physics of various interface phenomena occurring in electronic devices, and also the experimental methods characterizing them as well. Particularly, it discusses the electronic band structure and charge/spin transport (lateral, vertical) at interfaces, and their relations to the operational mechanisms of various actual electronic devices.

PHY731 Phase Transition and Critical Phenomena [상전이와 임계현상]

This course covers the core concepts of phase transitions and critical phenomena on which modern ideas of condensed matter and statistical physics are based. Starting from the classical examples in various lattice models of magnetism, the course reviews Landau Theory and scaling hypothesis to demonstrate that the behavior of many seemingly distinct physical systems near a phase transition is qualitatively the same, leading to the concept of universality class. The modern theory of Renormalization Group will be reviewed with a reference to exemplary classical and quantum many-body systems. Finally, a hands-on introduction into non-equilibrium critical phenomena will follow. This course assumes the prerequisite knowledge of undergraduate-level thermodynamics or statistical mechanics.

PHY761 Physics of Vacuum Electron Devices [진공 전자소자 물리]

This course covers basic principles of vacuum electron devices. The electron beam formation, beam-wave interaction, and application of vacuum electron devices are the main topics of this course. The modern vacuum electron devices such as micro-vacuum electronics, and THz frequency sources will be discussed. Students are required to take pre-requisites for this course.

PHY562 Advanced Plasma Physics [고급 플라즈마 물리]

This course covers advanced topics in plasma physics. Charged particle interactions and plasma instabilities will be discussed. The nuclear fusion science will be covered in the course. The fusion related instabilities, basic and advanced plasma diagnostics, and confinement theory will be discussed. The prerequisite courses are the undergraduate level electromagnetism, and plasma physics.

PHY763 Laser–Plasma Physics [레이저–플라즈마 물리]

This course is composed of two parts. Before the midterm, diverse subjects of laser-plasma interactions including the scattering, energy absorption by Bremsstrahlung, particle acceleration, nuclear fusion, terahertz generation, wakefield, and other nonlinear interactions are briefly introduced. After the midterm, specialized lectures are given on the laser-plasma-based particle acceleration and its numerical simulation.

PHY564 Accelerator Physics [가속기물리]

This course provides a comprehensive introduction to the physics of modern linear and circular accelerators, such as used for high-energy particle colliders, spallation neutron sources, rare isotope productions, and X-ray free electron lasers. Transverse and longitudinal beam dynamics, space-charge and wakefield effects, beam instabilities and non-linear phenomena are reviewed within the context of classical physics. Modern accelerator technologies, beam instrumentation and diagnostics, and advanced accelerator concepts are also introduced. The recommended prerequisite courses are the undergraduate-level electromagnetism and classical mechanics.

PHY765 Nuclear Fusion Engineering [핵융합 공학]

This course intends to cover basic principles of nuclear fusion and broad knowledge of the currenttechnology in the world. Physics of fusion plasmas and beam-wave interaction are the main themes of the course. Students are required to take pre-requisites for this course.

PHY881 Advanced Topics in Theoretical Physics [이론물리 고등논제]

The main purpose of this course is to teach various advanced topics in theoretical physics and discuss up to date theoretical and experimental results with students.

PHY882 Advanced Topics in Experimental Physics [실험물리 고등논제]

The main purpose of this course is to teach various advanced topics in experimental physics and discuss up to date theoretical and experimental results with students.

PHY590 Seminar [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the seminars.

PHY690 Master's Research [석사논문연구]

This course is related to the student's graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

PHY890 Doctoral Research [박사논문연구]

This course is related to the student's graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

Department of Mathematical Sciences

☐ Mathematical Sciences [MTH]

Department of Mathematical Science explores the connections between mathematics and its applications at both the research and educational levels. In addition to focusing on a traditional study in pure mathematics, our research at UNIST is devoted to encompass some of the most diverse and interdisciplinary research in the physical, business, economics, engineering, and biological sciences. The department provides a dynamic and engaging research environment in scientific computing, mathematical biology, finance, dynamical systems, image processing, number theory and analysis in PDEs. The undergraduate and graduate curriculum is planned with the following varied objectives: (1) to offer students an introduction to the fundamental study of quantity, structure, space, and change; (2) to prepare students for graduate study in pure or applied mathematics; (3) to serve the needs of students in fields that rely substantially on mathematics, such as the physics, biology, engineering, business and economics.

☐ Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 24 credits (at least 15 credits from Mathematical Sciences)	at least 4 credits
Doctoral Program	at least 60 credits	at least 24 credits (at least 15 credits from Mathematical Sciences)	at least 36 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 36 credits (at least 24 credits from Mathematical Sciences)	at least 24 credits

Curriculum

▶ Mathematical Sciences [MTH]

Course is	Course No.	Classi-fication	Course Title (Eng)	Course Title (Kor)	Cred.-Lect.-Exp.	Prerequisite	Convergence
Required	MTH590	Research	Seminar	세미나	1-1-0		
	MTH690		Master's Research	석사 연구	Value of Credit		
	MTH890		Doctoral Research	박사 연구	Value of Credit		
Elective	MTH501	Lecture	Real Analysis	실해석학	3-3-0		
	MTH502		Functional Analysis	함수해석학	3-3-0		
	MTH503		Probability and Stochastic Processes	확률 및 확률 과정론	3-3-0		
	MTH505		Numerical Analysis and Applications	수치해석 및 응용	3-3-0		
	MTH507		Numerical Linear Algebra	수치선형대수	3-3-0		
	MTH509		Partial Differential Equations	편미분방정식	3-3-0		
	MTH510		Nonlinear Partial Differential Equations	비선형 편미분방정식	3-3-0		O
	MTH511		Numerical Methods for Partial Differential Equations I	편미분방정식의 수치방법 I	3-3-0		
	MTH512		Numerical Methods for Partial Differential Equations II	편미분방정식의 수치방법 II	3-3-0		
	MTH513		Dynamical Systems	동적 시스템	3-3-0		
	MTH515		Mathematical Methods for Engineers	공학자를 위한 수학방법	3-3-0		O
	MTH517		Stochastic Calculus and applications	확률 미적분과 응용	3-3-0		
	MTH519		Advanced Statistics	고급 통계	3-3-0		
	MTH521		Computational Statistics for Bioscience	생명과학을 위한 계산 통계	3-3-0		O
	MTH531		Scientific Computing	과학계산	3-3-0		
	MTH532		Advanced Scientific Computing	고급과학계산	3-3-0		
	MTH551		Algebra I	대수학 I	3-3-0		
	MTH552		Algebra II	대수학 II	3-3-0		
	MTH553		Commutative Algebra	가환대수	3-3-0		
	MTH554		Algebraic Number theory	대수적 정수론	3-3-0		
	MTH555		Analytic Number theory	해석적 정수론	3-3-0		

Course is	Course No.	Classi-fication	Course Title (Eng)	Course Title (Kor)	Cred.-Lect.-Exp.	Prerequisite	Convergence
Elective	MTH556	Lecture	Algebraic Topology	대수적 위상수학	3-3-0		
	MTH557		Elliptic Curves	타원곡선론	3-3-0		
	MTH558		Automorphic Forms	보형형식론	3-3-0		
	MTH559		Homological Algebra	호몰로지 대수	3-3-0		
	MTH560		Representation Theory	표현론	3-3-0		
	MTH561		Differentiable Manifolds	미분다양체	3-3-0		
	MTH563		Differential Geometry	미분기하학	3-3-0		
	MTH565		Algebraic Geometry	대수적 기하학	3-3-0		
	MTH711		Selected Topics in Computational Mathematics I	계산수학 특론 I	3-3-0		
	MTH712		Selected Topics in Computational Mathematics II	계산수학 특론 II	3-3-0		
	MTH721		Selected Topics in Partial Differential Equations I	편미분방정식 특론 I	3-3-0		
	MTH722		Selected Topics in Partial Differential Equations II	편미분방정식 특론 II	3-3-0		
	MTH731		Selected Topics in Mathematical Biology I	생물수학 특론 I	3-3-0		
	MTH732		Selected Topics in Mathematical Biology II	생물수학 특론 II	3-3-0		
	MTH741		Selected Topics in Probability and Statistics I	확률과 통계 특론 I	3-3-0		
	MTH742		Selected Topics in Probability and Statistics II	확률과 통계 특론 II	3-3-0		
	MTH751		Selected Topics in Image Processing I	이미지 프로세싱 특론 I	3-3-0	MTH501 MTH505	
	MTH752		Selected Topics in Image Processing II	이미지 프로세싱 특론 II	3-3-0	MTH501 MTH505	
	MTH761		Selected Topics in Number Theory I	정수론 특론 I	3-3-0		
	MTH762		Selected Topics in Number Theory II	정수론 특론 II	3-3-0		
	MTH791		Selected Topics in Mathematics I	수학 특론 I	3-3-0		
	MTH792		Selected Topics in Mathematics II	수학 특론 II	3-3-0		
	MTH793		Selected Topics in Applied Mathematics I	응용수학 특론 I	3-3-0		
	MTH794		Selected Topics in Applied Mathematics II	응용수학 특론 II	3-3-0		

Description

MTH501 Real Analysis [실해석학]

Real analysis is fundamental to many of the other courses in applied mathematics. Topics include metric spaces, Banach spaces, measure theory, and the theory of integration and differentiation.

MTH502 Functional Analysis [함수해석학]

This covers certain topological-algebraic structures that can be applied analytic problems. Topics include Topological vector spaces, Completeness, Convexity, Duality in Banach spaces, Distributions, Fourier transforms, Banach algebras, Bounded and unbounded operators on a Hilbert spaces.

MTH503 Probability and Stochastic Processes [확률 및 확률 과정론]

Basic and advanced theories in probability and stochastic processes will be covered including expectation, conditional probability, law of large numbers, central limit theorem, markov chains, martingales, and Brownian motions.

MTH505 Numerical Analysis and Applications [수치해석 및 응용]

This course emphasizes the development of basic numerical algorithms for common problems formulated in science and engineering. The course covers interpolation and approximation of functions, numerical differentiation and integration, numerical solutions of ordinary differential equations and direct and iterative methods in linear algebra.

MTH507 Numerical Linear Algebra [수치 선형대수]

This course covers basic theory and methods for matrix computation. LU-decomposition, QR factorization, least square method. Condition numbers and accuracy. Solutions of large sparse matrix system and iterative methods.

MTH509 Partial Differential Equations [편미분방정식]

This course covers the theory of the classical partial differential equations, the method of characteristics for first order equations, the Fourier transform, the theory of distributions in Sobolev spaces, and techniques of functional analysis.

MTH510 Nonlinear Partial Differential Equations [비선형 편미분방정식]

This course covers the theory of the nonlinear partial differential equations, the method of characteristics for first order equations, Quasilinear equations, Fixed point theorems, and fully nonlinear equations.

MTH511 Numerical Methods for Partial Differential Equations I [편미분방정식의 수치방법 I]

Finite difference methods for solving ordinary and partial differential equations. Fundamental concepts of consistency, accuracy, stability and convergence of finite difference methods will be covered. Associated theory will be discussed.

MTH512 Numerical Methods for Partial Differential Equations II [편미분방정식의 수치방법 II]

Finite element methods for ordinary and partial differential equations will be covered. Algorithm development, analysis, and computer implementation issues will be addressed. Also we will discuss the generalized and discontinuous Galerkin finite element method.

MTH513 Dynamical Systems [동적 시스템]

This course provides tools to characterize qualitative properties of linear and nonlinear dynamical systems in both continuous and discrete time. The course covers stability analysis of differential equations, Hamiltonian systems, Pointcare mapping, and Reduction methods.

MTH515 Mathematical Methods for Engineers [공학자를 위한 수학방법]

This course provides concise introductions to mathematical methods for problems formulated in science and engineering. Some selected topics are functions of a complex variable, Fourier analysis, calculus of variations, perturbation methods, special functions, dimension analysis, tensor analysis.

MTH517 Stochastic Calculus and Applications [확률 미적분과 응용]

Brownian motion, Ito's rule, stochastic integrals, and stochastic differential equations as well as their numerical simulations are covered. Application to chemistry, finance and partial differential equations will be also included

MTH519 Advanced Statistics [고급 통계]

Mathematical backgrounds for basic statistical analyses are covered. We deal with properties of probability distributions, limit theorems including laws of larger numbers and central limit theorem, theories for hypothesis test and inference, analysis of variance, and non-parametric analysis

MTH521 Computational Statistics for Bioscience [생명과학을 위한 계산 통계]

Linear model, multivariate analysis, survival analysis and some machine learning methods for genome and clinical data analysis using R software

MTH531 Scientific Computing [과학계산]

This course provides fundamental techniques in scientific computation with an introduction to the theory and software of the topics: Monte Carlo simulation, numerical linear algebra, numerical methods of ordinary and partial differential equations, Fourier and wavelet transform methods. This course may involve numerical coding assignments and some use of software packages.

MTH532 Advanced Scientific Computing [고급과학계산]

Topics include an overview of computer hardware, software tools and packages, commonly used numerical methods, visualization of results, high-performance computing and parallel programming. This course may involve numerical coding assignments and some use of software packages.

MTH551 Algebra I [대수학 I]

The topics of this course includes Group theory, including theorems of Sylow; rings and ideals, factorization theory in integral domains.

MTH552 Algebra II [대수학 II]

This is a continuation of Algebra I. The topic includes modules over principal ideal rings, Galois theory of fields, multilinear algebra, structure of algebras.

MTH553 Commutative Algebra [가환대수]

Topics of commutative algebra include techniques of localization, Cohen-Macaulay rings, Gorenstein rings, complete intersections, regular local rings.

MTH554 Algebraic Number Theory [대수적 정수론]

The topic includes ideal theory, valuations, local fields, cyclotomic fields, an introduction to class-field theory, L-functions and class number formulas.

MTH555 Analytic Number Theory [해석적 정수론]

The topic includes theory on the zeros of zeta functions and L-functions for the prime number theorem in arithmetic progressions and Chebotarev density theorem, and the Sato-Tate conjectur

MTH556 Algebraic Topology [대수적 위상수학]

The topic includes homotopy theory, fundamental group and covering spaces, singular homology and cohomology theory.

MTH557 Elliptic Curves [타원곡선론]

The topic includes operation on elliptic curves, theory over the finite, complex, local, and global fields; rational points, and the Mordell-Weil theorem.

MTH558 Automorphic Forms [보형형식론]

The topic includes Modular forms, Whittaker model, Tate's thesis, Rankin-Selberg method, and local, global Langlands program.

MTH559 Homological Algebra [호몰로지 대수]

The topic includes category theory, Ext, Tor functor, spectral sequences, group cohomology, Lie-algebra cohomology, and sheaf cohomology.

MTH560 Representation Theory [표현론]

The topic includes representations of finite groups, Lie groups and Lie algebras.

MTH561 Differentiable Manifolds [미분다양체]

This course is a study of geometrical objects that can be endowed with coordinates enabling one to apply differential and integral calculus on them. Topics include manifolds as topological spaces, vector fields, differentiable forms, exterior differential, integration, de Rham cohomology.

MTH563 Differential Geometry [미분기하학]

This is a study of geometric structures of differentiable manifolds. Topics include Riemannian manifolds; completeness, submanifolds, constant curvature. Geodesics; conjugate points, variational methods, Myers theorem, nonpositive curvature.

MTH565 Algebraic Geometry [대수적 기하학]

Basic definitions and properties of algebraic varieties in affine and projective spaces: irreducibility, dimension, singular and smooth points.

MTH711 Selected Topics in Computational Mathematics I [계산수학 특론 I]

This course covers topics of current interest in computational mathematics for solving linear and nonlinear partial differential equations.

MTH712m Selected Topics in Computational Mathematics II [계산수학 특론 II]

This course covers topics of current interest in computational mathematics for solving linear and nonlinear partial differential equations.

MTH721 Selected Topics in Partial Differential Equations I [편미분방정식 특론 I]

This course covers an introduction of L_p theory of elliptic and parabolic differential equation and theory of Navier-Stokes equations. It also covers a wide range of topics in the modern analysis of PDEs selected for relevance to applications (geometry, material science, theoretical biology, finance, continuum mechanics, etc.)

MTH722 Selected Topics in Partial Differential Equations II [편미분방정식 특론 II]

This course covers topics of current interest in partial differential equations and a wide range of topics in the modern analysis of PDEs selected for relevance to applications (geometry, material science, theoretical biology, finance, continuum mechanics, etc.)

MTH731 Selected Topics in Mathematical Biology I [생물수학 특론 I]

This course covers advanced topics in mathematical biology including modeling in biochemical networks, population dynamics, and tumor cell growth.

MTH732 Selected Topics in Mathematical Biology II [생물수학 특론 II]

This course covers advanced topics in mathematical biology including modeling in biochemical networks, population dynamics, and tumor cell growth.

MTH741 Selected Topics in Probability and Statistics I [확률과 통계 특론 I]

Special topics in probability & statistics and their recent applications in science and engineering will be covered.

MTH742 Selected Topics in Probability and Statistics II [확률과 통계 특론 II]

Special topics in probability & statistics and their recent applications in science and engineering will be covered.

MTH751 Selected Topics in Image Processing I [이미지 프로세싱 특론 I]

This course introduces fundamental issues in image processing and provides mathematical ideas to understand and interpret images better via variational andd PDE methods. (Recommended pre-requisite courses : MTH501, MTH505)

MTH752 Selected Topics in Image Processing II [이미지 프로세싱 특론 II]

This course covers topics of current interest in image processing for mathematical analysis and introduces efficient algorithms for mathematical solutions. (Recommended pre-requisite courses : MTH501, MTH505)

MTH761 Selected Topics in Number Theory I [정수론 특론 I]

This course includes advanced topics of current interest in number theory.

MTH762 Selected Topics in Number Theory II [정수론 특론 II]

This course includes advanced topics of current interest in number theory.

MTH791 Selected Topics in Mathematics I [수학 특론 I]

This course covers topics of current interest in mathematics.

MTH792 Selected Topics in Mathematics II [수학 특론 II]

This course covers topics of current interest in mathematics.

MTH793 Selected Topics in Applied Mathematics I [응용수학 특론 I]

This course covers topics of current interest in applied mathematics.

MTH794 Selected Topics in Applied Mathematics II [응용수학 특론 II]

This course covers topics of current interest in applied mathematics.

MTH590 Seminar [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R & D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the seminars.

MTH690 Master's Research (1–3 credits) [석사 연구]

This course is related to the students graduate thesis. As such, students should be actively working on their research problems.

MTH890 Doctoral Research (3–9 credits) [박사 연구]

This course is related to the students graduate thesis. As such, students should be actively working on their research problems.

Department of Management Engineering

Management Engineering [ME]

Management Engineering is designed to study and research complex managerial phenomena in all major functional areas by combining management/business knowledge and scientific/ engineering methodologies. The main areas of interest include accounting, economics, finance, management information systems, marketing, operations management, organizational behavior, data analysis and decision making, and general management such as entrepreneurship, international business, strategy, and technology management.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 24 credits	at least 4 credits
Doctoral Program	at least 60 credits	at least 24 credits	at least 36 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 36 credits	at least 24 credits

Curriculum

▶ Management Engineering [ME]

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp	Prerequisite	Convergence
Required	MGT690	Research	Master's Research	석사연구	Value of Credit		
	MGT890		Doctoral's Research	박사 연구	Value of Credit		
Elective	MGE501	Lecture	Information Management & Analysis	정보관리 및 분석	3-3-0		
	MGE502		Statistical Programming	통계프로그래밍	3-3-0		O
	MGE503		Advanced Data Mining	고급 데이터마이닝	3-3-0		O
	MGE504		Business Modeling and Decision Making	비즈니스 모델링 및 의사결정	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp	Prerequisite	Convergence
Elective	MGE505	Lecture	Mathematical programming	수리계획법	3-3-0		
	MGE506		Supply Chain Management	공급망관리	3-3-0		
	MGE507		Optimization Theory	최적화 이론	3-3-0		
	MGE508		Service Systems Engineering and Management	서비스공학과 경영	3-3-0		
	MGE509		Advanced Quality Control	고급 품질관리	3-3-0		
	MTH501		Real analysis	실해석학	3-3-0		
	MTH503		Probability and stochastic processes	확률 및 확률 과정론	3-3-0		
	MTH505		Numerical Analysis and applications	수치해석 및 응용	3-3-0		
	MTH509		Partial Differential Equations	편미분방정식	3-3-0		
	MTH511		Numerical Methods for partial differential equations I	편미분방정식의 수치방법 I	3-3-0		
	MTH513		Dynamical systems	동적 시스템	3-3-0		
	MTH515		Mathematical Methods for Engineers	공학자를 위한 수학방법	3-3-0		
	MTH517		Stochastic Calculus and applications	확률 미적분과 응용	3-3-0		
	MTH531		Scientific Computing	과학계산	3-3-0		
	MTH591		Introduction to Mathematical Analysis	해석학 개론	3-3-0		
	MGE551		Special Topics in ME I	ME 특론 I	3-3-0		
	MGE552		Special Topics in ME II	ME 특론 II	3-3-0		
	MGE553		Special Topics in ME III	ME 특론 III	3-3-0		
	MGE554		Special Topics in ME Ⅳ	ME 특론 Ⅳ	3-3-0		
	MGE555		Special Topics in ME Ⅴ	ME 특론 Ⅴ	3-3-0		
	MGT501		Microeconomic Theory	미시경제이론	3-3-0		
	MGT502		Macroeconomic Theory	거시경제이론	3-3-0		
	MGT511		Research Methodology	연구방법론	3-3-0		
	MGT512		Econometrics	계량경제학	3-3-0		
	MGT513		Multivariate Analysis	다변량 분석	3-3-0		
	MGT515		Probability Models with Applications	확률모형론	3-3-0		
	MGT521		Business Ethics	기업윤리	1-1-0		○
	MGT590	Research	Seminars	세미나	1-1-0		
	MOT501	Lecture	Theories & Practices in Technology Management	기술경영 이론과 사례	3-3-0		
	MOT502		Organizational Change & Innovation Management	조직변화와 혁신경영	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp	Prerequisite	Convergence
Elective	MOT503	Lecture	Entrepreneurship and Strategy	기업가 정신과 전략	3-3-0		
	MOT504		Organization Theory Seminar	조직이론 세미나	3-3-0		
	MOT511		Organizational Behavior Theory	조직행위	3-3-0		
	MOT512		Strategic Management Theory	경영전략	3-3-0		
	MOT513		High Tech Management	하이테크 기술경영	3-3-0		
	MOT514		Intellectual Property Management	지적재산권 경영	3-3-0		
	MOT515		Institutions, Organizations, and Technology	인스티튜션, 조직과 기술	3-3-0		
	MIS501		IT for Networked Organizations	기업과 정보기술	3-3-0		
	MIS502		Data Mining	데이터마이닝	3-3-0		
	MIS511		IT Economics	IT 이코노믹스	3-3-0		
	MIS512		Mobile Technology & Business Innovation	모바일 기술과 비즈니스 혁신	3-3-0		○
	MIS513		IT Strategy	IT 전략	3-3-0		
	MKT501		Marketing Research & Analysis	마케팅 조사와 분석	3-3-0		○
	MKT502		Research Seminar in Consumer Behavior	소비자행동 세미나	3-3-0		
	MKT503		Marketing Strategy	마케팅 전략	3-3-0		
	MKT504		Advertising and Marketing Communications	광고와 마케팅 커뮤니케이션	3-3-0		
	MKT511		Market Assessment	시장 측정론	3-3-0		
	MKT512		Strategic Brand Management	전략적 브랜드관리	3-3-0		
	MKT513		Research Seminar in International Business	국제경영 세미나	3-3-0		
	MKT514		New Products Planning, Developing and Marketing	신제품 기획, 개발 및 마케팅	3-3-0		
	MGT540		Special Topics in General Management I	GM 특론 I	3-3-0		
	MGT541		Special Topics in General Management II	GM 특론 II	3-3-0		
	MGT542		Special Topics in General Management III	GM 특론 III	3-3-0		
	MGT543		Special Topics in General Management Ⅳ	GM 특론 Ⅳ	3-3-0		
	MGT544		Special Topics in General Management Ⅴ	GM 특론 Ⅴ	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp	Prerequisite	Convergence
Elective	FIN501	Lecture	Corporate Finance	기업재무론	3-3-0		
	FIN502		Derivative Securities	파생상품론	3-3-0		
	FIN503		Investments	투자론	3-3-0		
	FIN504		Corporate Governance	기업지배구조	3-3-0		
	FIN505		Applied Portfolio Management	포트폴리오 관리론	3-3-0		
	FIN511		Financial Markets and Institutions	금융기관론	3-3-0		
	FIN512		Financial Risk Management	금융위험 관리론	3-3-0		
	FIN513		Theory of Finance	재무이론 연구	3-3-0		O
	FIN514		Empirical Methods in Finance	재무실증 연구	3-3-0		O
	FIN515		Financial Engineering	금융공학	3-3-0		
	FIN516		Fixed Income Analysis	이자율상품분석	3-3-0		
	FIN517		Empirical Asset Pricing	자산가격 실증연구	3-3-0		
	FIN518		Market Microstructure	시장미시구조론	3-3-0		
	FIN519		Mergers and Acquisitions	기업인수합병	3-3-0		
	FIN520		Venture Capital and Private Equity	밴쳐캐피탈 및 사모투자	3-3-0		
	FIN521		Energy Markets	에너지 마켓	3-3-0		
	FIN522		Energy Trading	에너지 트레이딩	3-3-0		
	ACT501		Financial Accounting and Reporting Theory	재무회계 이론	3-3-0		
	ACT503		Auditing Theory & Practice	회계 감사 이론과 실제	3-3-0		
	ACT504		Contemporary Issues in Accounting	현대회계이론	3-3-0		
	ACT512		Accounting Information Systems	회계 정보시스템	3-3-0		
	ACT513		Research Methodology in Accounting	재무회계 연구방법론	3-3-0		
	FIN551		Special Topics in FIA I	FIA 특론 I	3-3-0		
	FIN552		Special Topics in FIA II	FIA 특론 II	3-3-0		
	ACT502		Special Topics in FIA III	FIA 특론 III	3-3-0		
	ACT511		Special Topics in FIA Ⅳ	FIA 특론 Ⅳ	3-3-0		
	ACT551		Special Topics in FIA Ⅴ	FIA 특론 Ⅴ	3-3-0		

Description

MGT 690 Master's Research [석사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

MGT 890 Doctoral's Research [박사논문연구]

This course is related with the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

MGE501 Information Management & Analytics [정보관리 및 분석]

In this course, students will study how information is produced and managed in enterprises. Main topics discussed include: the principles of information management; information management technologies; techniques to analyze information needs and use; and the social and ethical context of information management.

MGE502 Statistical Programming [통계프로그래밍]

This course will provide students with analytical and decision making skills through a variety of topics in statistics and optimization modeling. Underlying theory for statistical analysis and its business applications will be emphasized. This helps students evaluate and handle business situations with statistics in mind. As a result, students will be well prepared to describe and analyze data for decision makings in business fields such as marketing, operations, and finance. This course aims to teach students programming techniques for managing, and summarizing data, and reporting results.

MGE503 Advanced Data Mining [고급 데이터마이닝]

Data mining is the process of discovering new patterns from large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics and database systems. The basic data mining techniques and their use in a business context will be addressed. Furthermore, an advanced topic in data mining (i.e. process mining) will also discussed in the class.

MGE504 Business Modeling and Decision Making [비즈니스 모델링 및 의사결정]

This course will enable students to build deterministic and probabilistic models of business problems that lead to making better managerial decisions. Students will acquire the necessary skills to analyze complex business situations, develop mathematical models of those situations, explore and prioritize alternative solutions through formalized approaches, and do “what if?” sensitivity analysis to gain insight into why the chosen solution makes business sense. Among the topics covered will be linear and integer programming, dynamic programming, non-linear optimization, Monte Carlo simulation, decision analysis and utility theory, and multi-criteria decision making.

MGE505 Mathematical Programming [수리계획법]

This course provides an introduction to the optimization problems, algorithms and techniques, emphasizing basic methodologies and the underlying mathematical structures. The main subjects covered include basic linear programming, nonlinear programming, network flow problems, dynamic optimization, and applications.

MGE506 Supply Chain Management [공급망관리]

Derived from domestic and global competition, firms in many industries seek to create innovative ways to move products from raw materials through the manufacturing process to customers more efficiently and effectively. Such innovation has been facilitated by the development of information technology. The firms redesign their supply chains to collect, process, transmit, share, and use a large amount of information with efficacy. Still others are focusing on cooperative relationships among all the players in the value chain and bypassing unneeded stages. This course examines many of the recent innovations in this area with an emphasis on technologies

MGE507 Optimization Theory [최적화 이론]

Disciplined thought is often based on analytical models: simplified, quantitative depictions of a complex reality that allow you to focus your attention on a few key issues. Management runs on numbers and models. This course covers the strengths and weaknesses of these quantitative models. Furthermore this course focuses on models built using spreadsheets and, in particular, concentrates on optimization of spreadsheet models. Finally this course will instruct students on the use of discrete event simulation to model phenomena subject to random influences.

MGE508 Service Systems Engineering and Management [서비스공학과 경영]

Service systems in transportation, retail, healthcare, entertainment, hospitality, and other areas are configurations of people, information, organizations, and technologies that operate together for specific functions and values. One difficulty in engineering and managing complex service systems is the lack of data required to monitor and improve the system elements. However, with recent advances in sensing technologies, various kinds and massive amounts of data can be collected from the elements of the service system, such as people and physical objects. This advancement contributes to unlocking the limitations of engineering and managing service systems. In this course, we will learn and apply concepts and methods for engineering and management of service systems with various types of data. Through assignments and a term project, the students will develop their own cases of service systems engineering and management.

MGE509 Advanced Quality Control [고급 품질관리]

The objective of this course is to teach fundamental methods about anomaly and change detection in a process or an environment. Topics covered include the univariate and multivariate analysis for continuous and discrete data, risk adjustments, data pre-analyses (such as dimension reduction), and scan statistics. This course is designed for master's students in the engineering and statistics fields to learn about anomaly and change detections in terms of the basic concepts and practical tools. Also, it will help doctoral students in both fields broaden their knowledge base and get exposed to new applications.

MTH501 Real analysis [실해석학]

Real analysis is fundamental to many of the other courses in applied mathematics. Topics include metric spaces, Banach spaces, measure theory, and the theory of integration and differentiation.

MTH503 Probability and stochastic processes [확률 및 확률 과정론]

Basic and advanced theories in probability and stochastic processes will be covered including expectation, conditional probability, law of large numbers, central limit theorem, markov chains, martingales, and Brownian motions.

MTH505 Numerical Analysis and applications [수치해석 및 응용]

This course emphasizes the development of basic numerical algorithms for common problems formulated in science and engineering. The course covers interpolation and approximation of functions, numerical differentiation and integration, numerical solutions of ordinary differential equations and direct and iterative methods in linear algebra.

MTH509 Partial Differential Equations [편미분방정식]

This course covers the theory of the classical partial differential equations, the method of characteristics for first order equations, the Fourier transform, the theory of distributions in Sobolev spaces, and techniques of functional analysis.

MTH511 Numerical Methods for partial differential equations I [편미분방정식의 수치방법 I]

Finite difference methods for solving ordinary and partial differential equations. Fundamental concepts of consistency, accuracy, stability and convergence of finite difference methods will be covered. Associated theory will be discussed.

MTH513 Dynamical systems [동적시스템]

This course provides tools to characterize qualitative properties of linear and nonlinear dynamical systems in both continuous and discrete time. The course covers stability analysis of differential equations, Hamiltonian systems, Pointcare mapping, and Reduction methods.

MTH515 Mathematical Methods for Engineers [공학자를 위한 수학방법]

This course provides concise introductions to mathematical methods for problems formulated in science and engineering. Some selected topics are functions of a complex variable, Fourier analysis, calculus of variations, perturbation methods, special functions, dimension analysis, tensor analysis.

MTH517 Stochastic Calculus and applications [확률 미적분과 응용]

Brownian motion, Ito's rule, stochastic integrals, and stochastic differential equations as well as their numerical simulations are covered. Application to chemistry, finance and partial differential equations will be also included.

MTH531 Scientific Computing [과학계산]

This course provides fundamental techniques in scientific computation with an introduction to the theory and software of the topics: Monte Carlo simulation, numerical linear algebra, numerical methods of ordinary and partial differential equations, Fourier and wavelet transform methods. This course may involve numerical coding assignments and some use of software packages.

TH591 Introduction to Mathematical Analysis [해석학 개론]

This course is a beginning of the mathematics that includes the rigorous theories of differentiation, integration, sequences, infinite series, and limit of functions. These subjects are studied in the context of real numbers, complex numbers, and real and complex functions.

MGE551 Special Topics in ME I [ME 특론 I]

This course introduces graduate students with current and special topics in Management Engineering.

MGE552 Special Topics in ME II [ME 특론 II]

This course introduces graduate students with current and special topics in Management Engineering.

MGE553 Special Topics in ME III [ME 특론 III]

This course introduces graduate students with current and special topics in Management Engineering.

MGE554 Special Topics in ME Ⅳ [ME 특론 Ⅳ]

This course introduces graduate students with current and special topics in Management Engineering.

MGE555 Special Topics in ME Ⅴ [ME 특론 Ⅴ]

This course introduces graduate students with current and special topics in Management Engineering.

MGT501 Microeconomic Theory [미시경제이론]

The course offers graduate level students a systematic presentation of microeconomic theories. The use of mathematics to formulate and analyze economic models facilitates a more rigorous and thorough mastery of microeconomic theory. Mastery of these basic models of microeconomic analysis will provide students with the essential tools for solving a wide variety of applied economics and public policy problems. Topics will include consumer choice, firm behavior, market structure, game theory, factor markets and general equilibrium.

MGT502 Macroeconomic Theory [거시경제이론]

This course aims to provide students a basic understanding of theoretical foundations of macroeconomics at the graduate level. This course introduces basic macroeconomic models that help students understand the interactions of key macroeconomics variables (output, prices, and employment) and the impact of macroeconomic policies. The topics will include economic fluctuation, economic growth, monetary and fiscal policies.

MGT511 Research Methodology [연구방법론]

In this course, students will learn key issues and perspectives of scientific research methodology. The primary objective of this course is to provide the theoretical foundations and practical skills to effectively apply qualitative and quantitative research methods in business disciplines. It will help students formulate research questions, do independent literature research, analyze/interpret qualitative and quantitative data, and establish evaluation criteria. Further, the course helps students develop their ability to collect data in an appropriate manner.

MGT512 Econometrics [계량경제학]

This course aims to introduce students to quantitative techniques commonly used in economic analysis and research. This course focuses on the application of statistical methods to the testing and estimation of economic relationships. Students will be introduced to econometric tools of analysis, and will be prepared to perform analytical and statistical work in economics and other applied research areas.

MGT513 Multivariate Analysis [다변량 분석]

This course provides the basic concepts in statistics and applications to economics and management areas. It covers the use of multivariate normal sampling theory, linear transformations of random variables, and multi-sample tests, partial and multiple correlations, multivariate ANOVA and least squares, principal components analysis, and specially related topics.

MGT515 Probability Models with Applications [확률모형론]

This course is designed to provide students with advanced-level probability models with various applications required for graduate level research. The subjects covered in the course include the basic concepts in probability, discrete and continuous distributions, sampling distribution theory, and other related probability theories.

MGT 521 Business Ethics [기업윤리]

The purpose of this course is to enable students to reason about the role of ethics in trading and contracting in the energy commodity trading and financial market. In the course, students will participate in a series of case study discussions, focusing on analyzing the issues in moral terms and then making decisions and developing a set of reasons why the decision can ethically justified. During the discussion, additionally, students will think about the impact of their financial transactions on stakeholders and societies.

MGT540 Special Topics in General Management I [GM 특론 I]

This course introduces graduate students with current and special topics in General Management.

MGT541 Special Topics in General Management II [GM 특론 II]

This course introduces graduate students with current and special topics in General Management.

MGT542 Special Topics in General Management III [GM 특론 III]

This course introduces graduate students with current and special topics in General Management.

MGT543 Special Topics in General ManagementⅣ [GM 특론 Ⅳ]

This course introduces graduate students with current and special topics in General Management.

MGT544 Special Topics in General Management Ⅴ [GM 특론 Ⅴ]

This course introduces graduate students with current and special topics in General Management.

MGT 590 The Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&Din real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the seminars.

MOT501 Theories & Practices in Technology Management [기술 경영과 이론사례]

This course covers the challenges embedded in attempting to benefit from both incremental or routine innovation and more radical or revolutionary changes in products and processes. It also highlights the importance of innovation to both new ventures and to large established companies, and explores the organizational, economic and strategic problems that must be understood to ensure innovation is a long term source of competitive advantage. Based on the knowledge about the problems identified, students will learn to analyze the problems, and discuss and investigate the strategies to overcome the problems.

MOT502 Organizational Change & Innovation Management [조직변화와 혁신경영]

Successful companies are transforming themselves towards innovation models that involve everyone in the organization. Leaders who understand how to enable a cadence of innovation though/along with others will create a competitive advantage. In this class students will learn and apply three levels of knowledge: 1) innovation practices of global organizations, 2) how to embed innovation in an organization through business processes and core competencies, 3) capability tools to create a pipeline of innovation.

MOT503 Entrepreneurship and Strategy [기업가 정신과 전략]

This course provides students with a solid foundation in the research area of entrepreneurship and strategic issues of emerging and growing-stage ventures. It provides students with a view of entrepreneurship as a process of economic or social value creation by discussing the perspectives of conceptualizing and understanding of entrepreneurship for starting and managing a sustainable business. The topics include the distinct phases of opportunity recognition, entrepreneurial creativity and innovation. assembly of the financial and human resources needed to exploit the opportunity, launching the new venture, evaluating the challenges of growth and strategies for firm growth.

MOT504 Organization Theory Seminar [조직이론 세미나]

The goal of this course is to survey the major theoretical perspectives in organization theory (OT). Organization theory is currently one of the liveliest areas in all of management studies in part because of the importance of understanding organizations and their environment and in part because of the challenges to traditional theory that have emerged over the past 20 years. This course is designed to acquaint you with many of the core theoretical underpinnings of current organizational theory and help you apply them to real world settings. It examines the major theoretical approaches to organizations including organizational economics, resource dependence perspective, network theory, organizational ecology, and institutional theory and their current applications.

MOT511 Organizational Behavior Theory [조직행위]

Based on the discipline of social and managerial psychology, this course aims to cultivate mindsets and building skills to understand how organizations and their members affect one another. This course covers the diagnosis and resolution of problems in organizational settings. Students will learn theories and research related to organizational problems by identifying individual motivation and behavior, decision-making, interpersonal communication and influence, small group behavior, individual, and inter-group conflict and cooperation.

MOT512 Strategic Management Theory [경영전략]

Innovation increasingly plays a critical role in generating both economic growth and sources of competitive advantage. This course focuses on how firms (both new and old) can create and capture value from product, process, and service innovations. To do so, this course will introduce students to new tools and frameworks for examining both new and old problems related to innovation and technological change. This course consists of a mix between lectures and case studies, with an emphasis on class discussion and debate. While most of the case studies in class will focus on technology-oriented contexts, many of the insights developed during this course will be highly applicable to firms in non high-tech industries as well. A mastery of the tools and frameworks developed in this course will be useful to executives, consultants, entrepreneurs, government officials, investors, and any manager responsible for the introduction and implementation of new products or services.

MOT513 High Tech Management [하이테크 기술 경영]

This course explores the unique aspects of creating an effective strategy in technology- intensive businesses such as R&D investment, network externalities, technology development, technology based competitive advantages. Though many firms invest heavily in R&D, they are likely to experience their competitors taking advantage of their work. Others build great technologies, but fail to build the necessary complements and infrastructure to support the technology. This course tackles these issues directly, providing a series of frameworks that can be applied directly to a wide range of strategic problems.

MOT514 Intellectual Property Management [지적재산권 경영]

The course, Intellectual Property Management, focuses on intellectual property from the perspective of 'why' and 'how' for participants who have already covered the basics of 'what' Intellectual Property is.

MOT515 Institutions, Organizations, and Technology [인스티튜션, 조직과 기술]

This course as research seminar has three broad objectives: (1) providing and overview of important work in the economics and sociology of technological change and technology policy, (2) analyzing the role of innovation in firm strategy and (3) giving the student an introduction to important elements of the new institutional economics. We will be particularly focused on the implications of historical, behavioral, institutional, and organizational perspectives, particularly as they apply to technology innovation. Based on classic and contemporary readings we will examine debates on the drivers of the changes in institutions, organizations, and technology from the variety of perspectives drawing on the growing literature in economic sociology.

MIS501 IT for Networked Organizations [기업과 정보기술]

This course will provide students with an opportunity to study advanced topics in IT and MIS fields, both theoretically and practically. Topics include enterprise information systems, e-business, IT architectures, database management and system development.

MIS502 Data Mining [데이터마이닝]

Firms are likely to use various techniques of data mining for credit ratings, fraud detection, database marketing, customer relationship management, investments, and logistics are. This course introduces methods for data mining that help managers recognize patterns and use electronic data collected via the internet, e-commerce, electronic banking, point-of-sale devices, bar-code readers, and intelligent machines. This course covers the techniques such as subset selection in regression, collaborative filtering, tree-structured classification and regression, cluster analysis, and neural network methods.

MIS511 IT Economics IT [이코노믹스]

Information technology (IT) creates great opportunities for business by fundamentally reshaping products/services, operations, and business relationships. The course provides an in-depth economic analysis of the phenomena with managerial implications. It will cover economic value of information technology and its impact on industry and organizational structure. We will also examine such topics including, competition, pricing, bundling and versioning of information goods and network effects.

MIS512 Mobile Technology & Business Innovation [모바일 기술과 비즈니스 혁신]

By taking a journey into the history of mobile technologies/services and their current trends, this course investigates how mobile technologies have transformed and will continue to transform the world. The course explores various mobile technologies, their business applications, successful and failed cases, and related issues such as mobile policy or convergence among wired, wireless, and broadcasting services.

MIS513 IT Strategy [IT전략]

This course focuses on exploring and articulating the framework and methodology associated with investment in Information Technology to formulate and execute business strategy. This course will help students understand opportunities and challenges that firms confront in their IT investment decision making. Firms need to use IT to deliver business value. Today, IT is so closely related with business strategy and activities, and firms need strategy for IT management. Topics include IT values in business, IT impact on business model and on organizations.

MKT501 Marketing Research and Analysis [마케팅 조사와 분석]

Marketing Research and Analysis is designed to provide a conceptual framework and real-world applications for the role of research in managerial decision making. This framework will include a basic understanding of the research process, from the proposal stage to presenting the final results. The course will discuss key elements and issues in marketing research: sources of data, data collection techniques, specific applications of research for decision making, and analytical approaches for understanding the implications of the data for marketing decisions.

MKT502 Research Seminar in Consumer Behavior [소비자 행동 세미나]

Studies nature and determinants of consumer behavior: how different psychological characteristics and processes affect how people act when they buy, use, and experiences products or services. The impact of consumer decisions on the marketing strategies of organizations.

MKT503 Marketing Strategy [마케팅 전략]

Develops framework for strategic marketing plan based on customer behavior, market segmentation, product positioning, product life cycle, market responsiveness, and competitive reaction. Analysis of complex marketing problems involving policy and operational decisions; emphasis on creative marketing strategy.

MKT504 Advertising and Marketing Communications [광고와 마케팅 커뮤니케이션]

Examines marketing promotions from a communication standpoint. Discusses advertising, sales promotion, personal selling and publicity as components of the promotional program of an enterprise, including profit and nonprofit institutions marketing products and/or services. Emphasizes the planning, design and implementation of advertising campaigns.

MKT511 Market Assessment [시장 측정론]

Provides the tools to use to size a market opportunity such as customer need assessment, different methods for market segmentation and product positioning. Diffusion of innovation processes, conjoint analysis, and other methods for discerning preferences, and the role of competition.

MKT512 Strategic Brand Management [전략적 브랜드관리]

Brand management practices of for-profit and non-profit organizations. Understanding, crafting, measuring, and management of brand strategies. The strategic establishment of brand identities.

MKT513 Research Seminar in International Business [국제경영 세미나]

Analyzes marketing strategy across national boundaries, the problems of marketing within foreign countries, and the coordination of global marketing programs. Provides an analysis of marketing concepts and applications in a global environment, focusing on market management and cultural and institutional differences.

MKT514 New Products Planning, Developing and Marketing [신제품 기획, 개발 및 마케팅]

Considers the role of new products in the survival and growth strategies of organizations. Focuses on the major problems firms encounter in directing and managing their product development and marketing activities. Examines the development process from conception of ideas to commercial introduction, and the marketing life cycle from introduction to deletion of products.

FIN501 Corporate Finance [기업재무론]

This course is designed to provide a conceptual framework for understanding the field of corporate finance. The issues addressed in this course include time value of money, relation between risk and return, capital budgeting, and capital structure under certainty and uncertainty. This course will emphasize the logical structure of various theories and empirical evidence.

FIN502 Derivative Securities [파생상품론]

This course introduces the valuation models and risk management techniques used in options, futures and other derivative securities. It helps students understand derivative securities in detail by examining the structures of markets, analyzing pricing models and examining related empirical results.

FIN503 Investments [투자론]

This course provides students with a rigorous treatment of the core concepts of investment and their application to the study of financial markets. Topics include portfolio optimization and asset allocation, the theory of asset pricing models and their implications for portfolio management.

FIN504 Corporate Governance [기업지배구조]

This course studies the fundamental theories and practice of corporate governance. Corporate governance involves a set of relationships between a company's management, its board, its shareholders and other stakeholders. Corporate governance also provides the structure through which the objectives of the company are set, and the means of attaining those objectives and monitoring performances are determined. Topics include agency theory, separation of ownership and control, boards of directors, shareholder activism, as well as executive compensation.

FIN505 Applied Portfolio Management [포트폴리오 관리론]

Statistical programming such as SAS, R project, and Python is widely used in financial academic research as well as in financial industry. This course introduces basics of the statistical programming along with database management skills, and then provides applications of these tools to many financial economics problems such as optimal portfolio choice, risk managements and etc.

FIN511 Financial Markets and Institutions [금융기관 관리론]

This course focuses on the nature and the role of financial institutions in various capital and financial markets. It will cover the financial system and financial service industry, and addresses the various issues concerning risk measurement and management of various financial institutions.

FIN512 Financial Risk Management [금융위험 관리론]

This course is designed to introduce students to basic issues of financial risk management including the definition of risk, measures of financial risk and the concept of financial risk management. It will focus on various risk management techniques to estimate value-at-risk. Practical problems for financial institutions and firms are discussed in class.

FIN513 Theory of Finance [재무이론 연구]

This course studies the mathematical and economic foundations for discrete and continuous time models in modern finance theory. It covers stochastic calculus, optimization techniques and models to analyze advanced issues in the multi-period portfolio theory, the arbitrage pricing theory, term structure of interest rates and the multi-period asset pricing theory.

FIN514 Empirical Methods in Finance [재무실증 연구]

This course introduces students to various empirical methods used in modern financial economics. The course focuses on (i) the empirical techniques most frequently used in financial market analyses; and (ii) the application of these techniques to actual market data. The list of topics includes, but is not limited to, statistical properties of asset returns and the efficient markets hypothesis; empirical tests of asset pricing models (CAPM); event studies; and other topics such as propensity scoring methods, variance ratio, autocorrelation, bootstrapping, etc.

FIN515 Financial Engineering [금융공학]

This course is a cross-disciplinary field which covers mathematical and computational finance, statistics, and numerical methods that are useful for making structured financial instruments. Students will decompose and reconstruct several financial structured products.

FIN516 Fixed Income Analysis [이자율상품분석]

This course is designed to analyze fixed income markets including money markets, bond markets and interest rate derivatives markets such as swaps and options markets. Most of explanations will be applied to practical market situations.

FIN517 Empirical Asset Pricing [자산가격 실증연구]

This course is an introduction to empirical research in asset pricing. The main topic is the application of econometric methods in finance. Topics include tests of classic models of finance in the cross-section, predictability and excess volatility of equity returns, and systematic risk factors.

FIN518 Market Microstructure [시장미시구조론]

This course studies the main theoretical and empirical models used in market microstructure. Topics include mechanisms of how information is impounded in prices, sequential trade models, inventory control and empirical study of dealer inventories, market impact, as well as informed and strategic trading.

FIN519 Mergers and Acquisitions [기업인수합병]

This course is an introduction to mergers and acuisitions(M&A) for finance major. Topics include major elements of the acquisition process including corporate strategy, valuation, due diligence, financing decisions, transaction structures, restructuring options, takeover defense, and role of institutional investors.

FIN520 Venture Capital and Private Equity [밴쳐캐피탈 및 사모투자]

This course introduces private equity and venture capital as well as entrepreneurial finance. Topics include introduction of the private equity markets, the structure and objectives of private equity and venture capital funds, the analysis and financing of investment opportunities, and harvesting strategies for investments.

FIN521 Energy Markets [에너지 마켓]

This course introduces fundamentals of energy markets, which are commodity markets dealing with the trade and supply of oil or other sources of energy. In particular, the first part of this course is focusing on crude markets and the second part is dealing with the refined product markets. Topics may include a historical perspective on the crude oil markets and crude price, crude oil production economics, refining technology, products demand and supply, and the role played by logistics and transportation to the cost of crude oil. Further, this course covers the clean fuels, climate change and their influences on crude price.

FIN522 Energy Trading [에너지 트레이딩]

This course broadly consists of two major trading ways in energy markets: physical trading and derivatives (or paper) trading. Main topic of this course is trading mechanism in energy markets. Topics may include trading of commodities in an efficient and profitable manner, how commodity pricing mechanisms emerge, the role of the various market participants, the impact of liquidity of the different paper markets, and technical analysis for derivatives trading.

ACT501 Financial Accounting and Reporting Theory [재무회계 이론]

This course introduces financial reporting practices and financial accounting standards including IFRS (International Financial Reporting Standards) and US and Korean Accounting Standards. In addition, financial accounting theory will be discussed.

ACT503 Auditing Theory & Practice [회계 감사 이론과 실제]

This course introduces and discusses contemporary auditing practices and theories. The discussion will focus predominantly on computerized auditing and audit of High Tech and Energy companies. GAAS (Generally Accepted Auditing Standards) of US and Korea will be examined.

ACT504 Contemporary Issues in Accounting [현대회계이론]

This course will address contemporary issues in accounting such as IFRS, Balanced Scorecard, Strategic Cost Management, and Top Executive Compensation.

ACT512 Accounting Information Systems [회계정보시스템]

This course aims to provide a comprehensive understanding of the theoretical and practical applications of current information technology for accounting. Topics include the analysis and design of accounting information systems, accounting databases, and IS control and computerized auditing.

ACT513 Research Methodology in Accounting [재무회계 연구방법론]

This course introduces and explores Research Methodologies in Accounting: Empirical, Archival, and Behavioral. Students will be expected to replicate major research papers using modified data sets.

FIN551 Special Topics in FIA I [FIA 특론 I]

This course introduces graduate students with current and special topics in Finance / Accounting.

FIN552 Special Topics in FIA II [FIA 특론 II]

This course introduces graduate students with current and special topics in Finance / Accounting.

ACT502 Special Topics in FIA III [FIA 특론 III[

This course introduces graduate students with current and special topics in Finance / Accounting.

ACT511 Special Topics in FIA Ⅳ [FIA 특론 Ⅳ]

This course introduces graduate students with current and special topics in Finance / Accounting.

ACT551 Special Topics in FIA Ⅴ [FIA 특론 Ⅴ]

This course introduces graduate students with current and special topics in Finance / Accounting.

Graduate School of Technology and Innovation Management

Graduate School of Technology and Innovation Management

☐ Graduate School of Technology and Innovation Management

The Graduate School of Technology and Innovation Management is designed to educate future technology and innovation leaders in the corporate and public sectors. The primary tracks include [1] Industrial Innovation which offers courses on process and product innovations and the application of big data and IT in manufacturing industries, [2] Technological Entrepreneurship which provides a balanced set of theory and practice courses on technology commercialization and venture businesses, and [3] Strategic Technology Management which highlights an interdisciplinary problem-solving approach in a wide range of courses on complex technological and innovation decision problems.

☐ Credit Requirement

Program	Total Credits	Course Credit	Research credit
Master’s	at least 48 credits	at least 48 credits	-
Doctoral	at least 72 credits	at least 39 credits	at least 33 credits

☐ Curriculum

Course is	Course No.	Course Title(ENG)	Course Title(KOR)	C-L-E	Remark
Common Required (Master : Choose 8)	TIM501	Management of Technological Innovation	기술혁신경영론	3-3-0	
	TIM502	Managing People at Work	조직행동론	3-3-0	
	TIM503	Data Mining	데이터 마이닝	3-3-0	
	TIM504	Marketing	마케팅	3-3-0	
	TIM505	Principles of Finance & Accounting	재무와 회계원론	3-3-0	
	TIM506	Strategy	전략경영	3-3-0	
	TIM507	ManagementCommunications	경영 커뮤니케이션	3-3-0	
	TIM508	Seminar on Industry and Emerging Technology Trends	산업 및 첨단기술 세미나	3-3-0	
	TIM509	Operations Management	운영관리	3-3-0	
Master Required (Choose 2)	TIM691	Industry Internship	산업 인턴십	-	
	TIM692	Global Study Mission	글로벌 스터디미션	-	
	TIM693	Global Consulting Internship	글로벌 컨설팅 인턴십	-	

Course is	Course No.	Course Title(ENG)	Course Title(KOR)	C-L-E	Remark
Master Required (Choose 2)	TIM694	Capstone Project	캡스톤 프로젝트	3-0-6	
	TIM695	Technology, Innovation Management Consulting Project	기술혁신경영컨설팅 프로젝트	3-1-4	
Doctoral Required Research Methodology (Choose 6)	TIM710	Research Methodology	연구방법론	3-3-0	
	TIM711	Research Methodology for Technology Management	기술경영 연구방법론	3-3-0	
	TIM712	Technology commercialization and Entrepreneurship Seminar	기술사업화 및 창업 이론 세미나	3-3-0	
	TIM713	Industrial Innovation Seminar	산업혁신 이론 세미나	3-3-0	
	TIM714	Technology and Innovation Management Theory Seminar	기술경영 이론 세미나	3-3-0	
	TIM715	Strategy Theory	경영전략이론 세미나	3-3-0	
	TIM716	Advanced Microeconomics	고급미시경제학	3-3-0	
	TIM717	Advanced Econometrics	고급계량경제학	3-3-0	
	TIM718	Corporate Finance Theory	기업재무 이론 세미나	3-3-0	
	TIM891	Independent Study	개별연구	3-3-0	
Doctoral Required	TIM890	Thesis Research	논문연구	Value of Credit	
Elective	TIM610	Advanced Analytics for Process Innovation	비즈니스 프로세스 최적화	3-3-0	산업혁신트랙
	TIM611	Big Data and New Product Development	빅데이터와 신제품 개발	3-3-0	“
	TIM612	Statistical Analysis for Managers	관리자를 위한 통계분석	3-3-0	“
	TIM613	Business Model Innovation: Servitization of Manufacturing	비즈니스 모형 혁신: 제조업의 서비스화	3-3-0	“
	TIM614	Integration of IT, Manufacturing, and Operational Systems	IT, 제조, 운영시스템의 통합	3-3-0	“
	TIM615	Reverse Design and Rapid Prototyping	신속한 시제품 제작 기술	3-3-0	“
	TIM621	Experiential Entrepreneurship & Tech Commercialization	기업가 정신과 기술사업화	3-3-0	기술창업트랙
	TIM622	Entrepreneurial Finance	벤처 재무	3-3-0	“
	TIM623	Entrepreneurial Sales & Marketing	벤처 마케팅	3-3-0	“
	TIM624	Growth Strategies for New Ventures	신생벤처기업의 성장전략	3-3-0	
	TIM625	Operations for Entrepreneurs	벤처기업의 운영전략	3-3-0	“
	TIM626	Pursuing Entrepreneurship within Existing Firms	사내 기업가 정신	3-3-0	“
	TIM631	Leading Innovation and Change	혁신과 변화의 리더십	3-3-0	전략적기술경영트랙
	TIM632	Technology Value and Evaluation	기술가치 평가	3-3-0	“

Course is	Course No.	Course Title(ENG)	Course Title(KOR)	C-L-E	Remark
Elective	TIM633	Law and Intellectual Property Management	법과 지적재산권 관리	3-3-0	“
	TIM634	Disruptive/Radical Innovation and Practice	불연속 혁신과 실제	3-3-0	“
	TIM635	Technology Roadmapping for Strategy & Innovation	전략과 혁신을 위한 기술 로드맵핑	3-3-0	“
	TIM636	Regional Innovation Systems and Technology Policy	지역혁신 시스템과 기술정책	3-3-0	“
	TIM637	Open Innovation and Technology Acquisition Strategy	개방혁신과 기술획득 전략	3-3-0	“
	TIM638	Product Design and Development	제품 설계 및 개발	3-3-0	“
	TIM639	Project Management	프로젝트 관리	3-3-0	“
	TIM640	Business Models for High-Tech Products	하이테크 제품을 위한 비즈니스 모델	3-3-0	“
	TIM641	Manufacturing Systems and Supply Chain Design	제조 시스템과 공급망 설계	3-3-0	“
	TIM642	Knowledge Management and Innovation	지식경영과 혁신	3-3-0	“
	TIM643	Global R&D Management	글로벌 연구개발 관리	3-3-0	“
	TIM644	Negotiation and Deal-Making in Technology Industries	기술 산업에서의 협상과 거래	3-3-0	“
	TIM645	Managerial Economics	관리경제학	3-3-0	“
	TIM646	Technology Licensing Management	기술라이센싱 경영론	3-3-0	“
	TIM651	Special Topics in TIM Ⅰ	Special Topics in TIM Ⅰ	1-1-0	
	TIM652	Special Topics in TIM Ⅱ	Special Topics in TIM Ⅱ	2-2-0	
	TIM653	Special Topics in TIM Ⅲ	Special Topics in TIM Ⅲ	3-3-0	
	TIM654	Special Topics in TIM Ⅳ	Special Topics in TIM Ⅳ	3-3-0	
	TIM655	Special Topics in TIM Ⅴ	Special Topics in TIM Ⅴ	3-3-0	
	CDE511	Intergrated Design Project Ⅰ	통합디자인프로젝트 Ⅰ	3-2-2	
	CDE512	Ideation to Visualization	아이디어 시각화	3-2-2	
	CDE513	CAD for Design Engineering	디자인공학 CAD	3-2-2	
	CDE514	Engineering Technologies for Designers	디자이너를 위한 공학기술	3-2-2	
	CED515	Mechanical Elements & Design	기계요소 및 디자인	3-2-2	
	DHE581	Advanced Additive Manufacturing	고등적층제조	3-3-0	
	DHE572	Product Lifecycle Management	PLM	3-3-0	

Description

TIM501 Management of Technological Innovation [기술혁신경영론]

Throughout this course, students learn how firms create and acquire value from innovative products and services. In particular, this course covers topics such as existing companies'management of innovative products and services, technology protection, commercialization processes, plans to acquire value from technological innovation, managing technological changes competition in high tech industries, technology evolution, and IP issues in technology management.

TIM 502 Managing People at Work [조직행동론]

Students will learn theories and concepts to understand people, groups, and organizations in enterprises, as well as practical tools to achieve the goals of individuals, groups, and organizations. Related topics include motivation, human resource management, decision making, organizational culture and change, organizational conflict, individual characteristics, and emotions.

TIM 503 Data Mining [데이터 마이닝]

Data mining is the process of discovering new patterns from large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics, and database systems. Basic data mining techniques and their use in a business context will be addressed. Furthermore, an advanced topic in data mining (i.e. process mining) will also be introduced.

TIM 504 Marketing [마케팅]

This course deals with the subjects needed to design and execute the best marketing effort required to perform a successful strategy in target markets. Students will learn concepts and analytical tools needed for major marketing decisions through lectures, case discussions, case analysis, and presentation.

TIM 505 Principles of Finance & Accounting [재무와 회계원론]

This is a joint course in financial management and accounting. It focuses on the basic concepts and useful methodology to understand the essential knowledge of finance and accounting.

TIM 506 Strategy [전략경영]

This course is designed to address the theoretical and analytical tools relevant to the formulation and implementation of business/corporate strategy. Subjects covered in this course are: external/internal environment analysis, business strategy, corporate strategy, strategic processes, strategy execution, and competition in the high-tech industry. This course will utilize a variety of teaching methods that will help students to understand the practical application of strategic concepts.

TIM 507 Management Communications [경영 커뮤니케이션]

Communication plays a very important role in conceptualizing technological innovation in project teams as well as in developing businesses with stakeholders. Students will enhance their communication skills as they learn relevant communication theories and cases and participate in practice.

TIM 508 Seminar on Industry and Emerging Technology Trends [산업 및 첨단기술 세미나]

The latest information on industry, emerging trends in high-tech, and foreign companies' new technology development are discussed in this seminar presented by industry leaders and technology experts.

TIM 509 Operations Management [운영관리]

This course deals with ways to design and manage core manufacturing and service activities for a firm. Students learn the latest topics such as how to manage sourcing in a global environment and other major topics in management such as the movement of goods among suppliers, factories, and customers, production schedules, productive capacity adjustment, outsourcing/off-shore timing, and network management.

TIM 610 Advanced Analytics for Process Innovation [비지니스 프로세스 최적화]

In this course, students will learn how to visualize business processes inside and outside of the company, how to implement and control people and systems that are related to the performance of the task, and techniques to implement management systems that can efficiently manage and optimize the entire business. Real company cases will be analyzed by using Business Process Management Notation.

TIM 611 Big Data and New Product Development [빅데이터와 신제품 개발]

This course focuses on new product development using consumer and industrial big data. In particular, it deals with real-life domestic and international practices, including utilization of big data in the new product design, obtaining useful information about consumers from big data, and the improvement of existing products using big data.

TIM 612 Statistical Analysis for Managers [관리자를 위한 통계분석]

Analytical decision-making techniques using statistics and optimization models are the main topics of this course. It deals with the approach to statistically analyze business situations. Students will be able to use and analyze data in the fields of marketing, operations management, finance, and more.

TIM 613 Business Model Innovation: Servitization of Manufacturing [비지니스 모형 혁신: 제조업의 서비스화]

Manufacturing enterprises in a high-cost economic environment should innovate constantly in order to survive. Students learn how manufacturing companies manage innovative services that complement products. Various methods, including service, support, financial services, consulting services, design/development services, and installation services, will be discussed in the course. In addition, topics related to carrying out an innovative service such as the cost-benefit analysis of the service and ways of overcoming organizational change will be covered.

TIM 614 Integration of IT, Manufacturing, and Operational Systems [IT, 제조, 운영시스템의 통합]

This course focuses on basic concepts, applications, and domestic/international cases on internet of things and cyber physical production systems that are the basic idea of smart manufacturing. This course introduces the main structure and integration methods of vertical integration and also the structure, methods, and application of horizontal integration.

TIM 615 Reverse Design and Rapid Prototyping [신속한 시제품 제작 기술]

Students learn the process of rapidly creating a prototype. For this purpose, classes will be conducted in the laboratory, and the techniques of the production of various parts and design, and know-how will be shared. Specifically, 3D printing, laser cutting, water jet cutting, CNC milling, CNC turning, thermoforming, silicone molding, and CNC routers will be used.

TIM 621 Experiential Entrepreneurship & Tech Commercialization [기업가 정신과 기술사업화]

This course is to experience technology commercialization and develop the ability to discover and obtain business value from technologies. Students from diverse backgrounds, such as natural science, engineering, management, humanities, will work on projects in groups.

TIM 622 Entrepreneurial Finance [벤처 재무]

This course focuses on the financial problems of start-ups and ventures, and will discuss pros and cons of the various financial options available to these companies. In particular, bootstrapping, crowdfunding, government grants and loans, commercial banks, angel investing, DPOs, venture capital, venture banking, and small IPOs will be discussed.

TIM 623 Entrepreneurial Sales & Marketing [벤처 마케팅]

Students learn about key entrepreneurial marketing concepts and methods and discuss their real world applications in entrepreneurship. It begins with students picking an entrepreneurial venture for which to develop an operational marketing plan.

TIM 624 Growth Strategies for New Ventures [신생벤처기업의 성장전략]

This course focuses on the problems that new venture companies face during their growth stages. Topics will cover company life cycle, growth theories, growth strategy, the role of management, organizational structure, business model innovation, franchise growth strategy, and marketing and finance strategy for growth.

TIM 625 Operations for Entrepreneurs [벤처기업의 운영전략]

This course will analyze specific problems that resource constraint ventures face in building operational strategies and systems.

TIM 626 Pursuing Entrepreneurship within Existing Firms [사내 기업가 정신]

The object of this course is to understand the process of generating a new line of businesses and products in the existing company. Several types of in-house venturing activities as well as venture capital investment, licensing, alliances, joint ventures, and a variety of collaborations will be discussed. Organizational structure and culture that help manage in-house ventures are included as well.

TIM 631 Leading Innovation and Change [혁신과 변화의 리더십]

The objective of this course is to understand the process of adopting and spreading creativity, innovation, and changes within an organization. Students will understand the different types of organizational innovation, search for factors from inside and outside of the organization that influence the success of innovation, and learn about the role of leadership and change management.

TIM 632 Technology Value and Evaluation [기술가치 평가]

This course will focus on the methodology for assessing the value of technical knowledge, and includes the following topics: 1) The concept and options of technology valuation, 2) technology valuation models and methodology, 3) the important elements of technology valuation (market evaluation, intellectual property protection, commercialization strategies, commercialization plans and revenue)

TIM 633 Law and Intellectual Property Management [법과 지적재산권 관리]

This course deals with the comprehensive and practical application of intellectual property and covers topics such as intellectual property laws, industry competition, and the use of new technologies. Students will learn the effective use and strategic management practices of IP, which is used as a means to achieve technical and business objectives.

TIM 634 Disruptive/Radical Innovation and Practice [불연속 혁신과 실제]

Ways to embrace discontinuous innovation like disruptive and radical innovation in corporations are the main focus of this course. Students will identify the various reasons why introducing disruptive and radical innovation in the organization is difficult and navigate technical, organizational, and cultural solutions through an in-depth case analysis.

TIM 635 Technology Road-mapping for Strategy & Innovation [전략과 혁신을 위한 기술 로드맵핑]

Road-mapping techniques are used by many companies as a useful tool for creating social and economic value from technology. Through theory and practice, students will analyze how companies achieve strategic and innovative goals using technology road-mapping.

TIM 636 Regional Innovation Systems and Technology Policy [지역혁신 시스템과 기술정책]

The role of science, technology, and innovation in the economic development of emerging countries and regions is highlighted and analyzed in this course. It deals with the concepts needed to understand the role of technological innovation in economic growth, the institutional innovation transforming existing economies, technological catch-up, take-off strategies, and innovation policies to mobilize these efforts.

TIM 637 Open Innovation and Technology Acquisition Strategy [개방혁신과 기술획득 전략]

This course deals with theoretical and practical issues related to the acquisition of technology, which is one of the key activities for open innovation. Students will learn how to identify and forecast core technology or technology in need using future market requirements, consumer trends, technological developments, and patent trends. They will also learn how to manage specific methods of acquisition such as patent purchases, technical collaboration, licensing, etc.

TIM 638 Product Design and Development [제품 설계 및 개발]

Groups of students with various career backgrounds (management, engineering, industrial design, etc.) will learn modern tools and methods for product design and development. This project will develop a model/prototype of an actual product, including all phases of product development. Classes are conducted through case studies and exercises. Topics include: product planning, confirmation of customer needs, derived concepts, product design, industrial design, concept design, and design for manufacturing.

TIM 639 Project Management [프로젝트 관리]

This course covers the key issues for effective project management. Students learn process and scope management that are essential for project management, schedule management, cost management, personnel management, communications management, risk management, and procurement management.

TIM 640 Business Models for High-Tech Products [하이테크 제품을 위한 비즈니스 모델]

This course helps develop a business model for high-tech products and services. For a successful business model, consistency between important factors, such as the target customer, the proposed value, the range of activities, the value acquisition method, and strategic control, is needed. Students verify the consistency of a wide range of business models through various examples of industries, and learn how to respond in different situations.

TIM 641 Manufacturing Systems and Supply Chain Design [제조 시스템과 공급망 설계]

This course helpsdecision makers to make better decisions in the design of manufacturing and supply chain systems. Students learn approaches and models that help understanding and structuralizing the trade-offs and essential tasks in designing various systems. In particular, models, methodology, and software that are related to logistic network design, capacity planning, system flexibility, purchase-development issues, and the integration of product development are covered.

TIM 642 Knowledge Management and Innovation [지식경영과 혁신]

In the knowledge-based economy, intellectual property management is indispensable to create and maintain the competitiveness of enterprises. This course covers tools to understand how organizations generate knowledge, share, utilize, integrate and explores knowledge for creating competitive advantage. Several special topics such as knowledge transfer, knowledge reuse, and the development of innovative new products/services are also addressed.

TIM 643 Global R&D Management [글로벌 연구개발 관리]

Students learn the principles to systematically organize and manage R&Din international high-tech companies. The course covers the 3rd-generation research and development management techniques implemented in international conglomerates, the strategic role of R&D, organizational issues in R&D, risk/revenue assessment, open innovation, and configuring global R&D systems. It also introduces a 4th-generation R&D management, consisting of radical innovation and disruptive innovation.

TIM 644 Negotiation and Deal-Making in Technology Industries [기술 산업에서의 협상과 거래]

This course discuss and practice a set of negotiation and deal making skills that the technology managers and entrepreneurs can use in the process of technology adoption and commercialization. Students learn how to resolve differences in perspectives, time constraints, licensing negotiation, etc., by using various tools such as simulations and mock negotiations.

TIM 645 Managerial Economics [관리경제학]

This course helps create an optimal strategy through economic analysis in a given economic environment. The course deals with the main topics of micro and macroeconomics such as the characteristics of modern enterprise, organization structure design, reward systems, internal labor markets, capital markets, and basic game theory.

TIM 646 Technology Licensing Management [기술라이센싱 경영론]

This course is aimed to provide for students of department of TIM and related majors on licensing, a core biz model of technology commercialization based upon intellectual property rights. Licensing is a kind of contract, permitting a right to use of technology based on intellectual property rights and taking royalty in return thereof, and one technology, intellectual property rights, contracts and negotiation etc, and this course will provide overall knowledge and practical skills.

TIM 651, 652, 653, 654, 655 Special Topics in TIM Ⅰ, Ⅱ, Ⅲ, Ⅳ, Ⅴ

This course is designed to discuss contemporary topics in Technology & Innovation Management. Actual topics and cases will be selected by the instructor and may vary from term to term.

TIM 691 Industry Internship [산업 인턴십]

Students will experience and gain insight on real technology management problems through internships in domestic enterprises, small and medium venture companies, or UNIST family companies. Students are encouraged to discuss with mentors and advisors before and after the internship, and then turn in a written report.

TIM 692 Global Study Mission [글로벌 스터디미션]

Students will have problem solving in-class discussions, learn the latest information and trends in the field of technology start-ups and IT & industrial big data for half a semester within UNIST, then find solutions to problems that are discovered by visiting global leading companies, and build a global network at the same time.

TIM 693 Global Consulting Internship [글로벌 컨설팅 인턴십]

In order to acquire technology management experience from domestic and foreign companies, students will be dispatched or consult on the project of an enterprise.

TIM 694 Capstone Project [캡스톤 프로젝트]

This is a project course to solve the real-life problems of businesses. Students will apply the principles of technology management and plan problem-solving through on-site problem identification, problem analysis, site visiting, and identification of solutions. After the completion of the project, students must turn in a written report.

TIM 695 Technology Innovation Management Consulting Project [기술혁신경영컨설팅]

In this action learning course, teams of business owners, students, professors, and technology/consulting experts in certain technology areas find out actionable holistic solutions for SME/venture firms that aspire to becoming a global champion in the selected areas. This course helps learn and experience how to assess a SME/venture's managerial as well as innovation capabilities and with the help of industry experts develop an actionable solution for matching its technologies and market demands, and vice versa.

TIM 710 Research Methodology [연구방법론]

The primary objective of this course is to learn key issues and approaches of scientific research methodology and provide the theoretical bases to effectively apply qualitative and quantitative research methods in business disciplines. It help students to formulate research questions, do independent literature research, analyze/interpret qualitative and quantitative data, and establish evaluation criteria.

TIM 711 Research Methodology on Technology Management [기술경영 연구방법론]

Students will learn the quantitative and qualitative methodologies needed for research in advanced manufacturing, technology commercialization and entrepreneurship, and strategic management of technology. Advanced statistical analysis, experimental design, and simulation used for the analysis of the IP is included as well.

TIM 712 Technology Commercialization and Entrepreneurship Theory Seminar [기술사업화 및 창업 이론 세미나]

Students will discover various complex phenomena associated with technology commercialization and entrepreneurship and learn theories to explain them. Students will utilize concepts from economics, psychology, organizational behavior, and strategy and have to write a paper on a specific research topic at the end of the semester.

TIM 713 Industrial Innovation Theory Seminar [산업혁신 이론 세미나]

Students will discover technological and behavioral phenomena associated with the issues that occur when applying big data and ICT to industrial sites. They will solve and explain the issues by using various theories. Students are also expected to write a paper on a specific research topic at the end of the semester.

TIM 714 Technology Management Theory Seminar [기술경영 이론 세미나]

This course deals with the applications of recent research and techniques on technology and innovation theories.

TIM 715 Strategic Management Theory Seminar [경영전략 이론 세미나]

This course is to discuss strategy theories. Students read major papers and literature about competitive strategy, corporate strategy, corporate governance, innovation, entrepreneurship, growth, restructuring, diversification, M&A, and networks and write a term paper that fills the gap in the existing literature.

TIM 716 Advanced Microeconomics [고급 미시경제학]

Students will learn about various theories of microeconomics and write a paper on technology management topics by using microeconomic theory.

TIM 717 Advanced Econometrics [고급 계량경제학]

Students will learn the essential statistical methodologies required for doctoral research and experience various approaches of multivariate analysis such as panel analysis.

TIM 718 Corporate Finance Theory Seminar [기업재무 이론 세미나]

This course introduces the theory of recent and classic corporate financial management. In particular, it deals with decisions regarding corporate financial management such as capital budgeting, capital structure, dividend policy, IPOs, mergers and acquisitions, divestitures, and corporate valuation. Students will pick a topic of interest among these and write a research paper that describes prior research, data collection, empirical analysis, and interpretation of results and conclusions.

TIM 890 Research [논문연구]

Students write a dissertation based on a proposal, which has been approved by an advisor.

TIM 891 Independent Study [개별연구]

Students perform an in-depth independent study under the guidance of a supervisor.

CDE 511,521,522,531,532 Integrated Design Project I, II-A/B, III-A/B 통합디자인프로젝트I, II-A/B, III-A/B

The integrated design project I, II-A/B, III-A/Bare a series of project-based industry collaborative courses where students carry out elementary, intermediate, and advanced levels of independent projects for three semesters from the first semester of Masters Courses, through which students will learn and develop integrated, holistic knowledge and skill necessary for product development. These are mandatory courses for Masters Students in Industrial Design program. Taking design problems from industry, students will experience total approach toward product development from opportunity identification through concept generation, design engineering, and design verification with prototyping to development of business model. At the end of each semester, students demonstrate working prototypes of new product, product-service, or product-system concepts and file related patents. Student learning takes a balanced approach between contemporary theoretical knowledge and its pragmatic application through projects supervised by academic and industrial experts.

- IDP 2: advisor-driven: 8 weeks group, 8 week individual
- IDP 3: student-driven: students search partner companies. Work as a design consulting firm.

*CDE 512 Ideation to Visualization [아이디어 시각화]

The purpose of this course is to make students learn basic ideations to visualization skills. During the problem-posing and providing solutions through flexible thinking phases, the students will be trained to concretize their ideas and to visualize those ideas based on hands-on activity through conducting the tasks which have been initiated by themselves. The outcomes of this course will be a log book of ideation process and sketches, final presentation and exhibition of their concepts and visualized objects.

*CDE 513 CAD for Design Engineering [디자인공학 CAD]

The purpose of this course is to train basic CAD skills to the students. Students will learn solid modeling techniques for product design. Along with this, they will learn various methods related to product design from transforming sketches on paper into 3D solid data, elaborated modeling, design engineering and visualization, to workable prototyping methods using NC or RP technologies.

*CDE 514 Engineering Technologies for Designers [디자이너를 위한 공학기술]

The students in this course will learn basic engineering skills, specifically comprising physical computing skills for the implementation of their interactive product ideas, and programming skills to control the prototypes. In particular, students will learn electronics basics and programming using Arduino and Processing by conducting step-by-step exercises. During the course, students will discuss and practice how to apply technologies from the perspective of design. At the end of the course, students will ask to develop a simple interactive prototype using easily controllable sensors and actuators.

*CDE 515 Mechanical Elements and Design [기계요소 및 디자인]

Mechanical Elements and Design is one of the four CDE preliminary courses. The focus is on understanding what types of mechanical elements are available and how they can be used as part of product design. Based upon the understanding, students create a concept appropriate to a topic given by the responsible lecturer with a consortium of stakeholders and build a working prototype mainly using mechanical elements. In this way the students gain hands-on experience of and learn how to apply mechanical elements to product design. This course features a design-by-making approach for a real stakeholder.

Teaching plan for required courses of first semester

Courses	1st semester	
	8 weeks	8 weeks
Integrated Design Project I	Design research, user research, opportunity identification	**Co-project:** Students should fulfill each course's requirement while completing a project.
* Ideation to Visualization	Ideation, sketch, drawing, engineering drawing	
* CAD for Design Engineering	Solid CAD modelling, Assembly, Design engineering	
* Engineering Technologies for Designers	Programming, basic electronics & circuits	
* Mechanical Elements & Design	Mechanical elements, mechanical, functional prototyping	

DHE 581 Additive Manufacturing [고등적층제조]

This course studies the systematic process to extract the technological principles and knowhow of existing products and other systems. In particular, the course introduces some methods to digitize an existing physical part (e.g. 3D scanning) and construct CAD models of the parts. The concepts and tools for rapid prototyping such as Fused Deposition Method (FDM), Stereo Lithography Apparatus (SLA), Selective Laser Sintering equipments (SLS) and other 3D printing technologies will be introduced.

DHE 572 Product Lifecycle Management [PLM]

This course studies the concept and application of product lifecycle management (PLM), and covers Beginning of Lifecycle (BOL), Middle of Lifecycle (MOL), and End of Lifecycle (EOL) managements while placing emphasis on emerging information technologies and decision making issues. Through this course, the student will learn the in-depth understanding of lifecycle engineering.

Graduate School of Interdisciplinary Management

Graduate School of Interdisciplinary Management

1. Introduction

The Graduate School of Interdisciplinary Management (hereafter GSIM) trains students in the areas of Business Analytics (Biztics), Energy Commodity Trading and Financial Engineering (ECTFE), and Entrepreneurship & Innovation(E&I). ECTFE and Biztics programs grant PSM (Professional Science Masters) Degrees, and one-year E&I program which does not require a thesis or a paper, grants Master of Entrepreneurship and Innovation Degree.

2. Master's Programs

□ Program Introduction

Energy Commodity Trading & Financial Engineering (ECTFE)

The ECTFE program is designed to foster qualified traders in the energy commodity trading fields. The program is designed to provide knowledge and skills necessary to become qualified traders, such as international finance, financial risk management, supply chain management, derivatives, etc. The program will be of value for students who wish to become an expert in the financial management of energy firms, energy industry capital projects, energy trading and risk management.

Business Analytics (Biztics)

Students in the Business Analytics program provide knowledge and advanced skills necessary for analyzing various businesses. With the backgrounds of statistics, analytics programming and data mining, among others, the program helps students attain an ability to analyze and deal with big data. The program requires the fundamental management courses such as Marketing Research and Information Management as well as practical project courses such as Capstone Project, Business Analytics Practicum and Topics in Business Analytics. These courses will help students gain insight into both practical and academic issues dealing with the digitalization of data.

Entrepreneurship & Innovation (E&I)

Entrepreneurship and Innovation is designed to train students with both relevant knowledge and practical experience. This program includes specific business knowledge required to launch a new startup company and corporate entrepreneurship for established firms which want to create new business. It has two major tracks; one is for creating own business, and the other is for supporting new products/services launch in the entrepreneurship ecosystem. In this program, practical hands-on experience is mandatory for students to enhance their knowledge and practical skills.

☐ Credit Requirement

Program	Credit(minimum)
Energy Commodity Trading & Financial Engineering	at least 45 credits
Business Analytics	at least 45 credits
Entrepreneurship & Innovation	at least 33 credits

3. Curriculum

☐ Energy Commodity Trading & Financial Engineering (ECTFE)

Course is	Classification	Course No.	Course Title	Cred.-Lect.-Exp.
Elective	Lecture	ECT501	Introduction to Energy Industry & Market	3-3-0
	Lecture	ECT502	Principles of Finance	3-3-0
	Lecture	ECT503	International Economics	3-3-0
	Lecture	ECT511	Financial Mathematics	3-3-0
	Lecture	ECT512	Statistical Modeling in Finance	3-3-0
	Lecture	ECT513	Stochastic Calculus	3-3-0
	Lecture	ECT514	Computational Methods in Finance	3-3-0
	Lecture	ECT515	Investments	3-3-0
	Lecture	ECT516	Derivative Markets	3-3-0
	Lecture	ECT517	Quantitative Risk Management	3-3-0
	Lecture	ECT518	Financial Engineering	3-3-0
	Lecture	ECT519	Financial Management	3-3-0
	Lecture	ECT520	Financial Accounting	3-3-0
	Lecture	ECT523	International Finance	3-3-0
	Lecture	ECT524	Quantitative Methods in Finance	3-3-0
	Lecture	ECT525	Energy Strategy	3-3-0

Course is	Classification	Course No.	Course Title	Cred.-Lect.-Exp.
	Lecture	ECT526	Market Microstructure	3-3-0
	Lecture	ECT527	FICC Market and Analysis	3-3-0
	Lecture	ECT528	Trading Strategy	3-3-0
	Lecture	ECT529	Advanced Energy Trading	3-3-0
	Lecture	ECT531	Special Topics in ECTFE	1-1-0
	Lecture	ECT532	Special Topics in ECTFE	2-2-0
	Lecture	ECT533	Special Topics in ECTFE	3-3-0
	Lecture	ECT534	Energy Market	3-3-0
	Lecture	ECT535	Energy Trading	3-3-0
	Lecture	ECT536	Petroleum and Petrochemical Engineering	3-3-0
	Lecture	ECT551	Energy Market Fundamental I	1.5-1.5-0
	Lecture	ECT552	Energy Market Fundamental II	1.5-1.5-0
	Lecture	ECT553	Energy Market Fundamental III	1.5-1.5-0
	Lecture	ECT554	Energy Market Fundamental IV	1.5-1.5-0
	Lecture	ECT555	Energy Trading Fundamental I	1.5-1.5-0
	Lecture	ECT556	Energy Trading Fundamental II	1.5-1.5-0
	Lecture	ECT557	Trading Project/Practice I	1.5-1.5-0
	Lecture	ECT558	Trading Project/Practice II	1.5-1.5-0
	Lecture	ECT559	Trading Project/Practice III	1.5-1.5-0
	Lecture	ECT560	Trading Project/Practice IV	1.5-1.5-0
	Lecture	ECT691	Market Investigation	2-0-4
	Lecture	ECT692	Market Analysis	2-0-4
	Lecture	ECT693	Financial Engineering Project	2-0-4
	Lecture	ECT694	Capstone Project	2-0-4
	Lecture	ECT695	Energy Project	2-0-4
	Research	ECT561	Internship	-
	Lecture	MGT521	Business Ethics	1-1-0

※ MGT521 과목은 일반대학원에서 개설되는 과목

□ Business Analytics(Biztics)

Course is	Classification	Course No.	Course Title	Cred.-Lect.-Exp.
Elective	Lecture	BAT511	Introduction to Data Mining	3-3-0
	Lecture	BAT512	Advanced Data Mining with Artificial Intelligence	3-3-0
	Lecture	BAT513	Statistical Learning	3-3-0
	Lecture	BAT515	Analytics Programming	1.5-1.5-0
	Lecture	BAT516	Database Management	1.5-1.5-0
	Lecture	BAT522	Customer Analytics	3-3-0
	Lecture	BAT524	Introduction to Business Analytics	3-3-0
	Lecture	BAT526	Topics in Business Analytics I	1-1-0
	Lecture	BAT527	Topics in Business Analytics II	2-2-0
	Lecture	BAT528	Topics in Business Analytics III	3-3-0
	Lecture	BAT531	Multivariate Statistics	3-3-0
	Lecture	BAT541	Social Data Analytics	1.5-1.5-0
	Lecture	BAT542	Text Mining	1.5-1.5-0
	Lecture	BAT543	Supply Chain Analytics	3-3-0
	Research	BAT562	Internship	-
	Lecture	BAT571	Advanced Quality Control	3-3-0
	Lecture	BAT572	Systematic Technology Intelligence	3-3-0
	Lecture	BAT573	Service Systems Engineering and Management	3-3-0
	Lecture	BAT574	Predictive Maintenance	3-3-0
	Lecture	BAT581	Algorithmic and Quantitative Trading	3-3-0
	Lecture	BAT582	Data Driven Credit Modeling and Management	3-3-0
	Lecture	BAT583	Financial Engineering with AI	3-3-0
	Lecture	BAT584	FinTech Startup	3-3-0
	Lecture	BAT585	Financial Data Analysis with SAS	3-3-0
	Lecture	BAT586	Blockchains and Financial Services Industry	1.5-1.5-0
	Lecture	BAT591	Business Analytics Practicum	2-2-0
	Lecture	BAT691	Capstone Project	3-0-6
	Lecture	TIM504	Marketing	3-3-0
	Lecture	TIM506	Strategy	3-3-0
	Lecture	TIM509	Operations Management	3-3-0
	Lecture	TIM610	Advanced Analytics for Process Innovation	3-3-0
	Lecture	TIM611	Big Data and New Product Development	3-3-0
	Lecture	ECT502	Principles of Finance	3-3-0

※ TIM504, TIM506, TIM509, TIM611, TIM610 과목은 기술전문경영대학원(MOT)에서, ECT502는 융합경영대학원 에너지상품거래 및 금융공학(ECTFE) 에서 개설되는 과목

☐ Entrepreneurship & Innovation (E&I)

Course is	Classification	Course No.	Course Title	Cred.-Lect.-Exp.
Elective	Lecture	EPS501	Entrepreneurial Mindset	3-3-0
	Lecture	EPS502	Operating Startups	3-3-0
	Lecture	EPS511	Venture Financing	3-3-0
	Lecture	EPS512	Entrepreneurial Marketing	3-3-0
	Lecture	EPS513	Law and IP for Entrepreneur	3-3-0
	Lecture	EPS514	Global Entrepreneurship	3-3-0
	Lecture	EPS515	Growth Strategies	3-3-0
	Research	EPS590	Entrepreneurial Practice I	3-0-6
	Research	EPS591	Entrepreneurial Practice II	3-0-6
	Lecture	EPS599	Capstone Project	3-2-2

4. Course Descriptions

ECT501 Introduction to Energy Industry & Market

This course introduces the basic and comprehensive concepts on the global Energy industry and market (mainly Oil and Gas) ,following the wide-range value chains of industry. This course covers the fundamentals of E & P(upstream), trading(spot,forward and futures), risk management, transportation, refining, physical distribution required for the competent energy traders. In addition to the lecture, on the spot study will be combined such as field trip to refinery or petrochemical or shipping companies. This course will be focused on the overall and actual learning on the energy industry and trading sector.

ECT502 Principles of Finance

This course is designed to study principles of finance, which can be applied to the investment decision in various settings. We first learn the long-term investment decision in corporations or capital budgeting. Then, we learn theories and techniques of investment analysis for the selection and evaluation of investments, which are typically carried out in financial institutions. Topics include securities and markets, asset allocation, bond portfolio management, security analysis.

ECT503 International Economics

This course provides an overview of international macroeconomics. The first part of the course will introduce main concepts and theories about a country's exchange rate, trade balance and national income/output determination. The second part will combine these theories to build an integrated analytical framework to analyze world (macro) economic issues. In the last part of the course, we will apply the developed framework to several episodes of global economic events in the history.

ECT511 Financial Mathematics

In this course students will review and study mathematical concepts and methods which are essentially used in the field of financial engineering. The topics of this course include single and multivariable calculus, linear algebra, differential equations and numerical computation methods, and applications to option pricing models such as Black-Scholes model.

ECT512 Statistical Modeling in Finance

This course introduces regression analysis and applications to investment models. Principal components and multivariate analysis. Likelihood inference and Bayesian methods. Financial time series. Estimation and modeling of volatilities. Statistical methods for portfolio management.

ECT513 Stochastic Calculus

This course introduces the concepts and tools of stochastic calculus as required for effective pricing of complex financial derivatives in continuous time. The course stresses the practical applications of stochastic differential equations, Ito integrals, and measure transformations as required in advanced financial engineering practice and for the understanding of asset pricing theory. The material discussed in this course is used extensively in the some of the more advanced classes.

ECT514 Computational Methods in Finance

This course emphasizes numerical implementation of the option pricing models. Major topics include finite-difference methods, trees and lattices and Monte Carlo simulations with extensions. In addition to the basic pricing models, the course covers portfolio optimization methods and statistical methods or calibration of the parameters.

ECT515 Investments

This course introduces the basic principles in investments such as diversification, no arbitrage principle for security valuation, equilibrium asset pricing models such as CAPM, and factor models. This course further investigates fundamental valuation for commodities, fixed income securities, and contingent claims.

ECT516 Derivative Markets

This course introduces the basic features of futures and options. The course elaborates several approaches of pricing derivative securities such as binomial and trinomial option pricing, Black-Scholes formula, implied binomial trees. In addition, this course focuses on trading strategies of futures and options.

ECT517 Quantitative Risk Management

The course investigates core principles of risk management, particularly market and credit risk management using Value at Risk (VaR) and introduces other recent risk management tools.

ECT518 Financial Engineering

This course is for the student who is interested in modeling the derivatives. The general quantitative finance will be excluding mathematical proofs. All the theoretic explanation will be implemented with the Microsoft Excel for the practical uses the class.

ECT519 Financial Management

This course introduces two main financial decisions of firm managers: capital budgeting and capital structure. Then we learn how to raise funds to invest in a positive NPV projects via equity and debt financing. We finally learn some approaches to improve the value of corporations by improving corporate governance and implementing restructuring or mergers and acquisitions.

ECT520 Financial Accounting

Financial Accounting examines basic concepts of accounting and provides a basic framework to understand the financial statement in users' point of view. This course also provides overview of basic financial statements such as balance sheets, income statement and cash flow statement for financial and accounting decision making.

ECT523 International Finance

This module analyzes various issues that arise in an international corporate environment. The course covers topics such as : international and locational arbitrage strategies ; exchange rate determination theories and forecasting; exchange risk management; international portfolio; and MNC's financial structure, cost of capital and sources of finance.

ECT524 Quantitative Methods in Finance

This course introduces probability theory and basic statistics, regression analysis and multivariate analysis. This course also introduces the concepts and tools of stochastic calculus required for effective pricing of complex financial derivatives in discrete and continuous time.

ECT525 Energy Strategy

This course introduces the strategic decision making related to the energy policy including production, distribution and consumption. The strategy can be applied to oil supply and demand as well as alternative energy sources. The lecture will be provided with theories and several cases.

ECT526 Market Microstructure

This course is designed to introduce the trading behavior. Students are going to understand various structures of trading and exchanges including prices, quotes, transactions and volume which is made by traders, brokers and investors. They can be applied to an algorithmic trading or DMA as well.

ECT527 FICC Market and Analysis

This course is designed to introduce FICC market including fixed income, currency and commodity. Students are going to understand the time value of money and the relation between price and yield. The derivatives products underlain by money or bond such as swaps or options will be introduced as well. Most of explanations will be applied to practical market situations.

ECT528 Trading Strategy

Statistical programming such as SAS, R project, and Python is widely used in trading strategies in financial industry as well as in financial academic research. This course introduces basics of the statistical programming along with database management skills, and then provides applications of these tools to many financial economics problems such as trading strategies, optimal portfolio choice, risk managements and etc.

ECT529 Advanced Energy Trading

This course provides not only the basic concepts but also the advanced skills on the energy trading and risk management normally used in the energy trading world. This course initially covers the fundamentals of upstream & downstream in connection with actual oil and gas trading, exploring the whole value chain of energy industry. Futhermore, market analysis(spot, forward, futures, OTC, Exchanges and crude/products markets etc), defining the risks exposed by market player & risk management strategies and diversified trading skills based upon a wide variety of scenarios will be furnished to cultivate the competent energy traders. In addition to the lecture, both documentation practice related to energy trading and on the spot learning (field trip to the refinery or depot or shipping/trading companies) will be combined.

ECT531 Special Topics in ECTFE I

This course is designed to discuss contemporary topics in energy commodity market or financial engineering. Actual topics and cases will be selected by the instructor and may vary from term to term.

ECT532 Special Topics in ECTFE II

This course is designed to discuss contemporary topics in energy commodity market or financial engineering. Actual topics and cases will be selected by the instructor and may vary from term to term.

ECT533 Special Topics in ECTFE III

This course is designed to discuss contemporary topics in energy commodity market or financial engineering. Actual topics and cases will be selected by the instructor and may vary from term to term.

ECT534 Energy Market

This module provides the fundamental knowledge of international energy market and pricing methodologies. The aim of the module is to help students understand complexity of energy market formed by various micro and macro economic factors. In addition, this module will also allow students to understand how crude oil prices decided in different geographic markets such as Europe, US, and Asia.

ECT535 Energy Trading

This module will provides the fundamental knowledge of international energy trading. The aim of the module is to help students understand volatility, counterparty exposures, credit requirements, government regulations, unexpected events and geopolitics keep traders in a perpetual state of high alert. This module includes understanding the risk management in oil & gas trading, OTC markets & exchanges and paper instruments in oil trading.

ECT536 Petroleum and Petrochemical Engineering

The course is designed to overview of petroleum, refining and petrochemical products. A brief description of how to produce crude oil, Petroleum fuels, such a gasoline and diesel for all transportation vehicles. Petrochemical products and commodities derived from petrochemicals, for example, plastics, rubbers and synthetic fibers and also introduced.
Throughout this course, students will have opportunities to lean and discuss 1)how petroleum fuels and petrochemicals are manufactured, 2)how to add values to the products 3)hoe to manage and transfer petroleum products.

ECT551 Energy Market Fundamental I

This module provides the fundamental knowledge of international energy market and pricing methodologies. The aim of the module is to help students understand complexity of energy market formed by various micro and macro economic factors. In addition, this module will also allow students to understand how crude oil prices decided in different geographic markets such as Europe, US, and Asia.

ECT552 Energy Market Fundamental II

This module provides the fundamental knowledge of international energy market and pricing methodologies. The aim of the module is to help students understand complexity of energy market formed by various micro and macro economic factors. In addition, this module will also allow students to understand how crude oil prices decided in different geographic markets such as Europe, US, and Asia.

ECT553 Energy Market Fundamental III

This module provides the fundamental knowledge of international energy market and pricing methodologies. The aim of the module is to help students understand complexity of energy market formed by various micro and macro economic factors. In addition, this module will also allow students to understand how crude oil prices decided in different geographic markets such as Europe, US, and Asia.

ECT554 Energy Market Fundamental IV

This module provides the fundamental knowledge of international energy market and pricing methodologies. The aim of the module is to help students understand complexity of energy market formed by various micro and macro economic factors. In addition, this module will also allow students to understand how crude oil prices decided in different geographic markets such as Europe, US, and Asia.

ECT555 Energy Trading Fundamental I

This module will provides the fundamental knowledge of international energy trading. The aim of the module is to help students understand volatility, counterparty exposures, credit requirements, government regulations, unexpected events and geopolitics keep traders in a perpetual state of high alert. This module includes understanding the risk management in oil & gas trading, OTC markets & exchanges and paper instruments in oil trading.

ECT556 Energy Trading Fundamental II

This module will provides the fundamental knowledge of international energy trading. The aim of the module is to help students understand volatility, counterparty exposures, credit requirements, government regulations, unexpected events and geopolitics keep traders in a perpetual state of high alert. This module includes understanding the risk management in oil & gas trading, OTC markets & exchanges and paper instruments in oil trading.

ECT557 Trading Project/Practice I

This module will prepare students for a career in the oil and gas industry. The course commences with an introduction to energy market pricing and industry practices within an energy trading environment. Students will learn how a trading company operates and will become familiar with the standard operating protocol of a trading company. Students will practice these skills in real world trading simulation. The module includes the progress of a trade, from verbal agreement between two traders, through the subsequent preparation of a contract, operation of a contract with chartering, nomination of a tanker, invoicing and presentation of documents, and the settlement of claims.

ECT558 Trading Project/Practice II

This module will prepare students for a career in the oil and gas industry. The course commences with an introduction to energy market pricing and industry practices within an energy trading environment. Students will learn how a trading company operates and will become familiar with the standard operating protocol of a trading company. Students will practice these skills in real world trading simulation. The module includes the progress of a trade, from verbal agreement between two traders, through the subsequent preparation of a contract, operation of a contract with chartering, nomination of a tanker, invoicing and presentation of documents, and the settlement of claims.

ECT559 Trading Project/Practice III

This module will prepare students for a career in the oil and gas industry. The course commences with an introduction to energy market pricing and industry practices within an energy trading environment. Students will learn how a trading company operates and will become familiar with the standard operating protocol of a trading company. Students will practice these skills in real world trading simulation. The module includes the progress of a trade, from verbal agreement between two traders, through the subsequent preparation of a contract, operation of a contract with chartering, nomination of a tanker, invoicing and presentation of documents, and the settlement of claims.

ECT560 Trading Project/Practice IV

This module will prepare students for a career in the oil and gas industry. The course commences with an introduction to energy market pricing and industry practices within an energy trading environment. Students will learn how a trading company operates and will become familiar with the standard operating protocol of a trading company. Students will practice these skills in real world trading simulation. The module includes the progress of a trade, from verbal agreement between two traders, through the subsequent preparation of a contract, operation of a contract with chartering, nomination of a tanker, invoicing and presentation of documents, and the settlement of claims.

ECT691 Market Investigation

In this course, students will investigate historical movement and current status on a selected financial market with their related news.

ECT692 Market Analysis

In this course, students will read reports on a selected financial market written by analysts working on several financial institutions and make their own reports.

ECT693 Financial Engineering Project

In this course, students will take a project which is related to the financial engineering area. They can compose their own financial model or analysis markets empirically.

ECT694 Capstone Project

In this course, students will simulate their own selected role in the financial market. They can choose dealer, quants, analyst or sales as their role.

ECT695 Energy Project

In this course, students will take a project which is related to the energy market. They can develop their ideas on energy market and participate into real projects funded by public or private institution.

ECT561 Internship

Students will work for commodity trading desks (front, middle, and back offices) in the petroleum companies, banks, and trading firms. They will learn entry-level knowledge and practices to become traders, risk managers, and analysts.

MGT521 Business Ethics

The purpose of this course is to enable students to reason about the role of ethics in trading and contracting in the energy commodity trading and financial market. In the course, students will participate in a series of case study discussions, focusing on analyzing the issues in moral terms and then making decisions and developing a set of reasons why the decision can ethically justified. During the discussion, additionally, students will think about the impact of their financial transactions on stakeholders and societies.

BAT511 Introduction to Data Mining

Data mining is the process of discovering new patterns from large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics and database systems. The basic data mining techniques and their use in a business context will be addressed. Furthermore, an advanced topic in data mining (i.e. process mining) will also discussed in the class.

BAT512 Advanced Data Mining with Artificial Intelligence

Advanced data mining is the process of discovering new patterns from large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics and database systems. The Advanced data mining techniques and their use in a business context will be addressed.

BAT513 Statistical Learning

This course will provide students with analytical and decision making skills through a variety of topics in statistics and optimization modeling. Underlying theory for statistical analysis and its business applications will be emphasized. This helps students evaluate and handle business situations with statistics in mind. As a result, students will be well prepared to describe and analyze data for decision makings in business fields such as marketing, operations, and finance.

BAT515 Analytics Programming

This course teaches data analysis in Python and R, general-purpose languages that are easy enough to learn, fast enough to scale, and endowed with a wide range of powerful libraries that make data cleaning, visualization, and many common data analysis task.

BAT516 Database Management

This course is an introduction to database systems that manage very large amounts of data.One of the popular approaches in database management is relational model, which uses a two-dimensional table as its primary structure.The relational model underlies the major commercial database systems.

We cover relational design using the ER (Entity-Relationship) model and UML (Unified Modeling Language), and SQL (Structured Query Language), the standard query language for relational databases, will be learned and experienced. Another focus of this course will be data preparation for further business analytics. It includes the use of SQL along with statistical and data mining tool (e.g., SAS) and multi-dimensional data extraction from data warehouse.

BAT522 Customer Analytics

Customer analytics allow for ways to test new products, identifying customer needs, design promotion and advertising campaign and execute overall marketing strategy. Particular emphasis is placed on understanding of the core psychological processes of decision making by consumer, and customer's environment for segmentation of markets.

BAT524 Introduction to Business Analytics

In this course, students will study how information is produced and managed in enterprises. Main topics discussed include: the principles of information management; information management technologies; techniques to analyze information needs and use; and the social and ethical context of information management.

BAT526 Topics in Business Analytics I

This course will provide students with an opportunity to study how Business Analytics knowledge and techniques are applied in various fields. Possible topics include: Financial Analytics, Web Analytics, Healthcare Analytics, Text Mining, Social Analytics, and so on.

BAT527 Topics in Business Analytics II

This course will provide students with an opportunity to study how Business Analytics knowledge and techniques are applied in various fields. Possible topics include: Financial Analytics, Web Analytics, Healthcare Analytics, Text Mining, Social Analytics, and so on.

BAT528 Topics in Business Analytics III

This course will provide students with an opportunity to study how Business Analytics knowledge and techniques are applied in various fields. Possible topics include: Financial Analytics, Web Analytics, Healthcare Analytics, Text Mining, Social Analytics, and so on.

BAT531 Multivariate Statistics

This course provides students with an understanding of how to apply multivariate statistical methods in business. Emphasis is on developing a conceptual and practical understanding of how to apply these techniques. Most of the examples are from business; however, the information is applicable to any related discipline. This course is intended to provide the student with the following:

- · An introduction to the use of multivariate statistics in business research
- · A conceptual organization of the various multivariate techniques, with respect to the types of research questions and data sets appropriate for each technique

· A "laypersons" working understanding of how to use and interpret the results of each technique, including, for each technique, a conceptual overview, list of assumptions, diagnostics for assessing the assumptions, sample size requirements, mechanics of performing the analysis, and how to interpret the statistical output of the analysis.

BAT541 Social Data Analytics

Social media provides marketers with a way to better understand their customers. Viewing consumers' social media activity as the "voice of the consumer," this course exposes students to the analytic methods that can be used to convert social media data to marketing insights.

BAT542 Text Mining

This course will cover the major techniques for mining and analyzing text data to discover interesting patterns, extract useful knowledge, and support decision making. Detailed analysis of text data requires understanding of machine learning, natural language processing, and statistics., You will learn the basic concepts, principles, and major algorithms in text mining and their potential applications.

BAT543 Supply Chain Analytics

This course introduces the primary methods and tools that you will encounter in your practice of supply chains. Supply chains are complex systems involving multiple businesses and organizations with different goals and objectives. Many different analytical methods and techniques are used by researchers and practitioners alike to better design and manage their supply chains.

BAT562 Internship

By conducting an internship in an actual company or organization, students not only acquire hands-on experience but also apply their analytical capabilities to real-world situations.

BAT571 Advanced Quality Control

Fundamental methods about anomaly and change detection in a process or an environment. Methods covered include the univariate and multivariate analysis for continuous and discrete data, risk adjustments, data pre-analyses (such as dimension reduction), and scan statistics.
This course is designed for master's students in the engineering and statistics fields to learn about the basic concepts and practical tools for performing anomaly and change detections. It will help doctoral students in both fields broaden their knowledge base and get exposed to new applications. But theoretical analysis is NOT the focus of this course.

BAT572 Systematic Technology Intelligence

Technology intelligence is an activity that enables companies to identify the technological opportunities and threats that could affect the future growth and survival of their business. It aims to produce and disseminate the technological information needed for strategic planning and decision making. This course will deal with a variety of engineering-centric methods for technology intelligence. Students are expected to develop independent analytical capabilities including choice and implementation of rigorous methods.

BAT573 Service Systems Engineering and Management

Service systems in transportation, retail, healthcare, entertainment, hospitality, and other areas are configurations of people, information, organizations, and technologies that operate together for mutual benefit. One difficulty in engineering and managing complex service systems is the lack of data required to monitor and improve the system elements. However, with recent advances in sensing technologies, various kinds and massive amounts of data can be collected from the elements of the service system, such as people and physical objects. This advancement contributes to unlocking the limitations of engineering and managing service systems. In this course, we will learn and apply concepts and methods for engineering and management of service systems with various types of data. Through assignments and term project, the students will develop their own cases of service systems engineering and management.

BAT574 Predictive Maintenance

This course will cover the economic benefits of properly maintaining manufacturing equipment to minimize down time and capital cost of premature replacement, emphasizing techniques of predictive maintenance Students will learn how create maintenance plans, and predict and prevent system reliability issues before they occur.

BAT581 Algorithmic and Quantitative Trading

This course provides students with an opportunity to practice investment analysis and portfolio management, which involve recommending stocks and analyzing portfolios. In the beginning, the course introduces statistical programming such as SAS, R project and Python, which are widely used in asset management industry as well as in finance academic research. After building the foundation of empirical skills, students will apply them to large real financial data for investment analysis and portfolio management. Throughout the course, our focus will be on applying computational skills to solve multi-step financial problems. The course objectives are acquiring financial econometric skills: panel and time series regression, predictive regression, vector autoregressive model, state space model, Kalman filter, etc, getting hands-on experience in large financial datasets: Wharton Research Data Services (WRDS), SDC Platinum, and creating investment idea and backtesting it with historical data

BAT582 Data Driven Credit Modeling and Management

This course focuses on the practical challenges that arise in implementing a variety of credit risk models (e.g., default models and copula models) and introduces core principles and quantitative methodologies of financial risk management. We discuss a number of modeling frameworks for estimating default probabilities and default dependency. We also focus on various risk measures (e.g., Greeks, value-at-risk, and expected shortfall), which are used by traders and risk managers in financial institutions in practice. With a focus on data sets, we explore a number of data-driven approaches to implementing the risk measures and calibrating models. Finally, we discuss on other recent credit risk management issues such as CCP (Central counterparty), contingent capitals, and systemic risk under the new banking regulation

BAT583 Financial Engineering with AI

This course is for the student who is interested in implementing her/his idea on structuring financial products or making profit from given financial markets. General quantitative finance and introduction to AI strategies are going to be presented excluding mathematical proofs. Almost all explanation will be implemented with proper program languages for the practical uses during the class.

BAT584 FinTech Startup

This course is designed to familiarize students with the general activities and investment techniques of venture capital funds. From this course, students are expected to have obtained a deeper understanding of various functions of venture capital funds, and to have acquired the skills to analyze the values of investments made by venture capital funds. Moreover, this course studies how FinTech firms are incubated and ultimately bought to markt on emerging platform such as the Nasdaq Linq.

BAT585 Financial Data Analysis with SAS

This course will introduce students to many of financial data and how they are used in both real world and in the context of financial research. Financial data we deal with include the Trade and Quote (TAQ), center for research in security prices (CRSP), and Compustat. The course has twofold. On the first half of the semester, we will learn the basics of SAS program like how to create a SAS data set (DATA statements), how to get data into a SAS data set (INFILE/INPUT, SET, MERGE statements), how to create or modify variables (Assignment statements), how to conditionally execute statements (IF-THEN/ELSE statements), how to select specific observations (Subsetting IF statements), how to process a group of variables (ARRAY, DO-END statements) and how to use SAS macro for repetitive procedures. The second half of the course will focus on reading some of finance/accounting papers and replicate those techniques used in them. Time permitting, we will discuss some of empirical methods in finance/accounting research.

BAT586 Blockchains and Financial Services Industry

This course covers blockchains and related topics in the FinTech area. The new technology appears to represent an existential challenge for major parts of the finance industry including banks, securities companies, insurances, and exchanges. This course starts with a traditional topics of financial studies such as the nature of money, legacy payment and banking systems as well as the role of financial intermediaries. We will then study how new technologies shape the traditional financial industry. Topics may include crowdfunding, blockchain securities, smart contracts, and peer-to-peer lending.

BAT591 Business Analytics Practicum

In this course, students will not only have a chance to hear from CEOs, but also learn analytics-related techniques, such as data visualization, presentation skills, and consulting skills.

BAT691 Capstone Project

In order for an opportunity to apply their learning to a real field, students must complete a Capstone Project in collaboration with a company, under the supervision of an appointed advisor. The project scope is decided by discussion with the advisor.

TIM 504 Marketing

This course deals with the subjects needed to design and execute the best marketing effort required to perform asuccessful strategy in target markets. Students will learn concepts and analytical tools needed for major marketingdecisions through lectures, case discussions, case analysis, and presentation.

TIM 506 Strategy

This course is designed to address the theoretical and analytical tools relevant to the formulation and implementationof business/corporate strategy. Subjects covered in this course are: external/internal environment analysis, businessstrategy, corporate strategy, strategic processes, strategy execution, and competition in the high-tech industry. Thiscourse will utilize a variety of teaching methods that will help students to understand the practical application ofstrategic concepts.

TIM 509 Operations Management

This course deals with ways to design and manage core manufacturing and service activities for a firm. Students learn the latest topics such as how to manage sourcing in a global environment and other major topics in management such as the movement of goods among suppliers, factories, and customers, production schedules, productive capacity adjustment, outsourcing/off-shore timing, and network management.

TIM 610 Advanced Analytics for Process Innovation

In this course, students will learn how to visualize business processes inside and outside of the company, how to implement and control people and systems that are related to the performance of the task, and techniques to implement management systems that can efficiently manage and optimize the entire business. Real company cases will be analyzed by using Business Process Management Notation.

TIM 611 Big Data and New Product Development

This course focuses on new product development using consumer and industrial big data. In particular, it deals with real-life domestic and international practices, including utilization of big data in the new product design, obtaining useful information about consumers from big data, and the improvement of existing products using big data.

ECT502 Principles of Finance

This course is designed to study principles of finance, which can be applied to the investment decision in various settings. We first learn the long-term investment decision in corporations or capital budgeting. Then, we learn theories and techniques of investment analysis for the selection and evaluation of investments, which are typically carried out in financial institutions. Topics include securities and markets, asset allocation, bond portfolio management, security analysis.

EPS501 Entrepreneurial Mindset

This course focuses on how firms (both new and old) can create and capture value from product, process, and service technological innovations. To do so, this course will introduce students to new frameworks for examining both new and old problems related to innovation and technological change. This course consists of a mix between case studies and project courses, with an emphasis on class discussion and debate. While most of the case studies in class will focus on technology-oriented contexts, many of the insights developed during this course will be highly applicable to firms in non high-tech industries as well. A mastery of the tools and frameworks developed in this course will be useful to entrepreneurs responsible for the introduction and implementation of new products or services.

EPS502 Operating Startups

This course provides insight into the key steps needed to build a successful startup by designing a roadmap for developing and maintaining product and services, in a capital-efficient way and for maximum impact. The main idea in this course is learning how to rapidly develop and test ideas by gathering massive amounts of customer and marketplace feedback. Students will learn how to get out of the building and search for the real pain points and unmet needs of customers and how to find a proper solution and establish a suitable business model. Building a startup is not simply building an execution plan for a business model that the entrepreneur thinks will work, but rather, a search for the actual business model itself.

EPS511 Venture Financing

This course is designed primarily to improve the student’s ability to finance a new or growing venture. The advantages and disadvantages of the sources of new venture capital are studied from the entrepreneur’s viewpoint. Core topics include bootstrapping, government loans and grants, commercial banking, angels, middle market private placements, DPOs, venture capital, venture banking, and small IPOs. Brief attention is also given to franchising, licensing, strategic alliances, joint ventures, leasing, and buyouts. A review of financial terms, financial statements, capital structure, valuation, deal structure, due diligence, and term sheets is provided.

EPS512 Entrepreneurial Marketing

How do you effectively perform the marketing function as an entrepreneur with limited time, financial resources, and people? This course focuses on key entrepreneurial marketing concepts and methods and their real world application by entrepreneurs. This course begins with students picking an entrepreneurial venture for which to develop an operational marketing plan. The venture is preferably one that the students would consider actually implementing if the plan proves feasible. The course sessions will typically cover an aspect of marketing for an entrepreneurial venture. The venture could also be a company for whom you are currently working. In addition to clarifying the concepts and methodologies in the readings, the course sessions will attempt to apply the concepts to the ventures of the students.

EPS513 Law and IP for Entrepreneur

This course focuses on the protection of proprietary rights in inventions, writings, creative expression, software, trade secrets, trade designations, and other intangible intellectual products by federal patent, copyright, trademark and unfair competition law, and by state trade secrecy and unfair competition law. Consideration will be given to the challenges posed for traditional intellectual property paradigms by new technologies and the shift to an information-based economy. This course is designed for the legal issues for startups.

EPS514 Global Entrepreneurship

This course addresses various aspects of global entrepreneurship and the opportunities available to start-ups and small businesses in the global environment. It explores the opportunities that entrepreneurs create, the challenges they encounter, and the ways in which they exploit opportunities and address challenges to conduct business across national boundaries and cultures. This course also examines entrepreneurship across different countries and cultures and the role of cross-cultural customs and institutional networks in affecting global and immigrant entrepreneurship. As developing and growing entrepreneurial and innovative businesses is very different to managing large established businesses in an international or global context, this course explores the special problems and advantages associated with entrepreneurial small and medium enterprises as well as re-interpreting the skills students have acquired into a global context.

EPS515 Growth Strategies

This course focuses on the problems that new venture companies face during their growth stages. Topics will cover company life cycle, growth theories, growth strategy, the role of management, organizational structure, business model innovation, franchise growth strategy, and marketing and finance strategy for growth.

EPS590, Entrepreneurial Practice I

Entrepreneurial Practice is similar to research credits but applied to students' individual entrepreneurial activities every semester. Those activities include problem identification, customer and technology validation, business formulation and development, influence of the regulatory environment, product development, validating the business model, operational planning, launching the entrepreneurial venture, etc.

EPS591 Entrepreneurial Practice II

Entrepreneurial Practice is similar to research credits but applied to students' individual entrepreneurial activities every semester. Those activities include problem identification, customer and technology validation, business formulation and development, influence of the regulatory environment, product development, validating the business model, operational planning, launching the entrepreneurial venture, etc.

EPS599 Capstone Project

This is a project course to solve the real-life problems of startup businesses. Students will apply the frameworks and tools of entrepreneurship and innovation management, and plan problem-solving through on-site problem identification, problem analysis, site visiting, and identification of solutions. After the completion of the project, students must turn in a written report.

Graduate School of Creative Design Engineering

Graduate School of Creative Design Engineering

Creative Design Engineering [CDE]

The CDE graduate school aims to foster professional design-engineering experts to lead industrial and societal innovation, as well as professional researchers who can make pragmatic contributions within interdisciplinary design and engineering. The Masters program provides a unique curriculum to train professional design engineers and equip them with creativity in their approaches to design thinking, problem-solving, engineering knowledge and understanding of industrial technologies. Every semester, students will carry out new product development projects in the ‘project-based industry collaborative courses’. Through these courses, they will learn the necessary knowledge and skills for holistic product development. Student learning takes a balanced approach between contemporary theoretical knowledge and its pragmatic application through projects supervised by academic and industrial experts. At the end of the semester, students will demonstrate working prototypes of new products, product-service, or product-system concepts. Design outcomes are further put into the public domain through related patent applications. Discipline-specific knowledge and skills, required for product development, will be taught through a series of skills-based courses. For the ‘Master Graduation Project,’ students will perform an independent product development project throughout the course in their final year. By the project’s end, students will be requested to submit a project report in a thesis format and to exhibit the developed products, to a high level of functional and/or aesthetic fidelity, culminating in their performance to receive their final degree. Project progress and outcomes are continuously evaluated by academic and industry experts. PhD students will carry out design research projects whose outcomes are aimed at industrial application, societal development and/or contribution to design research. Thus, applicability of research outcomes, as well as contribution to the field, are important measures of success. This program is open to engineering or design-major graduates, and individuals with industry experience who have a passion for design.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 48 credits	at least 24 credits	at least 24 credits
Doctoral Program	at least 60 credits	at least 18 credits	at least 42 credits

☐ Required Credit for graduation

▶ Master's Program

Course Type		Course Title	Credit	Sub-total	Total
Required	Lecture	Integrated Design Project I	3	9	48
		Integrated Design Project II	3		
		Integrated Design Project III	3		
	Research	*Master Graduation Project(MGP)	21	24	
		The seminars	1		
		#Industry Internship or start-up training	2		
Elective	Lecture (Select 5)	3D CAD & Mechanical Design	3	15	
		Research Issues in CDE	3		
		Research Methodology	3		
		Strategic Product-Service Development	3		
		Interaction Design	3		
		Design Practice Innovation	3		
		Contextual Design	3		
		Research through Design	3		
		Sustainable Design	3		
		Design for Social Innovation	3		
		Design Research for Industry	3		
		Engineering Technologies for Designers	3		
		Professional Design Practice	3		
		Human-centered Design	3		

* MGP credits can be assigned to each semester in a flexible way based on discussion with the supervisors on how and when the students will initiate their projects.
# All CDE master's student should take either start-up training or Industry Internship during their summer or winter vacation in the first year.

▶ Doctoral Program

Course Types	Course Title	Credit	Subtotal	Total
Required	The seminars	1	42	60
	Doctoral Research	41		
Elective (Select 6)	-	18	18	

☐ Recommendation for Courses to Take for a master's student who entered in Spring semester (2018 봄학기 석사과정 입학생 추천 이수표)

1st semester		2nd semester	
Course title	Credit	Course title	Credit
Integrated Design Project I (통합디자인프로젝트 I)	3	Integrated Design Project II (통합디자인프로젝트 II)	3
Elective course 1	3	Elective course 3	3
Elective course 2	3	Elective course 4	3
		Master Graduation Project (석사졸업과제)	6
Total credit	9	Total credit	15

Summer or Winter vacation (1st year)		
Course title	Credit	Remarks
Industry Internship (산업체인턴십)	2	Over six weeks full time *Choose one
Start-up Training (창업훈련)	2	

3rd semester		4th semester	
Course title	Credit	Course title	Credit
Integrated Design Project III (통합디자인프로젝트 III)	3	Master Graduation Project (석사졸업과제)	9
Master Graduation Project (석사졸업과제)	6	The Seminars (세미나)	1
Elective course 5	3		
Total credit	12	Total credit	10

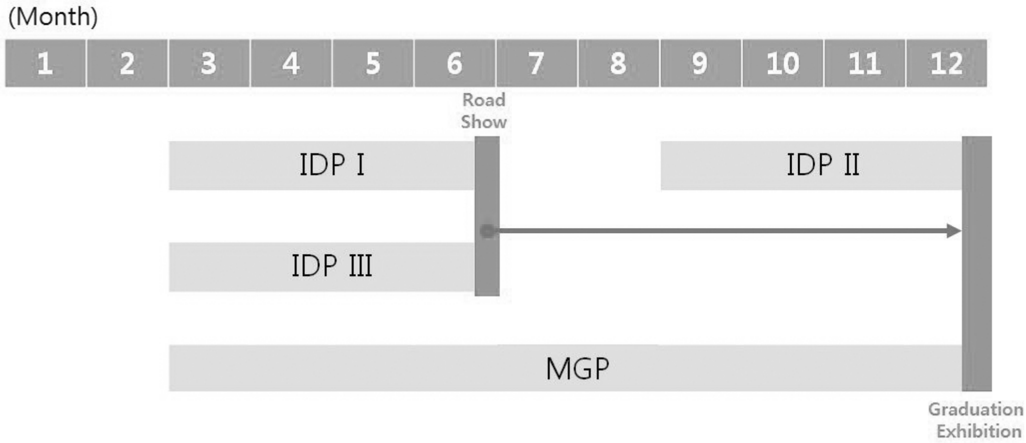
□ Recommendation for Courses to Take for a master's student who entered in Fall semester (2018 가을학기 석사과정 입학생 추천 이수표)

1st semester		2nd semester	
Course title	Credit	Course title	Credit
Integrated Design Project II (통합디자인프로젝트 II)	3	Integrated Design Project I (통합디자인프로젝트 I)	3
Elective course 1	3	Elective course 3	3
Elective course 2	3	Elective course 4	3
		Master Graduation Project (석사졸업과제)	6
Total credit	9	Total credit	15

Summer or Winter vacation (1st year)		
Course title	Credit	Remarks
Industry Internship (산업체인턴십)	2	Over six weeks full time *Choose one
Start-up Training (창업훈련)	2	

3rd semester		4th semester	
Course title	Credit	Course title	Credit
Master Graduation Project (석사졸업과제)	6	Integrated Design Project III (통합디자인프로젝트 III)	3
Elective course 5	3	Master Graduation Project (석사졸업과제)	9
		The Seminars (세미나)	1
Total credit	9	Total credit	13

□ Annual education plan for design project courses



Course	Description	Education focus	Teaching method	Outcomes
Integrated Design Project I	▪ Foundation for New Product Development	▪ Learning and practicing new product development process and methods ▪ Experiencing entire elements of new product development	▪ Collaborative team teaching	▪ Working prototype ▪ Patent application ▪ Project report ▪ Exhibition
Integrated Design Project II	▪ Industry technology &business environment-based on new product development	▪ Training and practicing new product development knowledge and skills in industry environment ▪ Developing new business items for companies	▪ Collaborative team teaching ✓ Planning and managing by a coordinator ✓ Delivering Lecture and/or workshop by lecturers ✓ Tutoring by supervisors	
Integrated Design Project III	▪ New product development consulting for companies	▪ Training project management skills and knowledge in a project team in industry environment ▪ Developing new products based on existing items with companies		
Master Graduation Project	▪ Self problem identification-led project execution in industry context	▪ Verifying the quality of an independent design engineer who has integrated perspective, creative problem-solving knowledge and skills and a business mind ▪ Executing a new product development project in industry context	▪ Supervision ✓ Main supervisor ✓ Co-supervisor	

□ Curriculum

▶ Creative Design Engineering [CDE]

Course Types	Classification	Course No.	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Prerequisite	Convergence
Required	Lecture	CDE511	Integrated Design Project I	통합디자인프로젝트 I	3-2-2		O
		CDE521	Integrated Design Project II	통합디자인프로젝트 II	3-0-6	CDE511	O
		CDE531	Integrated Design Project III	통합디자인프로젝트 III	3-0-6	CDE521	O
	Research	CDE691	*Master Graduation Project	석사졸업과제	*Value Of Credit		O
		CDE891	Doctoral Research	박사논문연구	*Value Of Credit		
		CDE910	Industry Internship	산업체인턴십	-		
		CDE911	Start-up training	창업훈련	-		
		DHE590	The Seminars	세미나	1-1-0		O
Elective	Lecture	CDE514	Engineering Technologies for Designers	디자이너를 위한 공학기술	3-2-2		
		CDE516	3D CAD & Mechanical Design	3D CAD와 기구설계	3-2-2		
		CDE601	Professional Design Practice	디자인실무	3-2-2		
		CDE602	Strategic Product-Service Development	전략적 제품-서비스 개발	3-2-2		
		CDE603	Interaction Design	인터랙션 디자인	3-2-2		
		CDE701	Research Methodology	연구방법론	3-3-0		
		CDE702	Research through Design	디자인을 통한 연구	3-3-0		
		CDE703	Design Practice Innovation	디자인실무혁신	3-3-0		
		CDE704	Design Research for Industry	기업을 위한 디자인연구	3-3-0		
		CDE705	Research Issues in CDE	CDE 연구논제	3-3-0		
		CDE706	Sustainable Design	지속가능디자인	3-3-0		
		CDE707	Human-centered Design	인간중심디자인	3-3-0		
		CDE708	Contextual Design	컨텍스츄얼 디자인	3-3-0		
		CDE709	Design for Social Innovation	사회적 혁신을 위한 디자인	3-3-0		
		CDE901	Special Topics in CDE 1	CDE 특론 1	3-3-0		

Course Types	Classification	Course No.	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Prerequisite	Convergence
		CDE902	Special Topics in CDE 2	CDE 특론 2	3-3-0		
		CDE903	Special Topics in CDE 3	CDE 특론 3	3-3-0		
		CDE904	Special Topics in CDE 4	CDE 특론 4	3-3-0		
		CDE905	Special Topics in CDE 5	CDE 특론 5	3-3-0		
		TIM504	Marketing	마케팅	3-3-0		
		TIM505	Principles of Finance & Accounting	재무와 회계원론	3-3-0		
		TIM506	Strategy	전략경영	3-3-0		
		TIM611	Big Data and New Product Development	빅데이터와 신제품 개발	3-3-0		
		TIM613	Business Model Innovation: Servitization of Manufacturing	비즈니스 모형 혁신: 제조업의 서비스화	3-3-0		
		TIM621	Experiential Entrepreneurship & Tech Commercialization	기업가 정신과 기술사업화	3-3-0		
		TIM622	Entrepreneurial Finance	벤처 재무	3-3-0		
		TIM624	Growth Strategies for New Ventures	신생벤처기업의 성장전략	3-3-0		

* MGP & Doctoral Research: from 3 to 9 credits each semester, TIM: Technology and Innovation Management

□ Description

CDE511 Integrated Design Project I [통합디자인프로젝트 I]

This is an introductory level design project course with a focus upon developing the necessary foundations of knowledge and skills for new product development. Students execute every step of the new product development process, from fuzzy front end and need finding through to the articulation of designs as prototypes, user scenario-boards, together with detail on technically functionality. For the first section of the course, students will identify design opportunities within the bounds of overarching themes related to user-centred problem domains. They will then develop new concepts while learning and practicing various design research methods. Students use necessary knowledge and skills for visualizing and specifying design concepts that are acquired from their elective courses offered simultaneously. For the final part of the semester, students will work to embody their concept designs as prototypes at a high level of fidelity on use, functional and/or aesthetic dimensions. The final outcomes of this course include prototype(s), project report and concept boards. Expected quality indicators and achievements may include patient and design award applications, design exhibitions and publication.

CDE521 Integrated Design Project II [통합디자인프로젝트 II]

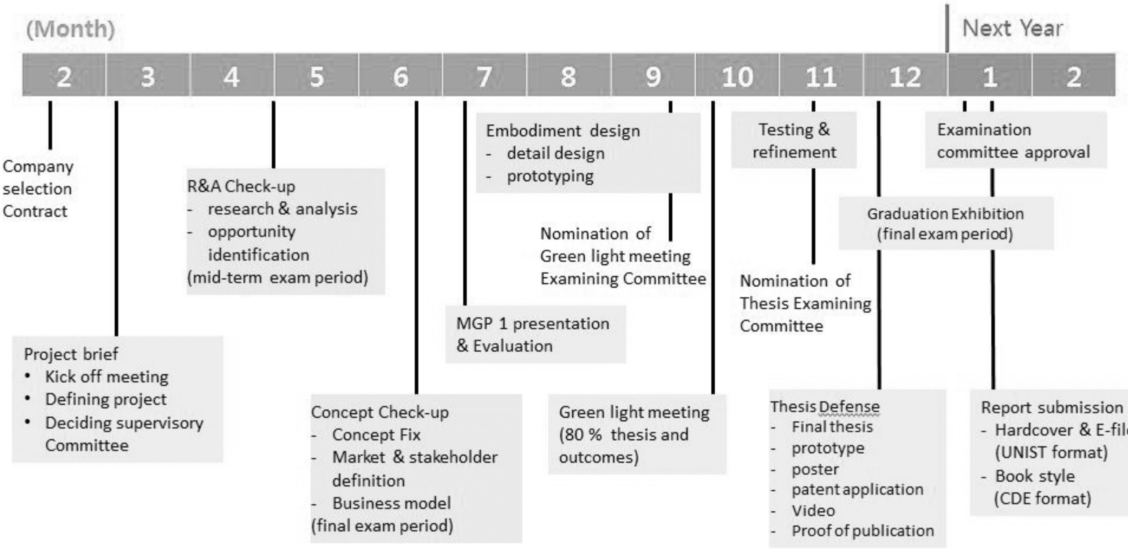
This is an intermediate level design project course with a focus upon the aquisition and application of new product development knowledge and skills. This course offers each students (or by teams) to drive their own design projects from concepts to prototypes for their favorite design-focused firms in the worldwide (e.g., Artemide, Airbnb, IKEA, B&O, Leica, MUJI or other domestic firms). The firms are not officially contracted; however, students can choose the company that they wanted to propose a design for them in the future. Students should come up with a design proposal and required to investigate and understand the design theme or philosophy of their firms that they have selected. Students will experience a total design process, and during each phases (in particular, the design development phase) they are encouraged to integrate the fundamental design and engineering knowledge (e.g., CAD, visualization, electronics / programming and prototyping and so on) for their final design outcome. Each students or a team should come up with a design proposal including a HW or SW semi-working prototype for their selected company at the final. The course will be comprised of lectures, studio classes, assignments and presentations.

CDE531 Integrated Design Project III [통합디자인프로젝트 III]

This is an advanced level design project course with a focus upon knowledge and skills necessary for project management in an industry environment. In groups, students will plan, organize and manage the entire product design project. Thus, this course emphasizes on student-team driven product design activity and teamwork. For the success of the course, it is desirable that students will formulate design projects based on existing items from partner companies. Although the course runs in the context of industry-collaboration, this does not mean that students should achieve the goal and requirements defined by the companies. Any decisions and project activities are made and executed in a student team-driven way with the assistance and guidance of supervisory teams. The final grade of this course will include functional prototype(s), a project report, and patient application. Project results will also be presented and demonstrated at the graduation exhibition during 15th and 16th week of the semester.

CDE691 Master Graduation Project [석사졸업과제]

Master Graduation Project is to verify students' qualities as independent designers, who have an integrated perspective, creative problem-solving knowledge and skills and a business mind. Students are required to fulfill their MGP research credits during the Master program period, and are expected to apply their knowledge and skills they acquired throughout the Master's degree to execute a new product development or a practical design research project. They will independently define a problem and deliver a practical solution using various methods and techniques of design, engineering and business. The final outcome should include strong design-related contributions (e.g., understanding users, design artifacts and functional prototype(s)) through their Master thesis and graduation exhibition. Also, students are strongly recommended to apply the patent of their design outcomes. Their outcomes will also be presented and demonstrated at the graduation exhibition during 15th and 16th week of the semester.



CDE891 Doctoral Research [박사논문연구]

This course is for doctoral students with an aim to conduct a research through design and valorize the result in a form of scientific writing for publication, patents, design awards or other equivalent forms. Students should actively work in a laboratory setting, gain experience through hands-on experimentation, and disseminate the outcomes to relevant communities.

CDE910 Industry Internship [산업체 인턴십]

Students will spend more than four weeks within industries as an intern to discover ideas or items related to Integrated Design Project III or Master Graduation Project. After an internship, students must submit a report which includes 1) lessons learned, 2) activities and 3) opportunities for a new project. Students are encouraged to do their internship at a large firm or a small but strong company which has clear potentials. All CDE master's student must take either this course or the start-up training course during winter or summer vacation.

CDE911 Start-up training [창업훈련]

This is individual project course where students attempt to commercialize the outcomes of project courses such as Integrated Design Project II.' Students should improve the quality of the design outcomes, establish marketing strategies, and do marketing activities utilizing various channels such as quick start-up or crowd funding program. All CDE master's student must take either this course or the start-up training course during winter or summer vacation.

DHE590 The Seminars [세미나]

The purpose of this course is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

CDE514 Engineering Technologies for Designers [디자이너를 위한 공학기술]

The students in this course will learn basic engineering skills, specifically comprising physical computing skills for the implementation of their interactive product ideas, and programming skills to control the prototypes. In particular, students will learn electronics basics and programming using Arduino and Processing by conducting step-by-step exercises. During the course, students will discuss and practice how to apply technologies from the perspective of design. At the end of the course, students will be asked to develop a simple interactive prototype using easily controllable sensors and actuators. The lessons learned from this course could support students' to supplement their fundamental engineering knowledge during taking Integrated Design Project courses.

CDE516 3D CAD & Mechanical Design [3D CAD와 기구설계]

The purpose of this course is to acquire knowledge and skills that are necessary for product design and design engineering practice with 3D CAD. It focuses on developing strategies of generating, testing, and implementing product design concepts with 3D CAD tool and mechanical design principles. With 3D CAD tool, students will learn and practice developing exterior shape of product concept, laying out structural / functional components inside of it, embodying structure and connections of components, generating assembly model, producing engineering drawings and photo-realistic rendering images, executing draft and stress analysis of components, and simulating interference and physical properties of the product such as weight, center of mass, etc. Based upon the understanding, students will create a product concept that has mechanical principles and implement it as a working prototype through fully utilizing 3D CAD and mechanical design principles.

CDE601 Professional Design Practice [디자인 실무]

This course addresses the generic and professional skills that designers need for their future careers, such as teamwork, presentation skills, building a portfolio, and communicating their competencies to potential employers and clients. In this course, students will learn skills required in design practice through visiting a design company and interviewing designers in the company.

CDE602 Strategic Product-Service Development [전략적 제품-서비스 개발]

New product-service development is the strategic way companies act in the changing competitive environment. Meeting the market demand as well as addressing societal and environmental issues through new products and services form an integral part of a company's competitiveness. In this course, students will be introduced with approaches to develop new products and related services that build on the company's core competences and the opportunities in the market while achieving the societal and environmental sustainability.

CDE603 Interaction Design [인터랙션 디자인]

The students in this class will learn ways to design and implement a highly-finished interactive prototype, specifically they will learn physical computing and programming skills for the implementation of their interactive product ideas. Students will learn systematic ways to generate novel and creative interactive product ideas by planning the concrete technologies to be used in their products and the hardware designs for implementation; and they will go through the iterative prototyping process of the concepts they have generated in order to complete their interactive prototypes that can be used in the real world. During the learning process, students will discuss ways to plan concrete technologies to be used in their products and the hardware designs for implementation based on their design concepts. They will have periodic discussions with the instructor about ways to improve their design concepts and to apply technologies from the perspective of design and interaction design research.

CDE701 Research Methodology [연구방법론]

This is an advanced lecture course to study various research methods which form the fundamentals of design research. Students are expected to learn systematic understanding of research methods and research process, which will lead them to conduct students' master or doctoral research.

CDE702 Research through Design [디자인을 통한 연구]

The purpose of this course is to make students learn essential theories and methodologies for research through design. They will experience a design process by using their initial concept prototype through research through design approach.

CDE703 Design Practice Innovation [디자인실무 혁신]

This course focuses upon the concept of design as reflective-practice as theory to conceptualize and define design and designing. Particular attention will be paid to the development of design ability, creative and innovative product design and development, the nature of design problems and their resolution, design thinking and cognition. Students will be required to engage in a practice-lead research project aimed at contributing to understanding of the knowledge, skills and abilities required in design practice.

CDE704 Design Research for Industry [기업을 위한 디자인 연구]

The purpose of this course is to train students to form and conduct their design research that can be easily blended and applied to Industry.

CDE705 Research Issues in CDE CDE [연구논제]

In this course, emerging topics of special interest in the combined areas of design and engineering will be selected under the guidance of a faculty member, and the student will present and discuss the current researches.

CDE706 Sustainable Design [지속가능 디자인]

"Sustainability" is becoming as a driving force in the spheres of business, socio-economic development and the environment. Studying the concept of design for everybody and for society will provide students new perspectives to the aspect of ethics and standards as a designer. This course deals with universal design, eco design and social design as new business models.

CDE707 Human-centered Design [인간중심디자인]

This course treats knowledge and insights from the human sciences as far as this contributes to our understanding of the way we (mis)use products, are aesthetically pleased or emotionally touched by them through our various sense modalities (touch, sound, vision), experience (dis)comfort, risk or safety in use, and learn to operate products in (in)appropriate ways. Connections will thus be revealed between the way our various systems work and the way we understand, use, and (emotionally) experience products. The course is built on a few themes and for each theme relevant literature will be selected and shared.

CDE708 Contextual Design [컨텍스츄얼디자인]

Students in this course will learn about how to use empirical method to gather data about people's social and cultural contexts. At the end of this class, students should be able to design a study that allows them to take a question and answer it using appropriate data collection and analysis techniques. Techniques will include how to interview people, including designing questions that allow people to provide you with information, observing humans doing various tasks and activities to learn about how they interact with computers. For each technique, students will learn what types of question it can answer, how to go about using it, and how does it influence their study design.

CDE709 Design for Social Innovation [사회적 혁신을 위한 디자인]

This course aims at addressing complex problems of contemporary society and bringing positive changes through design interventions. Various theories, approaches and tools such as co-design, service design, and assistive technology are explored to understand and cope with social and environmental problems at systems level. The outcomes of design for social innovation are not solutions per se but the environment that empower conception and implementation of these solutions.

CDE901~905 Special Topics in CDE1~5 [CDE 특론 1~5]

This course consists of students-led seminars on contemporary topics in Design Research and Practice.

TIM 504 Marketing [마케팅]

This course deals with the subjects needed to design and execute the best marketing effort required to perform a successful strategy in target markets. Students will learn concepts and analytical tools needed for major marketing decisions through lectures, case discussions, case analysis, and presentation.

TIM 505 Principles of Finance & Accounting [재무와 회계원론]

This is a joint course in financial management and accounting. It focuses on the basic concepts and useful methodology to understand the essential knowledge of finance and accounting.

TIM 506 Strategy [전략경영]

This course is designed to address the theoretical and analytical tools relevant to the formulation and implementation of business/corporate strategy. Subjects covered in this course are: external/internal environment analysis, business strategy, corporate strategy, strategic processes, strategy execution, and competition in the high-tech industry. This course will utilize a variety of teaching methods that will help students to understand the practical application of strategic concepts.

TIM 611 Big Data and New Product Development [빅데이터와 신제품 개발]

This course focuses on new product development using consumer and industrial big data. In particular, it deals with real-life domestic and international practices, including utilization of big data in the new product design, obtaining useful information about consumers from big data, and the improvement of existing products using big data.

TIM 613 Business Model Innovation: Servitization of Manufacturing [비지니스 모형 혁신: 제조업의 서비스화]

Manufacturing enterprises in a high-cost economic environment should innovate constantly in order to survive. Students learn how manufacturing companies manage innovative services that complement products. Various methods, including service, support, financial services, consulting services, design/development services, and installation services, will be discussed in the course. In addition, topics related to carrying out an innovative service such as the cost-benefit analysis of the service and ways of overcoming organizational change will be covered.

TIM 621 Experiential Entrepreneurship & Tech Commercialization [기업가 정신과 기술사업화]

This course is to experience technology commercialization and develop the ability to discover and obtain business value from technologies. Students from diverse backgrounds, such as natural science, engineering, management, humanities, will work on projects in groups.

TIM 622 Entrepreneurial Finance [벤처 재무]

This course focuses on the financial problems of start-ups and ventures, and will discuss pros and cons of the various financial options available to these companies. In particular, bootstrapping, crowdfunding, government grants and loans, commercial banks, angel investing, DPOs, venture capital, venture banking, and small IPOs will be discussed.

TIM 624 Growth Strategies for New Ventures [신생벤처기업의 성장전략]

This course focuses on the problems that new venture companies face during their growth stages. Topics will cover company life cycle, growth theories, growth strategy, the role of management, organizational structure, business model innovation, franchise growth strategy, and marketing and finance strategy for growth.