UNIST Academic Calendar 2011

Year	Month	Date	Schedule
2011 Spring Semester	3	1(Tue)	2011 Spring Semester Begins Holiday-Independence Movement Day
		2(Wed)	Matriculation Ceremony
		2(Wed) ~ 8(Tue)	Confirmation and Changes of Registered Courses for the 2011 Spring semester
		21(Mon)	Deadline for Course Drop for the 2011 Spring Semester
		28(Mon)	First Quarter of the Semester
	4	15(Fri)	Submission Due Date for the List of Courses to Open during the 2011 Summer Session and the Fall Semester
		19(Tue) ~ 25(Mon)	Mid-term Exams
	5	2(Mon)	Deadline for Course Withdrawal for the 2011 Spring Semester
		5(Thu)	Holiday-Children's Day
		10(Tue)	Holiday-Buddha's Birthday
		11(Wed) ~ 13(Fri)	Preliminary Course Registration for the 2011 Summer Session
		12(Thu) ~ 13(Fri)	UNISTAR Spring Festival
		23(Mon)	Third Quarter of the Semester, Deadline for Registering Official Absence
		31(Tue) ~ 6. 2(Thu)	Course Registration for the 2011 Summer Session
	6	6(Mon)	Holiday-Memorial Day
		7(Tue) ~ 9(Thu)	Preliminary Registration for the Interdisciplinary Major
		14(Tue) ~ 20(Mon)	Final Exams
		21(Tue) ~ 8. 28(Sun)	Summer Vacation
		21(Tue) ~ 8. 1(Mon)	Summer Session
	7	1(Fri)	Due Date for Submitting Students' Grades for the 2011 Spring Semester , Deadline for Course Withdrawal for the 2011 Summer Session
		8(Fri)	Deadline for Grade Changes
		27(Wed) ~ 29(Fri)	Registration of Official Absence/Return
	8	2(Tue) ~ 4(Thu)	Course Registration for the 2011 Fall semester
		12(Fri)	Due Date for Submitting Students' Grades for the 2011 Summer Session
		15(Mon)	Holiday-Independence Day
		16(Tue) ~ 18(Thu)	Registration for the 2011 Fall Semester

Year	Month	Date	Schedule
2011 Fall Semester	8	29(Mon)	2011 Fall Semester Begins
		29(Mon) ~ 9. 3(Fri)	Confirmation and Changes of Registered Courses for the 2011 Fall Semester
	9	11(Sun) ~ 13(Tue)	Holiday-Chuseok, University Foundation Day(13/Tue)
		16(Fri)	Deadline for Course Drop for the 2011 Fall Semester
		23(Fri)	First Quarter of the Semester
	10	3(Mon)	Holiday-National Foundation Day
		14(Fri)	Submission Due Date for the List of Courses to Open during the 2011 Winter Session and the 2012 Spring Semester
		24(Mon) ~ 28(Fri)	Mid-term Exams
		28(Fri)	Deadline for Course Drop for the 2011 Fall Semester
	11	4(Fri) ~ 5(Sat)	UNISTAR Autumn Festival
		8(Tue) ~ 10(Thu)	Preliminary Course Registration for the 2011 Winter Session
		18(Fri)	Third Quarter of the Semester, Deadline for Registering Official Absence
		29(Tue) ~12. 1(Thu)	Course Registration for the 2011 Winter Session
	12	6(Tue) ~ 8(Thu)	Registration for the Interdisciplinary Major
		12(Mon) ~ 16(Fri)	Final Exams
		19(Mon) ~ 2. 29(Wed).2012	Winter Vacation
		19(Mon) ~ 1. 27(Fri).2012	Winter Session
		25(Sun)	Holiday-Christmas
		30(Fri)	Due Date for Submitting Students' Grades for the 2011 Fall Semester Deadline for Course Withdrawal for the 2011 Winter Session
	2012 1	1(Sun)	Holiday-New Year's Day
		6(Fri)	Deadline for Grade Changes
		22(Sun) ~ 24(Tue)	Holiday-Lunar New Year's Day
		25(Wed) ~ 27(Fri)	Registration for Official Absence/Return
	2	7(Tue) ~ 9(Thu)	Course Registration for the 2012 Spring Semester
		10(Fri)	Due Date for Submitting Students' Grades for the 2011 Winter Session
		14(Tue) ~ 16(Thu)	Registration for the 2012 Spring Semester

Contents

Division of General Studies

1. Division Introduction

UNIST has a strong point in educating practical applications of science, engineering, and techno-management, based on the philosophy of technology convergence. We also emphasize training in basic sciences, AHS (arts, humanities, social sciences), IT, communication, and language. All those subjects are important for enhancing the creativity and global leadership of the students. For those purposes Division of General Studies provides freshmen with basic courses, and sophomores and upperclassmen will have opportunities to take advanced courses of basic sciences. By utilizing such programs in Division of General Studies, the students can investigate the world of advanced basic sciences as well as their majors in engineering and management.

2. 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 work. By following UNIST's vision, which is completing multidisciplinary courses, we are opening a course named ‘Introduction to Disciplines’ to provide sufficient information (individual departments, open track, and multidisciplinary studies, etc) to the students, before they start their specialties.

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 Leadership and Teamwork, Innovation and Entrepreneurship, and Microeconomics.

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

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. Required Credit

□ Engineering Field

Engineering Field					
Major	Major	Track 1 / Track 2		33/27	
		Internship		3	
Subtotal					63
Fundamental	Math & Science	Calculus I/Calculus II		6	
		Differential Equations/Applied Linear Algebra/Statistics : Choose two		6	
		General Physics I, II		6	
		General Physics Lab		2	
		General Chemistry I, II		6	
		General Chemistry Lab		2	
		General Biology		3	
	IT	Engineering Programming		3	
		Engineering Programming Lab.		2	
		Dynamics of IT (or designated course by each school)		3	
	MGT	Leadership and Teamwork		3	
		Innovation and Entrepreneurship		3	
Subtotal					45
Liberal Arts	English	Prerequisite	English Foundation	4	
		Group1	English Forward, Building Writing/ Building Speaking & Grammar : Choose one		
		Group2	English Forward, Building Writing/ Building Speaking & Grammar : Choose one		
		Group3	Building Writing/ Building Speaking & Grammar		
	Language	Chinese Foundation/Chinese Forward : Choose one		2	
	AHS	Arts and Creativity		3	
		Literature and Creativity		3	
		Globalization and Economy		3	
		Society and Culture		3	
		Evolution of Civilization		3	
		What is "I"?		3	
		Effective Communication		3	
Subtotal					27
Free Elective	Free Elective			0	
Subtotal					0
Leadership	ULP	UNIST Leadership Program I		2AU	
		UNIST Leadership Program II		2AU	
		UNIST Leadership Program III		2AU	
		UNIST Leadership Program IV		2AU	
Subtotal					8AU
Total 135 credits / 8AU					

※ Students who entered UNIST in 2009 should take 'UNIST Leadership Program I & II', 4 AU(Activity Unit, 1AU=1Hour/week)

□ Management Field

Techno Management Field					
Major	Major	Track 1 / Track 2		33/27	
		Internship		3	
Subtotal					63
Fundamental	Math & Science	Calculus/Applied Linear Algebra		6	
		Statistics		3	
		General Physics		3	
		General Chemistry		3	
		General Biology		3	
	IT	Business Programming		3	
		Dynamics of IT		3	
		Dynamics of IT Lab.		2	
	MGT	Leadership and Teamwork		3	
		Innovation and Entrepreneurship		3	
		Economics		3	
Subtotal					35
Liberal Arts	English	Group1	Prerequisite	English Foundation	4
			English Forward, Building Writing/ Building Speaking & Grammar : Choose one		
		Group2	English Forward, Building Writing/ Building Speaking & Grammar : Choose one		
		Group3	Building Writing/ Building Speaking & Grammar		
	Language	Chinese Foundation/Chinese Forward : Choose one		2	
	AHS	Arts and Creativity		3	
		Literature and Creativity		3	
		Globalization and Economy		3	
		Society and Culture		3	
		Evolution of Civilization		3	
		What is “I”?		3	
		Effective Communication		3	
Subtotal					27
Free Elective	Free Elective			9	
Subtotal					9
Leadership	ULP	UNIST Leadership Program I		2AU	
		UNIST Leadership Program II		2AU	
		UNIST Leadership Program III		2AU	
		UNIST Leadership Program IV		2AU	
Subtotal					8AU
Total 134 credits / 8AU					

※ Students who entered UNIST in 2009 should take 'UNIST Leadership Program I & II', 4 AU(Activity Unit, 1AU=1Hour/week)

4. Curriculum

□ Engineering Field

Course	Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Fundamental	M&S	MTH111	Calculus I	3-3-0	1-1	
		MTH112	Calculus II	3-3-0	1-2	
		PHY101	General Physics I	3-3-0	1-1	
		PHY102	General Physics I H	3-3-0	1-1	
		PHY103	General Physics II	3-3-0	1-2	
		PHY104	General Physics II H	3-3-0	1-2	
		PHY106	General Physics Lab	2-0-4	1-1 1-2	
		CHE101	General Chemistry I	3-3-0	1-1	
		CHE102	General Chemistry II	3-3-0	1-2	
		CHE104	General Chemistry Lab	2-0-4	1-1 1-2	
		BIO101	General Biology	3-3-0	1-1 1-2	
		MTH103	Applied Linear Algebra	3-3-0	2-1	
		MTH201	Differential Equations	3-3-0	2-2	MTH111 or MTH101
		MTH211	Statistics	3-3-0	2-2	
	IT	ITP107	Engineering Programming	3-2-2	1-2	
		ITP117	Engineering Programming Lab.	2-0-4	1-2	
		ISM201	Dynamics of IT	3-3-0	2-1	
	MGT	GMT101	Leadership and Teamwork	3-3-0	2-1	
		GMT102	Innovation and Entrepreneurship	3-3-0	2-2	
General Education	ENG	-	English Foundation	Prerequisite		
		ENG107	English Forward	2-2-0	1-1 1-2	
		ENG108	Building Writing	2-2-0	1-1 1-2	ENG107
		ENG109	Building Speaking & Grammar	2-2-0	1-1 1-2	ENG107
	LNG	LNG201	Chinese Foundation	2-2-0	2-2	
		LNG202	Chinese Forward	2-2-0	2-2	
	AHS	AHS101	Arts and Creativity	3-3-0	1-1 1-2	
		AHS102	Literature and Creativity	3-3-0	1-1 1-2	
		AHS103	Globalization and Economy	3-3-0	1-1 1-2	
		AHS104	Society and Culture	3-3-0	1-1 1-2	
		AHS105	Evolution of Civilization	3-3-0	1-1 1-2	
		AHS106	What is "I" ?	3-3-0	1-1 1-2	
		AHS107	Effective Communication	3-3-0	1-1 1-2	
Free Elective	ENG	ENG106	Introduction to English Styles	3-3-0	1-2	
		ENG110	English Language & Culture	3-3-0	1-1	ENG107
		ENG111	English for Business	3-3-0	1-1	ENG107
Leadership	ULP	ULP101	UNIST Leadership I	2AU	1-1	
		ULP102	UNIST Leadership II	2AU	1-2	
		ULP201	UNIST Leadership III	2AU	2-1	
		ULP202	UNIST Leadership IV	2AU	2-2	

□ Management Field

Course	Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Fundamental	M&S	MTH101	Calculus	3-3-0	1-1	
		MTH103	Applied Linear Algebra	3-3-0	1-1	
		PHY105	General Physics	3-3-0	1-1 1-2	
		CHE103	General Chemistry	3-3-0	1-1 1-2	
		BIO101	General Biology	3-3-0	1-1	
		MTH211	Statistics	3-3-0	2-1	
	IT	ISM201	Dynamics of IT	3-3-0	1-2	
		ISM202	Dynamics of IT Lab.	2-0-4	1-1 1-2	
		ITP108	Business Programming	3-2-2	1-2	
	MGT	GMT101	Leadership and Teamwork	3-3-0	1-2	
		GMT102	Innovation and Entrepreneurship	3-3-0	2-1	
		GMT106	Economics	3-3-0	2-2	
General Education	ENG	-	English Foundation	Prerequisite		
		ENG107	English Forward	2-2-0	1-1 1-2	
		ENG108	Building Writing	2-2-0	1-1 1-2	ENG107
		ENG109	Building Speaking & Grammar	2-2-0	1-1 1-2	ENG107
	LNG	LNG201	Chinese Foundation	2-2-0	2-2	
		LNG202	Chinese Forward	2-2-0	2-2	
	AHS	AHS101	Arts and Creativity	3-3-0	1-1 1-2	
		AHS102	Literature and Creativity	3-3-0	1-1 1-2	
		AHS103	Globalization and Economy	3-3-0	1-1 1-2	
		AHS104	Society and Culture	3-3-0	1-1 1-2	
		AHS105	Evolution of Civilization	3-3-0	1-1 1-2	
		AHS106	What is “I” ?	3-3-0	1-1 1-2	
		AHS107	Effective Communication	3-3-0	1-1 1-2	
Free Elective	ENG	ENG106	Introduction to English Styles	3-3-0	1-2	
		ENG110	English Language & Culture	3-3-0	1-1	ENG107
		ENG111	English for Business	3-3-0	1-1	ENG107
Leadership	ULP	ULP101	UNIST Leadership I	2AU	1-1	
		ULP102	UNIST Leadership II	2AU	1-2	
		ULP201	UNIST Leadership III	2AU	2-1	
		ULP202	UNIST Leadership IV	2AU	2-2	

Required Mathematics Course for Each Track [for the Engineering Field]

School	Track	Required Mathematics course
School of Electrical and Computer Engineering	Computer Science & Engineering	Applied Linear Algebra, Differential Equations
	Communication, Control & Signal Processing	Applied Linear Algebra, Differential Equations
	Electronic Design & Applications	Applied Linear Algebra, Differential Equations
	Device Physics	Applied Linear Algebra, Differential Equations
School of Mechanical and Advanced Materials Engineering	Mechanical System Design & Manufacturing	Applied Linear Algebra, Differential Equations
	Thermo-Fluid & Power Engineering	Applied Linear Algebra, Differential Equations
	Advanced Materials Engineering	Applied Linear Algebra, Differential Equations
School of Nano-Bioscience and Chemical Engineering	Nanochemical Science & Engineering	Applied Linear Algebra, Differential Equations
	Advanced Chemical Engineering	Applied Linear Algebra, Differential Equations
	Bioengineering	Applied Linear Algebra, Differential Equations
	Biomedical Science	Applied Linear Algebra, Statistics
School of Design and Human Engineering	Integrated Industrial Design	Choose Two Among : Applied Linear Algebra, Differential Equations, Statistics
	Affective & Human Factors Design	Applied Linear Algebra, Statistics
	Engineering & Systems Design	Applied Linear Algebra, Statistics
School of Urban and Environmental Engineering	Environmental Analysis & Pollution Control Engineering	Differential Equations, Choose One Between: Applied Linear Algebra, Statistics
	Earth Science & Engineering	Differential Equations, Choose One Between: Applied Linear Algebra, Statistics
	Urban Development Engineering	Differential Equations, Choose One Between: Applied Linear Algebra, Statistics
Interdisciplinary School of Green Energy	Energy Conversion & Storage	Applied Linear Algebra, Differential Equations
	Nuclear Energy	Applied Linear Algebra, Differential Equations

※ Complete based on 1TR

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

□ Course Change (Correspondence / Substitution)

classification	2009-1 Curriculum			Substitution	2009-2 Curriculum		
	Course No.	Course Title	Remark		Course No.	Course Title	Remark
IT	ITP101	Excel	abolished	→	ITP105	Practical IT	
	ITP102	Access	abolished				
	ITP103	Java	abolished	→	ITP106	Introduction to Programming	
	ITP104	C++	abolished				

classification	2009 Curriculum			Substitution	2010 Curriculum		
	Course No.	Course Title	Remark		Course No.	Course Title	Remark
MTH	MTH101	Calculus	(No change for MGT)	→	MTH111	Calculus I	ENG field
	-	-			MTH112	Calculus II	ENG field
ENG	ENG101	Intermediate English	abolished	→	ENG107	English Forward	
	ENG102	Advanced English	abolished	→	ENG108	Building Writing	
	-	-			ENG109	Building Speaking & Grammar	New course
	ENG103	Building English Writing	abolished	→	ENG110	English Language & Culture	
	ENG104	Building English Grammar for Speaking	abolished	→	ENG111	English for Business	
	ENG105	English 24	abolished	→	ENG106	Introduction to English Styles	
IT	ITP106	Introduction to Programming	abolished	→	ITP107	Engineering Programming	ENG field
					ITP108	Business Programming	MGT field

※ Students who want to take 'ENG105 English 24' again but already took 'ENG106 Introduction to English Styles' cannot register for it can register for 'ENG110' or 'ENG111' as a substitution → In this case, you must apply for the substitution by visiting the Academic Affairs Team.

classification	2010 Curriculum			Substitution	2011 Curriculum		
	Course No.	Course Title	Remark		Course No.	Course Title	Remark
MGT	GMT105	Microeconomics		→	GMT106	Economics	

☐ IT course required to take according to each school

School	Programming	'Dynamics of IT' or designated course by each school	Practical IT
School of Electrical and Computer Engineering	Engineering Programming	Data Structure	Programming Lab.
School of Mechanical and Advanced Materials Engineering		Dynamics of IT	
School of Nano-Bioscience and Chemical Engineering		Computational Methods for Biological and Chemical Engineering	
School of Design and Human Engineering		Design IT, 3D CAD & Prototyping, Multimedia Design, Dynamics of IT : choose 1	
School of Urban and Environmental Engineering		Dynamics of IT or IT courses designated by other schools	
Interdisciplinary School of Green Energy		Dynamics of IT IT courses designated by other schools	
School of Technology Management	Business Programming	Dynamics of IT	Dynamics of IT Lab.

※ How to take IT course

Students of ECE, NBC and DHE should follow the guide below :

1. Students who want to take Dynamics of IT again MUST take Dynamics of IT.
2. Students who take neither Dynamics of IT neither IT course designated by the school MUST take the IT course designated by the school.
3. If students didn't take Dynamics of IT but took an IT course designated by the school, the credits can be recognized as IT field credits.

☐ How to take the second language course

(only for international students)

International students can take either one of Chinese courses or Korean courses(opened by UNIST Language Center) according to their choices.

Required Fundamentals
(when students choose tracks from another field)

☐ Fundamentals required by MGT field students when they choose ENG field tracks

Course Title	School of Electrical and Computer Engineering				School of Mechanical and Advanced Materials Engineering			School of Nano-Bioscience and Chemical Engineering			
	CSE	CCS	EDA	DPH	TFP	SDM	AME	NCS	ACE	BEN	BMS
Calculus I	A	A	A	A	A	A	A	A	A	A	A
Calculus II	O	O	O	R	R	R	O	O	O	O	O
Applied Linear Algebra	A	A	A	A	A	A	A	A	A	A	A
Differential Equations	R	R	R	R	R	R	R	R	R	R	O
Statistics	-	-	-	-	-	-	-	-	-	-	A
General Physics I	A	A	A	R	R	R	A	A	A	A	A
General Physics II	R	R	R	R	R	R	R	O	R	R	O
General Chemistry I	O	O	O	O	A	A	R	R	R	R	R
General Chemistry II	O	O	O	O	O	O	R	R	R	R	R
General Physics Lab	R	R	R	R	R	R	R	O	O	R	O
General Chemistry Lab	O	O	O	O	O	O	R	R	R	R	R

Course Title	School of Design and Human Engineering			School of Urban and Environmental Engineering			Interdisciplinary School of Green Energy	
	IID	AHE	ESD	PCE	ESE	UDE	ECS	NUE
Calculus I	A	A	A	A	A	A	A	A
Calculus II	O	R	R	O	O	O	R	R
Applied Linear Algebra	A	A	A	A	A	A	A	A
Differential Equations	O	O	O	R	R	R	R	R
Statistics	A	A	A	A	A	A	-	-
General Physics I	A	A	A	A	A	A	R	R
General Physics II	O	O	O	O	O	O	R	R
General Chemistry I	A	A	A	A	A	A	R	R
General Chemistry II	O	O	O	R	R	O	R	R
General Physics Lab	O	O	O	O	O	O	R	R
General Chemistry Lab	O	O	O	R	R	O	R	R

☐ Fundamentals required by ENG field students when they choose MGT field tracks

Course Title	School of Technology Management			
	GMT	TIE	FIA	MIB
Leadership and Teamwork	R	R	R	R
Innovation and Entrepreneurship	R	R	R	R
Economics	R	R	R	R

R : Required A : Accepted O : Optional

☐ For MGT students who choose Engineering field track as their 2nd track

1. Students who complete General Physics in 2009 ☞ They don't have to take General Physics I
   (In 2009, General Physics I and General Physics were designated as similar courses)
2. Students who didn't take General Physics in 2009 ☞ They should take General Physics I if it is required by their 2nd track (Refer to the table above)

☐ Required Courses to Take When Change the Field

1. Management Field -> Engineering Field

Category	Course	Remarks
Accepted	Calculus = Calculus I	
	Business Programming = Engineering Programming	
Identical	Applied Linear Algebra = Applied Linear Algebra	
	Statistics = Statistics	
	General Biology = General Biology	

2. Engineering Field -> Management Field

Category	Course	Remarks
Accepted	Calculus I = Calculus	
	Engineering Programming = Business Programming	
	General Physics I = General Physics	
	General Chemistry I = General Chemistry	
Identical	Applied Linear Algebra = Applied Linear Algebra	
	Statistics = Statistics	
	General Biology = General Biology	

5. Description

MTH101 Calculus

Calculus 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.

MTH111 Calculus I

Calculus 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

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.

MTH103 Applied Linear Algebra

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

MTH201 Differential Equations

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.

MTH211 Statistics

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

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

Students, who take this course driven by famous experts, can 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

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

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

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.

PHY106 General Physics Lab

General Physics Lab is a one-semester introductory university physics laboratory course intended for students who plan to major in the fields of science and engineering. It provides students with hands-on experience in performing actual experimental activities for the topics selected in classical mechanics, thermodynamics, optics, wave mechanics, and electrodynamics. This lab course is aimed at helping students improve their understanding on related physical concepts and the relevance of experimental activities in physics area.

CHE101 General Chemistry I

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

CHE102 General Chemistry II

As the continuation of General Chemistry I, this course includes chemical kinetics, chemical equilibrium, acid and base, electrochemistry, thermodynamics, transition elements and coordination chemistry. This course is designed for students who plan to major in one of the engineering schools.

CHE103 General Chemistry

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 technology management.

CHE104 General Chemistry Lab

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.

BIO101 General Biology

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, metabolism, reproduction, and genetics. The laboratory activities will demonstrate some of the concepts presented in lecture and will introduce the student to the scientific method and techniques. Each class will consist of two lectures per week and one laboratory class per month.

GMT101 Leadership and Teamwork

This course provides theoretical background and practical tools for the effective management of organizations and for improving leadership capabilities. The main topics include personality, motivation, leadership and team management, organization design, culture, and organizational changes, in both micro and macro perspectives.

GMT102 Innovation and Entrepreneurship

This course offers a framework for understanding the entrepreneurial process faced by entrepreneurs, and perspectives that seek to understand how technological innovation and new business development can generate growth and economic value. Theoretical models, practical tools and business cases are discussed in the class.

GMT106 Economics

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.

ITP107 Engineering Programming

This course introduces the fundamental concepts and methodology of computer

programming, especially in C++. This course aims at providing students with basic programming skills along with clear understanding of the state-of-the-art computer program design concepts. The scope of this course includes the syntax of ANSI standard C++, which covers expression syntax, decision making, loops, functions, arrays, algorithms, pointers, and C++ classes as well as the basic elements of the OOP (object-oriented programming) concepts.

ITP117 Engineering Programming Lab.

In this course, students will gain hands-on experience in C++ programming in UNIX environment. This course introduces the usage of the UNIX operating system and how to design, compile, test, and debug C++ programs. This course includes a lecture session and a laboratory session that take place once a week respectively. Lecture sessions will provide the introduction to UNIX commands for basic file manipulation, vi editor, as well as special features of the UNIX shell environment. Laboratory sessions will emphasize the implementation of C++ programs. A large number of programming assignments will be handed out that could be typically completed during the lab session. Programming assignments will cover basic programming concepts such as variables, assignments, conditional branch, loops, functions, arrays, file streams, and OOP that is learned from Engineering Programming course.

ITP108 Business Programming

This course aims at providing attendees with understanding of the computer system mechanisms along with basic programming skills. The scope of this course includes the principles of computer systems, organization of computer hardware, as well as the basic elements of Visual Basic programming such as its syntax, program structures, data types, arithmetic operations, functions, loops, and branch operations.

ISM201 Dynamics of IT

This course presents information systems concepts from a managerial perspective to understand how information systems work and how they are used for business purposes. It is designed to help students understand and use fundamental information systems principles so that they will efficiently and effectively function as future knowledge workers and managers. Topics include: hardware and software of computers, telecommunication and networks (including the Internet), database management,

e-commerce, systems development and systems security.

ISM202 Dynamics of IT Lab.

This course is an introduction to the major components of MS Office software for personal and organizational productivity improvement. Focus is on MS Excel and MS Access for spreadsheet and database applications through covering features in MS Excel such as working and formatting worksheets, using formulas and functions, creating and modifying charts, and using analytical options and Macros; and those in MS Access such as creating tables, forms, & reports, entering/editing/deleting/displaying data, sorting/filtering records, queries, expressions, sharing data between applications.

English Foundation (no-credit)

This course is offered for students who need basic training in reading and listening in order to take regular-credit English courses. The students will study materials on-line and are required to pass an exit test.

ENG107 English Forward

This course is the general English class which focuses on training in English listening and discussion. The major goal of the course is to help UNIST students grow more autonomous in learning English through the experience of the virtual English course. The students will actively participate in on-line learning and in-class discussions of the studied listening materials.

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 & Grammar

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.

ENG110 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.

ENG111 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.

LNG201 Chinese Foundation

This is a lecture and discussion-based course. Chinese Foundation is not open to students who have learned, from whatever source, enough Chinese to qualify for more advanced courses. It is an introduction to fundamentals of standard Chinese, including pronunciation, grammar, and Chinese characters, with emphasis on all basic language skills (speaking, listening comprehension, reading, and writing).

LNG202 Chinese Forward

This is a lecture and discussion-based course. Recommended preparation for Chinese Forward is the ability to speak and understand Mandarin or other Chinese dialects at elementary levels. It is designed for students who already have listening and speaking skills in Mandarin or other Chinese dialects at elementary levels. Training in all basic language skills (speaking, listening, reading, and writing).

AHS101 Arts and Creativity

Arts and creativity are inseparable, in as much as a piece of art cannot be born without creativity. More importantly, artistic creativity is not limited to arts. The significance of creativity has been widely recognized as essential to problem-solving skills. In this course, students will look at various examples of artistic creativity and in so doing, they will be expected to nurture their creativity.

AHS102 Literature and Creativity

Creativity has been perceived as important because it is recognized as essential

to problem-solving skills. This course aims at looking into the dynamic relationship between literature and creativity. In doing so, we will explore major genres of literature and the mechanisms of creativity. The intersection of literature and science will be given special attention as well.

AHS103 Globalization and Economy

This course focuses on how the growing impact of globalization is transforming the economy and culture of the world. It also discusses the issues on how to deal with the fast changing structures of the economy and market as globalization is being accelerated.

AHS104 Society and Culture

Cultural diversity has become an important issue in Korea as it is worldwide. In response to the social conditions of globalized society, this course aims at familiarizing students with diverse societies and cultures. Understanding other cultures will lead students to a better appreciation of their own culture. Ultimately, this course will prepare students to contribute to the global society.

AHS105 Evolution of Civilization

This course aims to investigate the factors behind the stages of civilizations. It provides causal explanations of why some civilizations rose and fell in the past. Students will improve not only the ability to analyze history but also think critically about it. An emphasis can be put on the impact science and technology had on the evolution of civilizations.

AHS106 What is "I"?

This course is an attempt to answer the question, What is “I”?, drawing upon multiple disciplines: philosophy, psychology, computer science, neuroscience, biology, and physics. We aim to increase our ability to think critically and communicate effectively by being engaged in argumentations over the issues concerning logic, morality, happiness, death, mind, science, religion, and self.

AHS107 Effective Communication

This course will improve the students' ability to communicate effectively, which is essential for success in both the professional and academic worlds. In order to become a more skillful and effective communicator, students will learn about the

basic theories and techniques of presentations, as well as technical writing. The class will give students the opportunity to practice these two skills. Also, critiques and feedback of all oral and written performances will be given.

ULP101, 102, 201, 202 UNIST Leadership I, II, III, IV

In the leadership program, students independently decide activities to do for a semester. While they experience systematic and specialized community life, they can develop qualifications required to be competent leaders such as upright character, cooperative spirit, commitment, etc.

School of Electrical and Computer Engineering

1. School Introduction

The School of Electrical and Computer Engineering aims to educate students and nurture them as global leaders in the field of electrical and computer engineering through solid theoretical study along with realistic applications, who can play central roles not only for the cutting-edge IT industry but also for the new growth-engine industries of interdisciplinary complex systems including automotive, shipbuilding and large-scale energy plants. In order to help students in the school to design the curriculum for themselves, the broad range of studies in the coursework are organized to concentrate on 4 area tracks with fewer compulsory subjects so that the students can plan for the future with flexibility and can carry out any double-major degree program with ease. Further, the school's well-rounded curriculum, with both theory and practice properly balanced, will strengthen our students' fundamental theoretical knowledge as well as applied technological skills and will aid them to be front-runners later in graduate school or in industry. With "student-centeredness" as its educational banner, the School of ECE is determined to be one of the most excellent places to study electrical and computer engineering in the world.

2. Undergraduate Programs

□ Track Introduction

1) Computer Science and Engineering

"Computer science and engineering" aims to improve the quality of human life by researching and developing computer and information systems which are pervasive in every facet of modern life. In this track, students will learn the foundational principles behind operating systems, compilers, and networks, which are necessary to implement computer systems, and will study computer graphics, artificial intelligence,

algorithms, and information security, which are essential to utilize computer systems for practical uses. With this curriculum, we cultivate the finest engineers who are able to research and develop embedded systems, high performance massive computing systems, wireless and wired network systems and services, information engineering, computer vision, natural language processing, and other computer applications of critical importance in the upcoming era.

2) Communication, Control and Signal Processing (CCS)

Communication, Control and Signal Processing (CCS) track concerns itself with a broad spectrum of future problems in human life and seeks potential solutions through the system approach. More specifically, the CCS track studies those system-related technologies in control, communication and sensor networks, statistical inference and decision theory, optimization, and signal processing. The CCS track encourages the students and researchers alike to initiate a wide range of interactions among different areas in assistive robotics, computer vision and human computer interface, sensor network and its applications, biomedical imaging and devices. The CCS track draws students with keen interests in enabling technologies to bring a future way of life to the present day, so that our students can be futuristic system and robot designers, statistics and signal processing experts, and pioneers of human computer interfaces, working side by side to invent and reinvent how everyday life can be enhanced with the aid of technology. In general, students with a broad range of backgrounds, and with a wide variety of objectives for study are welcome to join CCS to take the initiative to tailor their study accordingly.

3) Electronic Design & Applications (EDA)

Electronic Design & Applications (EDA) is a vital area of electrical engineering represented by the core technology needed in implementing many consumer electronics, automotive IT, communication systems and handheld devices. In the EDA track, students will learn basic electronics and integrated circuits to design and test key components for many practical engineering technologies. Digital/Analog circuits design, VLSI design, high speed mixed-signal IC, RF and Wireless IC design are among the curriculum covered in the EDA track, encompassing 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.

4) Device Physics (DPH)

The splendid material civilization that the human society experiences today could be called "electron-driven" civilization. The majority of useful technologies surrounding us such as public media, ultra-fast communication, information technology, computers, and energy facilities are based on various electron devices. In other words, from the 19th century through today it has been the epoch of Electron Art, and such a stream will continue through the remaining 21st century, and even further. In the Device Physics track of UNIST, we aim at cultivating human resources who can comply with such a stream. The students majoring in the device physics track will learn about semiconductor engineering, display engineering, optoelectronic devices, plasma, RF and terahertz engineering as well as basic courses such as electromagnetic theory, quantum mechanics, materials for electrical engineering, etc.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)	
		1Track	2Track
Computer Science & Engineering	Required	21	15
	Elective	12	12
Communication, Control and Signal Processing	Required	21	15
	Elective	12	12
Electronic Design and Applications	Required	21	15
	Elective	12	12
Device Physics	Required	21	15
	Elective	12	12

□ Curriculum

▶ Computer Science&Engineering(CSE)

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	CSE201	Digital System Lab	2-1-2	2-1	
	CSE232	Discrete Mathematics	3-3-0	2-2	CSE231
	EDA201	Basic Circuit Theory	3-3-1	2-2	
	CSE301	Computer Organization	3-3-0	3-1	CSE201
	CSE331	Introduction to Algorithms	3-3-0	3-1	CSE231
	CSE490	Interdisciplinary Project	1-0-2	4-2	
1TR:R 2TR:E	CSE211	Introduction to Programming Languages	3-3-0	2-2	CSE231
	CSE311	Introduction to Operating Systems	3-3-0	3-2	
Elective	CSE231	Data Structures	3-3-0	2-1	
	CSE321	Introduction to Database	3-3-0	3-2	CSE231
	CSE351	Introduction to Computer Network	3-3-0	3-2	
	CSE431	Applied Programming	3-3-0	4-1	CSE331
	CSE461	System Design Lab	3-1-4	4-2	
	CCS201	Probability and Introduction to Random Processes	3-3-0	4-2	

▶ Communication, Control and Signal Processing (CCS)

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	CSE201	Digital System Lab	2-1-2	2-1	
	CCS201	Probability and Introduction to Random Processes	3-3-0	2-2	
	EDA201	Basic Circuit Theory	3-3-1	2-2	
	CCS301	Signals and Systems	3-3-0	3-1	
	EDA301	Microelectronics I	3-3-0	3-1	
	CCS490	Interdisciplinary Project	1-0-2	4-2	
1TR:R 2TR:E	CCS302	Introduction to Communications	3-3-0	3-1	CCS201
	CCS303	Introduction to Control	3-3-0	3-2	CCS301
Elective	DPH201	Electromagnetics I	3-3-0	2-1	
	TFP301	Numerical Analysis	3-3-0	3-1	
	CCS304	Digital Signal Processing	3-3-0	3-2	CCS301
	CCS305	Communication Systems	3-3-0	3-2	CCS302
	CCS401	Data Communication Networks	3-3-0	4-1	CCS302
	CCS402	Advanced Control Techniques	3-3-0	4-1	CCS303
	CCS403	Advance Digital System Lab	3-1-4	4-1	CCS301,CCS302, CCS303

▶ Electronic Design and Applications(EDA)

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	CSE201	Digital System Lab	2-1-2	2-1	
	DPH201	Electromagnetics I	3-3-0	2-1	
	EDA201	Basic Circuit Theory	3-3-1	2-2	
	EDA301	Microelectronics I	3-3-0	3-1	EDA201
	DPH301	Introduction to electronic devices	3-3-0	3-1	EDA201
	EDA490	Interdisciplinary Project	1-0-2	4-2	
1TR:R 2TR:E	CCS301	Signals & Systems	3-3-0	3-1	CSE201
	EDA403	Electronics Experiment Laboratory	3-1-3	4-2	EDA301
Elective	CCS201	Probability and Introduction to Random Processes	3-3-0	2-2	
	CSE301	Computer Organization	3-3-0	3-1	CSE201
	DPH302	Microelectronics Lab	3-1-4	3-2	EDA301
	EDA303	Microelectronics II	3-3-0	3-2	EDA301
	EDA401	Analog Integrated Circuits	3-3-0	4-1	EDA301
	EDA404	Introduction to VLSI Design	3-3-2	4-1	EDA301
	CCS302	Introduction to Communications	3-3-0	4-1	CCS301
	DPH401	Solid State Physics	3-3-0	4-1	EDA201
	DPH403	Semiconductor engineering	3-3-0	4-1	EDA201

▶ Device Physics(DPH)

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	DPH201	Electromagnetics I	3-3-0	2-1	
	CSE201	Digital System Lab	2-1-2	2-1	
	EDA201	Basic Circuit Theory	3-3-1	2-2	
	DPH301	Introduction to electronic devices	3-3-0	3-1	
	DPH303	Quantum mechanics I	3-3-0	3-1	
	DPH490	Interdisciplinary Project	1-0-2	4-2	
1TR:R 2TR:E	DPH202	Electromagnetics II	3-3-0	2-2	
	DPH304	Quantum mechanics II	3-3-0	3-2	
Elective	AME250	Modern Physics of Materials	3-3-0	2-2	
	DPH302	Microelectronics Lab	3-1-4	3-2	
	DPH305	Thermal and statistical physics	3-3-0	3-2	
	DPH401	Solid state physics	3-3-0	4-1	
	DPH403	Semiconductor engineering	3-3-0	4-1	
	DPH405	Optoelectronics	3-3-0	4-2	

□ Course Change(Correspondence/Substitution)

Year	Course No.	Category	Course Title	C-L-E	Remark
2010	CSE231	R	Data Structures	3-3-0	
2011	CSE231	E	Data Structures	3-3-0	
2010	CCS401	R	Probability and Introduction to Random Process	3-3-0	
2011	CCS201	R	Probability and Introduction to Random Process	3-3-0	
2010	CSE232	E	Discrete Mathematics	3-3-0	
2011	CSE232	R	Discrete Mathematics	3-3-0	
2010	CSE211	E	Introduction to Programming Languages	3-3-0	
2011	CSE211	1TR	Introduction to Programming Languages	3-3-0	1TR:R, 2TR:E
2010	DPH201	R	Eletrodynamics I	3-3-0	
2011	DPH201	R	Eletromagnetics I	3-3-0	
2010	DPH202	E	Eletrodynamics II	3-3-0	
2011	DPH202	1TR	Eletromagnetics II	3-3-0	1TR:R, 2TR:E

□ Description

CSE201 Digital System Lab

To understand the basic principles of digital logic circuit, this course introduces the fundamental concepts, components and operations of digital system. TTL, ECL, CMOS, binary system, Boolean algebra and logic gate, combinational logic, and sequential logic are covered.

CSE211 Introduction to Programming Languages

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.

CSE231 Data Structures

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

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

CSE301 Computer Organization

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 Introduction to Operating Systems

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

CSE321 Introduction to Database

This course introduces the concept of databases and provides basic experience in database programming. This includes the relational model, relational algebra, and SQL, and object-relational databases. XML data, and relational design principles are in the scope of this course.

CSE331 Introduction to Algorithms

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.

CSE351 Introduction to Computer Network

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.

CSE431 Applied Programming

This course introduces the basic concepts and design principles of artificial intelligence by practicing the design and implementation of simple intelligence applications.

CSE461 System Design Lab.

The aim of this course is for students to obtain development skills in embedded systems by designing and implementing diverse embedded applications which are commonly used to control consumer electronics and machine.

CSE490 Interdisciplinary Project

This course is joined with another track for the completion of a term project through collaboration. Students are required to conceive a novel idea, which will be realized by designing and fabricating a product by using the best knowledge learned at the undergraduate level. Lastly, students will present their work in public for evaluation.

CCS201 Probability and Introduction to Random Processes

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.

CCS301 Signals and Systems

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.

CCS302 Introduction to Communications

This course introduces core concepts in communication systems; amplitude, frequency, pulse, and pulse coded modulation, narrow band noise representation and signal-to-noise ratios for various modulation scheme, pulse shaping, timing recovery, carrier synchronization and equalization.

CCS303 Introduction to Control

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.

CCS304 Digital Signal Processing

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.

CCS305 Communication Systems

This course concerns the real communication systems in practical situations. Advanced topics such as CDMA/TDMA cellular systems, personal communication networks (PCN) technologies are covered.

CCS401 Data Communication Networks

This course covers general connection methods of networks and applications. The topics are: wireless connection technologies, multi-connection control and scheduling, system capacity maximization and adhoc sensor networks.

CCS402 Advanced Control Techniques

Based on mathematical foundations, this course concerns advanced control methods such as adaptive control, robust control, predictive control, fuzzy control, etc.

CCS403 Advanced Digital System Lab

This course aims to study the design and experiment skills for practical development of advanced digital systems, which are commonly used to communication, control, and signal processing applications.

CCS490 Interdisciplinary Project

This course is joined with another track for the completion of a term project through collaboration. Students are required to conceive a novel idea, which will be realized by designing and fabricating a product by using the best knowledge learned at the undergraduate level. Lastly, students will present their work in public for evaluation.

EDA201 Basic Circuit Theory

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 VLIS, magnetically coupled networks, power analysis, laplace transform, capacitor, inductor, and polyphase circuits are main topics of the course. The LabView tool will be introduced and used for basic experiments. This course is focused on both hands-on experience and design practice.

EDA301 Microelectronics 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.

EDA303 Microelectronics II

This course is the succession of the Microelectronics I 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.

EDA401 Analog Integrated Circuits

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.

EDA403 Electronics Experiment Laboratory

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 characterisitcs, 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.

EDA404 Introduction to VLSI Design

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.

EDA490 Interdisciplinary Project

This course is joined with another track for the completion of a term project through collaboration. Students are required to conceive a novel idea, which will be realized by designing and fabricating a product by using the best knowledge learned at the undergraduate level. Lastly, students will present their work in public for evaluation.

DPH201 Electromagnetics 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.

DPH202 Electromagnetics II

This course is the second half of the one-year electromagnetics 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. Also, we will learn about flow of electromagnetic power, smith chart, impedance matching, waveguide and cavity, and antenna which are the key applications in communication area.

DPH301 Introduction to Electronic Devices

This course first covers the 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 various electronic devices such as PN junction, bipolar transistor, Metal/Semiconductor junction, field effect transistor, microwave devices, and photonic devices.

DPH302 Microelectronics Lab

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.

DPH303 Quantum Mechanics I

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

DPH304 Quantum Mechanics II

This course is the second half of one-year quantum physics 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.

DPH305 Thermal and Statistical Physics

This introductory course covers basic principles and applications of statistical thermodynamics. The course includes the statistical approach in mechanical problems, the relation of macroscopic thermodynamics and microscopic statistical mechanics, Kinetic Theory and transport phenomena, and fundamentals of quantum statistical mechanics. Also the actual applications of statistical thermodynamics to the gas, liquid and solid systems are introduced.

DPH401 Solid State Physics

As an introductory course to solid state physics for engineering majors, this course covers crystal structure, lattice vibration, free electron theory in metals, the quantum electron theory and the concept of band theory, electron transport in metal/semiconductor/insulator, dielectric and magnetic properties of materials, and superconducting materials.

DPH403 Semiconductor Engineering

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.

DPH405 Optoelectronics

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.

DPH490 Interdisciplinary Project

This course is joined with another track for the completion of a term project through collaboration. Students are required to conceive a novel idea, which will be realized by designing and fabricating a product by using the best knowledge learned at the undergraduate level. Lastly, students will present their work in public for evaluation.

AME250 Modern Physics of Materials

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.

TFP301 Numerical Analysis

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.

3. Graduate Programs

□ Computer Science & Engineering

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.

• 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 embedded systems, parallel and distributed computing, real-time systems, operating system virtualization, mobile computing, the Internet computing, and ubiquitous computing.

• 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.

• Applied Computing

The scope of applied computing is quite broad, covering many application fields that strongly emphasize practical purpose. Thanks to the exponential growth in

computer technology, Information Technology (IT) has spread to virtually every corner of our modern world, creating new sciences and engineering such as: artificial intelligence, data mining, semantic web, security and privacy, bio-medical informatics, computational biology, telematics, robotics, and interactive technology spanning computer graphics, computer vision, and human computer interaction. UNIST's interdisciplinary research strategy is very well suited to the research demand of this area.

□ Electrical Engineering

Electrical engineering (EE) is one of three graduate programs offered by the school of ECE at UNIST. EE is responsible for everything from designing integrated circuits to developing application systems. Research in EE includes information and control systems; communication, control, and signal processing and electronic designs; analog and RF circuits, VLSI digital circuits and CAD.

• Communication, Control, & Signal Processing

The Communication, Control, and Signal Processing Track 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 Communication, Control, and Signal Processing areas are to be proactively merged together to create new benefits with the advent of ubiquitous information society driven by digital convergence. The research field of the track also covers cutting-edge future IT technologies and convergence systems such as next generation multimedia communications, human-friendly intelligent robotic systems, digital broadcasting-communication services, and future smart home systems.

• Analog, Digital & RF Circuit Design

Analog, digital & RF circuit design program focuses on a vital area of electrical engineering represented by the core technology needed in implementing many consumer electronics, automotive IT, communication systems and handheld devices. 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.

□ Applied Physics

UNIST Applied physics graduate program spans a broad range of research fields on various device-related topics based on fundamental understanding of physics. The fields covered are electronic devices, electronic materials, plasma physics, beam-wave interaction, and vacuum electronics. All faculty members are jointly affiliated with other majors such as Nano-biosicence and Chemical Engineering, and Green Energy, which enables extensive interdisciplinary researches between fields.

• Electronic Devices & Materials

The main research interests of electronic devices & materials major are basically in developing next-generation electronic devices that overcome the limitations of the conventional Si-based CMOS technology, and also exploring the material systems that can take fundamental roles of realizing those new electronic devices. The current research for electronic devices focus on nanoscale non-planar CMOS devices, multifunctional quantum devices, and new type of nonvolatile memory devices overwhelming the current flash memory devices. Regarding the material systems, we mainly focus on oxide thin films and wide bandgap semiconductors such as SiC and GaN that are particularly useful for noble electronic and optoelectronic devices. Another important research topic is for developing high-performance and portable THz detectors, which is a part of the cooperative research effort in Applied Physics program aiming at developing THz sensing system for security, safety, and medical applications.

• Plasma & Vacuum Electronics

The Plasma & Vacuum Electronics track focuses on basic plasma physics, beam-wave interaction, high power microwave/THz source development and its applications. Plasma physics is a major physics branch which has been researched for many decades, and there are being developed many devices/applications based on plasma physics.

We are interested in the idea of laser wakefield electron accelerator which is based on strong beam-wave interaction. Also, high power THz source development based on vacuum electronics is our main interest. We are currently working on developing a pulsed high power THz source. Using the high power THz source, we also research on its applications such as detection of radioactive material, and medical applications.

□ 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 32 credits	at least 18 credits	at least 14 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

□ Curriculum

▶ Electrical & Computer Engineering

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Elective	ECS571	Organic Electronics	3-3-0		
	ECE511	Computer Architecture	3-3-0		CSE301
	ECE512	Operating Systems	3-3-0		CSE311,CSE301
	ECE513	Formal Languages and Automata	3-3-0		
	ECE515	Algorithm Design	3-3-0		
	ECE516	Compiler Design	3-3-0		CSE211,CSE231
	ECE517	Distributed Systems	3-3-0		CSE231,CSE311
	ECE518	Modern Cryptography	3-3-0		CSE232
	ECE529	Special Topics in CSE	3-3-0		
	ECE530	Image Processing	3-3-0		CCS201,CCS301
	ECE531	Intelligent Systems	3-3-0		CCS201,CCS301
	ECE532	Linear System Theory	3-3-0		CCS201,CCS301, CCS303
	ECE533	Advanced Linear Algebra	3-3-0		CCS201,CCS301
	ECE534	Communication Theory	3-3-0		CCS201,CCS301, CCS302
	ECE535	Robotics	3-3-0		CCS201,CCS301, CCS303
	ECE536	3D Visual Processing	3-3-0		
	ECE537	Audio Engineering	3-3-0		CCS304
	ECE549	Special Topics in CCS	3-3-0		
	ECE551	Analog Filters	3-3-0		EDA301
	ECE552	Operational Amplifier Design	3-3-0		EDA301
	ECE553	Digital Integrated Circuits	3-3-0		EDA301
	ECE569	Special Topics in EDA	3-3-0		
	PHY501	Classical Mechanics	3-3-0		
	AME503	Statistical Mechanics	3-3-0		
	ECE571	Electrodynamics	3-3-0		DPH201,DPH202
	ECE572	Numerical methods in Electromagnetics	3-3-0		DPH201,DPH202
	ECE573	Quantum Mechanics	3-3-0		DPH303,DPH304
	ECE574	Plasma Physics	3-3-0		DPH201,DPH202
	ECE575	Modern RF Engineering	3-3-0		DPH201,DPH202
	ECE576	Advanced Electrodynamics	3-3-0		
	ECE577	Advanced Quantum Mechanics	3-3-0		
	ECE589	Special Topics in DPH	3-3-0		

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Elective	ECE710	Natural Language Processing	3-3-0		
	ECE713	Computer Networks	3-3-0		
	ECE714	Artificial Intelligence	3-3-0		
	ECE715	Computer Graphics and HCI	3-3-0		
	ECE716	Database Design	3-3-0		
	ECE717	Computational Complexity	3-3-0		ECE513
	ECE729	Advanced Special Topics in CSE	3-3-0		
	ECE730	Modern Probability Theory and Stochastic Processes	3-3-0		CCS201,CCS301
	ECE731	Information Theory	3-3-0		CCS201,CS301, CCS302,ECE730
	ECE732	Advance Digital Signal Processing	3-3-0		CCS201,CCS301, CCS304,ECE730
	ECE733	Optimal Control Theory	3-3-0		CCS201,CCS301, ECE730
	ECE734	Estimation & Decision Theory	3-3-0		CCS201,CCS301, CCS304,ECE730
	ECE735	Pattern Recognition	3-3-0		CCS201,CCS301, ECE730
	ECE736	Channel Coding Theory	3-3-0		CCS201,CCS301, CCS302,ECE730
	ECE737	Data Compression	3-3-0		CCS201,CCS301, ECE730
	ECE749	Advanced Special Topics in CCS	3-3-0		
	ECE751	Advanced Analog IC Design	3-3-0		EDA301,EDA303
	ECE752	Advanced Integrated System Design	3-3-0		EDA301,EDA303
	ECE753	Wireless IC Design	3-3-0		EDA301,EDA303
	ECE754	Low Noise Electronic System Design	3-3-0		EDA301,EDA303
	ECE755	Frequency Synthesizers	3-3-0		EDA301,EDA303
	ECE756	Electronic Oscillators	3-3-0		EDA301,EDA303
	ECE769	Advanced Special Topics in EDA	3-3-0		
	ECE771	Thin Film Engineering	3-3-0		DPH401
	ECE772	Nanoscale Electronic Devices	3-3-0		DPH401
	ECE773	Compound Semiconductor Devices	3-3-0		DPH401
	ECE774	Plasma in Device Manufacturing	3-3-0		DPH201,DPH202
	ECE775	Practical RF Engineering	3-3-0		
	ECE776	Numerical Semiconductor Device Modeling	3-3-0		
	ECE777	Advanced Accelerator Engineering	3-3-0		
	ECE778	Electronic Carrier Transport Physics	3-3-0		
	ECE779	High Power Microwaves and THz Sources	3-3-0		
	ECE780	Laser-Plasma Physics	3-3-0		
	ECE781	Nuclear Fusion Engineering	3-3-0		
	ECE789	Advanced Special Topics in DPH	3-3-0		
	ECE590	The Seminars	1-1-0		
	ECE690	Master's Research	Value of Credit		
	ECE890	Doctoral Research	Value of Credit		

□ Description

ECS571 Organic Electronics

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.

ECE511 Computer Architecture

This course provides the in-depth understanding of the design issues of processors, memory hierarchy, data bus architectures, and storage technologies.

ECE512 Operating Systems

This course covers a broad range of operating systems with a special emphasis on distributed systems, virtualized systems, embedded systems, and other experimental operating systems.

ECE513 Formal Languages and Automata

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.

ECE515 Algorithm Design

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.

ECE516 Compiler Design

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.

ECE517 Distributed Systems

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, fault tolerance, and security. 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 textbook and research papers. The goals of this course are to understand how large-scale, distributed computational systems are built, and to provide you with the tools necessary to evaluate new technologies after the course ends.

ECE518 Modern Cryptography

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.

ECE529 Special Topics in CSE

This course introduces new research topics in CSE.

ECE530 Image Processing

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.

ECE531 Intelligent Systems

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.

ECE532 Linear System Theory

This course provides basic unified system approaches for various engineering problems; equilibrium points and linearization, natural and forced response of state equations, system equivalence and Jordan form, BIBO stability, controllability and duality, control-theoretic concepts.

ECE533 Advanced Linear Algebra

This course extends the undergraduate linear algebra and focus on vector spaces, dual vector spaces, eigenvalues and eigenvectors, 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.

ECE534 Communication Theory

This course introduces various analog and digital communication technologies and provide theory, design and analysis of communication systems from a signal processing perspective. Topics include CDMA, DPCM, DM, characterization of mobile wireless channels, demodulation of DS-SS signals, diversity techniques, interference suppression methods, and low-complexity adaptive receivers.

ECE535 Robotics

This course introduces advanced topics in robot control methods such as servo mechanism design, man machine interface, teleoperation, force control, and stereo vision.

ECE536 3D Visual Processing

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.

ECE537 Audio Engineering

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.

ECE549 Special Topics in CCS

This course introduces new research topics in CCS.

ECE551 Analog Filters

This course is an introduction to the theory, design techniques, and applications of analog passive, active, and switched-capacitor filters.

ECE552 Operational Amplifier Design

This course studies analysis and design techniques for the utilization of integrated circuit operational amplifiers for applications in electronic systems.

ECE553 Digital Integrated Circuits

This course studies analysis and design of bipolar and MOS digital integrated circuit families necessary for memory design and their applications in modern electronic systems.

ECE569 Special Topics in EDA

This course introduces new research topics in EDA.

PHY501 Classical Mechanics

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.

AME503 Statistical Mechanics

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.

ECE571 Electrodynamics

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.

ECE572 Numerical methods in Electromagnetics

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.

ECE573 Quantum Mechanics

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.

ECE574 Plasma Physics

The cutting-edge technologies in nano-scales strongly require proper tools of diagnostics, the highly coherent and high-brightness X-ray. In this course students study the application of laser-plasma for table-top particle acceleration and X-ray generation for that purpose. In addition to that, the nuclear fusion methods for future energy by magnetic and inertial confinement are also introduced.

ECE575 Modern RF Engineering

We cover RF generation by electron-beam devices, such as magnetron, gyrotron, and klystron. In the later part of the course, general ideas of terahertz radiations by vacuum devices and laser systems are provided.

ECE576 Advanced Electrodynamics

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.

ECE577 Advanced Quantum Mechanics

As an extension of ECE573(Quantum Mechanics), this course deals with purturbation theory, variational method, scattering theory, quantum statistical mechanics, etc. which are essential to explain many physical phenomena occurring actually in nature.

ECE589 Special Topics in DPH

This course introduces new research topics in DPH.

ECE710 Natural Language Processing

This course introduces the theory and techniques to process natural language with computer systems.

ECE713 Computer Networks

This course provides in-depth understanding of design and implementation of computer networks from the physical layer up to the service layer. Also, wireless networking is covered in this course.

ECE714 Artificial Intelligence

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.

ECE715 Computer Graphics and HCI

This course introduces the state-of-the-art visual and haptic interface technology for designing effective human-computer interfaces.

ECE716 Database Design

This course introduces the design and implementation details of various forms of database management systems such as the relational model, object-oriented model, distributed model and embedded model.

ECE717 Computational Complexity

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.

ECE729 Advanced Special Topics in CSE

This course introduces new research topics in CSE.

ECE730 Modern Probability Theory and Stochastic Processes

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.

ECE731 Information Theory

This course introduces information theory for communications. Topics include definition of measures of information and their properties, capacity of discrete and continuous channels with noise, source and channel coding theorems, fundamentals of channel coding, noiseless source coding, and source coding with a fidelity criterion.

ECE732 Advance Digital Signal Processing

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.

ECE733 Optimal Control Theory

This course introduces optimal analysis and synthesis by the major procedures of classical calculus of variations and general theory of performance indices. Topics includes dynamic programming, mathematical programming, and variable-gradient techniques, parameter-perturbation, minimax, learning-system methods, and optimal control-system estimation.

ECE734 Estimation & Decision Theory

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.

ECE735 Pattern Recognition

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.

ECE736 Channel Coding Theory

This course introduces coding theories for detection and correction of channel errors. Topics include block codes, cyclic codes, convolution codes, Viterbi decoder, Turbo codes, and LDPC codes.

ECE737 Data Compression

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.

ECE749 Advanced Special Topics in CCS

This course introduces new research topics in CCS

ECE751 Advanced Analog IC Design

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.

ECE752 Advanced Integrated System Design

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.

ECE753 Wireless IC Design

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.

ECE754 Low Noise Electronic System Design

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 acheive noise reduction.

ECE755 Frequency Synthesizers

Frequency synthesizers generate many discrete RF frequencies from one reference frequency. General synthesizers, digital PLL, direct digital, and hybrid synthesizers are covered.

ECE756 Electronic Oscillators

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.

ECE769 Advanced Special Topics in EDA

This course introduces new research topics in EDA

ECE771 Thin Film Engineering

Thin film technology becomes more and more important as the size of electronic devices gets smaller. This course introduces the fabrication technology of thin films and the methodologies of analyzing their material properties. Also, the actual applications where thin films take a critical role will be discussed.

ECE772 Nanoscale Electronic Devices

Technologies of nano-scale memory and functional devices are introduced. The issues are nano transistor, nano-wire applications, giant magnetoresistance and spintronics, nano-floating gate memory, etc.

ECE773 Compound Semiconductor Devices

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.

ECE774 Plasma in Device Manufacturing

Plasma is widely used for contemporary materials processing. In this course, the plasma processing of semiconductors and other electronic devices are introduced.

ECE775 Practical RF Engineering

This course intends to offer hands-on experiences in RF engineering field. Frequency range from RF, microwave, millimeterwave, and up to THz wave is going to be covered in the measurements. Basic measurements such as Smith chart, S-parameter, resonance, etc for the purpose of understanding high frequency phenomena are provided. Students are required to take pre-requisites for this course.

ECE776 Numerical Semiconductor Device Modeling

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.

ECE777 Advanced Accelerator Engineering

This course introduces advanced accelerator concepts including linear accelerator, superconducting accelerator, FEL, laser-based accelerator and etc. Beam dynamics and stability conditions are going to be discussed. Students are required to take pre-requisites for this course.

ECE778 Electronic Carrier Transport Physics

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.

ECE779 High Power Microwave and THz Sources

This course covers basic principles of high power microwave/millimeterwave/THz wave sources and their applications. Especially, the course is focussed in vacuum device based sources such as klystrons, TWTs, and gyrotrons. Students are

required to take pre-requisites for this course.

ECE780 Laser-Plasma Physics

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.

ECE781 Nuclear Fusion Engineering

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.

ECE789 Advanced Special Topics in DPH

This course introduces new research topics in DPH

ECE590 The Seminars

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.

ECE690 Master's Research

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

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.

School of Mechanical and Advanced Materials Engineering

1. School Introduction

The School of Mechanical and Advanced Materials Engineering focuses on world-class research and education specialized in automotive, shipbuilding, MEMS (Micro Electro Mechanical Systems), and advanced materials in order to nurture creative experts and scholars who can contribute to the development and advancement of cutting-edge industries. With the state-of-the-art facilities, the combination of traditional engineering and IT, and interdisciplinary approaches, the school concentrates on a variety of fields, including design, manufacturing, system analysis, energy, and advanced material technologies. In addition, the education of our students emphasizes creativity and ingenuity. This school provides students with track curricula in which they can learn about advanced fields, such as mechanical systems, design innovation, thermofluid control, precision processing, semiconductors, polymers, nano-based functional materials, and intelligent materials.

2. Undergraduate Programs

□ Track Introduction

1) Mechanical System Design & Manufacturing (SDM)

Manufacturing is the process of converting raw materials into value-added products. The science and technology of manufacturing processes and systems have made dramatic advances on a global scale and continue to have a major impact on the global economies and the standard of living. An indispensible part of the field of Mechanical Engineering, manufacturing in particular, is optimal design of mechanical systems, including automobiles, aircrafts, power systems, machinery, and their integral components. In the Mechanical System Design and Manufacturing track, students are educated and trained to learn the underlying principles of mechanical design and manufacturing engineering, and to apply the knowledge to real-world examples and case studies hands-on. Disciplines include machine design, advanced materials

processing, laser-assisted manufacturing, micro/nano machining, MEMS, biomedical products, controls and mechatronics, acoustics and dynamics, and tribology.

2) Thermo-Fluid & Power Engineering (TFP)

Automobiles, aircraft, ships, and submarines are designed using the principles of Fluid Mechanics because they move in a fluid such as air and water; they are propelled by a power-generating device such as a jet engine or an internal combustion engine, which are all based on the principles of Thermodynamics. Thermo-Fluid & Power Engineering is a branch of engineering that deals with problems like these, and has numerous important applications, such as heat problems in microchips and light emitting diodes, wind power, blood flow, micro/nanofluidics (which is one of the key technologies in biochip research), and heat exchanger design in nuclear power plants.

3) Advanced Materials Engineering (AME)

Advanced Materials Engineering is directed towards the general concept of understanding various materials such as metals, ceramics, semiconductors, polymers, and so on. This track enables students to understand why materials behave the way they do, how materials are made, and how new materials with unique properties can be created, by not only macroscopic but also microscopic understanding of materials. Students will learn about advanced materials based on structural materials covering cars, ships, aerospace, civil, telecommunication materials covering semiconductors, and displays, energy materials covering solar cells, fuel cells, batteries, superconductors, and supercapacitors, and environmental materials. Finally, students can play a key role in a wide range of modern technologies and industrial fields.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)	
		1Track	2Track
Mechanical System Design & Manufacturing	Required	31	25
	Elective	2	2
Thermo-Fluid & Power Engineering	Required	28	22
	Elective	5	5
Advanced Materials Engineering	Required	22	16
	Elective	11	11

□ Curriculum

▶ Mechanical System Design & Manufacturing

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	TFP210	Thermodynamics	3-3-0	2-1	
	TFP220	Fluid Mechanics	3-3-0	2-2	
	SDM230	Solid Mechanics	3-3-0	2-1	
	SDM250	Mechanical Drawing and Lab	3-2-2	2-2	
	SDM270	Dynamics	3-3-0	2-2	
	TFP300	Mechanical Engineering Lab	3-1-4	3-2	
	SDM350	Manufacturing Processes and Lab	3-2-2	3-1	SDM230
	SDM352	Creative Engineering Design I	3-0-6	3-2	SDM250
	SDM490	Interdisciplinary Project	1-0-2	4-2	
1TR : R 2TR : E	SDM351	Machine Element Design	3-3-0	3-1	SDM250, SDM230
	SDM370	System Dynamics and Control	3-3-0	3-1	SDM270
Elective	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	
	SDM231	Applied Solid Mechanics	3-3-0	2-2	SDM230
	SDM302	Introduction to Finite Element Method	3-3-0	3-2	SDM230
	TFP310	Heat Transfer	3-3-0	3-1	TFP210,TFP220
	TFP320	Applied Fluid Mechanics	3-3-0	3-1	TFP220
	SDM431	Introduction to Plastic Deformation	3-3-0	4-1	SDM230
	SDM451	Introduction to MEMS	3-3-0	4-1	
	SDM452	Creative Engineering Design II	3-0-6	4-1	SDM352
	SDM453	CAD/CAM/CAE	3-0-6	4-2	SDM250
	SDM454	Optimal Design	3-0-6	4-2	
	TFP455	Multiscale System Design	3-3-0	4-1	TFP220
	SDM470	Mechanical Vibration	3-3-0	4-1	SDM270
	SDM472	Introduction to Sensors	3-3-0	4-2	
	SDM473	Acoustics	3-3-0	4-2	

▶ Thermo Fluid & Power Engineering

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	TFP210	Thermodynamics	3-3-0	2-1	
	TFP220	Fluid Mechanics	3-3-0	2-2	
	SDM230	Solid Mechanics	3-3-0	2-1	
	SDM270	Dynamics	3-3-0	2-2	
	TFP300	Mechanical Engineering Lab	3-1-4	3-2	
	TFP310	Heat Transfer	3-3-0	3-1	TFP210
	SDM352	Creative Engineering Design I	3-0-6	3-2	SDM250
	TFP490	Interdisciplinary Project	1-0-2	4-2	
1TR : R 2TR : E	TFP211	Applied Thermodynamics	3-3-0	2-2	TFP210
	TFP320	Applied Fluid Mechanics	3-3-0	3-1	TFP220
Elective	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	
	NUE211	Fundamentals of Nuclear Engineering I	3-3-0	2-1	
	SDM231	Applied Solid Mechanics	3-3-0	2-2	SDM230
	SDM250	Mechanical Drawing and Lab	3-2-2	2-2	
	TFP301	Numerical Analysis	3-3-0	3-1	
	ACE303	Transport Phenomena	3-3-0	3-1	
	TFP311	Internal Combustion Engine	3-3-0	3-2	TFP210
	TFP312	Mechatronics and Thermofluid Control	3-3-0	3-2	
	SDM350	Manufacturing Processes and Lab	3-2-2	3-1	
	SDM351	Machine Element Design	3-3-0	3-1	SDM250,SDM230
	SDM370	System Dynamics and Control	3-3-0	3-1	SDM270
	TFP411	Combustion	3-3-0	4-1	TFP210,TFP220
	TFP412	Air-conditioning and Refrigeration	3-3-0	4-1	TFP210
	SDM451	Introduction to MEMS	3-3-0	4-1	
	SDM452	Creative Engineering Design II	3-0-6	4-1	SDM352
	TFP455	Multiscale System Design	3-3-0	4-1	TFP220
	TFP456	Energy System Design	3-3-0	4-1	TFP210,TFP220
	SDM470	Mechanical vibration	3-3-0	4-1	SDM270
	SDM472	Introduction to sensors	3-3-0	4-2	

▶ Advanced Materials Engineering

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	
	AME203	Physical Chemistry of Materials I : Thermodynamics	3-3-0	2-1	
	AME230	Introduction to Crystallography	3-3-0	2-2	
	AME300	Materials Laboratory I	3-1-4	3-1	
	AME312	Phase Transformation of Materials	3-3-0	3-1	
	AME490	Interdisciplinary Project	1-0-2	4-2	
1TR : R 2TR : E	AME212	Mechanical Behavior of Materials	3-3-0	2-2	
	AME350	Solid State Physics of Materials	3-3-0	3-1	
Elective	AME211	Physical Chemistry of Materials II : Reaction Engineering	3-3-0	2-2	
	AME250	Modern Physics of Materials	3-3-0	2-2	
	AME301	Materials Laboratory II	3-1-4	3-2	
	AME311	Metallurgical Engineering	3-3-0	3-2	
	TFP301	Numerical Analysis	3-3-0	3-1	
	AME351	Thin Film Technology	3-3-0	3-2	
	AME353	Surface Engineering	3-3-0	3-2	
	AME354	Introduction to Semiconductor	3-3-0	3-2	
	AME370	Introduction to Polymer Materials	3-3-0	3-1	
	AME371	Soft Materials Engineering	3-3-0	3-2	
	AME401	Transmission Electron Microscopy	3-3-0	3-2	
	AME410	Dislocation Theory	3-3-0	4-1	
	AME411	Physical Metallurgy	3-3-0	4-1	
	AME430	Electrical Ceramics	3-3-0	4-1	
	AME431	Magnetic Properties of Materials	3-3-0	4-2	
	AME452	Semiconducting Devices	3-3-0	4-1	
	AME454	Semiconducting Process	3-3-0	4-2	
	AME470	Polymer Physics	3-3-0	4-2	

□ Course Change(Correspondence/Substitution)

Year	Course No.	Category	Course Title	C-L-E	Remarks
'09/'10	MCM202	R	Introduction to Materials Science & Engineering	3-3-0	
2011	AME202	R	Introduction to Materials Science & Engineering	3-3-0	
2010	MCM203	R	Physical Chemistry of Materials	3-3-0	
2011	AME203	R	Physical Chemistry of Materials I:Thermodynamics	3-3-0	
2010	SDM250	R	Mechanical Drawing and Lab	3-3-0	
2011	SDM250	R	Mechanical Drawing and Lab	3-2-2	
2010	TFP211	E	Applied Thermodynamics	3-3-0	
2011	TFP211	1TR	Applied Thermodynamics	3-3-0	1TR:R, 2TR:E
2010	AME211	E	Thermodynamics of Materials	3-3-0	
2011	AME211	E	Physical Chemistry of Materials II:Reaction Engineering	3-3-0	
2010	AME212	E	Mechanical Properites of Materials	3-3-0	
2011	AME212	1TR	Mechanical Behavior of Materials	3-3-0	1TR:R, 2TR:E

□ Description

SDM230 Solid Mechanics

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.

SDM231 Applied Solid Mechanics

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.

SDM250 Mechanical Drawing and Lab

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.

SDM270 Dynamics

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.

SDM302 Introduction to Finite Element Method

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.

SDM350 Manufacturing Processes and Lab

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.

SDM351 Mechanical Element Design

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.

SDM352 Creative Engineering Design I

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.

SDM370 System Dynamics and Control

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.

SDM431 Introduction to Plastic Deformation

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.

SDM451 Introduction to MEMS

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.

SDM452 Creative Engineering Design II

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.

SDM453 CAD/CAM/CAE

In this course, students study the theories and algorithms of CAD/CAM/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 CAD/CAM/CAE techniques.

SDM454 Optimal Design

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.

SDM470 Mechanical Vibration

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.

SDM472 Introduction to Sensors

This course introduces principles and characteristics of diverse physical, chemical, and biological sensors and teaches how to convert the measured values from the sensors into meaningful result.

SDM473 Acoustics

For the control of sound/noise, study of acoustic terminology, fundamental principles of sound/noise generation, wave propagation, wave equation solution, and instrumentation will be covered in this course.

SDM490 Interdisciplinary Project

This course is joined with another track for the completion of a term project through collaboration. Students are required to conceive a novel idea, which will be realized by designing and fabricating a product by using the best knowledge learned at the undergraduate level. Lastly, students will present their work in public for evaluation.

TFP210 Thermodynamics

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.

TFP211 Applied Thermodynamics

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.

TFP220 Fluid Mechanics

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.

TFP300 Mechanical Engineering Lab

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.

TFP301 Numerical Analysis

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.

TFP310 Heat Transfer

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.

TFP311 Internal Combustion Engine

This course covers internal combustion engines such as 4-cycle spark ignition, 4-cycle compression ignition and 2-cycle engines. The topics include fundamentals of thermodynamics in engines, combustion and fuel properties, lubricant and

lubrication, heat transfer, friction phenomena, power, efficiency, and emissions.

TFP312 Mechatronics and Thermofluid Control

Mechatronics is a fusion course consisting of mechanical engineering and electronics engineering. This course covers how to control mechanical systems by using a microprocessor, electric circuits, OP-AMP, analog circuits, and embedded programming.

TFP320 Applied Fluid Mechanics

In this course, based on the topics learned in TFP220, advanced topics such as viscous flows, inviscid flows, lift and drag, basic turbulent flows, fundamentals of compressible flows, and turbomachinery will be covered.

TFP411 Combustion

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.

TFP412 Air-conditioning and Refrigeration

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.

TFP455 Multiscale System Design

This course aims at extending the design principles based on mechanics to designing multi-scale systems. It not only deals with the design principles that are important in macro systems, but it also studies new design principles that are more important in micro-/nano-scales when the ratio of surface to volume decreases. COMSOL Multi-physics, which is a multi-physics modeling and simulation software is also taught to improve the capability of modeling, analyzing and designing multi-scale systems.

TFP456 Energy System Design

This course covers optimal design methods for thermal fluids systems consisting of heat exchangers, burners, compressors and pumps, etc. Mathematical formulations for large thermal fluid systems and their solution methods are presented, and several optimization methods for design of the systems are also provided.

TFP490 Interdisciplinary Project

This course is joined with another track for the completion of a term project through collaboration. Students are required to conceive a novel idea, which will be realized by designing and fabricating a product by using the best knowledge learned at the undergraduate level. Lastly, students will present their work in public for evaluation.

AME202 Introduction to Materials Science and Engineering

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.

AME203 Physical Chemistry of Materials I : Thermodynmaics

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.

AME211 Physical Chemistry of Materials II : Reaction Engineering

This course is designed to extend the concepts and knowledge learned from subject MCM202 Physical Chemistry 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.

AME212 Mechanical Properties of Materials

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.

AME230 Introduction to Crystallography

This course covers the derivation of symmetry theory; lattices, point groups, space groups, and their properties; use of symmetry in tensor representation of crystal properties, including anisotropy and representation surfaces; and applications to piezoelectricity and elasticity.

AME250 Modern Physics of Materials

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.

AME300 Materials Laboratory I

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.

AME301 Materials Laboratory II

This course is a selective senior subject in the Department of Materials Science and Engineering, designed to be taken in conjunction with the core lecture subject MCM211 Mechanical Properties of Materials and MCM350 Electronic Properties of Materials. The laboratory subject combines experiments illustrating mechanical and electrical/optical/magnetic properties of materials and structure-property relationships through practical materials examples including metals, alloys, ceramics, and semiconductors.

AME311 Metallurgical Engineering

This course will cover the basic principles of physical metallurgy and various phenomena occuring in metals. The synthesis methods of various metals and the effects of the annealing process on the properties of metals will be introduced as well as the representative examples of metals developments.

AME312 Phase Transformation of Materials

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.

AME350 Solid State Physics of Materials

This course will provide fundamental knowledges of electrical, magnetic, and optical properties of various materials such as metals, ceramics, and semiconductors (and superconductors).

AME351 Thin Film Technology

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.

AME353 Surface Engineering

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. The novel properties of surfaces can be used to develop structural and functional materials.

AME354 Introduction to Semiconductor

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.

AME370 Introduction to Polymer Materials

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.

AME371 Soft Materials Engineering

In this course, students learn the physics and chemistry of soft materials, including colloids, polymers, gels, rubbers, biomaterials and liquid crystals. Soft materials often self-assemble into nano- and micrometer scale structures, producing novel new materials or templates for them. The most diverse soft materials are polymers and this course covers their physical chemistry including intermolecular forces, energies, phase transitions, elastic property and dynamics.

AME401 Transmission Electron Microscopy

Theoretical and practical aspects of conventional and high-resolution transmission electron microscopy and related techniques will be covered; Imaging theory, kinematical and dynamical diffraction theory. Diffraction contrast analysis of imperfect crystals will also be covered; phase contrast analysis of crystal lattice structures. This class includes laboratory.

AME410 Dislocation Theory

This course examines crystal structures, kinds of defects, and dislocation. It also covers Burgers vector, dislocation observation, and stress generation, cross-link, loop and mechanism of multiplication of dislocations in materials .

AME411 Physical Metallurgy

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.

AME430 Electrical Ceramics

This course will present the subject of dielectric crystals and their electrical properties; discussion and correlation of ferroelectric and piezoelectric properties of several crystal classes; coverage in detail of the perovskite class of ferroelectric compounds; and discussion of spiral, garnet, and hexagonal type ferrimagnetic crystals and their properties.

AME431 Magnetic Properties of Materials

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.

AME452 Semiconductiong Devices

This course will cover several display materials and devices such as the liquid crystal display (LCD), plasma display panel (PDP). light-emitting diode (LED), and organic light-emitting diodes (OLED), etc.

AME454 Semiconducting Process

This course will cover the semiconductor processing for basic IC fabrication as well as design introduction to IC processing, MOSFET etc. It will be composed of the wafer fabrication, vacuum, thin film, etch, lithography, diffusion, ion implantation etc.

AME470 Polymer Physics

This course introduces natural and synthetic polymers and their physical properties. Students will learn structure and property of polymers starting from the single chain conformation. The emphasis is on the universial static and dynamic behavior of polymers in solvents and melts. In addition this course covers basic chemical synthesis and chemical property of polymers.

AME490 Interdisciplinary Project

This course is joined with another track for the completion of a term project through collaboration. Students are required to conceive a novel idea, which will be realized by designing and fabricating a product by using the best knowledge learned at the undergraduate level. Lastly, students will present their work in public for evaluation.

3. Graduate Programs

□ Mechanical Engineering

• System Design and Manufacturing

Manufacturing is the process of converting raw materials into value-added products. The science and technology of manufacturing processes and systems have made dramatic advances on a global scale and continue to have major impact on the global economies and the standard of living. An indispensable part of the field of Mechanical Engineering, manufacturing in particular, is optimal design of mechanical systems, including automobiles, aircrafts, power systems, machinery, and their integral components. The System Design and Manufacturing Program deals with the underlying principles of mechanical design and manufacturing engineering and their applications. Disciplines include machine design, advanced materials processing, laser-assisted manufacturing, micro/nano machining, MEMS, mechanics of materials, biomedical products, controls and mechatronics, acoustics and dynamics, tribology, and energy harvesting and generating systems.

• Intelligent Robotics

As an emerging engineering science and technology, Intelligent Robotics involves fundamental research in control theory to the conception, design, and prototype evaluation of innovative mechatronics systems and applications to robots and automation. Research in Intelligent Robotics focuses on the convergence of mechanical, electrical and electronic and computer disciplines in modern engineering processes, aimed at achieving a cost-effective, optimal balance between mechanical structure and their overall control. The multi-body dynamics, fuzzy and neural networks for control and identification, precision engineering and motion control schemes are the key theories in robotics. Areas of concentration include but are not limited to service robots, humanoid, exoskeletal robots, robots for medical & rehabilitation, prosthetics, tele-robots, intelligent dummies, unmanned vehicles, intelligent sensors and actuators, etc..

• Thermofluid and Energy Systems

The Thermofluid and Energy Systems Program is a branch of mechanical engineering that deals with the conversion of chemical/thermal/nuclear energy into mechanical work; the transfer of thermal energy from one physical system to another; the study of fluids and the forces on them. Research in this program focuses on design and development of efficient energy conversion systems, heat transfer in multi-scale

systems, and control of fluid motion in various thermofluid systems. Research areas of this program include all kinds of engines, heating and cooling systems, energy harvesting systems, ventilation, heat exchangers, power systems and others. The research areas are not limited to the conventional thermofluid systems but also include newly-emerging topics such as heat transfer in micro-electronic systems, energy harvesting from wind and biofuels, micro/nanofluidics for bioengineering, next-generation automobile engines and gas turbines, and others.

□ Advanced Materials Engineering

• Electronic Materials

The field of Hybrid Electronic Materials Program is directed towards understanding why electronic materials behave the way they do, how electronic materials are made, and how new materials with unique properties can be created, by hybridizing conventional materials such as metal, ceramic, semiconductor, carbon and polymer based on nanoscience and nanotechnology. We will open up new vistas in the design of hybrid materials for (opto-) electronics applications such as displays, sensors, nano-generators, photovoltaics, transistors, flexible devices and so on by integrating theory and experiment to develop deep understanding of understanding how their structure, from the atomic level to that of common objects, influences mechanical, optical, electrical, magnetic, and chemical properties. Furthermore, we will pursue fundamental chemical and structural understandings of the interfaces between organic and inorganic materials including nanowires, quantum dots and graphene, leading to advances in interface engineering and processing that are enabling for novel hybrid materials and technologies. Finally, students can play a key role in creating a wide range of modern technologies; from Fundamental subjects of Physics/Chemistry to Engineering applications of Mechanical Engineering/Electronic Engineering, as well as Materials Science and Engineering

• Structural Materials

The field of Green Structural Materials Program encompasses environmentally friendly, high-performance metals, ceramics, polymers, and composites for structural applications. The Program involves a multi-faceted approach, combining materialss cience (e.g.,microstructure control, alloy design, interface chemistry, structure-property relationships, materials characterization, multiscale simulations, etc.) and design and manufacturing (e.g.,materials development and selection, processing and forming, surface treatment, joining, etc.)

technologies. Core areas include but are not limited to lightweight, high-modulus/strength materials for aerospace, military, and automotive applications, high-strength, corrosion-resistant, anti-fouling materials for marine applications, and durable, environmentally benign materials for civil applications. Allied areas of concentration include nanomaterial-enabled technologies that can impart multi-functionalities, such as, conductivity, flame resistance, wear resistance, etc., to the aforementioned structural materials.

☐ 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 32 credits	at least 18 credits	at least 14 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

□ Curriculum

▶ Mechanical Engineering

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Elective	MEN500	Advanced Numerical Methods	3-3-0		◇
	MEN501	Continuum Mechanics	3-3-0		SDM230
	MEN502	Advanced Mechanical Engineering Analysis	3-3-0		
	MEN510	Advanced Thermodynamics	3-3-0		TFP210
	MEN511	Advanced Heat Transfer	3-3-0		TFP220, TFP310
	MEN520	Advanced Fluid Mechanics	3-3-0		TFP210, TFP220, Multi-Variable Calculus
	MEN521	Micro/Nanofluidics	3-3-0		TFP220 or TFP310
	MEN522	Computational Thermo-Fluid Engineering	3-3-0		TFP220, Programming experience
	MEN523	Advanced Thermofluid Measurement	3-3-0		◇
	MEN524	Aerosol Technology	3-3-0		
	MEN530	Advanced Solid Mechanics	3-3-0		
	MEN531	Finite Element Method	3-3-0		SDM230
	MEN532	Failure Analysis and Design for Reliability	3-3-0		SDM230
	MEN533	Mechanics of Polymer Solids and Fluids	3-3-0		◇
	MEN534	Scanning Probe Microscopy	3-3-0		◇
	MEN551	Computer-Aided Design	3-3-0		◇
	MEN552	Manufacturing Processes and Systems	3-3-0		SDM230, SDM350
	MEN553	Manufacturing and Process Engineering	3-3-0		SDM350
	MEN554	Machine Tool Analysis and Control	3-3-0		SDM350
	MEN555	Net Shape Manufacturing	3-3-0		SDM350
	MEN556	Laser Materials Interaction & Processing	3-3-0		Consent of the instructor
	MEN557	Polymer and Composite Manufacturing	3-3-0		◇
	MEN558	Micro and Nanofabrication	3-2-2		◇
	MEN559	BioMEMS	3-3-0		◇
	MEN570	Advanced Dynamics	3-3-0		
	MEN571	Robotics	3-3-0		
	MEN572	Advanced Analytic Kinematics	3-3-0		
	MEN591	Special Topic-Gas Kinetic Theory	3-3-0		
	MEN592	Special Topic - Biomechanics	3-3-0		
	MEN590	The Seminars	1-1-0		◇
	MEN690	Master's Research	Value of Credit		
	MEN890	Doctoral Research	Value of Credit		

◇ Graduate standing in Engineering or related discipline

▶ Advanced Materials Engineering

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Elective	AME500	Advanced Transmission Electron Microscopy	3-3-0		
	AME501	Advanced Thin Film Technology	3-3-0		
	AME502	Instrumental Analysis of Materials	3-3-0		
	AME503	Statistical Mechanics	3-3-0		Undergraduate level Physical Chemistry or related discipline
	AME504	Quantum Analysis and Modeling	3-3-0		
	AME505	Advanced Thermodynmaics of Materials	3-3-0		
	AME510	Advanced Synthesis for Ceramic-Metal Composite Materials: Hard Materials	3-3-0		
	AME511	Advanced Structural Materials	3-3-0		
	AME512	Advanced Metallurgical Engineering	3-3-0		
	AME530	Advanced Electric Ceramics	3-3-0		
	AME531	Light Emitting Diodes	3-3-0		
	AME540	Advanced Magnetic Materials	3-3-0		AME351 or related discipline
	AME550	Physics in Semiconductor	3-3-0		
	AME551	Surface and Interface Sciences	3-3-0		
	AME553	Nano Materials and Devices	3-3-0		
	AME570	Polymer Materials Chemistry	3-3-0		Undergraduate level Introduction to Polymer Science and Engineering or related discipline
	AME571	Organic Optoelectric Materials and Devices	3-3-0		
	AME572	Carbon Nano Materials	3-3-0		◇
	AME580	Polymer Structure and Properties	3-3-0		
	AME590	The Seminars	1-1-0		◇
	AME690	Master's Research	Value of Credit		
	AME890	Doctoral Research	Value of Credit		

◇ Graduate standing in Engineering or related discipline

□ Description

MEN500 Applied Numerical Methods

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

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

This course introduces application of mathematical methods to the description and analysis of systems in mechanical engineering.

MEN510 Advanced Thermodynamics

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

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.

MEN520 Advanced Fluid Mechanics

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 Micro/Nanofluidics

Micro-/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 Thermo-Fluid Engineering

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

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

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)

MEN530 Advanced Solid Mechanics

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

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 Failure Analysis and Design for Reliability

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.

MEN533 Mechanics of Polymer Solids and Fluids

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.

MEN534 Scanning Probe Microscopy

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.

MEN551 Computer-Aided Design

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

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

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

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.

MEN555 Net Shape Manufacturing

This course focuses on the manufacturing of discrete parts to net or near net dimensions by stamping, forging, machining, and tube hydroforming.

MEN556 Laser Materials Interaction & Processing

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

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 Micro and Nanofabrication MEMS

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 research areas such as electronic engineering, biochemistry, chemistry, physics, medical science and etc.

MEN559 BioMEMS

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.

MEN570 Advanced Dynamics

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

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 analytic kinematics

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.

MEN590 The Seminars

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.

MEN591 Special topic - Gas Kinetic Theory

This course introduces the molecular theory of gases and modern transport theory. Starting from the basic concepts, such as the distribution function, classical theory of specific heats, binary collisions, viscosity, and heat conductivity, transport theory based on the Boltzmann equation is extensively discussed.

MEN592 Special topic - Biomechanics

Biomedical engineering is the application of engineering principles and techniques to the medical field and it is highly interdisciplinary field. It combines the design and problem solving skills of engineering with medical and biological sciences to improve healthcare diagnosis and treatment. Due to this diversity, it is typical for a biomedical engineer to focus on a particular subfield or group of related subfields. This lecture will be focused on Biomechanics which applies engineering mechanics and its related subjects to biological systems, mainly the human to solve medical problems by studying the function and structure of living organisms.

MEN690 Master's Research

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.

MEN890 Doctoral Research

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.

AME500 Advanced Transmission Electron Microscopy

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 transmission electron microscopy analysis 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.

AME501 Advanced Thin Film Technology

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.

AME502 Instrumental Analysis of Materials

This course presents the principle of vibrational spectroscopy and various accessories for measurement of various samples. Topics include structural and thermal characterization by using FT-IR spectroscopy and characterization of carbon nanomaterials by using Raman spectroscopy.

AME503 Statistical Mechanics

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.

AME504 Quantum Analysis and Modeling

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

AME505 Advanced Thermodynmaics of Materials

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.

AME510 Advanced Synthesis for Ceramic-Metal Composite Materials: Hard Materials

This course explains the synthesis procedure of various composites combined with metal, ceramics, polymer. The microstructural properties and mechanical properties, and Strengthening and Fracture Toughness of composites will be covered.

AME511 Advanced Structural Materials

In this advanced structural materials course, we will learn how different crystal structural classes of materials are inter-related, and how properties evolve as a consequence of the different structural families.

AME512 Advanced Metallurgical Engineering

In this class, students will learn the structure and property of metals. The course also covers various applications following their novel physical, chemical and mechanical properties, hence students will gain the ability to develop of new metals and other composite materials.

AME530 Advanced Electric Ceramics

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.

AME531 Light Emitting Diodes

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.

AME540 Advanced Magnetic Materials

To give students an understanding of magnetism, measurement, and its applications, magnetic properties of various materials (diamagnetism, paramagnetism, ferromagnetism, ferrimagnetism etc.) based on solid sate physics and crystallographic theory will be studied and magnetic measurement methods such as fluxmeter and gaussmeter will be introduced. Lots of applications such as motor, transformer core and recording media will be also covered.

AME550 Physics in Semiconductor

This course is designed to provide professional understanding in the current (and future) device physics. The basics of semiconductor devices will be reviewed and detailed phenomenological study on transistor, metal-semiconductor contact, PN junction, MOS capacitor, JFET, and FRAM etc. will be offered.

AME551 Surface and Interface Sciences

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.

AME553 Nano Materials and Devices

The course is an exploration of nanomaterials such as nanoparticles, nanotubes, nanowires, and nanostructured thin films with structural and property characterization, novel physical and chemical properties analysis techniques. These materials are difficult to synthesize and characterize but are nevertheless at the forefront of science and technology in many fields. This course will cover the methods for creating, manipulating and measuring these materials with an emphasis on the current scientific literature. The novel properties and potential applications will also be addressed.

AME570 Polymer Materials Chemistry

In this class fundamentals of polymers, including their structure and synthesis as well as their chemical and physical properties based on polymer synthesis, polymerization and polymer reaction will be introduced. The thermodynamics of polymer solutions and melts, including chain conformations in those states will be dealt and mechanical properties of polymer such as the characteristic of configuration and conformation, glass transition temperature, viscoelasticity, and so on will be explained. Polymer blends and block copolymer based on polymer solution theory will also be dealt with.

AME571 Organic Optoelectric Materials and Devices

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.

AME572 Carbon Nano Materials

This course will deal with the thermal, mechanical, physical, electric chemical

properties of carbon nano materials such as fluorene, nanotube and graphene. The related applications and analysis of carbon allotropes will also be covered.

AME580 Polymer Structures and Properties

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.

AME590 The Seminars

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.

AME690 Master's Research

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.

AME890 Doctoral Research

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.

School of Nano-Bioscience and Chemical Engineering

1. School Introduction

The School of Nano-Bioscience and Chemical Engineering was designed for an emerging field combining Chemical Engineering principles with Life Science and Nanotechnology. 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 Nano-Bioscience and Chemical Engineering encompasses a wide range of interests including biomedical and genetic engineering, green energy and environments, and advanced materials. Students can achieve in-depth knowledge and hands-on experience on nano materials and devices, polymers, fine chemicals, applied molecular chemistry, bioengineering, biomedical engineering, life science, and chemical engineering-related subjects.

2. Undergraduate Programs

□ Track Introduction

1) Nanochemical Science (NCS)

Since the creation of synthetic polymers, a number of new materials and products, such as common plastics, fibers and artificial hearts, have been developed. Recent technological advances enable us to create and control nanometer scale structures. Furthermore, the creation of polymeric materials with the ability to self-assemble into nanostructures is clearly useful. In this track, students will learn the physics and chemistry of polymers, with an emphasis on their application within the development of new materials and nanostructures. This track aims to produce brilliant and creative scientific minds that are familiar with the principles of nanochemical sciences and the cutting-edge equipment available at the state-of-the-art facilities provided by UNIST.

2) Advanced Chemical Engineering (ACE)

The Advanced 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.

3) Bioengineering (BEN)

This track leads the way in interdisciplinary research and education by being at the intersection of engineering, medicine, and natural sciences. The goal of this track is to improve human health and quality of life and to solve global crises related with energy and the environment through the study of protein and genetic engineering, molecular biology and chemical engineering and many other scientific principles. As such, the Bioengineering track offers a number of pertinent courses which will provide the students with the know-how and practical experience needed, through in-depth discussions and laboratory experiments, to become leading researchers and experts within this discipline and the cutting-edge equipment available at the state-of-the-art facilities provided by UNIST.

4) Biomedical Science (BMS)

Biomedical Science offers interdisciplinary research training based on 1) Biology, where fundamental understanding of living organisms is obtained, and 2) Applied knowledge to medical science in order to improve the quality of life. Recent ground-breaking achievements, including the human genome project, stem cell research, cloning techniques, and innovative therapies in cancer, and age-related diseases, highlight the potential of Biomedical Science to be one of the most promising areas in science. This 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.

☐ Credit Requirement

Track	Required/Elective	Credit(minimum)	
		1Track	2Track
Nanochemical Science	Required	22	16
	Elective	11	11
Advanced Chemical Engineering	Required	21	15
	Elective	12	12
Bioengineering	Required	21	15
	Elective	12	12
Biomedical Science	Required	21	15
	Elective	12	12

□ Curriculum

▶ Nanochemical Science(NCS)

course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark
Required	NCS201	Organic Chemistry I	3-3-0	2-1	
	ACE201	Physical Chemistry I	3-3-0	2-1	
	NCS231	Organic Chemistry II	3-3-0	2-2	
	NCS302	Introduction to Polymer Science and Engineering	3-3-0	3-1	
	NCS301	Instrumental Analysis	3-3-0	3-2	
	NCS490	Interdisciplinary Project	1-0-2	4-2	
1TR : R 2TR : E	ACE202	Physical Chemistry II	3-3-0	2-2	
	NCS431	Current Topics in Nanochemical Science	3-3-0	4-1	
Elective	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	
	AME211	Physical Chemistry of Materials II : Reaction Engineering	3-3-0	2-1	
	BMS211	Biochemistry I	3-3-0	2-1	
	NCS261	Organic/Physical Chemistry Laboratory I	2-0-4	2-2	
	BEN301	Computational Methods for Biological and Chemical Engineering	3-3-0	3-1	Substitute Course for Dynamic IT
	ACE303	Transport Phenomena	3-3-0	3-1	
	ACE331	Physical Chemistry III	3-3-0	3-1	
	NCS361	Organic/Physical Chemistry Laboratory II	2-0-4	3-1	
	ACE321	Inorganic Chemistry	3-3-0	3-2	
	NCS322	Nano-device Processing	3-3-0	3-2	
	ACE323	Introduction to Chemical Process	3-3-0	3-2	
	NCS333	Polymer Materials Science	3-3-0	3-2	
	AME351	Thin Film Technology	3-3-0	3-2	
	ECS354	Introductory electrochemistry	3-3-0	3-2	
	AME371	Soft Materials Engineering	3-3-0	3-2	
	ECS353	Solid State chemistry	3-3-0	4-1	
	NCS414	Organic Electronic Materials	3-3-0	4-1	
	ACE434	Current Topics in Advanced Chemical Engineering	3-3-0	4-1	
	AME452	Semiconducting Devices	3-3-0	4-1	
	EDA201	Basic Circuit Theory	3-3-1	4-2	
	ECS312	Inorganic Chemistry II	3-3-0	4-2	
	NCS421	Introduction to Biopolymers	3-3-0	4-2	
	ACE431	Introduction to Catalysis	3-3-0	4-2	
	BEN431	Materials for Biomedical Applications	3-3-0	4-2	
	NCS432	Introduction to Surface & Colloid Science	3-3-0	4-2	
	NCS415	Introduction to Nanoscience and Nanotechnology	3-3-0	4-2	
	AME454	Semiconducting Process	3-3-0	4-2	
	AME470	Polymer Physics	3-3-0	4-2	

▶ Advanced Chemical Engineering(ACE)

course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark
Required	NCS201	Organic Chemistry I	3-3-0	2-1	
	ACE201	Physical Chemistry I	3-3-0	2-1	
	ACE211	Chemical Reaction Engineering	3-3-0	2-2	
	ACE302	Advanced Chemical Engineering Laboratory	2-0-4	3-1	
	ACE303	Transport Phenomena	3-3-0	3-1	
	ACE490	Interdisciplinary Project	1-0-2	4-2	
1TR : R 2TR : E	ACE321	Inorganic Chemistry	3-3-0	3-2	
	ACE323	Introduction to Chemical Process	3-3-0	3-2	
Elective	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	
	BMS211	Biochemistry I	3-3-0	2-1	
	ACE202	Physical Chemistry II	3-3-0	2-2	
	TFP211	Applied Thermodynamics	3-3-0	2-2	
	NCS231	Organic Chemistry II	3-3-0	2-2	
	NCS261	Organic/Physical Chemistry Laboratory I	2-0-4	2-2	
	BEN301	Computational Methods for Biological and Chemical Engineering	3-3-0	3-1	Substitute Course for Dynamic IT
	NCS302	Introduction to Polymer Science	3-3-0	3-1	
	ACE331	Physical Chemistry III	3-3-0	3-1	
	NCS361	Organic/Physical Chemistry Laboratory II	2-0-4	3-1	
	NCS301	Instrumental Analysis	3-3-0	3-2	
	NCS322	Nano-device Processing	3-3-0	3-2	
	NCS333	Polymer Materials Science	3-3-0	3-2	
	AME351	Thin Film Technology	3-3-0	3-2	
	ECS354	Introductory Electrochemistry	3-3-0	3-2	
	ECS353	Solid State Chemistry	3-3-0	4-1	
	ECS421	Fundamentals of Fuel Cell (Systems)	3-3-0	4-1	
	NCS431	Current Topics in Nanochemical Science	3-3-0	4-1	
	ACE434	Current Topics in Advanced Chemical Engineering	3-3-0	4-1	
	AME452	Display and Devices	3-3-0	4-1	
	EDA201	Basic Circuit Theory	3-3-1	4-2	
	ECS312	Inorganic Chemistry II	3-3-0	4-2	
	ECS372	Introduction to Solar Cells	3-3-0	4-2	
	NCS415	Introduction to Nanoscience and Nanotechnology	3-3-0	4-2	
	ACE431	Introduction to Catalysis	3-3-0	4-2	
	NCS432	Introduction to Surface & Colloid Science	3-3-0	4-2	
	AME454	Semiconducting Process	3-3-0	4-2	

▶ Bioengineering(BEN)

course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark
Required	BMS211	Biochemistry I	3-3-0	2-1	
	BMS261	Biochemistry Laboratory	2-0-4	2-1	
	ACE211	Chemical Reaction Engineering	3-3-0	2-2	
	BEN311	Transport Phenomena in Biological Systems	3-3-0	3-1	
	BEN321	Nano-Bioengineering	3-3-0	3-2	
	BEN490	Interdisciplinary Project	1-0-2	4-2	
1TR : R 2TR : E	BEN323	Biochemical Engineering	3-3-0	3-2	
	BEN434	Current Topics in Bioengineering	3-3-0	4-1	
Elective	NCS201	Organic Chemistry I	3-3-0	2-1	
	ACE201	Physical Chemistry I	3-3-0	2-1	
	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	
	BEN231	Microbiology	3-3-0	2-1	
	BMS201	Molecular Biology	3-3-0	2-2	
	BMS202	Molecular Biology Laboratory	2-0-4	2-2	
	BMS221	Biochemistry II	3-3-0	2-2	
	BEN301	Computational Methods for Biological and Chemical Engineering	3-3-0	3-1	Substitute Course for Dynamic IT
	BMS301	Cell Biology	3-3-0	3-1	
	BEN314	Instrumental Bioanalysis	3-3-0	3-1	
	BEN317	Metabolic Engineering	3-3-0	3-1	
	BMS302	Developmental Biology	3-3-0	3-2	
	BEN316	Protein Engineering	3-3-0	3-2	
	BEN318	Fundamentals of Quantitative Biology	3-3-0	3-2	
	NCS322	Nano-device Processing	3-3-0	3-2	
	NCS333	Polymer Materials Science	3-3-0	3-2	
	BMS361	Cell Biology & Genetics Laboratory	2-0-4	3-2	
	BEN411	Physical Biology of the Cell	3-3-0	4-1	
	NCS431	Current Topics in Nanochemical Science	3-3-0	4-1	
	ACE434	Current Topics in Advanced Chemical Engineering	3-3-0	4-1	
	BMS434	Current Topics in Biomedical Science	3-3-0	4-1	
	SDM451	Introduction to MEMS	3-3-0	4-1	
	ECS372	Introduction to Solar Cells	3-3-0	4-2	
	BEN412	Microbial Physiology	3-3-0	4-2	
	BMS421	Biomedical Imaging	3-3-0	4-2	
	BEN431	Materials for Biomedical Applications	3-3-0	4-2	
	NCS432	Introduction to Surface & Colloid Science	3-3-0	4-2	

▶ Biomedical Science(BMS)

course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark
Required	BMS211	Biochemistry I	3-3-0	2-1	
	BMS261	Biochemistry Laboratory	2-0-4	2-1	
	BMS201	Molecular Biology	3-3-0	2-2	
	BMS301	Cell Biology	3-3-0	3-1	
	BMS332	Anatomy and Physiology	3-3-0	3-2	
	BMS490	Interdisciplinary Project	1-0-2	4-2	
1TR : R 2TR : E	BMS221	Biochemistry II	3-3-0	2-2	
	BMS434	Current Topics in Biomedical Science	3-3-0	4-1	
Elective	NCS201	Organic Chemistry I	3-3-0	2-1	
	BEN231	Microbiology	3-3-0	2-1	
	BMS202	Molecular Biology Laboratory	2-0-4	2-2	
	ACE211	Chemical Reaction Engineering	3-3-0	2-2	
	BEN301	Computational Methods for Biological and Chemical Engineering	3-3-0	3-1	Substitute Course for Dynamic IT
	BEN314	Instrumental Bioanalysis	3-3-0	3-1	
	BEN317	Metabolic Engineering	3-3-0	3-1	
	BMS302	Developmental Biology	3-3-0	3-2	
	BEN316	Protein Engineering	3-3-0	3-2	
	BEN318	Fundamentals of Quantitative Biology	3-3-0	3-2	
	BEN323	Biochemical Engineering	3-3-0	3-2	
	BMS333	Genetics	3-3-0	3-2	
	BMS361	Cell Biology & Genetics Laboratory	2-0-4	3-2	
	BEN411	Physical Biology of the Cell	3-3-0	4-1	
	BMS432	Immunology	3-3-0	4-1	
	BEN434	Current Topics in Bioengineering	3-3-0	4-1	
	BEN412	Microbial Physiology	3-3-0	4-2	
	BMS421	Biomedical Imaging	3-3-0	4-2	
	BEN431	Materials for Biomedical Applications	3-3-0	4-2	
	BMS431	Bioinformatics	3-3-0	4-2	

□ Course Change(Correspondence/Substitution)

Year	Course No.	Category	Course Title	C-L-E	Remark
2009	BEN232	E	Molecular Biology	3-3-0	
2011	BMS201	R			
2009	FCE301	R	Kinetics	3-3-0	abolished
2010	BEN201	R	Biochemistry	3-3-0	
2011	BMS211	R	Biochemistry I	3-3-0	
2010	BEN202	R	Biochemistry Lab	2-0-4	
2011	BMS261	R	Biochemistry Lab	2-0-4	
2010	FCE201	R	Physical Chemistry I : Thermodynamics	3-3-0	
2011	ACE201	R	Physical Chemistry I	3-3-0	
2010	NPS201	R	Organic Chemistry I	3-3-0	
2011	NCS201	R	Organic Chemistry I	3-3-0	
2010	BIE232	E	Microbial Physiology	3-3-0	
2011	BEN412	E	Microbial Physiology	3-3-0	
2010	BIE261	E	Molecular Biology Lab.	2-0-4	
2011	BMS202	E	Molecular Biology Lab.	2-0-4	
2010	FCE202	R	Physical Chemistry II : Kinetics	3-3-0	
2011	ACE202	E	Physical Chemistry II	3-3-0	
2010	NPS202	R	Introduction to Nanoscience and Nanotechnology	3-3-0	
2011	NCS415	E	Introduction to Nanoscience and Nanotechnology	3-3-0	
2010	NPS231	E	Organic Chemistry II	3-3-0	
2011	NCS231	R	Organic Chemistry II	3-3-0	
2010	NPS261	E	Organic/Physical Chemistry Lab. I	2-0-4	
2011	NCS261	E	Organic/Physical Chemistry Lab. I	2-0-4	
2010	BEN201	R	Biochemistry	3-3-0	
2011	BMS211	R	Biochemistry I	3-3-0	

□ Description

NCS201 Organic Chemistry 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.

ACE201 Physical Chemistry I

Theories of classical thermodynamics are covered in this course. First, second, and third laws of thermodynamics are explained along with basics concepts of thermodynamics such as equilibrium, pressure, temperature, heat, internal energy, free energies, work, enthalpy, and entropy.

NCS231 Organic Chemistry 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.

NCS302 Introduction to Polymer Science and Engineering

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.

NCS301 Instrumental Analysis

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).

NCS490 Interdisciplinary Project

This course is joined with other tracks for completing a term project through collaboration. Students are required to conceive a novel idea, which will be realized by designing and fabricating a product by using the best knowledge acquired at the undergraduate level. Lastly, students will present their work in public for evaluation.

ACE202□Physical Chemistry II

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.

NCS431 Current Topics in Nanochemical Science

In recent years nanoscience and nanotechnology have grown rapidly. Nanochemical 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 nanochemical science.

BMS211 Biochemistry I

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.

NCS261 Organic/Physical Chemistry Laboratory I

This course is a complementary laboratory course to the Organic Chemistry (I) and Physical Chemistry (I) lectures. It is designed to aid students in developing more advanced laboratory skills and techniques for the practical application of organic/physical chemistry principles. Learning to work safely is a primary concern. In the Organic/Physical Chemistry (I) Laboratory, students are introduced to basic techniques used in organic chemistry laboratories, such as extraction, distillation, and recrystallization and become familiar with several methods for organic analysis. In addition, the student will learn how to prepare informative lab reports. And also, students will learn several experimental techniques with an emphasis on spectroscopy and polymer characterization.

BEN301 Computational Methods for Biological and Chemical Engineering

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.

ACE303 Transport Phenomena

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.

ACE331 Physical Chemistry III

Statistical thermodynamics and kinetic theory are the two main topics 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 the course, basic kinetic theory including reaction rate, collision, diffusion, and activated complex theory (Eyring equation) are covered.

NCS361 Organic/Physical Chemistry Laboratory II

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.

ACE321 Inorganic Chemistry

The objective of this course is to understand basic principles of modern inorganic chemistry. Topics covered include atomic and molecular structures, molecular shape and symmetry, structure of solids, acid-base, oxidation-reduction, bonding, structure, synthesis and reactivity of transition metal complex, d- and f- block organometallic compounds, and catalysis

NCS322 Nano-device Processing

The goal of this course is to introduce the fundamental concepts and processes used in device design and fabrication with nano-scales so that students can be more effective problem solvers in the industrial environment. Specifically, we aim to instill an appreciation of the advantages and limitations of modern semiconductor technology, unveil the chemistry behind the processes used in chip fabrication, and introduce the challenges that are currently faced in the industrial setting.

ACE323 Introduction to Chemical Process

The operational conditions should be optimized to reach the goals of efficient production, enhanced quality of products, improved safety and energy saving. This course offers the understanding of various types of chemical processes and the methodology of optimizing processes by controlling physical devices via mathematical algorithms.

NCS333 Polymer Materials Science

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.

NCS414 Organic Electronic Materials

Organic electronic materials are currently recognized as key materials for next-generation energy and electronic devices.

This course is aiming at understanding molecular design, synthesis, and charge transport mechanism of organic electronic materials such as organic semiconductors, conducting polymers, and graphenes. In addition, this course will introduce fabrication methods, operation principles, and performance optimization methods of organic electronic devices including organic field-effect transistors (OFETs), organic light-emitting diodes (OLEDs), organic solar cells, and sensors.

ACE434 Current Topics in Advanced Chemical Engineering

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.

NCS421 Introduction to Biopolymers

This undergraduate course is designed to deliver the basic concepts of biopolymers. Biopolymers involve natural macromolecules including proteins and nucleic acids that function as materials both in biological and non-biological applications. The course will cover topics including (i) introduction and definition of biopolymers, (ii) proteins and polypeptides, (iii) nucleic acids, (iv) other biomacro molecules, (v) artificial polymers for biological applications, and (vi) biomacro molecules for biological and non-biological applications.

ACE431 Introduction to Catalysis

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.

BEN431 Materials for Biomedical Applications

This course discusses the critical role of biomaterial in biomedical applications, ranging from the selection of materials, and the processing to the performance testing. The biocompatible issues of metallic, polymeric, ceramic, and composite implants and devices will be discussed. Emphasis will be placed on understanding how biological systems interact with biomaterial in the various aspects of physics, chemistry, biology and materials science.

NCS432 Introduction to Surface & Colloid Science

In this course, common concepts such as the van der Waals forces and surface tensions are discussed from first principles, and other important microscopic forces are introduced. Then, the students will learn the roles of various intermolecular and interparticle forces in determining the properties of simple systems such as gases, liquids, and solids, of more complex colloidal, polymeric, and biological systems. The self-assembly of micro- and nano-components through surface interactions are an essential part of the current nanotechnology.

NCS415 Introduction to Nanoscience and Nanotechnology

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

ACE211 Chemical Reaction Engineering

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.

ACE302 Advanced Chemical Engineering Laboratory

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.

BMS261 Biochemistry Laboratory

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.

BEN311 Transport Phenomena in Biological Systems

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.

BEN321 Nano-Bioengineering

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.

BEN323 Biochemical Engineering

The purpose of this course is to engineer biological strategies to produce useful products and also to design bio-reactors in which biological organisms or molecules can be used. The course covers the basic application of biology and biochemistry to bio-reaction engineering.

BEN434 Current Topics in Bioengineering

This course discusses recent research trends on bioengineering. 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.

BEN231 Microbiology

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.

BMS201 Molecular Biology

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.

BMS202 Molecular Biology Laboratory

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.

BMS221 Biochemistry 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.

BMS301 Cell Biology

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.

BEN314 Instrumental Bioanalysis

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.

BEN317 Metabolic Engineering

This course introduces the basic theories and practical applications used in metabolic engineering, offering a systematic analysis of complex metabolic pathways and ways of employing recombinant DNA techniques to alter cell behavior, metabolic patterns, and product formation.

BMS302 Developmental Biology

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.

BEN316 Protein Engineering

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.

BEN318 Fundamentals of Quantitative Biology

Quantitative biology is distinguished from the mathematical methods for biological sciences or any intermediate disciplines in between mathematics and biology. This course outlines the viewpoint from which the life phenomena arising from physicochemical interactions between molecules in a cell are considered the information processing that a cell utilizes to adapt to the changing environment or random fluctuations. We will review DNA replication, transcriptional and translational control, and particularly, DNA-protein interaction on quantitative basis to study the combinatorial control of gene expression. Throughout the course, students will be guided to find the right biology questions on quantitative basis: Theory-oriented students will critically appreciate modern experimental methods and understand if/how ideas can be tested. Experimentalists will be advised to design proper experiments and discriminate the quality of relevant modeling studies.

BMS361 Cell Biology & Genetics Laboratory

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.

BEN411 Physical Biology of the Cell

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.

BMS434 Current Topics in Biomedical Science

This course will provide in-depth coverage of current hot topics in biomedical science.

BEN412 Microbial Physiology

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.

BMS421 Biomedical Imaging

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.

BMS332 Anatomy and Physiology

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

BMS333 Genetics

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.

BMS432 Immunology

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.

BMS431 Bioinformatics

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.

3. Graduate Programs

□ Biological Science & Engineering

Biological science has been pioneering the pursuit of answers to the most urgent questions regarding human health and welfare. The division of Biological Science at UNIST is the fastest growing leading institution in Korea and is active in interdisciplinary research on many important human diseases to develop novel therapeutics and diagnostic technologies. The students in the Biological Science division will learn the fundamental principles underlying life processes of living organisms as well as engineering concepts to generate useful things from scientific findings and principles.

The graduate division of Biological Science offers Master's and Doctoral degrees in Biomedical Science, Bioengineering, and Nanobiotechnology. Each program is closely intertwined with other programs not only within the division but throughout the university tor encourage groundbreaking interdisciplinary research.

• Biomedical Science

The graduate program of Biomedical Science 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 program 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 program 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.

• Bioengineering

The graduate program of Bioengineering 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 globalcrises related to energy and the environment. Research in the graduate program of Bioengineering focuseson 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 bioengineering graduate program leads the students to become leading researchers and experts within their area as well as creative leaders for both academia and industry.

• Nanobiotechnology

The graduate program of Nanobiotechnology emphasizes research and education at the crossroads of biotechnology and nanoscience, two interdisciplinary areas each of which combines advances in science and engineering. Research at the graduate program of Nanobiotechnology covers the application of the tools and processes of nano/microfabrication to build devices for studying biosystems as well as the utilization of biological systems optimized through evolution, such as cells, cellular components, nucleic acids, and proteins, to fabricate functional nanostructured and mesoscopic architectures comprised of organic and inorganic materials. This graduate program also aims to train all the graduate students in the program as leading researchers and experts in the nanoscience and biotechnology fields through a wide range of courses, in-depth discussions, and laboratory experiments.

□ Chemical Science & Engineering

Chemical science, one of major disciplines in science, has been pioneering the pursuit of answers to the most important questions that confront the world.

The Division of Chemical Sciences at UNIST, the fastest growing graduate institution in the nation, is aiming to be a world-leader in chemistry and chemical engineering. To achieve this goal, the division is actively expanding its faculty, which will number more than 40 by the end of 2012. Already regarded as one of the finest institutions in Korea, the program provides its graduate students with a state-of-the-art research environment and facilities.

The Graduate Division of Chemical Sciences is comprised of three programs: Chemistry, Chemical Engineering, and Polymer Sciences.

Each of these programs provide a unique opportunity for students to encounter major scientific and technological challenges, such as generating renewable energy, synthesizing new drugs, searching for new catalysts, creating bio-inspired nanostructures, developing organic electronics and flexible devices and building powerful transistors and sensors.

The division offers Master's and Doctoral degrees in Chemistry, Chemical Engineering, and Polymer Science. Each program is closely intertwined with other programs not only within the division but throughout the university to encourage groundbreaking interdisciplinary research.

Faculty members in the division are involved in cutting-edge research programs that encompass all areas of chemical science: Organic Chemistry, Inorganic Chemistry, Physical Chemistry, Biological Chemistry, Polymer Science and 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, Nano-Bio Institute and Chemical Sciences Facility.

• Chemistry

The Chemistry program offers exciting opportunities for our graduate students not only to perfect the disciplines of their choice but also to experience a world-class environment for interdisciplinary research. The program is dedicated to delivering a world-class education and research opportunities for our graduate students to aid them in becoming world-leading scientists in academia and industry.

Through a wide range of courses and lab experiences, the graduate students within this program will be trained to fully understand chemical concepts and to think logically. Moreover, their communication skills will be enhanced by regular research meetings, progress talks and conference attendance.

The program offers Master's and Doctoral degrees in all branches of chemistry, including organic, physical, inorganic, materials, polymer, biological and analytical chemistry.

• Chemical Engineering

The scope of Chemical Engineering has vastly expanded in the recent decades from classical research to highly interdisciplinary areas, such as materials, nanoscience, nanoelectronics and biological engineering.

This program at UNIST emphasizes creativity, innovation and engineering principles. For example, chemical engineering principles originally developed for petroleum science are being applied to state-of-the-art technologies including nano/micro-electronics, solar cells, biomimicking molecules and nanocatalysts.

The Chemical Engineering program offers Master's and Doctoral degrees in all areas of chemical engineering as well as recently emerging fields, such as nanoscience, materials, catalysis and bioengineering.

• Polymer Science & Engineering

The Polymer Sciences program, one of the finest in the nation, offers Master's and Doctoral degrees in all areas of polymer science and engineering such as synthesis, physics, nanoscience, materials engineering and biopolymers.

The field of polymers is highly dynamic and interdisciplinary. We provide both a broad-based and fundamental introduction to all of the major polymer subfields as well as individualized courses of study. Flexibility in the curriculum allows students to undertake basic coursework in related programs (chemistry, chemical engineering, bioengineering, biomedical science) and/or more specialized coursework in polymers. Although some students will enter the program with previous polymer experience, either academic or industrial, a polymer background is not required.

The program's collection of polymer instrumentation is one of the largest in the nation, a feature that permits doctoral students in this program to gain unusually broad experimental proficiency during their thesis research.

□ 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 32 credits	at least 18 credits	at least 14 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

□ Curriculum

[Core Subject]

course is	Course No.	Course Title	Cred.-Lec.-Exp.	Semester	Remark
Elective	NBC501	Advanced Biochemistry	3-3-0	1	
	NBC503	Advanced Molecular Biology	3-3-0	1	
	NBC504	Biology and Micro/Nanotechnology	3-3-0	1	
	NBC506	Advanced Polymer Chemistry	3-3-0	1	
	NBC507	Advanced Spectroscopy and imaging	3-3-0	1	
	NBC508	Advanced Materials Chemistry	3-3-0	1	
	NBC502	Advanced Cell Biology	3-3-0	2	
	NBC505	Advanced Bioengineering	3-3-0	2	
	NBC509	Advanced Nanoscience and Nanotechnology	3-3-0	2	
	NBC510	Advanced Chemical Engineering	3-3-0	2	

course is	Course No.	Course Title	Cred.-Lec.-Exp.	Semester	Remark
Elective	NBC551	Bioanalysis	3-3-0	1	*
	NBC552	Systems Biology	3-3-0	1	*
	NBC553	Stem Cell Engineering	3-3-0	1	*
	NBC554	Cancer Biology	3-3-0	1	*
	NBC555	Biochemistry of Diseases	3-3-0	1	*
	NBC602	Protein Crystallography	3-3-0	1	
	NBC603	Signal Transduction in Cells	3-3-0	1	
	NBC606	Essential Biology for Engineers	3-3-0	1	
	NBC617	Analytical Chemistry of Biomolecules	3-3-0	1	
	NBC651	Advanced Physics for Nanomaterials	3-3-0	1	
	NBC652	Semiconductor Processing	3-3-0	1	
	NBC653	Advanced Physical Chemistry	3-3-0	1	
	NBC654	Catalysis	3-3-0	1	
	NBC655	Advanced Biopolymer	3-3-0	1	
	NBC656	Advanced Organic Electronics	3-3-0	1	
	NBC657	Polymer Structures and Properties	3-3-0	1	
	NBC658	Advanced Instrumental Analysis	3-3-0	1	
	NBC701	Molecular Physiology	3-3-0	1	
	NBC702	Biorefinery	3-3-0	1	
	NBC704	Biomaterial-based Nanobiotechnology	3-3-0	1	
	NBC705	Current Topics in Bioenergy and Biotechnology	3-3-0	1	
	NBC706	Spacial Aspects of Magnetic Resonance	3-3-0	1	
	NBC707	Control of Biomolecules	3-3-0	1	
	NBC708	Current Topics in Immunology II	3-3-0	1	
	NBC709	Topics in Genome Data Analysis	3-3-0	1	
	NBC750	Inventions and Patents	3-3-0	1	
	NBC751	Carbohydrate Chemistry	3-3-0	1	
	NBC801	Special Lectures in Nanobioscience and Chemical Engineering A	3-3-0	1	
	NBC802	Special Lectures in Nanobioscience and Chemical Engineering B	3-3-0	1	
	NBC803	Special Lectures in Nanobioscience and Chemical Engineering C	3-3-0	1	
	NBC804	Special Lectures in Nanobioscience and Chemical Engineering D	3-3-0	1	
	NBC805	Special Lectures in Nanobioscience and Chemical Engineering E	3-3-0	1	
	NBC590	The Seminars	1-1-0	1	
	NBC690	Master's Research	Value of Credit	1	
	NBC890	Doctoral Research	Value of Credit	1	

* common courses

Course is	Course No.	Course Title	Cred.-Lec.-Exp.	Semester	Remark
Elective	NBC531	Technical Writing in English	3-3-0	2	
	NBC532	Design and Analysis of Experiments	3-3-0	2	
	NBC556	BioMEMS	3-3-0	2	*
	NBC616	Analysis of Biomolecules	3-3-0	2	
	NBC558	Structural Biology	3-3-0	2	*
	NBC607	Micro and Nanofabrication	3-3-0	2	
	NBC608	Current topics in Immunology I	3-3-0	2	
	NBC609	Protein Science	3-3-0	2	
	NBC610	Current Topics in Quantitative Biology	3-3-0	2	
	NBC611	Biosensors and Bioassays	3-3-0	2	
	NBC612	Quantitative Analysis for Biomedical Images	3-3-0	2	
	NBC613	Advanced Microbial Physiology	3-3-0	2	
	NBC614	Neurobiology	3-3-0	2	
	NBC615	Current Topics of Synthetic Biology	3-3-0	2	
	NBC557	Biomolecular Network	3-3-0	2	*
	NBC659	Advanced Process Control	3-3-0	2	
	NBC660	Advanced Organic Chemistry	3-3-0	2	
	NBC661	Advanced Analytical Chemistry	3-3-0	2	
	NBC711	Current Topics of Biomedical Research	3-3-0	2	
	NBC712	Frontiers of Biomedical Engineering	3-3-0	2	
	NBC713	Mitochondria Biology	3-3-0	2	
	NBC714	Statistical Genetics	3-3-0	2	
	NBC715	Advanced Structural Biology	3-3-0	2	
	NBC752	Advanced Printed Electronics	3-3-0	2	
	NBC753	Advanced Transport Phenomena	3-3-0	2	
	NBC754	Nanolithography	3-3-0	2	
	NBC755	Nonlinear Spectroscopy	3-3-0	2	
	NBC756	Surface Science	3-3-0	2	
	NBC757	Supramolecular Chemistry	3-3-0	2	
	NBC758	Advanced Organic Nanomaterials	3-3-0	2	
	NBC806	Special Lectures in Nanobioscience and Chemical Engineering F	3-3-0	2	
	NBC807	Special Lectures in Nanobioscience and Chemical Engineering G	3-3-0	2	
	NBC808	Special Lectures in Nanobioscience and Chemical Engineering H	3-3-0	2	
	NBC809	Special Lectures in Nanobioscience and Chemical Engineering I	3-3-0	2	
	NBC810	Special Lectures in Nanobioscience and Chemical Engineering J	3-3-0	2	
	NBC590	The Seminars	1-1-0	2	
	NBC690	Master's Research	Value of Credit	2	
	NBC890	Doctoral Research	Value of Credit	2	

* common courses

□ Description

NBC501 Advanced Biochemistry

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.

NBC503 Advanced Molecular Biology

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.

NBC504 Biology and Micro/Nanotechnology

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).

NBC506 Advanced Polymer Chemistry

This course will provide advanced level topics in Polymer Chemistry including an introduction to Polymer Chemistry and the Physical Chemistry of Polymers. The course is designed to deliver graduate students a comprehensive understanding of the chemistry of polymer synthesis and the physical behaviors of polymers. Topics will cover (i) chemistry of polymers, (ii) physical properties of polymers, (iii) solution thermodynamics of polymers, and (iv) advanced topics in polymer chemistry and physical chemistry of polymers.

NBC507 Advanced Spectroscopy and Imaging

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 FTIR, 2DIR, FTNMR, 2DNMR, MRI, and other frequently used spectroscopic techniques such as pump-probe spectroscopy and flourescence resonance energy transfer (FRET).

NBC508 Advanced Materials Chemistry

This course is intended primarily as an introduction course to materials and solid state chemistry for graduate students and advanced undergraduate students. The objective is to understand solids from a chemical perspective and introduce general solid state synthesis methodologies and characterization techniques. Topics covered will include structure and structure determination of crystalline solids; free electron model for metals; electronic band structure; chemical bonding in solids; and structure-property relationships.

NBC502 Advanced Cell Biology

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.

NBC505 Advanced Bioengineering

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.

NBC509 Advanced Nanoscience and Nanotechnology

This course presents a review of recent scientific papers in modern nanoscience and nanotechnology, and introduces principles of sciences and technologies appearing in the review. This course deals with advanced subjects.

NBC510 Advanced Chemical Engineering

The course is intended as an introduction to advanced chemicals manufacturing

and a guide to the principles and elements of process development. It will provide an overview of the chemical engineering discipline, e.g. thermodynamics, synthesis and reaction engineering.

NBC551 Bioanalysis

The goals of this class are 1) basic introduction to DNA, RNA and protein structure, 2) methods for the elucidation of biopolymer structure including PCR, sequencing, electrophoresis, DNA microarrays, cDNA microarrays, protein microarrays, expression analysis, fluorescence spectroscopy and electrochemical techniques, and 3) implementation of conventional bench-top tools for biomolecular analysis followed by a comparison to micro-scale and nano-scale tools for molecular analysis. In particular, scaling factors will be evaluated when transitioning molecular analysis tools to micro- and nano-scale processing.

NBC552 Systems Biology

This course is designed to teach students about Biology with the systemic view rather than the reductive methods. Due to the emergent properties, the phenomena in living organisms cannot be often explained as the sum of its components. Therefore, the recent trend is to integrate each specific area of the biological sciences and to interpret data by utilizing various methods including genomics, proteomics, and metabolics for a better grasp of biological processes.

NBC553 Stem Cell Engineering

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.

NBC554 Cancer Biology

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.

NBC555 Biochemistry of Diseases

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.

NBC602 Protein Crystallography

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.

NBC603 Signal Transduction in Cells

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.

NBC617 Analytical Chemistry of Biomolecules

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.

NBC651 Advanced Physics for Nanomaterials

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.

NBC652 Semiconductor Processing

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.

NBC653 Advanced Physical Chemistry

Lectures on various topics of advanced level physical chemistry are provided in the course. Statistical thermodynamics, quantum chemistry, laser spectroscopy, and chemical reaction dynamics are the main contents of this course. One or two of the topics are covered in detail each semester.

NBC654 Catalysis

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.

NBC655 Advanced Biopolymer

This graduate course will provide the concepts and applications of biopolymers originated from Nature and artificial synthetic polymers. The course is designed to deliver interested graduate students a definition of biopolymers and a creative thinking about how to exploit natural macromolecules as novel materials. The topics will include (i) definition of biopolymers, (ii) protein and polypeptides, (iii) nucleic acids, (iv) other naturally occurring biopolymers, (v) synthetic polymers for biomedical applications, (vi) synthetic chemistry of biopolymers, (vii) applications.

NBC656 Advanced Organic Electronics

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.

NBC657 Polymer Structures and Properties

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.

NBC658 Advanced Instrumental Analysis

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 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.

NBC701 Molecular Physiology

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 biomoleculars will be discussed.

NBC702 Biorefinery

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.

NBC704 Biomaterial-based Nanobiotechnology

This course will review current developments of nanobiotechnology utilizing biomaterials such as nucleic acids, proteins, and carbohydreates 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.

NBC705 Current Topics in Bioenergy and Biotechnology

This course will review current research and publications related to bioenergy and biotechnology and the issues/goals being addressed. Students are required to participate within in-depth discussions about the topics and how it applies to their own research goals.

NBC706 Spatial Aspects of Magnetic Resonance

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.

NBC707 Control of Biomolecules

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.

NBC708 Current Topics in Immunology II

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.

NBC709 Topics in Genome Data Analysis

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.

NBC750 Inventions and Patents

Students can learn how to think creatively and how to make inventions. Students can practice creative thinking (e.g. Triz), claim analysis, and writing patent specifications by using case studies or their own projects.

NBC751 Carbohydrate Chemistry

Carbohydrates are one of the most important components of living cells along with proteins, lipids and nucleic acids. The course covers basic carbohydrate chemistry including synthetic methods, reaction mechanism and stereoelectronic effects.

NBC531 Technical Writing in English

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.

NBC532 Design and Analysis of Experiments

Various tools for design of experiments and statistical data analysis methods including 6 sigma in R&D, technical roadmap, QFD, technical tree, process mapping, MSA, DOE are discussed. Students can practice them by applying the techniques to case studies or their own projects.

NBC556 BioMEMS

This course introduces BioMEMS, one of the most common interdisciplinary research areas, and will initially cover the physical principles of micro-structure and micro-fabrication techniques. The latter part of the class will cover case studies of design, fabrication, and the application of diverse micro/nano-devices, including

micro/nano-mechanical sensors (accelerometer, pressure sensor, flow sensor, temperature sensor), micro-actuators, and microfluidics.

NBC616 Analysis of Biomolecules

An introduction to the principles of analytical biochemistry with an emphasis on quantitative methods. Modern experimental methods such as mass spectrometry, microarray and SNP as well as basic instrumental methods involving spectrophotometry, chromatography, beta/gamma radiation counter will be discussed.

NBC558 Structural Biology

Recent technical developments including gene cloning, the power of the computer and its relevant software has speed up the informational acquisition of protein three-dimensional structures. The aim of this course is to understand the structural and functional logic of proteins. The lecture will cover 1) a brief introduction to the techniques in determining protein structure, 2) recurring structural motifs and domains, and 3) the biological functions inferred by the structural information. The lecture will also provide students with basic ideas about DNA and virus structure, the prediction, engineering, and design of protein structures.

NBC607 Micro and Nanofabrication

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.

NBC608 Current topics in Immunology I

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.

NBC609 Protein Science

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.

NBC610 Current Topics in Quantitative Biology

This course reviews the current achievements in the field of quantitative biology. Emphasis is on hands-on analytical and numerical methods that have been successfully applied to the studies of gene expression regulation, metabolic control, protein-protein interaction, and other topics in cell biology. Basic notions of thermodynamics (statistical mechanics) and enzyme kinetics will be helpful, but not required. Regarding the mathematical prerequisite, calculus level mathematics will suffice.

NBC611 Biosensors and Bioassays

This class will cover the broad application of biological components within sensors and array systems. Topics will span a range of sizes, from whole organism applications down to single cell assays and finally at protein/DNA/aptamer-based sensors, and applications, from environmental and industrial to medical and therapeutic. Although a general text will be used, current research publications will also be discussed within class. Students are required to participate within in-depth discussions about the topics and how it applies to their own research goals

NBC612 Quantitative Analysis for Biomedical Images

Fundamental image signal processing with particular emphasis on problems in biomedical research and clinical medicine will be studied. There will be emphasis on quantitative image handling of MRI, PET and optical image data. The topic will include data acquisition, imaging, filtering, feature extraction, pattern recognition and modeling.

NBC613 Advanced Microbial Physiology

Pre-requisite: Microbiology is strongly recommended. 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. Graduate students will be graded on a different scale than undergraduates.

NBC614 Neurobiology

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.

NBC615 Current Topics of Synthetic Biology

A series of presentations 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 will improve their performance as an independent researchers.

NBC557 Biomolecular Network

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.

NBC659 Advanced Process Control

This course provides the analysis and design of chemical process control systems in depth.

NBC660 Advanced Organic Chemistry

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.

NBC661 Advanced Analytical Chemistry

This course focuses on the theoretical and practical aspects of instrumental methods of chemical analysis. The separation, identification and quantification of analyses will be discussed. The student will develop critical thinking skills in the areas of instrument selection, method development, and data interpretation.

NBC711 Current Topics of Biomedical Research

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.

NBC712 Frontiers of Biomedical Engineering

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.

NBC713 Mitochondria Biology

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.

NBC714 Statistical Genetics

This course covers topics in evolution and population genetics as well as related statistical methods

NBC715 Advanced Structural Biology

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.

NBC752 Advanced Printed Electronics

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.

NBC753 Advanced Transport Phenomena

This course provides an in-depth understanding about how momentum, mass and heat are transferred. It covers the electromagnetic effects on the transport phenomena and fluid dynamics in micro- or nano- fluidic channels.

NBC754 Nanolithography

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.

NBC755 Nonlinear Spectroscopy

This course is designed to introduce various types of nonlinear spectroscopy to graduates who do not have much knowledge of it. Principles and applications of

pump-probe spectroscopy, coherent anti-stokes Raman spectroscopy (CARS), second harmonic generation (SHG), ultrafast 2D IR and 2D electronic spectroscopy are covered in detail.

NBC756 Surface Science

This course is intended primarily as an introduction course to surface science for graduate students. The objective of this course is to understand basic principles of surface phenomena and reactions on surfaces. Topics covered include structure, thermodynamics, dynamics, and electrical properties of surfaces, principles and uses of surface characterization methods, and catalysis by surfaces.

NBC801-810 Special Lectures in Nanobioscience and Chemical Engineering 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.

NBC590 The Seminars

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.

NBC690 Master's Research

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.

NBC890 Doctoral Research

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.

NBC757 Supramolecular Chemistry

This graduate level course will deliver the basic concepts, history, and modern

examples and applications of supramolecular chemistry. The course is designed to deliver to interested graduate students (i) concepts and chemistry of supramolecular chemistry, (ii) self-assembly of molecules and nano-objects, (iii) thermodynamic and physical principles of self-assembly, and (iv) modern examples and applications of self-assembly and supramolecular chemistry.

NBC758 Advanced Organic Nanomaterials

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.

School of Design and Human Engineering

1. School Introduction

The School of Design and Human Engineering (DHE) focuses on theoretical and practical studies of innovative design creation by investigating all aspects of product and product-service system development including needs finding, strategy establishment, planning, conceptualization, analysis of human capabilities and limitations, system integration, manufacturing and business implementation. DHE emphasizes synthetic thought processes that require interdisciplinary and convergent knowledge from (but not limited to) art, engineering, humanities and science. DHE provides three specialized tracks - Integrated Industrial Design (IID), Affective & Human Factors Engineering (AHE), and Engineering & Systems Design (ESD). A wide range of curricula will help students become global experts making innovations with creativity in diverse areas across design and engineering.

2. Undergraduate Programs

□ Track Introduction

1) Integrated Industrial Design (IID)

The IID track is designed 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, which relates to analyzing users and markets, searching unmet needs, generating creative ideas, developing form and function, prototyping and starting up new business. Through balanced courses in theory and practice, students will learn how to establish design strategies and plans, how to generate creative design concepts and how to implement innovative design ideas. Students majoring in the IID track will play roles as integrative design thinkers and practitioners in future society, and lead positive and innovative change in our society by employing user-centered design and scientific methods.

2) Affective & Human Factors Engineering (AHE)

Human factors is the branch of science that applies what is known about human behavior, mental processes, and anatomy and physiology to design development, and evaluation of work methods, environments, technologies, and systems. In the affective & human factors engineering track, students will learn the basic knowledge and functions of human physical & cognitive systems, general ergonomics, and HCI (human computer interaction). This track also teaches color science, which is the scientific discipline dealing with measuring, quantifying and controlling colors we perceive.

3) Engineering & Systems Design (ESD)

The objective of the 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 engineering designer but also as a design manager who is capable of driving new product development projects.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)	
		1TR	2TR
Integrated Industrial Design (IID)	Required	28	22
	Elective	5	5
Affective & Human Factors Design (AHE)	Required	28	22
	Elective	5	5
Engineering & Systems Design (ESD)	Required	28	22
	Elective	5	5

Classification		DHE Required	DHE Elective	Required only for 1st Track	Track Required	Track Elective	Credit (minimum)
1st track(DHE)/ 2nd track(DHE)	1st track (IID, AHE, ESD)		6	6	16	5	33
	2nd track (IID, AHE, ESD)	6			16	5	27
1st track(DHE)/ 2nd track (other school)	1st track (IID, AHE, ESD)	6	3	6	16	2	33
	2nd track (other school's tracks)				in conformity with the 2nd track's credit requirement		27
1st track (other school)/ 2nd track(DHE)	1st track (other school's tracks)			in conformity with the 1st track's credit requirement			33
	2nd track (IID, AHE, ESD)	6	3		16	2	27

□ Curriculum

Course	Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark (Prerequisite)
DHE	DHE Required	DHE201	Design Thinking	3-3-0	2-1 2-2	
		DHE402	Creative Design	3-0-6	4-2	(each track's 4-1 required courses)
	DHE Elective	DHE311	3D CAD & Prototyping	3-2-2	3-1	IID&ESD
		DHE312	UI / UX Design	3-2-2	4-1	IID&AHE
		DHE313	Color Science & Design	3-2-2	3-1	IID&AHE
		DHE314	Creativity & Innovation	3-2-2	3-2	IID&AHE& ESD
		DHE315	High Touch Design	3-2-2	3-1 3-2	IID&AHE &ESD
		DHE316	Digital Human	3-2-2	3-2	AHE&ESD
		DHE412	Design Management	3-3-0	4-2	IID&ESD

▶ Integrated Industrial Design(IID)

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark (Prerequisite)
Required	IID201	Design Elements and Principles	3-1-4	2-1	
	IID202	Product Design Fundamentals	3-0-6	2-2	(IID201)
	IID301	Product Design I	3-0-6	3-1	(IID202)
	IID302	Product Design II	3-0-6	3-2	(IID301)
	IID401	Design System	3-0-6	4-1	(IID302)
	IID490	Interdisciplinary Project	1-0-2	4-1 4-2	
	DHE201	Design Thinking	3-3-0	2-1 2-2	
	DHE402	Creative Design	3-0-6	4-2	(IID401)
1TR : R 2TR : E	IID204	Design Knowledge and Skill 1	3-1-4	2-2	
	IID303	Design Knowledge and Skill 2	3-1-4	3-1	
Elective	IID304	Design Research Methodology	3-2-2	3-2	
	IID305	Multimedia Design	3-1-4	3-1	
	IID306	Design Knowledge and Skill 3	3-1-4	3-2	
	IID403	Design Marketing	3-2-2	4-1	
	DHE311	3D CAD & Prototyping	3-2-2	3-1	
	DHE312	UI / UX Design	3-2-2	4-1	
	DHE313	Color Science & Design	3-2-2	3-1	
	DHE314	Creative & Innovation	3-2-2	3-2	
	DHE315	High Touch Design	3-2-2	3-1 3-2	
	DHE412	Design Management	3-3-0	4-2	
	AHE201	Introduction to Human Factors Engineering	3-3-0	2-1	
	ESD201	Introduction to Engineering Design	3-3-0	2-1	
	AHE202	Engineering Psychology	3-3-0	2-2	
	AHE391	Color Image Engineering	3-2-2	3-2	

▶ Affective &Human Factors Engineering(AHE)

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark (Prerequisite)
Required	AHE201	Introduction to Human Factors Eng.	3-3-0	2-1	
	AHE202	Engineering Psychology	3-3-0	2-2	
	AHE301	Experimental Design	3-1-4	3-1	
	AHE340	Usability Engineering	3-2-2	3-2	
	AHE405	System Engineering	3-3-0	4-1	
	AHE490	Interdisciplinary Project	1-0-2	4-1 4-2	
	DHE201	Design Thinking	3-3-0	2-1 2-2	
	DHE402	Creative Design	3-0-6	4-2	(AHE405)
1TR : R 2TR : E	AHE420	Safety Engineering	3-3-0	4-2	
	AHE320	Work Measurement & Methods	3-3-0	3-1	
Elective	AHE203	Engineering Economy	3-3-0	2-2	
	AHE391	Color Image Engineering	3-2-2	3-2	
	AHE400	Quality Engineering	3-3-0	4-1	
	AHE450	Brain Computer Interface	3-3-0	4-1	
	AHE455	Affective Engineering	3-3-0	4-2	
	DHE312	UI / UX Design	3-2-2	4-1	
	DHE313	Color Science & Design	3-2-2	3-1	
	DHE314	Creativity & Innovation	3-2-2	3-2	
	DHE315	High Touch Design	3-2-2	3-1 3-2	
	DHE316	Digital Human	3-2-2	3-2	
	DHE412	Design Management	3-3-0	4-2	
	ESD201	Introduction to Engineering Design	3-3-0	2-1	

▶ Engineering&Systems Design (ESD)

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark (Prerequisite)
Required	ESD201	Introduction to Engineering Design	3-3-0	2-1	
	SDM250	Mechanical Drawing and Lab.	3-2-2	2-2	
	ESD321	Engineering Design Methods	3-3-0	3-1	(MTH103)
	ESD441	Manufacturing System Design & Simulation	3-3-0	3-2	
	ESD431	Engineering Design Projects I	3-0-6	4-1	
	ESD490	Interdisciplinary Project	1-0-2	4-1 4-2	
	DHE201	Design Thinking	3-3-0	2-1 2-2	
	DHE402	Creative Design	3-0-6	4-2	(ESD431)
1TR : R 2TR : E	ESD232	System Control	3-2-2	2-2	
	ESD322	Design for X	3-3-0	3-2	
Elective	ESD231	Design IT	3-2-2	2-2	
	SDM350	Manufacturing Processes and Lab	3-2-2	3-1	(SDM230/ equivalent)
	ESD451	Introduction to Vehicle Design	3-3-0	4-1	
	DHE311	3D CAD & Prototyping	3-2-2	3-1	
	DHE314	Creativity & Innovation	3-2-2	3-2	
	DHE315	High Touch Design	3-2-2	3-1 3-2	
	DHE316	Digital Human	3-2-2	3-2	
	DHE412	Design Management	3-3-0	4-2	
	SDM302	Introduction to Finite Element Method	3-3-0	3-2	(SDM230)
	SDM351	Mechanical System Design	3-3-0	3-1	(SDM250 & SDM230)
	SDM453	CAD/CAM/CAE	3-0-3	4-2	(SDM250)
	CSE461	System Design Lab.	3-1-4	4-2	
	AHE201	Introduction to Human Factors Eng.	3-3-0	2-1	
	AHE301	Experimental Design	3-1-4	3-1	
	AHE391	Color Image Engineering	3-2-2	3-2	(AHE390)
	AHE420	Safety Engineering	3-3-0	4-2	
	AHE400	Quality Engineering	3-3-0	4-1	

□ Course Change(Correspondence/Substitution)

Year	Course No.	Category	Course Title	C-L-E	Remark
2010	IID222	E	Design Elements and Principles	3-1-4	
2011	IID201	R	Design Elements and Principles	3-1-4	
2010	IID221	R	Product Design Fundamentals	3-0-6	
2011	IID202	R	Product Design Fundamentals	3-0-6	
2010	IID201	R	Introduction to Industrial Design	3-3-0	abolished
2010	IID223	E	Design Graphics	3-1-4	abolished

□ Description

DHE201 Design Thinking

This course is an introductory course in 'Design' and 'Design Thinking' running by team teaching. At least three disciplines taking an important role in the 'Product Development Process' join to run this course. Students will learn various problem-solving methods and the roles of each discipline in the Product Development Process through lectures and through conducting a small problem-solving project.

DHE402 Creative Design

This course is joined with other tracks to complete a term project through collaboration. Students are required to conceive a novel idea, which will be realized by designing, engineering and fabricating a product and proposing business model by using the best undergraduate level knowledge. Lastly, students will present their work in public for evaluation.

DHE311 3D CAD & Prototyping

This course deals with Virtual Product Design Process with 3D Computer Aided Design methods. Students learn various virtual methods related to product design from transforming sketches on a paper into 3D solid data, elaborated modeling, design engineering and visualization to workable prototyping methods with NC or RP and conduct a small project using virtual product design process.

DHE312 UI / UX Design

Fundamentals of user interface / user experience design are addressed including research methods, data analysis, applications, and success stories.

DHE313 Color Science & Design

In this course, students will learn color as a science and also as an art. The human visual system, color measurement systems, color order systems and

psychophysical experimental methods will be taught to understand color as a science while various color combinations will be studied and applied to design works to understand color as an art. Students will conduct their projects focusing on their own interests, science or art.

DHE314 Creativity and Innovation

This course provides an introduction to human creativity, theory of invention (TRIZ) and creativity/innovation in design. The student will obtain the ability to continuously develop successful innovative products, processes and other systems. Furthermore, the student will learn the systematic mapping process through which a creative and innovative idea is translated into reality.

DHE315 High Touch Design

High Touch Design is a process that tries to develop a user friendly, compatible, and aesthetic product based on 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. Term project will be assigned to create a non-existing product.

DHE316 Digital Human

This course deals with theories and applications of CAD (Computer-Aided Design) and DHM (Digital Human Model). You also learn how to use specific CAD/DHM tools (e.g., AUTOCAD, CATIA, RAMSIS).

DHE412 Design Management

This course covers two perspectives of design management; one is design management related to design organization and business and the other is design management realted to product quality in entire product development process. Students will learn how to compose design organization and manage design process effectively in terms of design business in one perspective. In the other perspective, customer-focused quality management, quality controls along the value chain over the whole product lifecycle, and product driven supplier configuration will be discussed.

IID201 Design Elements and Principles

This introductory course will focus on form creation and creative presentation techniques. Basic elements and principles of 2D and 3D design are learnt through lectures and though practical application tutorials in which the relationship between visual and functional elements of design will be understood. Also the principle of esthetic harmony will be covered in the course.

IID202 Product Design Fundamentals

This is an introductory course in product design. It deals with the subject from the observation technique of design problems to the design solving methods through design processes. Through designing low-tech products, students learn the necessary skills for solving observed problems through to the construction of a final prototype.

IID301 Product Design I

This course is a practical introduction to product design focusing on product innovation, production process and techniques, characteristics of materials, and things that should be considered throughout the design production process. The course is structured to develop students' abilities to design products according to the mass production system by improving current design practices.

IID302 Product Design II

This course is structured to focus on market related and product designs. Issues, such as product life cycles, classification of markets, and consumer motivation to purchase products will be central to the course. The course objective is for students to satisfy consumer needs by learning how to survey, gather statistics, and weight the benefits and drawbacks of cultural anthropological approaches to design theory.

IID401 Design System

The objective of this course is to investigate the integrated concept of design products and its system. Emphasis is given to applying innovative and systematic approaches to complex design problems. As a total design, it will focus on not only hardware but also software to create a holistic design solution. The course will emphasize the team work and collaborative learning to solve theoretical and

practical design issues.

IID490, AHE490, ESD490 Interdisciplinary Project

This course is in collaboration with other tracks and requires the student to perform a term project. Students are required to conceive a novel idea which will be envisioned by designing and fabricating a product using the knowledge gained during their studies. Lastly, students will be required to present their work for public evaluation.

IID204 Design Knowledge and Skill 1

Photoshop & Poster / Information design & illustrator / Rhinos / Photography
This course is composed of a "1 month - 4 modules". This course focuses on 2D, 3D computer graphics tools. The course structured to develop students' ability to correctly employ 2D & 3D design processes and software applications.

IID303 Design Knowledge and Skill 2

Prototyping / Design Engineering / Design Material / Production Method
This course is composed of "1 month - 4 modules". Student will learn engineering and manufacturing knowledge for designers. This course will deal with the engineering design issues, effective prototyping using various machines, materials and production skills for product designers.

IID304 Design Research Methodology

This course is designed to study how to effectively solve the general problems happening in the process of research, analysis, integration, and evaluation of design. Students gain ability to understand design problems and solutions, generate creative ideas, and know how to collect and use data and make a decision regarding design.

IID305 Multimedia Design

The objectives of this course are to understand the complicated features of multimedia technology and industries, and to study multimedia design theory and its applications. Emphasis is given to experimenting with image, sound, and video editing techniques for creating multimedia title designs.

IID306 Design Knowledge and Skill 3

Portfolio / Design communication / Professional Practice / Design Venture

This course is composed of "1 month - 4 modules". The course addresses the fundamental characteristics of design theory and communication. Emphasis is also given to practical CV, portfolio design proposals through the use of various mediums. This course also aims at understanding the fundamentals of design practice in the real world, such as, how to manage a design consulting firm, corporate design groups, and how to write design contracts.

IID403 Design Marketing

This is a lecture course to study new consumer and market related product designs. Students are to learn diverse marketing survey methods with statistical analysis such as product positioning, market segmentation, life style analysis, and concept evaluation. This course also aims at understanding the fundamentals of design practice in the real world, such as, understanding relations with various people including clients, buyers and sellers, how to run design consulting firm, practical knowledge of managing the corporate design group, how to write design contracts.

AHE201 Introduction to Human Factors Eng.

This course surveys human factors engineering emphasizing the systems approach to workplace and machine design. 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.

AHE202 Engineering Psychology

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

AHE301 Experimental Design

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 presentation. Primary focus is

on linear regression (simple and multiple) and analysis of variance (single and multiple factor).

AHE340 Usability Engineering

This course deals with definition of usability and its quantification metrics in order to make user-centered systems.

AHE405 System Engineering

Human factors input into operator-system design, development, testing, and evaluation. Emphasis is given to the systems approach to human-machine interfacing, with discussions of practical application of specific methodologies and analytical techniques. Each student performs a design project relying on applicationof systems analysis and design techniques.

AHE420 Safety Engineering

This course deals with transportation safety principles related to humans, vehicles and infrastructure, principles of design for safety, principles and practices of empirical evaluation of safety, principles and practices of an accurate investigation and epidemiological evaluation of safety, and principles and practices of safeguards and controls.

AHE320 Work Measurement & Methods

This course deals with the methods for assessing and improving performance of individuals and groups in organizations. The techniques includes various basic industrial engineering tools, work analysis, data acquisition and application, performance evaluation and appraisal, and work measurement procedures.

AHE203 Engineering Economy

This course deals with the evaluation of various types of necessary economic tradeoffs made during the design and operation of engineering systems. Upon completion of this course, you will be able to perform profitability analyses of proposed engineering designs.

AHE391 Color Image Engineering

Color reproduction characteristics and color matching methods are studied for the various imaging devices commonly used in color image engineering.

AHE400 Quality Engineering

This course is about application of statistical methods and probability models to the monitoring and control of product quality. Techniques for acceptance sampling by variables and attributes are presented. Shewhart control charts for both classes of quality characteristics are examined in depth. The motivation for each method, its theoretical development, and its application are presented. Emphasis is given to designing effective quality control procedures.

AHE450 Brain-Computer Interface

Fundamentals and application areas of brain-computer interface (BCI) are addressed together with human factors issues for engineering improved BCI systems.

AHE455 Affective Engineering

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

ESD201 Introduction to Engineering Design

This course introduces entry-level students to the basic concepts and methods of engineering design including design, production and other product life-cycle issues. Students will study real-world design problems to obtain an knowledge of how the design processes work both in theory and in practice. Engineering design projects will be undertaken during the semester.

SDM250 Mechanical Drawing and Lab.

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 perform a creative mechanical drawing project. The projects will help students learn to work efficiently in a team environment and improve their communication skills.

ESD321 Engineering Design Methods

This course examines essential engineering design methods for each step of the design process. Quality Function Deployment (QFD), functional flow analysis and morphological analysis will be studied for the product specification and the generation phase of design alternatives, whilst various optimization techniques, interval arithmetic, constraint satisfaction &propagation algorithms and Multiple Criteria Decision Analysis (MCDA) will be discussed for the selection phase of design alternatives. Theoretical exercises with case studies will complement the course.

ESD441 Manufacturing System Design & Simulation

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 work cells including robots, material handling systems and other auxiliary equipments are functioning to maximum efficiency and productivity.

ESD431 Engineering Design Projects I

Students will work in design teams and undertake product design projects involving the product specification, conceptual design, detailed design and prototype-making/testing. The essential design knowledge and tools obtained throughout the Design & Human Engineering program will be effectively applied to product design projects. The progress of each design project will be reviewed based on formal presentations at mid-semester and completed project outcomes will be demonstrated at the end of the semester.

ESD232 System Control

This course aims to introduce students to the fundamental principles of mechatronic systems and control. Students will study dynamics of mechanical, electrical and hybrid systems. Topics include: sensors and actuators, intelligent control systems, control theory and programming of industrial control systems including programmable logic controllers (PLC).

ESD322 Design for X

This course introduces the student to some basic concepts and methods in Design for X (DFX). The student will understand today's important design issues, and learn Multiple criteria Design Optimization (MDO) methods to make trade-offs between conflicting and non-commensurable criteria and optimize the design of a product from different points of view(assembly, manufacture, environment, changeability, modularity and other factors). The course also provides a brief introduction to sustainable design (green design), Life Cycle Assessment (LCA), Inclusive design and Integrated Product Service System (IPSS). Theoretical exercises and projects will complement the course.

ESD231 Design IT

This course studies essential and practical software tools and methods for engineering design. Students will improve their understanding of IT applications in engineering design. Practical laboratories and projects will complement the course.

SDM350 Manufacturing Processes and Lab

The course introduces engineering materials used in industry from the perspectives of composition, microstructures, properties, and heat treatment, provide an extensive knowledge of various manufacturing processes, develop basic mathematical descriptions for selected processes, and help 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.

ESD451 Introduction to Vehicle Design

The student studies some selected topics in vehicle design such as styling and aerodynamics in vehicle body design, modern materials for vehicle, new manufacturing challenge and crashworthiness. Future trends and some advanced topics in vehicle design including vehicle telemetry/diagnostics embedded systems are introduced.

SDM302 Introduction to finite element method

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.

SDM351 Mechanical Component Design

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.

SDM453 CAD/CAM/CAE

In this course students are introduced to the theories and algorithms of CAD/CAM/CAE used in design and manufacturing of products. Students will refine their ability to design, analyze, and manufacture various products using CAD/CAM/CAE techniques.

CSE461 System Design Lab.

The aim of this course is for students to obtain development skills in embedded systems by designing and implementing diverse embedded applications which are commonly used to control consumer electronics and machine.

3. Graduate Programs

□ Interdisciplinary Design and Engineering

• Product Development & Innovation

Product development and Innovation (PDI) deals with systematic approach to product innovation. It involves various aspects over product development process of products and product-service combinations from conceptualization, via prototyping to business processes like product commercialization. PDI program offers a balanced mix of theory and practice integrating industrial design and engineering design methods and technologies. You will learn how to catch design demands and opportunities from people, society and technology, and how to perform complex design activities with advanced design methods and technologies, and how to plan, execute and manage product development processes in multidisciplinary teams and distributed environments.

• User Experience & User Interface Design

User Experience & User interface Design (UX/UI design) program deals with how a user experiences and uses a product focusing in particular on diverse methods to understand users to propose and develop new and innovative design and interaction concept. Its methods involve what make users to decide to purchase specific products and what they do with them and expect from them, and how they use and feel from them. You will learn how to observe users, how to set up design direction from user research data building using scenario, and how to test prototypes for newly proposed design and interaction concepts.

• Strategic Design

Strategic Design (SD) program is designed to provide students with methods and technologies on market and trend analysis, consumer research, design conceptualization to carve out new market and market opportunities. SD improves students' ability as design coordinators, manager or strategist to perform and manage design projects considering various aspects related to market, competition, consumer, corporate strategy in the complex and competitive environment of industry. You will learn skills and technologies for conceptualization, development and introduction of strategically sound, sustainable and commercially successful products and services.

• Human Factors Engineering

Human Factors Engineering (HFE) is concerned with designing a variety of systems (e.g., machines, computers, and work environments) in a way that is compatible with human capabilities and limitations. Main tasks of HFE practitioners are 1) to apply existing human performance knowledge to the design or modification of equipment, and 2) to generate new experimental data required for design.

The M.S. & Ph.D. degrees in the HFE option emphasize both methodology and content areas. Methodology areas include a detailed study of existing research, design, and evaluation methods. Content areas include affective engineering, physical ergonomics, and cognitive ergonomics, which are supplemented by supporting courses such as auditory communication, computer displays, industrial safety, and transportation systems.

• Color Science & Engineering

Color science is the scientific discipline dealing with measuring, quantifying and controlling colors we perceive. The graduate course provides the subjects for color vision and color science. Also, engineering methodology is studied to control the colors in the various application areas. The graduate students conduct the fundamental researches such as modeling color appearance phenomena, image quality or color emotion etc, and then apply their theories to the color engineering field.

• Systems Engineering

The systems engineering program is designed to provide the student with advanced education and practical training to become skilled at the logical / systematic synthesis and analysis processes in engineering system design, through which basic science principles, engineering technologies and creative/innovative ideas are translated into products, processes and other systems in reality. The program teaches the student to think not only creatively, but also systematically in order to create something new, or modify/rearrange something that pre-exists for retrofit while placing emphasis on optimal system configuration, intelligent control and simulation. Furthermore, the program teaches the student how to plan and manage the entire product development process. This will prepare the student to succeed not merely as an engineering designer but also as a design manager who is capable of driving the new product development projects.

□ 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 32 credits	at least 18 credits	at least 14 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

□ Curriculum

▶ Design Engineering Convergence Major

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Pre requisite	Related Major
Elective	DHE501	Transdisciplinary Design Practice I	3-0-6	1		All
	DHE502	Transdisciplinary Design Practice II	3-3-0	2	DHE501	All
	DHE503	Transdisciplinary Design Research Issues	3-3-0	1		All
	DHE504	Master Graduation Project	2-2-0	1,2	DHE502	All
	DHE590	The Seminars	1-1-0	1,2		All
	DHE690	Master's Research	Value of Credit	1,2		All
	DHE890	Doctoral Research	Value of Credit	1,2		All
	DHE511	Design issues	3-3-0	1,2		PDI, UX/UI, SD, SE
	DHE512	Research Methodology	3-3-0	1,2		All
	DHE711	Future Design Studies	3-3-0	1,2		All
	DHE712	Sustainable Design	3-3-0	1,2		All
	DHE518	Innovative Product Development	3-3-0	1,2		PDI,SD,SE, HEF
	DHE519	Design Theory & Methodology	3-3-0	1,2		PDI,SE
	DHE520	Transportation Design	3-3-0	1,2		PDI,SD,SE
	DHE526	Human-centered Design	3-3-0	1,2		All
	DHE527	Interaction Design	3-3-0	1,2		PDI,UX/UI
	DHE528	Interactive technology	3-3-0	1,2		PDI,UX/UI
	DHE726	Contextual Design	3-3-0	1,2		PDI,UX/UI, SD, HFE
	DHE728	Cross Cultural Design Studies	3-3-0	1,2		PDI,UX/UI, SD
	DHE533	Project Leadership	3-3-0	1,2		PDI,SD,SE
	DHE534	Brand & Product Strategy	3-3-0	1,2		PDI,SD
	DHE535	Contextual Design 2	3-3-0	1,2		PDI,UX/UI SD
	DHE733	Design Marketing Informatics	3-3-0	1,2		PDI,SD
	DHE734	Design Policy & strategy	3-3-0	1,2		UX/UI,SD
	DHE540	Human Factors Research Design	3-3-0	1,2		HFE,SE
	DHE541	Human Factors Systems Design	3-3-0	1,2		HFE,SE
	DHE542	Advanced Multivariate Methods & Data Mining	3-3-0	1,2		HFE,SE
	DHE543	Human Performance in Transportation System	3-3-0	1,2		HFE,SE
	DHE544	Macroergonomics	3-3-0	1,2		HFE,SE
	DHE545	Operations Research	3-3-0	1,2		HFE,SE
	DHE546	Cultural Ergonomics	3-3-0	1,2		PDI,UX/UI, SD,HFE
	DHE550	Human Physical Capabilities	3-3-0	1,2		PDI,UX/UI, HFE

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Pre requisite	Related Major
Elective	DHE551	Advanced Auditory Display Design	3-3-0	1,2		UX/UI,HFE
	DHE557	Usability Engineering II	3-3-0	1,2		UX/UI,HFE
	DHE558	Human Information Processing	3-3-0	1,2		PDI,UX/UI, HFE
	DHE740 DHE741 DHE742 DHE743	Advanced Topics in Human Factors	3-3-0	1,2		HFE,SE
	DHE745 DHE746 DHE747 DHE748	Techniques and Methodologies in Ergonomics	3-3-0	1,2		ALL
	DHE560	Color Science	3-3-0	1	(DHE313)	PDI,UX/UI, HFE,CSE
	DHE561	Psychophysics	3-3-0	1		UX/UI,CSE
	DHE562	Cross-media color reproduction	3-3-0	2		UX/UI,CSE
	DHE563	Color System	3-3-0	2		CSE
	DHE564	Color Psychology	3-3-0	1		UX/UI,CSE
	MIB503	Marketing Research Method	3-3-0	2		PDI,SD
	TIE542	Strategies for Technology Innovation & Entrepreneurship	3-3-0	2		ALL
	ECE530	Image Processing	3-3-0			CSE
	ECE735	Pattern Recognition	3-3-0			CSE
	MEN531	Finite Element Method	3-3-0			SE
	DHE565	Research Topics in Color Science & Engineering I	3-3-0	1		ALL
	DHE566	Research Topics in Color Science & Engineering II	3-3-0	2		ALL
	DHE761	Human Vision	3-3-0	1		UX/UI,HFE, CSE
	DHE762	Advanced Color Science	3-3-0	1		CSE
	DHE763	Color & Emotion	3-3-0	2		PDI,UX/UI HFE,CSE
	DHE764	Advanced Topics in Color Science & Engineering I	3-3-0	1		ALL
	DHE765	Advanced Topics in Color Science & Engineering II	3-3-0	2		ALL
	DHE570	Advanced Engineering Design Methods	3-3-0	1	ESD321	PDI,SE
	DHE580	Digital Product Development	3-2-2	1		PDI,SE
	DHE571	Root Cause Analysis	3-3-0	2		SE
	DHE581	Reverse Engineering & Rapid Prototyping	3-3-0	2		PDI,SE
	DHE582	Virtual Manufacturing System	3-2-2	1		PDI,SE
	DHE572	Product Lifecycle Management	3-2-2	2		PDI,SE

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Pre requisite	Related Major
Elective	DHE583	Modern Vehicle Design	3-3-0	1		PDI,SE
	DHE584	Vehicle Electronics	3-3-0	2		SE
	DHE770	Design Knowledge Management	3-3-0	1		PDI,SD,SE
	DHE771	Eco-design	3-3-0	2		PDI,SE
	DHE773	Advanced Topics in Engineering Design	3-3-0	1		SE
	DHE780	Advanced Topics in Vehicle Design	3-3-0	1		SE
	DHE565	Research Topics in Color Science & Engineering I	3-3-0	1		ALL
	DHE566	Research Topics in Color Science & Engineering II	3-3-0	2		ALL
	DHE761	Human Vision	3-3-0	1		UX/UI,HFE, CSE
	DHE762	Advanced Color Science	3-3-0	1		CSE
	DHE763	Color & Emotion	3-3-0	2		PDI,UX/UI HFE,CSE
	DHE764	Advanced Topics in Color Science & Engineering I	3-3-0	1		ALL
	DHE765	Advanced Topics in Color Science & Engineering II	3-3-0	2		ALL
	DHE570	Advanced Engineering Design Methods	3-3-0	1	ESD321	PDI,SE
	DHE580	Digital Product Development	3-2-2	1		PDI,SE
	DHE571	Root Cause Analysis	3-3-0	2		SE
	DHE581	Reverse Engineering & Rapid Prototyping	3-3-0	2		PDI,SE
	DHE582	Virtual Manufacturing System	3-2-2	1		PDI,SE
	DHE572	Product Lifecycle Management	3-2-2	2		PDI,SE
	DHE583	Modern Vehicle Design	3-3-0	1		PDI,SE
	DHE584	Vehicle Electronics	3-3-0	2		SE
	DHE770	Design Knowledge Management	3-3-0	1		PDI,SD,SE
	DHE771	Eco-design	3-3-0	2		PDI,SE
	DHE773	Advanced Topics in Engineering Design	3-3-0	1		SE
	DHE780	Advanced Topics in Vehicle Design	3-3-0	1		SE

□ Description

DHE501 Transdisciplinary Design Practice I

This is the first of a two course sequence that aims to provide graduate design and engineering students with transdisciplinary design experience in dealing withreal-world product development projects. Students will work in design teams and undertake practical design projects from conceptual design to production and business modeling.

DHE502 Transdisciplinary Design Practice II

This is the second of the two project-centered courses that provides an open-ended design experience through the creative and disruptive collaboration of all design, engineering and business disciplines. In particular, this second course focuses on transdisciplinary industry-sponsored and global design projects offered in conjunction with the UNICIAD (UNIST Collaborative Integrative Applicative Design) global design program.

DHE503 Transdisciplinary Design Research Issues

This course introduces recent research topics (e.g., Industrial Design, Engineering Design, Ergonimics, HCI, UX, Innovation) that are commonly addressed across disciplines, and discuss the differences in research approach among disciplines. It covers basic and advanced theoryand methodologies involved in transdisciplinary research.

DHE504 Master Graduation Project

This course is offered for Master Students who take Practice-Oriented Masters Program aiming at fostering competent design engineers who have integrated perspectives, creative problem-solving abilities, as well as business skills. 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 winning, outcome transfer into a business or publication of research outcome is expected.

DHE590 The Seminars

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 exchange ideas and information to reach creative and fine-tuned solutions to various pressing global problems via a series of seminars.

DHE690 Master's Research

Students should be actively working in a laboratory setting and gaining experience through hands-on experimentation in order to complete their graduate thesis and dissertation.

DHE890 Doctoral Research

Students should be actively working in a laboratory setting and gaining experience through hands-on experimentation in order to complete their graduate thesis and dissertation.

DHE511 Design Issues

This study is designed to construct a holistic view of design theories and issues discussed in design academia. Students are asked to build a perspective of understanding current stream of design issues.

DHE512 Research Methodology

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 prepare students to conduct graduate level (master or doctoral research).

DHE711 Future Design Studies

Design has been always user-centered to compliment current trends. It is often an effective tool to envision and visualize the future. The objective of this course is to learn systematic design methods and explore various scenarios to understand and describe and predict the future. The course will explore cultural dynamics, technology trends, market contexts and target audiences.

DHE712 Sustainable Design

"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.

DHE518 Innovative Product Development

Theory and practice related to innovation are covered in this course. Students explore how and why innovation happens by analyzing innovation cases and various things surrounding innovation such as technologies, human needs, design processes, manufacturing and methods. Students are expected to complete product development projects.

DHE519 Design Theory and Methodology

Students will explore design theory and methodology. Participants will analyze the difference and commonality of design methods and processes between industrial design and engineering design.

DHE520 Transportation Design

This is a studio course to study engineering and design theories on transportation design regarding mechanics, ergonomics and structures. Students are to learn to deal with mechanical, formal and symbolic elements on transportation design. Through a collaborative project with related industry and research institution, student will analyze and construct new design direction and concepts.

DHE526 Human-centered Design

This course is a project-based introduction to the design of products and processes that meet human needs. Students are given a problem area in which to innovate and will be led through the process of investigating cultural, emotional, technological, and business factors to develop new concepts, creating and testing prototypes, and iterative designs. Principal focus will be placed on understanding the interaction between people, products, and services. The course includes lectures, labs, assigned readings, homework assignments and projects.

DHE527 Interaction Design

This is a lecture / studio course to study general theories on usability regarding learning-ability, efficiency, memorability, satisfaction for information appliances or media. Students are to learn diverse methods related with usability such as heuristic evaluation, task analysis and usability testing so that they can have the capability to lead user-centered design.

DHE528 Interactive technology

This studio course will focus on techniques and technologies for designing interactions. Students will learn interactivity from both a technical and an experiential perspective, and consider its application in a variety of context. In this course students will develop a variety of skills for designing, prototyping and evaluating interactions and develop a facility for commenting and critiquing interaction design.

DHE726 Contextual Design

The course aims at teaching user-centered design methods for identifying users' hidden needs so that innovative design can be created. User-centered methods from stage of planning to idea-generation and evaluation will be covered including user-observation, scenario-based design, self-camera, user-diary, usability testing, user-participatory design etc. Students are expected to build up the capability to plan creative design concepts and conduct user-studies.

DHE728 Cross Cultural Design Studies

Design represents the culture of everyday life. In this global world, local culture represents the identity of the people and influences behaviors nations. Through the comparative study of various cultures, students will understand the unique and universal characteristics of Korean culture. Class participants will complete projects to culture an empathetic understanding of design objects to meet the needs of the local population.

DHE533 Project Leadership

This course will explore leadership theory in the context of business and project management. Student will learn how to organize teams, manage resources, set goals and objectives with emphasis on working in multi-disciplinary environments.

Theoretical underpinnings of communication theory and other related disciplines will also be explored.

DHE534 Brand & Product Strategy

This course bridges branding and product theory with practical skills to build a holistic brand, service, product strategy. Students will develop the key business planning skills by examining business case studies, product platforms, product life-cycles and marketing issues, and the mobilization of the necessary business resources to bring an idea to market.

DHE535 Contextual Design2

The course aims at teaching user-centered design methods for identifying users' hidden needs so that innovative user friendly designscan be created. User-centered methods from stage of planning to idea-generation and evaluation will be covered including user-observation, scenario-based design, self-camera, user-diary, usability testing, user-participatory design etc. Students are expected to build up the capability to plan creative design concepts and conduct user-studies.

DHE733 Design Marketing Informatics

This is a lecture course to study consumer and market behavior related to new product designs. Students are to learn diverse marketing survey methods, statistical analysis, product positioning, market segmentation, life style analysis, and concept evaluation.

DHE734 Design Policy and Strategy

This course aims at understanding the position and roles of design in a company, government and any organizational structure. Using case studies, students will examine design policies and strategies to strengthen the competitiveness of an organization.

DHE540 Human Factors Research Design

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.

DHE541 Human Factors System Design

This course explores human factor inputs into operator-system design, development, testing, and evaluation. Lectures will cover specific methodologies and techniques and how they related to the design and selection of engineering modeling and manual control systems.

DHE542 Advanced Multivariate Methods & Data Mining

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.

DHE543 Human Performance in Transportation Systems

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.

DHE544 Macroergonomics

The course explores the optimization of work system design through consideration of relevant personnel, technological, and environmental variables and their interactions. Emphasis is placed on theoretical background, research methods, analyses, design, development and applications of work systems and the relationship between macro and micro-ergonomics.

DHE545 Operations Research

Basic techniques and methods of Operations Research are presented. The course will cover the phases of problem identification, model building and analytical methods of decision making. Students will be introduced to the implementation of these algorithms and models.

DHE546 Cultural Ergonomics

This course is a survey of the theories, methods, and applications of cultural ergonomics, a specialty area within the discipline of Human Factors Engineering and Ergonomics. This course is organized around 4 system modules -Industrial Safety Systems, Computer-based & Communication Systems, Learning & Training Systems, and Healthcare Systems.

DHE550 Human Physical Capabilities

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.

DHE551 Advanced Auditory display Design

This course is an examination of the human sensory and perceptual experience of sound, with emphasis on relating the capabilities and limitations of audition to the design of auditory display systems and to noise abatement in hearing conservation efforts. In addition to discussion of human sound reception and sensitivity, human psychological and physiological responses to sound will be covered.

DHE557 Usability Engineering II

Design and evaluation of effective user interfaces, beginning with principles for designing the product. Development process for user interaction separate from interactive software development. Development process includes iterative life cycle management, systems analysis, design, usability specifications, design representation techniques, prototyping, formative user-based evaluation. Integrative and cross-disciplinary approach with main emphasis on usability methods and the user interaction development process.

DHE558 Human Information Processing

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.

DHE740,741,742,743 Advanced Topics in Human Factors

This course consists of students-led seminars on contemporary topics in Human Factors.

DHE745,746,747,748 Techniques and Methodologies in Cognitive and Physical Ergonomics

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.

DHE560 Color Science

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.

DHE561 Psychophysics

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.

DHE562 Cross-media color reproduction

Color signal control methods such as device characterization and gamut mapping are introduced to reproduce the same colors on the various imaging devices.

DHE563 Color System

Various color order systems such as Munsell and NCS and the color harmony theories are studied.

DHE564 Color Psychology

The psychological effects of colors are studied.

DHE565, DHE566 Research Topics in Color Science & Engineering I, II

This course is designed for Master course students to introduce the current trends and the state-of the-art color science & engineering. To maintain flexibility in this course, the topics and the instructors will be changed every semesters.

DHE761 Human Vision

The process of human visual perception starting from the retina to the visual cortex is studied along with various adaptation process.

DHE762 Advanced Color Science

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).

DHE763 Color & Emotion

The color emotion scaling methods are studied based on color psychology.

DHE764, DHE765 Advanced Topics in Color Science & Engineering I, II

This course is designed for PhD course students to introduce the current trends and the state-of the-art color science & engineering. The topics and the instructors in this course will be regularly updated to provide students with the latest findings and methodologies in this rapidly evolving field.

DHE570 Advanced Engineering Design Methods

This course covers advanced optimisation techniques, interval arithmetic, constraint satisfaction & propagation algorithms and Multiple Criteria Decision Analysis (MCDA) and distributed Artificial Intelligence (DAI) as design verification and evaluation methods. Uncertainty theories and normative/prescriptive theories of decision making will be discussed to model imprecise information and the choice under risk in early phase design. Theoretical exercises with case studies will complement the course.

DHE580 Digital Product Development

This course examines the state-of-the-art digital infrastructure to plan, design, manufacture and validate of new products. The course introduces the student to a wide range of basic topics in the geometrical modeling & system modeling methods. The student will understand how computer graphics including virtual and augmented reality (VR/AR) is used in product design. The student will also learn how to integrate design, engineering and manufacturing, and how to simulate the entire product development process in a virtual environment.

DHE571 Root Cause Analysis

Root Cause Analysis (RCA) methods and No Fault Found (NFF) phenomena will be introduced as product diagnostics methods. The course covers data analysis, fault identification and elimination. Some topics from the state-of-the-art in vehicle diagnostics will be offered selectively each year.

DHE581 Reverse Engineering & Rapid Prototyping

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 concept and tools for rapid prototyping such as Stereo Lithography Apparatus (SLA), Selective Laser Sintering equipments (SLS) and 3D printing will be introduced.

DHE582 Virtual Manufacturing System

This course studies virtual manufacturing technologies to construct, control and maintain virtual factories, by using commercial solutions. The student learns virtual machining and digital mock-up to discover potential faults causes in product/process designs as well as manufacturing system layout. Robot Off-Line-Programming (OLP) will also be discussed.

DHE572 Product Lifecycle Management

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.

DHE583 Modern Vehicle Design

The student studies the essential topics in modern vehicle design such as styling and aerodynamics in vehicle body design; modern materials for vehicle; new manufacturing challenges crash worthiness; vehicle control systems; suspension system & components; engine design; transmission & driveline; and braking systems. Future trends in vehicle design will be discussed. Industry experts will be invited to lecture on the challenges of modern vehicular design.

DHE584 Vehicle Electronics

This course introduces students to automotive electronics focusing on sensors, actuators, and control systems. Vehicle telemetry/diagnostics systems including required embedded systems will be studied.

DHE770 Design Knowledge Management

This course deals with information & communication technology-based infrastructure to represent, store, acquire, classify, analyze, and finally share design information and knowledge. The student will thus learn why information management is important in collaborative design, and how information management supports the current design process as well as design knowledge proliferation.

DHE771 Eco-design

This course studies how to design a recyclable product and its reconfigurable manufacturing process in order to minimize environmental impacts of the product during its whole lifecycle. In particular, the students will discuss about how to reduce energy consumption, minimize CO2 emission and save natural resources such as air, water and other materials.

DHE773 Advanced Topics in Engineering Design

In this course, advanced topics of special interest in the various areas of engineering design will be selected under the guidance of a faculty member, and the student will present and discuss the current researches.

DHE780 Advanced Topics in Vehicle Design

In this course, advanced topics of special interest in the various areas of vehicle design will be selected under the guidance of a faculty member, and the student will present and discuss the current researches.

MIB503 Marketing Research Method

This course will focus on both qualitative and quantitative aspects of marketing research. Marketing research is an organized way of developing and providing information for decision-making purposes. More specifically, this class 1) provides student with the skills for systematic problem analysis, 2) gives a critical eye for marketing research and appreciation for its potential contributions and limitations, and 3) help students gain a working "hands-on" experience with the full process of marketing research from the formulation of the research problem through the research design, the data collection methods, the questionnaire design, the sampling schemes, and the data analysis.

TIE542 Strategies for Technology Innovation & Entrepreneurship

This class 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 along term source of competitive advantage. Based on the knowledge about the problems identified, students will learn analyzing the problems, and discuss and investigate the strategies to overcome the problems.

ECE530 Image Processing

This course introduces mathematical representation of continuous and digital images, basic coding schemes and formats, picture enhancement, models of image degradation and restoration, segmentation, and pattern recognition.

ECE735 Pattern Recognition

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.

MEN531 Finite Element Method

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.

School of Urban and Environmental Engineering

1. School Introduction

Environmental pollution and climate change caused by modern industrialization and urbanization are directly related to the survival of human beings. With no doubt, 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 towards the improvement of human welfare.

In this division, students will gain basic knowledge related to urban and environmental issues and study more advanced courses represented by three tracks: (1) Environmental analysis and pollution control engineering (environmental analysis, water and air treatment, soil remediation), (2) Earth science and engineering (climate change, global environment, environmental modeling) and (3) Urban development engineering (sustainable design and materials of infrastructures, urban planning and design).

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 Analysis & Pollution Control Engineering (PCE)

The mission of this track is to provide the students with the highest quality technical and professional education in the analysis and treatment of environmental pollutants. This track emphasizes the basic principles of various state-of-the-art instruments, instrumental analysis, physicochemical and biological removal of pollutants, environmental remediation, waste treatment and recycling.

2) Earth Science and Engineering (ESE)

This track focuses on local environmental problems as well as global environmental issues, including climate change. Global environments, climate modeling, environmental fate models, remote sensing, air/soil/water pollution monitoring and hydrology will be studied. On the basis of these courses, the environmental fate of various pollutants and scales will be comprehensively investigated and pollution reduction plans will be established.

3) Urban Development Engineering (UDE)

This major offers fundamental and integrated engineering education essential in pursuing the development of sustainable and resilient urban built environment, with principal aiming at green city planning, sustainable design, construction, and management of urban infrastructures, advanced eco-friendly construction materials, and intelligent transportation systems.

○ Credit Requirement

Track	Required/Elective	Credit(minimum)	
		1Track	2Track
Environmental Analysis & Pollution Control Engineering	Required	16	10
	Elective	17	17
Earth Science and Engineering	Required	16	10
	Elective	17	17
Urban Development Engineering	Required	16	10
	Elective	17	17

□ Curriculum

▶ Environmental Analysis and Pollution Control Engineering

Course is	Course No.	Course Title	Cred.-Lec.-Exp.	Semester	Remark
Required	PCE201	Introduction to Environmental Engineering	3-3-0	2-1	
	ESE201	Environmental Chemistry	3-3-0	2-1	
	ESE301	Environmental Impact Assessment	3-3-0	3-1	
	PCE490	Interdisciplinary Project	1-0-2	4-1	
1TR : R 2TR : E	PCE202	Air Pollution	3-3-0	2-2	
	PCE203	Water Pollution	3-3-0	2-2	
Elective	BEN231	Microbiology	3-3-0	2-1	
	ACE201	Physical Chemistry I	3-3-0	2-1	
	NCS201	Organic Chemistry I	3-3-0	2-1	
	ACE202	Physical Chemistry II	3-3-0	2-2	
	ACE211	Chemical Reaction Engineering	3-3-0	2-2	
	NCS231	Organic Chemistry II	3-3-0	2-2	
	TFP220	Fluid Mechanics	3-3-0	2-2	
	PCE301	Water Treatment Engineering	3-3-0	3-1	(MTH201)
	ESE302	Analysis of Pollutant	3-2-2	3-1	(CHE102, CHE104)
	ACE303	Transport Phenomena	3-3-0	3-1	
	TFP320	Applied Fluid Mechanics	3-3-0	3-1	(TFP220)
	PCE302	Soil Pollution	3-3-0	3-2	
	PCE303	Aquatic Chemistry Laboratory	3-2-2	3-2	(CHE102, CHE104)
	NCS301	Instrumental Analysis	3-3-0	3-2	
	PCE401	Water and Wastewater Engineering	3-3-0	4-1	(MTH201)
	PCE402	Environmental Remediation	3-3-0	4-1	
	PCE403	Wastes Management	3-3-0	4-1	
	PCE404	Environmental Bioprocess	3-3-0	4-2	
	PCE405	Special Topics in Pollution Control Engineering	3-3-0	4-2	
	ESE403	Environmental Toxicology	3-3-0	4-2	

▶ Earth Science and Engineering

Course is	Course No.	Course Title	Cred.-Lec.-Exp.	Semester	Remark
Required	ESE202	Global Environment	3-3-0	2-1	
	PCE201	Introduction to Environmental Engineering	3-3-0	2-1	
	ESE301	Environmental Impact Assessment	3-3-0	3-1	
	PCE490	Interdisciplinary Project	1-0-2	4-1	
1TR : R 2TR : E	ESE203	Atmosphere and Ocean Sciences	3-3-0	2-2	
	ESE204	Environmental Geology	3-3-0	2-2	
Elective	ESE201	Environmental Chemistry	3-3-0	2-1	
	BMS211	Biochemistry I	3-3-0	2-1	
	NCS201	Organic Chemistry I	3-3-0	2-1	
	PCE202	Air Pollution	3-3-0	2-2	
	PCE203	Water Pollution	3-3-0	2-2	
	UDE203	Geographic Information System	3-3-0	2-2	
	TFP220	Fluid Mechanics	3-3-0	2-2	
	ESE302	Analysis of Pollutant	3-2-2	3-1	(CHE102, CHE104)
	ESE303	Environmental Ecology	3-3-0	3-1	
	TFP301	Numerical Analysis	3-3-0	3-1	
	ESE304	Hydrology	3-3-0	3-2	(MTH201)
	ESE305	Remote Sensing	3-3-0	3-2	
	PCE302	Soil Pollution	3-3-0	3-2	
	PCE303	Aquatic Chemistry Laboratory	3-2-2	3-2	(CHE102, CHE104)
	ESE401	Hydraulics	3-3-0	4-1	(MTH201)
	ESE406	Biogeochemistry	3-3-0	4-1	
	PCE402	Environmental Remediation	3-3-0	4-1	
	ESE403	Environmental Toxicology	3-3-0	4-2	
	ESE404	Climate Dynamics	3-3-0	4-2	(MTH201)
	ESE405	Groundwater Engineering	3-3-0	4-2	(MTH201)
	ESE407	Special Topics in Earth Science Engineering	3-3-0	4-2	

▶ Urban Development Engineering

Course is	Course No.	Course Title	Cred.-Lec.-Exp.	Semester	Remark
Required	UDE201	Introduction to Urban Engineering	3-3-0	2-1	
	ESE301	Environmental Impact Assessment	3-3-0	3-1	
	UDE303	Urban Planning	3-3-0	3-2	
	PCE490	Interdisciplinary Project	1-0-2	4-1	
1TR : R 2TR : E	UDE203	Geographic Information System	3-3-0	2-2	
	UDE204	Engineering Mechanics	3-3-0	2-2	
Elective	UDE202	Sustainable Design	3-3-0	2-1	
	ESE202	Global Environment	3-3-0	2-1	
	GMT211	Microeconomics	3-3-0	2-2	
	TFP220	Fluid Mechanics	3-3-0	2-2	
	UDE301	Transportation Systems	3-3-0	3-1	
	UDE302	Urban Survey Analysis Techniques	3-3-0	3-1	
	UDE304	Design of Urban Structures	3-3-0	3-1	
	TFP301	Numerical Analysis	3-3-0	3-1	
	UDE305	Civil Engineering Materials and Lab	3-2-2	3-2	
	UDE306	Reinforced Concrete	3-3-0	3-2	
	UDE401	Urban Transportation Planning	3-3-0	4-1	
	UDE402	Analysis of Structural Systems	3-3-0	4-1	
	PCE401	Water and Wastewater Engineering	3-3-0	4-1	(MTH201)
	PCE403	Wastes Management	3-3-0	4-1	
	ESE401	Hydraulics	3-3-0	4-1	(MTH201)
	UDE403	Urban Renewal	3-3-0	4-2	
	UDE404	Urban Infrastructure Engineering	3-3-0	4-2	
	UDE405	Special Topics in Urban Development Engineering	3-3-0	4-2	
	ESE404	Climate Dynamics	3-3-0	4-2	(MTH201)

□ Course Change(Correspondence/Substitution)

Year	Course No.	Category	Course Title	C-L-E	Remark
2010	ESE201	E	Environmental Chemistry	3-3-0	
2011	ESE201	R	Environmental Chemistry	3-3-0	PCE Track
2010	ESE202	E	Global Environment	3-3-0	
2011	ESE202	R	Global Environment	3-3-0	
2010	UDE201	R	Introduction to Urban and Ecological Engineering	3-3-0	
2011	UDE201	R	Introduction to Urban Engineering	3-3-0	
2010	UDE202	E	Environmental Design	3-3-0	
2011	UDE202	E	Sustainable Design	3-3-0	
2010	PCE203	E	Water Pollution	3-3-0	
2011	PCE203	1TR	Water Pollution	3-3-0	
2010	PCE202	E	Air pollution	3-3-0	
2011	PCE202	1TR	Air pollution	3-3-0	
2010	UDE306	E	Urban Infrastructure Engineering	3-3-0	
2011	UDE404	E	Urban Infrastructure Engineering	3-3-0	
2010	ESE404	E	Introduction to Climate Change	3-3-0	
2011	ESE404	E	Climate Dynamics	3-3-0	

□ Description

PCE201 Introduction to Environmental Engineering

This course explores basic concepts of environmental research and addresses core issues such as air, water, soil, preservation, microbiology, and waste prevention and management.

PCE202 Air Pollution

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

PCE203 Water Pollution

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.

PCE301 Water Treatment Engineering

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

PCE302 Soil Pollution

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.

PCE303 Aquatic Chemistry Laboratory

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.

PCE401 Water and Wastewater Engineering

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.

PCE402 Environmental Remediation

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.

PCE403 Wastes Management

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

PCE404 Environmental Bio-process

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

PCE405 Special Topics in Poiiution Control Engineering

This course introduces new research topics in pollution control engineering.

PCE490 Interdisciplinary Project

This course is in collaboration with other tracks and requires the student to perform a term project. Students are required to conceive a novel idea, which will be envisioned by designing and fabricating a product using the knowledge gained during their studies. Lastly, students will present their work in public for evaluation.

ESE201 Environmental Chemistry

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.

ESE202 Global Environment

The aim of this course is to comprehensively understand various environmental problems, such as geophysical and chemical phenomena, on the basis of

environmental sciences. Human influences such as urbanization, industrialization and the increased use of fossil energy will be studied as major causes of environmental pollution, stratospheric ozone depletion and the desertification process.

ESE203 Atmosphere and Ocean Sciences

This course is an introduction to the dynamics and phenomenology of Earth''s atmosphere and oceanic currents. 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.

ESE204 Environmental Geology

This course offers an introduction to geological processes and materials, and how they affect people and the environment. Specific topics include earthquakes, volcanism, masswasting, floods, coastal hazards, and climatic change. Optional topics may include such items as energy and water resources, subsidence, and waste disposal.

ESE301 Environmental Impact Assessment

An environmental impact assessment (EIA) is a tool to evaluate the impact of urban development on the surrounding environment. EIA can be directly used for decision making, suggesting a modified development plan, or its eventual cancellation. In this course, practical methods for EIA will be studied.

ESE302 Analysis of Pollutant

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.

ESE303 Environmental Ecology

This course deals with basic ecological principles (properties of populations and communities) and study interaction between environmental change (stress or pollution) and the distribution and diversity of organisms in different habitats.

ESE304 Hydrology

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

ESE305 Remote Sensing

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.

ESE401 Hydraulics

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.

ESE403 Environmental Toxicology

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 bio-sensors, and regulation policies will be covered.

ESE404 Climate Dynamics

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.

ESE405 Groundwater Engineering

Topics covered will include groundwater geology, flow nets, hydrologic cycles, resource evaluation, contamination and issues of underground engineering methods as well as others.

ESE406 Biogeochemistry

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.

ESE407 Special Topics in Erarth Science Engineering

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

UDE201 Introduction to Urban Engineering

This course introduces an overview of major Urban/Civil Engineering disciplines including structural, geotechnical, construction materials, and transportation engineering, as well as urban planning and design. Also, fundamentals of physical principles in each area, and elementary design problems if possible, will be discussed.

UDE202 Sustainable Design

This course introduces basic concepts behind sustainable urban development. Discussed topics include global environmental issues motivating sustainable development, building assessment in terms of their environmental impacts, proposed frameworks for achieving sustainability, measuring progress through sustainability indicators, and life cycle assessment.

UDE203 Geographic Information system

Geographic Information Systems (GIS) are used for collecting and analyzing urban and environmental data sets. Through various practices with real data, students in this class will learn how to use GIS software.

UDE204 Engineering Mechanics

This course deals with the mechanics of solids in the context of statics, dynamics, and mechanics of materials. It includes aspects of engineering analysis,

design, and modeling methods for the forces and moments that act either external to the engineering system or within it and transfer through the structure, and for the relationships between the external loads and the intensity of internal forces.

UDE301 Transportation Systems

In this course, students will learn basic theories of transport systems to understand overall traffic phenomena. Practical methods for the analysis of traffic volume and simulations will be covered.

UDE302 Urban Survey Analysis Techniques

This course covers elementary statistics, probability and other types of quantitative reasoning useful for analyzing urban phenomena.

UDE303 Urban Planning

This course deals with principles and theories of land use planning, urban environment planning and transport planning in urban areas and also covers urban renewal of old cities that face long-term infrastructural decay

UDE304 Design of Urban Structures

This course is designed to develop the student's ability to apply principles of engineering mechanics to the design of urban structures: (1) selection of the type of structural form to be used and the material of which the structure is to be made, (2) determination of external loads expected to act on the structure, (3) calculation of stresses and deformations that will be produced in individual members due to external loads, and (4) determination of sizes of members so that applied stresses and deformations are acceptable.

UDE305 Civil Engineering Materials and Lab

This course covers macroscopic mechanical behavior of engineering materials in terms of phenomena at nanometer and micrometer levels for the three types of engineering materials (metals, ceramics, and polymers) with emphasis on specific materials used in civil engineering: Portland cement concrete, steel, rocks, etc.

UDE306 Reinforced Concrete

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.

UDE401 Urban Transporation Planning

The aim of this course is to make students understand transportation systems in urban environment and introduce various methodologies for an efficient transportation plan and to solve real world transportation problems.

UDE402 Analysis of Structural Systems

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 both 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.

UDE403 Urban Renewal

This course deals with methods preparing reasonable policies for urban renewal and/or new city construction via comprehensive analysis of possible social and economic influences. Relevant systems and processes for renewal and compensation for residents will be studied.

UDE404 Urban Infrastructure Engineering

This course provides an introduction to the urban technological side; water resources, water supply and drainage system, environment, structure, subway, waste treatment plants. This course will help the students to gain a better understanding of urban infrastructure.

UDE405 Special Topics in Urban Development Engineering

This undergraduate-level course is designed for subject offerings of new and developing areas in Urban Development Engineering intended to augment the

existing curriculum. See class schedule or course information for topics and prerequisites.

3. Graduate Programs

□ Urban and Environmental Engineering

• Civil Engineering

The Civil Engineering major in UNIST UEE Graduate Program is intended to contribute to developing smart green cities. Qualitative and quantitative analyses of urban phenomena are used to address the planning, design, construction, and management of sustainable urban built environment. Particular emphasis is placed on education and research related to the engineering of sustainable urban infrastructures.

• Urban Planning

The Urban Planning in UNIST UEE Graduate Program is an interdisciplinary research program that builds upon the theories of urban planning and design necessary for constructing ubiquitous ecological cities sustaining future human life. Special emphasis is placed on education and research related to the planning and development of sustainable urban infrastructures.

• Environmental Engineering

UNIST's Environmental Engineering Program focuses on science and technologies needed to protect nature and human lives from pollution. This program provides students with coursework and research on development and management of water resources, water and air quality control, and advanced techniques to analyze and treat pollutants in various media.

• Earth and Environmental Sciences

The ESE major is an inter-disciplinary study to understand the environmental issues in global and regional scales including the climate change. Enrolled students research the science- and engineering-based methodologies to reconstruct the past, observe the present, and predict the future of the Earth system in various temporal and spatial scales, based on the integrated knowledge of atmospheric, oceanic, and earth sciences. The major also aims to develop the state-of-the-art engineering technologies to achieve those scientific goals.

□ 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 32 credits	at least 18 credits	at least 14 credits
Combined Maseter's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

□ Curriculum

▶ Environmental Engineering / ▶ Earth and Environmental Sciences

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Elective	ENV501	Aquatic Chemistry	3-3-0		
	ENV502	Analysis and Monitoring of Organic Pollutants	3-3-0		
	ENV503	Introduction to Membrane Technology to Water/Wastewater Treatment	3-3-0		
	ENV504	Mass Spectrometry	3-3-0		
	ENV505	Advanced Environmental Engineering	3-3-0		
	ENV506	Waste Management	3-3-0		
	ENV507	Wastewater Treatment and Process Design	3-3-0		
	ENV508	Air Pollution Management	3-3-0		
	ENV509	Special Topic for Environmental Engineers	3-3-0		
	ENV510	Environmental Organic Chemistry	3-3-0		
	ENV511	Environmental Photochemistry	3-3-0		
	ENV512	Environmental Nanotechnology	3-3-0		
	ENV513	Introduction to Advanced Oxidation Technology	3-3-0		
	ENV514	Physical and Chemical Treatment Processes	3-3-0		
	ENV515	Movement and Fate of Organic Contaminants in Water	3-3-0		
	ENV516	Satellite Remote Sensing	3-3-0		
	ENV517	Climate-Environment Modeling	3-3-0		
	ENV518	Special Course on Climate Change	3-3-0		
	ENV519	Biosensors	3-3-0		
	ENV590	The Seminars	1-1-0		
	ENV690	Master's Research	Value of Credit		
	ENV890	Doctoral Research	Value of Credit		

▶ Civil Engineering / ▶ Urban Planning

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Elective	URB501	Urban Infrastructure	3-3-0		
	URB502	Evaluation of Transportation Policy	3-3-0		
	URB503	Traffic Impact Analysis	3-3-0		
	URB504	Road Engineering	3-3-0		
	URB505	Intelligent Traffic System	3-3-0		
	URB506	Traffic Modeling	3-3-0		
	URB507	Urban Development and Management	3-3-0		
	URB508	Traffic Engineering	3-3-0		
	URB509	Environmental Ecology Design	3-3-0		
	URB510	Finite Element Methods	3-3-0		
	URB511	Structural Dynamics	3-3-0		
	URB512	Earthquake Engineering	3-3-0		
	URB513	Advanced Structural Design	3-3-0		
	URB514	Characterization of Construction Materials	3-3-0		
	URB515	Smart Infrastructure Health Monitoring	3-3-0		
	URB516	Reliability of Structures	3-3-0		
	URB517	Special Topics in Urban Engineering	3-3-0		
	URB590	The Seminars	1-1-0		
	URB690	Master's Research	Value of Credit		
	URB890	Doctoral Research	Value of Credit		

□ Description

ENV501 Aquatic Chemistry

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.

ENV502 Analysis and Monitoring of Organic Pollutants

This course will focus on multimedia sampling, extraction, cleanup and instrumental analysis for environmental monitoring of organic pollutants.

ENV503 Introduction to Membrane Technology to Water/Wastewater Treatment

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.

ENV504 Mass Spectrometry

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.

ENV505 Advanced Environmental Engineering

For graduate students whose major was not environmental engineering, the history of environmental engineering and major disciplines will be introduced.

ENV506 Waste Management

This course will introduce waste classification, physico-chemical properties, instrumental analysis, waste source, collection and recycling, remediation and treatment and life cycle assessments (LCA).

ENV507 Wastewater Treatment and Process Design

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.

ENV508 Air Pollution Management

This course covers various research fields related to air pollution including ambient air sampling, instrumental analysis, advanced monitoring, long-range transport, comprehensive management and reduction of air pollution.

ENV509 Special Topics for Environmental Engineers

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.

ENV510 Environmental Organic Chemistry

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.

ENV511 Environmental Photochemistry

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.

ENV512 Environmental Nanotechnology

This course introduces the recent research trends about environmental nanotechnologies and also covers the environmental impact of engineered nanoparticles.

ENV513 Introduction to Advanced Oxidation Technology

This course provides basic concepts and principles of advanced oxidation technologies for environmental remediation which include ozonation, Fenton systems and photocatalytic processes.

ENV514 Physical and Chemical Treatment Processes

This course is an introduction to the fundamentals of physical and chemical treatment processes.

ENV515 Movement and Fate of Organic Contaminants in Water

This course covers basic principles on the transport of organic chemicals in surface waters and ground-waters. Including their sorption, mass transfer, advection, dispersion rates, etc.

ENV516 Satellite Remote Sensing

The theory and applied techniques for the satellite remote sensing will be introduced. The course begins with the basic theory of atmospheric radiation and the retrieval algorithm for various geophysical variables. The latter half of the course will specifically focus on how to utilize recently obtained atmospheric composition, vegetation and soil moisture, which are very important in various science and engineering applications related with the climate change.

ENV517 Climate-Environment Modeling

This course introduces the state-of-the-art modeling technology for predicting future global climate and environmental changes. Course topics include the comprehensive understanding on major component models including the global climate prediction model, the chemical transport model and the regional and urban scale prediction models and the coupling strategy for a unified prediction system.

ENV518 Special Course on Climate Change

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.

ENV519 Biosensors

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 biosensors, including their classes, development, fabrication, validation and current use in a variety of applications, especially in toxicity sensing.

ENV590 The Seminars

The purpose of this seminar is to extend knowledge to the state-of-the-art R&D in real scientific fields; and to gain direct experience by contacting experts in various fields of study. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

ENV690 Master's Research

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.

ENV890 Doctoral Research

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.

URB501 Urban Infrastructure

This course aims to understand the characteristics of urban infrastructure,methods of financial support for urban infrastructure and the process of the infrastructure development. This course also provides an overview of innovative approaches to sustainable infrastructure, design and management and the evaluation of infrastructure economics.

URB502 Evaluation of Transportation Policy

This course covers principles and case studies about analyzing the social and economic effects of various policies related to investment, operation management and regulations of transportation.

URB503 Traffic Impact Analysis

This course focuses on studying the evaluation processes of traffic impact caused by the urban and regional development. The course also uses analysis and evaluations traffic flows to detected traffic problems.

URB504 Road Engineering

The basic concepts of road engineering including road planning, design, pavement and maintenance will be studied. After this course, students will understand how to construct environmentally-friendly and efficient road networks.

URB505 Intelligent Traffic System

This course provides basic concepts of intelligent transportation systems (ITS). The elementary characteristics of traffic problems, ITS architecture, integrated core technology of IT are introduced.

URB506 Traffic Modeling

This course aims to obtain and construct simulations methods for safe driving and less congested traffic flow based on real measurement data. Overall traffic situations, such as locations of intersections, traffic lanes, traffic flow with time and pedestrians, are considered within the design traffic systems.

URB507 Urban Development and Management

This course introduces the various techniques of land use planning, urban growth management and urban development strategies for the development and management of sustainable urban environments.

URB508 Traffic Engineering

A course covers basic the principles of traffic flow theory, analytic techniques of traffic flow systems, traffic controls using traffic signal systems and traffic management, etc.

URB509 Environmental Ecology Design

The aim of this course is to introduce various ecology planning techniques for optimized and sustainable environments.

URB510 Finite Element Methods

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.

URB511 Structural Dynamics

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.

URB512 Earthquake Engineering

This course covers effects of earthquake shaking on the built environment; nonlinear dynamic response characteristics of structures (e.g., stiffness, strength, ductility) representation of earthquake inputs in static and dynamic analysis modeling of steel and concrete structures under earthquakes preventive design of structures (buildings, bridges, and underground structures) soil-structure interaction and probabilistic earthquake risk analysis.

URB513 Advanced Structural Design

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.

URB514 Characterization of Construction Materials

This course introduces laboratory methods used to characterize civil engineering materials, including mercury intrusion porosimetry, gas absorption, thermal analysis, scanning electron microscopy, and X-ray diffraction. General topics covered for each method are theoretical background, calculation methods, models, and underlying assumptions, as well as operation of the instrument.

URB515 Smart Infrastructure Health Monitoring

This course introduces concepts and theories of smart sensors and their applications on infrastructure health monitoring. Included are material properties of advanced smart sensors, data acquisition and analysis, digital signal processing, passive, active, semi-active control theories, system identification, damage detection, and random vibration concepts.

URB516 Reliability of Structures

The course topics include fundamentals of probability and statistics, extreme value distributions, probability of failure, reliability, reliability index, failure modes of structures, reliability of structures, system reliability, and application of probabilistic methods in describing and defining design loads and load combinations on structures.

URB517 Special Topics in Urban Engineering

This graduate-level course is designed for subject offerings of new and developing areas in Urban Engineering intended to augment the existing curriculum. See class schedule or course information for topics and prerequisites.

URB590 The Seminars

The purpose of this seminar is to extend knowledge to the state-of-the-art R&D in related scientific fields and for the students to obtain indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to develop creative ideas through the Seminars.

URB690 Master's Research

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.

URB890 Doctoral Research

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.

Interdisciplinary School of Green Energy

1. School Introduction

There are various environmentally friendly renewable energy resources available which have the potential to mitigate the consequences of using fossil fuels and the associated pollution caused by them. These power generation techniques are described as renewable because they are not depleting limited natural resources such as oil and gas which are finite.

The Interdisciplinary School of Green Energy has committed itself to pursuing research into these green technologies as a way of shifting our dependence on fossil fuels towards the production of more sustainable and economically sound energy source, particularly in the fields of manufacture, supply, storage, transmission, and usage.

The Interdisciplinary School of Green Energy is currently carrying out research into the next generation solar cells and photovoltaic systems to harness the infinite potential of the suns energy. In the field of energy conversion and storage, ground breaking research is being conducted on the development of high density energy storage batteries as well as fuel cells to convert hydrogen into an electrical current. The application of which will lead to cleaner burning less polluting vehicles.

In addition, a more effective use of hydrogen energy will be studied by developing better ways to produce and store hydrogen. Nuclear energy is the largest carbon-free non-fossil energy source as well as the lowest cost supplier for electricity production in the world. The research field in nuclear energy at UNIST includes the advancement of safety in operating nuclear power plants, the development of generation fourth (Gen-IV) small and medium-sized nuclear reactors, the hydrogen production utilizing nuclear energy conversion, and the development of nuclear fusion reactors.

2. Undergraduate Programs

□ Track Introduction

1) Energy Conversion & Storage (ECS)

This course will cover the principles and application of the fuel cell, solar cell, and energy storage devices such as lithium ion and polymer cells. In addition, the effective production, use, and storage of hydrogen and its application will be explored.

2) Nuclear Energy (NUE)

This course will cover the operational and safety requirements of nuclear power plants, the development of advanced small and medium-sized nuclear reactors, and hydrogen production utilizing nuclear energy conversion and the development of nuclear fusion reactors.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)	
		1Track	2Track
Energy Conversion & Storage	Required	21	15
	Elective	12	12
Nuclear Energy	Required	22	16
	Elective	11	11

□ Curriculum

▶ Energy Conversion & Storage

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	ECS213	Fundamentals of energy materials	3-3-0	2-1	
	NCS201	Organic Chemistry I	3-3-0	2-1	
	ECS353	Solid State chemistry	3-3-0	3-1	
	ECS354	Introductory electrochemistry	3-3-0	3-2	
	ECS212	Energy conversion and storage lab	2-0-4	3-2	
	ECS490	Interdisciplinary Project	1-0-2	4-2	
Required 1TR : R 2TR : E	ACE201	Physical chemistry I	3-3-0	2-1	
	ECS201	Inorganic chemistry I	3-3-0	2-2	
Elective	ACE202	Physical Chemistry II	3-3-0	2-2	
	ECS371	Electronic Devices	3-3-0	3-1	
	ECS372	Introduction to Solar cells	3-3-0	3-2	
	ECS471	Solar cells lab	2-0-4	4-1	
	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	
	DPH201	Electrodynamics I	3-3-0	3-1	
	NCS231	Organic Chemistry II	3-3-0	2-2	
	ACE331	Physical Chemistry III	3-3-0	3-1	
	ECS341	Instrumental Analysis for Materials	3-3-0	3-1	
	NCS301	Instrumental Analysis	3-3-0	3-2	
	NCS415	Introduction to nanoscience and nanotechnology	3-3-0	4-2	
	ECS312	Inorganic Chemistry II	3-3-0	3-2	
	NCS333	Polymer Material Science	3-3-0	3-2	
	ECS421	Fundamentals of fuel cell (systems)	3-3-0	4-1	
	TFP301	Numerical Analysis Electrochemical	3-3-0	3-1	
	ECS504	Electrochemical Energy Conversion & Storage	3-3-0	4-1	
	DPH401	Solid State Physics	3-3-0	4-1	

▶ Nuclear Energy

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	NUE311	Introduction to Nuclear Reactor Theory	3-3-0	3-1	
	NUE312	Nuclear System Engineering & Experiment	3-2-2	3-1	
	NUE313	Nuclear Materials Engineering & Experiment	3-2-2	3-2	
	NUE321	Nuclear Engineering Design and Lab	3-0-6	3-2	
	NUE421	Nuclear Reactor Lab	3-0-6	4-1	
	NUE490	Interdisciplinary Project	1-0-2	4-2	
1TR : R 2TR : E	NUE211	Fundamentals of Nuclear Engineering I	3-3-0	2-1	
	NUE212	Fundamentals of Nuclear Engineering II	3-3-0	2-2	
Elective	TFP210	Thermodynamics	3-3-0	2-1	
	AME202	Introduction to Materials Science & Engineering	3-3-0	2-1	
	SDM230	Solid Mechanics	3-3-0	2-1	
	NUE233	Nuclear Radiation engineering & Experiment	3-2-2	2-2	
	AME211	Physical Chemistry of Materials II: Reaction Engineering	3-3-0	2-2	
	TFP220	Fluid Mechanics	3-3-0	2-2	
	ACE201	Physical Chemistry I	3-3-0	3-1	
	TFP310	Heat Transfer	3-3-0	3-1	
	TFP301	Numerical Analysis Electrochemical	3-3-0	3-1	
	DPH303	Quantum Mechanics I	3-3-0	3-1	
	DPH304	Quantum Mechanics II	3-3-0	3-2	
	DPH305	Thermal and Statistical Physics	3-3-0	3-2	
	NCS415	Introduction to nanoscience and nanotechnology	3-3-0	4-2	
	CSE211	Introduction to Programming Languages	3-3-0	2-2	
	AME212	Mechanical Behavior of Materials	3-3-0	3-2	
	NUE411	Nuclear Power Plant Engineering	3-3-0	4-1	
	NUE461	Computer Applications in Nuclear Engineering	3-2-2	4-1	
	DPH402	Plasma engineering	3-3-0	4-1	
	DPH201	Electrodynamics I	3-3-0	4-1	
	SDM370	System Dynamics and Control	3-3-0	4-1	
	AHE201	Introduction to Human Factors Eng.	3-3-0	4-1	
	CCS301	Signals and Systems	3-3-0	4-1	
	CCS401	Probability and Introduction to Random Processes	3-3-0	4-2	
	NUE432	Nuclear Fuel Cycle Engineering	3-3-0	4-2	
	NCS301	Instrumental Analysis	3-3-0	3-2	

□ Course Change(Correspondence/Substitution)

Year	Course No.	Category	Course Title	C-L-E	Remark
2010	ECS213	E	Fundamentals of Energy Materials	3-3-0	
2011	ECS213	R	Fundamentals of Energy Materials	3-3-0	
2010	NUE211	R	Fundamentals of Nuclear Engineering	3-3-0	
2011	NUE211	1TR	Fundamentals of Nuclear Engineering I	3-3-0	
2010	NUE233	E	Nuclear Radiation Engineering	3-3-0	
2011	NUE233	E	Nuclear Radiation Engineering & Experiment	3-2-2	
2010	NUE212	R	Introduction to Nuclear Reactor Theory	3-3-0	
2011	NUE311	R	Introduction to Nuclear Reactor Theory	3-3-0	
2010	ECS254	R	Inorganic Chemistry I	3-3-0	
2011	ECS201	1TR	Inorganic Chemistry I	3-3-0	

□ Description

ECS213 Fundamentals of energy materials

This course covers the fundamentals of energy materials related to energy conversion and storage devices, such as batteries, supercapcitors and fuel cells. In addition, this course will explore the scientific principles underlying various storage and conversion principles and wed them to experimental procedures to be carried out in the laboratory.

NCS201 Organic Chemistry I

Introduction to the classification, structure, reactions, and reaction mechanisms of carbon compounds. The general outcome goals are 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 biochemistry, molecular biology, and materials applications of polymers.

ECS353 Solid State chemistry

This course explores the basic principles of 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, electrochemistry, biochemistry, chemical kinetics, diffusion, synthesis method, and phase diagrams. Examples are drawn from energy generation and storage devices such as batteries, fuel cells, and superconductors.

ECS354 Introductory electrochemistry

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.

ECS212 Energy conversion and storage lab

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 performance tests.

ECS490 Interdisciplinary Project

This course is serves as a collaborative project bridging principles and theories with real world applications. Students are required to conceive a novel idea, which will be envisioned by designing and fabricating a product using the knowledge learned at undergraduate level. Lastly, students will present their work in public for evaluation.

ACE201 Physical Chemistry I

Thermodynamics is a discipline about the movement or flow (dynamics) of heat or energy (thermo-). A system of our interest is defined as its equilibrium state, and the energy flow between the system and its surrounding is understood. 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.

ECS201 Inorganic chemistry 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.

ACE202 Physical Chemistry II

This course is designed to provide an understanding of kinetics as it applies to chemical reactions from the microscopic viewpoint and to provide the theoretical

foundation required for designing chemical reactors for controlling chemical reactions.

ECS371 Electronic Devices

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.

ECS372 Introduction to Solar cells

Human need energy for a living. Although we obtain energy from food to sustain our body, we need more and more energy to keep our life comfortable. The first thing we can keep in mind for this might be electricity. Since the electrical energy can be converted almost every other energy form (heat, light etc.), direct conversion from sun light to electricity is very important. Based on the same reason, producing electrical energy through photovoltaic energy conversion by solar cells is the human counterpart. This course provides a fundamental understanding of the functioning of solar cells. The discussion includes the solar cell structures, various kinds of them, their theoretic parts, and analysis tools.

ECS471 Solar cells lab

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.

AME202 Introduction to Materials Science and Engineering

The need for new materials is now increasing as both the mechanical and (opto-)electronic devices become small, light, and integrated. The understanding on basic structure and property of materials in the area of metal, semiconductor, ceramics, and polymers is essential to develop new materials. The primary goal of this course is to explore the fundamental sciences and techniques associated with various structures, properties, and engineering processes. This lecture is to help

students understand the relationship between microstructures of materials and physical (mechanical, electrical, magnetic, optical) and chemical properties.

DPH201 Electrodynamics I

This course first deals with basic electroand 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. Then, it covers the theories related to time-varying electromagnetic waves like Faraday law, Maxwell's equations, wave equation, reflection and refraction of electromagnetic waves at the boundary of dielectric materials. Also, we will learn about flow of electromagnetic power, smith chart, impedance matching, waveguide and cavity, and antenna which are the key applications in communication area.

NCS231 Organic Chemistry 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..

ACE331 Physical Chemistry III

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.

ECS341 Instrumental Analysis for Materials

The conventional analysis methods are carried out by precipitation, extraction, or distillation. For the analysis, the separated components were then treated with

reagents that yielded products that could be recognized by colors or varying characteristics. Traditionally, these methods were time consuming and lacked the precision of current measurement instruments. As a result, this course will explore the benefits of modern instrumental analysis and tools. Instrumental analysis has higher sensitivity and takes relatively short time to complete the analysis. Methods include FTIR, NMR, X-ray analysis, Raman, Voltammetry, etc.

NCS301 Instrumental Analysis

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).

NCS415 Introduction to Nanoscience and Nanotechnology

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

ECS312 Inorganic Chemistry 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.

NCS333 Polymer Material Science

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.

ECS421 Fundamentals of fuel cell (systems)

This class is dealing with the system of the lithium ion batteries and fuel cells, such as proton exchange membrane(PEM), molten carbon fuel cells (MCFC), solid oxide fuel cells (SOFC), and phosphorous fuel cells (PFC).

TFP301 Numerical Analysis Electrochemical

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

DPH401 Solid State Physics

As an introductory course to solid state physics for engineering majors, this course covers crystal structure, lattice vibration, free electron theory in metals, the quantum electron theory and the concept of band theory, electron transport in metal/semiconductor/insulator, dielectric and magnetic properties of materials, and superconducting materials.

NUE311 Introduction to Nuclear Reactor Theory

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.

NUE312 Nuclear System Engineering & Experiment

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.

NUE313 Nuclear Materials Engineering & Experiment

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.

NUE321 Nuclear Engineering Design and Lab

In this course, students select specific topics for their own experiments or simulations among current issues in various nuclear system designs which need improvement or enhancement. Through implementations by experiments or simulations, a chance for enhancement directions that are suggested by students would be provided.

NUE421 Nuclear Reactor Lab

Experiments are performed for production of radioisotopes, neutron activation analysis, neutron radiography, and fuel burnup measurement utilizing Research Reactor. The reactor system is described with reference to the Kori Units 3 & 4, Westinghouse three- loop pressurized water reactors. Their Final Safety Analysis Report (FSAR) is reviewed to examine the thermal and hydraulic system behavior spanning from an abnormal condi- tion to a loss-of-coolant accident condition. The Compact Nuclear Simulator (CNS) is utilized to study the reactor dynamics involving startup and shutdown practice, to examine the thermal hydraulic behavior of the system after a component malfunction or an operator error, and to compare the results against the licensing calculation reported in the FSAR.

NUE490 Interdisciplinary Project

This course is serves as a collaborative project bridging principles and theories with real world applications. Students are required to conceive a novel idea, which will be envisioned by designing and fabricating a product using the knowledge

learned at undergraduate level. Lastly, students will present their work in public for evaluation.

NUE211 Fundamentals of Nuclear Engineering I

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.

NUE212 Fundamentals of Nuclear Engineering II

This course deals with the basic engineering principles underlying the nuclear power plant design and operation. Major subjects are: ①various types of nuclear energy utilizations (nuclear fission/fusion for electricity generation, nuclear ship propulsion, nuclear rockets, nuclear batteries, etc.) ② introduction to nuclear power reactors, ③ nuclear fuel cycles and radioactive waste disposal, ④ heat transfer of nuclear reactors, ⑤ introduction to radiation and its application, and etc.

TFP210 Thermodynamics

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

AME202 Introduction to Materials Science and Engineering

The need for new materials is now increasing as both the mechanical and (opto-)electronic devices become small, light, and integrated. The understanding of the basic structure and properties of materials in the area of metal, semiconductor, ceramics, and polymers is essential to develop new materials. The main background of this course is teaching the fundamental sciences and techniques associated with various structures, properties, and engineering processes. This lecture is to help students understand the relationship between microstructures of

materials and physical (mechanical, electrical, magnetic, optical) and chemical properties.

SDM230 Solid Mechanics

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.

NUE233 Nuclear Radiation engineering & Experiment

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.

AME211 Physical Chemistry of Materials II: Reaction Engineering

This course is designed to extend the concepts and knowledge learned from subject AME202 Physical Chemistry of Materials and provide fundamental understanding of the thermodynamics for materials scientist and engineers. It covers phase equilibrium, calculation of heat capacitance, and the relation between free energy and phase diagram.

TFP220 Fluid Mechanics

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.

ACE201 Physical Chemistry I

Thermodynamics is a discipline about the movement or flow (dynamics) of heat or

energy (thermodynamics). A system of our interest is defined as its equilibrium state, and the energyflow between the system and its surrounding is also taught. Thermodynamics provides the essential strategies (1) for calculating energy conversion (for example, in engines) and (2) for determining the equilibrium composition of a chemically reacting system.

TFP310 Heat Transfer

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.

TFP301 Numerical Analysis Electrochemical

This course introduces numerical methods with emphasis on algorithm construction, analysis and implementation. It covers 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, initial-value problems for ordinary differential equations.

DPH303 Quantum mechanics I

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

DPH304 Quantum mechanics II

This course is the second half of one-year quantum physics 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.

DPH305 Thermal and statistical physics

This introductory course covers basic principles and applications of statistical

thermodynamics. The course includes statistical approach in mechanical problems, the relation of macroscopic thermodynamics and microscopic statistical mechanics, Kinetic Theory and transport phenomena, and fundamentals of quantum statistical mechanics. Also the actual applications of statistical thermodynamics to the gas, liquid and solid systems are introduced.

NCS415 Introduction to Nanoscience and Nanotechnology

This course deals with interesting subjects in modern nanoscience and nanotechnology. This course especially provides principles and applications of unique characteristics which are observed in materials of nanometer scale.

CSE211 Introduction to Programming Languages

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.

AME212 Mechanical Behavior of Materials

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.

NUE411 Nuclear Power Plant Engineering

Applications of digital computers to solve nuclear engineering problems based on applied nuclear engineering codes. Topics include deterministic and Monte Carlo methods; discretization methods, problems with multigroup neutron diffusion, depletion, and kenetics; Two-fluid two-phase modelling of thermalhydrailic phenomena in reactor heat transport systems including modeling and simulation of postulated accidents. This is a simulation-based course; it includes computer code simulation assignments.

NUE461 Computer Applications in Nuclear Engineering

Applications of digital computers to solve nuclear engineering problems based on applied nuclear engineering codes. Topics include deterministic and Monte Carlo methods; discretization methods, problems with multigroup neutron diffusion, depletion, and kusitics; Two-fluid two-phase modelling of thermalhydrailic phenomena in reactor heat trang ort sydelms including modeling and simulation of postulated accidents. This is a simulation-based course; it includes computer code simulation assignments.

DPH402 Plasma engineering

In this course, topics such as the generation and sustaining of plasma, transport and confinement of plasma, stability and equilibrium of plasma are studied.

DPH201 Electrodynamics I

This course is the first half of one-year electrodynamics 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.

SDM370 System Dynamics and Control

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 autopilot, 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.

AHE201 Introduction to Human Factors Eng.

This course surveys human factors engineering emphasizing the systems approach to workplace and machine design. 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

CCS301 Signals and Systems

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.

CCS401 Probability and Introduction to Random Processes

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.

NUE432 Nuclear Fuel Cycle Engineering

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.

NCS301 Instrumental Analysis

This course introduces principles of analytical instruments which are needed for the characterization of various materials, and provides the opportunity to learn how to operate them in laboratories. This course deals with many instruments 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).

3. Graduate Programs

☐ Energy Conversion & Storage Major

This track will cover the principles and application of the fuel cell and energy storage devices(Li-ion cell). In addition, a more effective use of hydrogen energy will be studied by developing better ways to produce and store hydrogen.

- Energy Conversion
- Energy Storage
- Nanomaterials for Energy
- Battery Science and Technology

☐ Nuclear Energy Major

This track includes the advancement of safety measures in operating nuclear power plants, the development of fourth generation (Gen-IV) small and medium-sized nuclear reactors, the hydrogen production utilizing nuclear energy conversion, and the development of nuclear fusion reactors.

- Nuclear Science and Engineering

☐ 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 32 credits	at least 18 credits	at least 14 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

□ Curriculum

▶ Energy Conversion & Storage (ECS)

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Elective	ECS571	Organic Electronics	3-3-0	1	
	ECS572	Special Topics on Solar Cells	3-3-0	1	
	ECS645	Special Topics in Chemistry of Polymeric Materials	3-3-0	1	
	ECS644	Nanostructures and Nanomaterials	3-3-0	2	
	ECS672	Special Topics on Solid State Physics	3-3-0	2	
	ECS673	Special Topics on Nano Thin Films	3-3-0	2	
	ECS646	Special Topics on Organic Electronics	3-3-0	1	
	ECS501	Special Topics on Li-ion Batteries	3-3-0	1	
	ECS502	Solid State Chemistry	3-3-0	1	
	ECS503	Electrochemistry	3-3-0	1	
	ECS504	Electrochemical Energy Conversion & Storage	3-3-0	1	
	ECS541	Nanochemistry	3-3-0	1	
	ECS641	Nanomaterials for Energy Storage	3-3-0	2	
	ECS542	Special Topics on Electronic Materials	3-3-0	1	
	ECS621	Fundamental principles of Advanced Fuel Cells	3-3-0	2	
	ECS521	Special Topics on Fuel Cells	3-3-0	1	
	ECS601	Special Topics on Applied Electrochemistry	3-3-0	2	
	ECS602	Special Topics on Electrochemistry	3-3-0	2	
	ECS642	Special Topics on lithography	3-3-0	2	
	ECS643	Special Topics on Supramolecular Chemistry	3-3-0	2	
	ECS543	Special Topics on Nanomaterial Analysis	3-3-0	1	
	ECS544	Special topics on X-ray powder diffraction analysis XRD	3-3-0	2	
	ECS545	Advanced Inorganic Chemistry	3-3-0	2	
	ECS505	Organic materials for rechargeable batteries	3-3-0	1	
	ECS506	Crystallography	3-3-0	1	
	ECS671	Advanced Organic Spectroscopy	3-3-0	2	

▶ Nuclear Energy (NUE)

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Elective	NUE501	Structural Mechanics in Energy Systems	3-3-0	1	
	NUE502	Engineering of Nuclear Energy Systems	3-3-0	1	
	NUE503	Special Topics on Structural Materials in Energy Systems	3-3-0	2	
	NUE504	Advanced Energy Conversion	3-3-0	2	
	NUE505	Modeling and Simulation in Energy Systems	3-3-0	2	
	NUE506	Fast Reactor Engineering	3-3-0	1	
	NUE507	Nuclear Reactor Dynamics	3-3-0	2	
	NUE508	Special topics in Nuclear Energy Engineering I	3-3-0	1	
	NUE509	Special topics in Nuclear Energy Engineering II	3-3-0	2	
	NUE510	Nuclear Reactor Core Design and Engineering	3-3-0	1	
	NUE511	Nuclear Fuel Engineering	3-3-0	1	
	NUE512	Radiation Measurement Systems	3-3-0	1	
	NUE513	Nuclear Reactor Core Analysis I	3-3-0	1	
	NUE514	Nuclear Reactor Core Analysis II	3-3-0	2	

▶ Common

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Required	GEE590	Seminars	1-1-0	1,2	
	GEE690	Master's Research	Value of Credit	1,2	
	GEE600	Research Trends in Green Energy I	3-3-0	1,2	
Required (Doctor)	GEE890	Doctoral Research	Value of Credit	1,2	
Elective	GEE790	Research Trends in Green Energy II	2-2-0	1,2	

□ Description

GEE600 Research Trends in Green Energy I

This course is designed to investigate recent trends in green energy fields and provide discussions with other students, researchers, and professors.

GEE790 Research Trends in Green Energy 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.

ECS571 Organic Electronics

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.

ECS572 Special Topics on Solar Cells

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.

ECS645 Special Topics in Chemistry of Polymeric Materials

The primary objective of this course provides graduate students with a rich understanding of traditional polymer chemistry such as synthetic tools, properties and applications of polymeric materials. Furthermore, this takes students to the comprehensive coverage of new polymers with spatially extended π-bonding system abbreviated as “conjugated polymers. This course of action particularly suits those students wishing to develop their knowledge of polymer chemistry.

ECS644 Nanostructures and Nanomaterials

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.

ECS672 Special Topics on Solid State Physics

This course will cover the fundamental concepts in solids for students who major in engineering. Topics will include electrical, optical, thermal, and transporting properties of solids, and energy band theory and applications of semiconductors.

ECS673 Special Topics on Nano Thin Films

This course presents concepts of nanosized thin films in various applications of nanotechnologies. Topics include synthetic methods of inorganic, polymeric thin films and 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.

ECS646 Special Topics on Organic Electronics

This advanced course will cover the special issues on organic electronics such as polymer light-emitting diodes, polymer solar cells. Based on the understanding of the basic properties of organic semiconductors, this course will focus on the applications using conjugated polymers and detailed discussions of its current techniques will follow.

ECS501 Special Topics on Li-ion Batteries

This course will emphasize the advanced technologies in electrode and battery systems of the Li-ion cells. Recent technology updates for anode and cathode materials in terms of energy density and safety will be covered as well as in-depth discussions and presentations. Furthermore reviewing patents and papers are also important class tools. Finally, future technologies in Li-ion cells will be discussed.

ECS502 Solid State Chemistry

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.

ECS503 Electrochemisty

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.

ECS504 Electrochemical Energy Conversion & Storage

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.

ECS541 Nanochemistry

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.

ECS641 Nanomaterials for Energy Storage

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.

ECS542 Special Topics on Electronic Materials

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.

ECS621 Fundamental Principles of Advanced Fuel Cells

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.

ECS521 Special Topics on Fuel Cells

This class covers the various topics for fuel cells. It focuses on thermodynamics, kinetics, mass transport, modeling and measurement of cell performance.

ECS601 Special Topics on Applied Electrochemistry

Current issues and state-of-the-art techniques in applied electrochemistry are reviewed and discussed.

ECS602 Special Topics on Electrochemisty

Current issues and state-of-the-art techniques in electrochemistry are reviewed and discussed.

ECS642 special topics on lithography

This course is for students who are interested in the fabrication of multidimensional organic/inorganic structures. This course will offer a general overview of the fabrication of 1D, 2D, and 3D structures. Topics will include several fabrication techniques ("self-assembly based" techniques a fast and inexpensive method, "construction based" techniques, and hybrid techniques such as interference lithography), some basic optics and photoresist chemistry, and other advanced lithography techniques.

ECS643 Special Topics on Supramolecular Chemistry

This course presents concepts and applications of supramolecular chemistry which is the area of chemistry that focuses on the molecular systems consisting of rod-coil, coil-coil, and their combinations. These topics are important to understand many biological systems, and to use in a variety of applications, like separation
membranes, chemical sensors, molecular recognition, and templates for fabrication of nanoparticles. This course is designed for graduate students with backgrounds in organic chemistry, inorganic chemistry, and materials science.

ECS543 Special Topics on Nanomaterials analysis

Nanomaterials show different properties and characteristics so analytical methods of nanomaterials have been developed. This course surveys recent research trends in analytical methods of nanomaterials and their applications to energy-related materials.

ECS544 Special topics on X-ray powder diffraction analysis XRD

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.

ECS545 Advanced Inorganic Chemistry

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.

ECS505 Organic materials for rechargeable batteries

This course covers the organic materials (electrolytes) which are applied to rechargeable batteries. It will focus on the basic knowledge of the design of electrolytes and the understanding of the electrode-electrolyte interface.

ECS506 Crystallography

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.

ECS671 Advanced Organic Spectroscopy

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.

NUE501 Structural Mechanics in Energy Systems

Structural components in energy systems, their functional purposes, operating conditions, and mechanical/structural design requirements. Combines mechanic 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 Systems

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

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 systems including nuclear.

NUE 504 Advanced Energy Conversion

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.

NUE 505 Modeling and Simulation in Energy Systems

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.

NUE506 Fast Reactor Engineering

This course deals with the basic principles, characteristics, and applications of the fast reactors utilizing fast neutrons. The fast reactor development history, its roles and major design requirements are discussed. Major features of fast reactors are studied in terms of the core design, reactor kinetics, and fuel management. Various fast reactor concepts are discussed and the energy conversion engineering is also covered. Finally the latest developments in the fast reactor and relevant issues will be introduced.

NUE507 Nuclear Reactor Dynamics

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 reactors 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 are covered.

NUE508 Special topics in Nuclear Energy Engineering I

This course covers the special field of nuclear engineering such as nuclear batteries, nuclear propulsion and space applications which are not covered by other courses. The content can be variable and will be chosen by the instructor.

NUE509 Special topics in Nuclear Energy Engineering II

This course covers the special field of nuclear engineering such as nuclear safety, probabilistic safety assessment and creative nuclear research reactors which are not covered by other courses. The content can be variable and will be chosen by the instructor.

NUE510 Nuclear Reactor Core Design and Engineering

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

This course explores the manufacturing process of new fuels, operation of produced fuels, and the management of spent fuels in nuclear power plants. It deals with theoretical models and experimental studies on various aspects relevant for the design of nuclear fuels including swelling, fission gas release, property changes of cladding materials after irradiation, interaction between fuel element and cladding.

NUE512 Radiation Measurement Systems

This course covers the generation, amplification, transfer and measurement of electronic signals from nuclear radiation detectors or instruments based on the physical principles of the electronics signal and noise. Also it deals with the design principles of radiation counting, spectroscopy, timing and imaging systems.

NUE513 Nuclear Reactor Core Analysis I

This course covers the advanced theory on nuclear fission reactors. Specific topics includes the following: nuclear fission phenomenon, the chain nuclear reaction, diffusion/moderation/absorption of neutrons, and multi-group neutron diffusion equations.

NUE514 Nuclear Reactor Core Analysis II

This course covers the advanced theory on nuclear fission reactors. Specific topics includes the following: heterogeneous reactors, reactor dynamics, reactivity and its change, perturbation theory and adjoint solutions.

School of Technology Management

1. School Introduction

The School of Technology Management 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, Accounting, International Business, Marketing and Entrepreneurship.

2. Undergraduate Programs

□ Track Introduction

1) General Management (GMT)

Students in the General Management area are trained both in technology and management to be creative global business leaders in domestic and international corporations as well as in academia. The General Management area is designed to provide general management education and is committed to enhancing the knowledge of business and management issues in all major functional areas. Courses covered in General Management include Organizational Behavior, International Business, Marketing, Financial Accounting, Managerial Accounting, Financial Management, Strategic Management, Operations Management, Economics, and Data Analysis & Decision Making.

2) Technology Management/Information System/Entrepreneurship (TIE)

Technology Management addresses the major issues necessary to understand production and service operations and provides a framework for the analysis of a wide range of managerial decision making processes in today's global economy.

Courses in Technology Management include Technology Management, Process & Quality Management, Case Studies in Technology Management and other related courses.

Information Systems is designed to provide the necessary understanding in both technical and business issues relating to the business use of information technology. Courses in Information Systems include Database and Data Mining, E-Business, Strategic Management of IT and other related courses on the management of information systems and use of information technology.

Entrepreneurship is about identifying, valuing and capturing business opportunities in a new or existing organization. Entrepreneurship provides the understanding of the entrepreneurial process and the knowledge and skills of successful entrepreneurs. The courses include Innovation and Entrepreneurship, Managing Innovation and Change, and other related subjects in Technology Management.

3) Finance/Accounting (FIA)

Students in Finance/Accounting are 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, Accounting Information Systems, and Auditing which cover the principles and practices of accounting.

4) Marketing/International Business (MIB)

Students in Marketing/International Business areas are trained for careers in domestic and international corporations and government agencies as well as

careers in academia.

Marketing studies the issues on acquiring and retaining customers for products and services so as to create a mutually beneficial exchange between a company and its customers. Courses in Marketing include Consumer Behavior, Digital Marketing and Marketing Strategy.

With the globalization of the world economy, International Business ensures students prepare for the challenges of operating businesses in the international environment. International Business is typically taken along with other areas in Technology Management from a global perspective. Courses in International Business include International Marketing, International Finance and Global Business Strategy.

□ Credit Requirement

Track	Required/Elective	Credit(minimum)	
		1Track	2Track
General Management	Required	31	31
	Elective	2	-
Technology Management / Information Systems / Entrepreneurship	Required	19	19
	Elective	14	8
Finance / Accounting	Required	16	16
	Elective	17	11
Marketing / International Business	Required	16	16
	Elective	17	11

* The General Management track includes 10 basic courses in Technology Management, and can be selected, as well as the other 3 tracks, if students are fulfilling only one tract in the School of Technology Management. Students who choose 2 tracks within the School of Technology Management must select tracks among 3 other than the General Management track. Ten required courses in General Management are required for the students to fulfill 2 tracks within Technology Management.

□ Curriculum

▶ General Management Track

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Pre-requisite
Required	GMT211	Microeconomics	3-3-0	2	(GMT106)
	GMT202	Organizational Behavior	3-3-0	2	
	GMT203	International Business	3-3-0	2	
	GMT204	Marketing Management	3-3-0	1	
	GMT205	Financial Accounting	3-3-0	1	
	GMT206	Managerial Accounting	3-3-0	2	
	GMT207	Financial Management	3-3-0	1	
	GMT208	Strategic Management	3-3-0	2	
	GMT209	Operations Management	3-3-0	1	(ISM202, MTH211)
	GMT210	Data analysis & Decision Making	3-3-0	2	(ISM202, MTH211)
	GMT490	Interdisciplinary Project	1-0-2	2	
Elective	GMT321	Macroeconomics	3-3-0	1	(GMT211)
	GMT322	Econometrics	3-3-0	2	(MTH211)
	GMT323	Game Theory	3-3-0	1	
	GMT341	Business Ethics	3-3-0	2	
	GMT351	Legal Environment of Business	3-3-0	2	
	GMT491	Independent Study	3-3-0		
	GMT492	Capstone Projects	3-3-0		

▶ Technology Management/Information Systems/Entrepreneurship Track

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Pre-requisite
Required	GMT202	Organizational Behavior	3-3-0	2	
	GMT205	Financial Accounting	3-3-0	1	
	GMT207	Financial Management	3-3-0	1	
	GMT208	Strategic Management	3-3-0	2	
	GMT209	Operations Management	3-3-0	1	(ISM202,MTH211)
	GMT210	Data analysis & Decision Making	3-3-0	2	(ISM202,MTH211)
	TIE490	Interdisciplinary Project	1-0-2	2	
Elective	TIE301	Technology Management	3-3-0	1	
	TIE302	Process & Quality Management	3-3-0	2	(GMT209)
	TIE303	Operations Research	3-3-0	2	
	TIE321	Database and Data Mining	3-3-0	1	(ISM202,MTH211)
	TIE322	e-Business	3-3-0	2	
	TIE323	Strategic Management of IT	3-3-0	1	(GMT208,ISM201)
	TIE324	Mobile Business	3-3-0	2	
	TIE410	Special Topics in Technology Management	3-3-0	2	
	TIE430	Special Topics in Knowledge & Information Management	3-3-0	2	
	TIE441	Managing innovation and Change	3-3-0	1	
	TIE442	High Technology Entrepreneurship	3-3-0	2	
	TIE443	Entrepreneurship and Venture Management	3-3-0	2	
	TIE450	Special Topics in Entrepreneurship	3-3-0	1	
	GMT323	Game Theory	3-3-0	1	
	GMT341	Business Ethics	3-3-0	2	
	GMT351	Legal Environment of Business	3-3-0	2	
	GMT491	Independent Study	3-3-0		
	GMT492	Capstone Projects	3-3-0		
	MIB302	Internet Marketing	3-3-0	2	(GMT204,GMT208)

▶ Finance/ Accounting Track

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Pre-requisite
Required	GMT211	Microeconomics	3-3-0	2	(GMT106)
	GMT205	Financial Accounting	3-3-0	1	
	GMT206	Managerial Accounting	3-3-0	2	
	GMT207	Financial Management	3-3-0	1	
	GMT210	Data analysis & Decision Making	3-3-0	2	(ISM202, MTH211)
	FIA490	Interdisciplinary Project	1-0-2	2	
Elective	FIA301	Investment Analysis	3-3-0	2	(GMT207)
	FIA302	Money and Banking	3-3-0	1	(GMT207)
	FIA303	Futures and Options	3-3-0	2	(GMT207)
	FIA321	Intermediate Accounting I	3-3-0	1	(GMT205)
	FIA322	Intermediate Accounting II	3-3-0	2	(GMT205, GMT206)
	FIA323	Accounting Information Systems	3-3-0	1	(GMT205, GMT206)
	FIA401	Financial Engineering	3-3-0	1	(GMT207)
	FIA409	Case Studies in Finance	3-3-0	2	(GMT207)
	FIA410	Special Topics in Finance	3-3-0	2	(GMT205)
	FIA421	Auditing	3-3-0	2	(FIA322)
	FIA429	Case Studies in Accounting	3-3-0	1	(FIA322)
	GMT321	Macroeconomics	3-3-0	1	(GMT211)
	GMT322	Econometrics	3-3-0	2	(GMT211)
	GMT341	Business Ethics	3-3-0	2	
	GMT351	Legal Environment of Business	3-3-0	2	
	GMT491	Independent Study	3-3-0		
	GMT492	Capstone Projects	3-3-0		
	MIB322	International Finance	3-3-0	2	

▶ Marketing/International Business Track

Courseis	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Pre-requisite
Required	GMT208	Strategic Management	3-3-0	2	
	GMT203	International Business	3-3-0	2	
	GMT204	Marketing Management	3-3-0	1	
	GMT207	Financial Management	3-3-0	1	
	GMT210	Data analysis & Decision Making	3-3-0	2	(ISM202,MTH211)
	MIB490	Interdisciplinary Project	1-0-2	2	
Elective	MIB301	Consumer Behavior	3-3-0	1	(GMT204,GMT208)
	MIB302	Internet Marketing	3-3-0	2	(GMT204,GMT208)
	MIB303	Quantitative Marketing Decision Making	3-3-0	2	(GMT204,GMT208)
	MIB321	International Marketing	3-3-0	1	
	MIB322	International Finance	3-3-0	2	
	MIB402	Marketing Research	3-3-0	1	(GMT204,GMT208)
	MIB403	Advertising Management	3-3-0	1	
	MIB404	Experimental Design with Applications in Marketing	3-3-0	2	(GMT204,GMT208)
	MIB409	Case Studies in Marketing	3-3-0	1	(GMT204,GMT208)
	MIB410	Special Topics in Marketing	3-3-0	2	(GMT204,GMT208)
	MIB421	Global Business Strategy	3-3-0	2	
	MIB429	Case Studies in international Business	3-3-0	1	
	MIB430	Special Topics in International Business	3-3-0	2	
	GMT321	Macroeconomics	3-3-0	1	(GMT211)
	GMT322	Econometrics	3-3-0	2	(GMT211)
	GMT341	Business Ethics	3-3-0	2	
	GMT351	Legal Environment of Business	3-3-0	2	
	GMT491	Independent Study	3-3-0		
	GMT492	Capstone Projects	3-3-0		
	TIE321	Database and Data Mining	3-3-0	1	(ISM202,MTH211)

□ Course Change(Correspondence/Substitution)

Year	Course No.	Category	Course Title	C-L-E	Remark
2010	GMT201	R	Macroeconomics	3-3-0	
2011	GMT321	E	Macroeconomics	3-3-0	

□ Description

GMT202 Organizational Behavior

Organizational behavior is the study and application of knowledge about how individuals or groups of people act within organizations. 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.

GMT203 International Business

Companies compete in the international market within a globalized 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 international business issues.

GMT204 Marketing Management

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.

GMT205 Financial Accounting

Financial Accounting examines the basic concepts of accounting and provides a basic framework to understand the financial statement from a users'point of view. This course also provides the overview of basic financial statements such balance sheets, income statements and cash flow statements for financial and accounting decision making.

GMT206 Managerial Accounting

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

GMT207 Financial Management

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.

GMT208 Strategic Management

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.

GMT209 Operations Management

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.

GMT210 Data analysis & Decision Making

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.

GMT211 Microeconomics

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.

GMT321 Macroeconomics

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.

GMT322 Econometrics

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.

GMT323 Game Theory

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.

GMT341 Business Ethics

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.

GMT351 Legal Environment of Business

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.

GMT490 Interdisciplinary Project

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.

GMT491 Independent Study

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.

GMT492 Capstone Projects

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.

TIE301 Technology Management

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.

TIE302 Process & Quality Management

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.

TIE303 Operations Research

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.

TIE321 Database and Data Mining

This course studies the basic theory and application of databases, and presents techniques for identifying patterns in data.

TIE322 E-Business

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.

TIE323 Strategic Management of IT

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.

TIE324 Mobile Business

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.

TIE410 Special Topics in Technology Management

This course is designed to discuss contemporary topics in technology management. Actual topics and cases will be selected by the instructor and may vary from term to term.

TIE430 Special Topics in Knowledge & Information Management

This course is designed to discuss contemporary topics in knowledge management. Actual topics and cases will be selected by the instructor and may vary from term to term.

TIE441 Managing Innovation and Change

This course covers current issues and theories on the management of innovation and change in new and existing organizations. It prepares students to understand practical business cases.

TIE442 High technology Entrepreneurship

This course is designed to introduce recent trends in emerging high technologies and to discuss strategic and managerial issues and cases in high-tech industries. Students will have an opportunity to learn new perspectives on strategies as well as technological knowledge and implications in emerging high-tech industries.

TIE443 Entrepreneurship and Venture Management

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.

TIE450 Special Topics in Entrepreneurship

This course is designed to discuss contemporary topics in entrepreneurship. Actual topics and cases will be selected by the instructor and may vary from term to term.

TIE490 Interdisciplinary Project

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.

FIA301 Investment Analysis

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

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 Options

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.

FIA321 Intermediate Accounting I

Financial accounting is related to the preparation of financial statements for decision makers, such as shareholders, employees, suppliers, banks, and others. Financial Accounting can be regarded as the process of summarizing financial data which is taken from an organization's financial records and publishing in the form of annual (or more frequent) reports for the benefit of interested people.

FIA322 Intermediate Accounting II

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.

FIA323 Accounting Information Systems

This course helps students better understand and make use of accounting information systems. Also, by having the chance to use the ERP (Enterprise Resource Planning) software, students will be able to develop practical abilities in their field and to provide reliable accounting information for people interested in companies.

FIA401 Financial Engineering

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.

FIA409 Case Studies in Finance

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

This course covers the recent special issues of Corporate Finance, Money and Banking, Investments, Financial Engineering, Derivative Securities and Risk Management. This is an advanced course with an introduction into some empirical and quantitative methods.

FIA421 Auditing

This course presents basic concepts, practical procedures and statistical techniques of auditing. It will focus on auditing standards, planning, supervising an audit engagement and auditing in computerized environments.

FIA429 Case Studies in Accounting

This course helps students understand the subjects in Accounting, and gives opportunities to discuss the managerial and academic issues through practical cases in Accounting.

FIA490 Interdisciplinary Project

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.

MIB301 Consumer Behaviors

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.

MIB302 Internet Marketing

This course provides the marketing theories and applications from the consumers' perspective with the development of e-commerce and internet technology. It examines the impact of new internet technologies and e-business on consumers and marketing media. The class will discuss the current digital marketing strategies, specific internet techniques, and relevant sociological issues.

MIB303 Quantitative Marketing Decision Making Engineering

Marketers are seeing increasingly faster changes in the marketplace and are barraged with an ever increasing amount of information. While many view traditional marketing as art and some view it as science, new marketing increasingly looks like engineering. This course provides students with the know-how and tools to collect the right information and perform analysis to make better marketing plans, better product designs, and better decisions. The goal of this course is to train marketing engineers to translate concepts into context-specific operational decisions and actions using analytical, quantitative, and computer modeling techniques.

MIB321 International Marketing

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.

MIB322 International Finance

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.

MIB402 Marketing Research

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.

MIB403 Advertising Management

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

MIB404 Experimental Design with Applications in Marketing

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.

MIB409 Case Studies in Marketing

his course helps students understand the subjects in Marketing, and gives opportunities to discuss the managerial and academic issues through practical cases in Marketing.

MIB410 Special Topics in Marketing

This course is designed to discuss contemporary topics and issues in marketing including marketing in nonprofit organizations, marketing of services, marketing in the public sector, and marketing in an economy of scarcity. In principle, only one topic area is addressed in any one semester. Course content reflects contemporary developments and the current interests of instructors and students.

MIB421 Global Business Strategy

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.

MIB429 Case Studies in International Business

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.

MIB430 Special Topics in International Business

This is an advanced course on selected issues in the theory and application of international business. Actual topics and cases will be chosen by the instructor and may vary from each semester.

MIB490 Interdisciplinary Project

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.

3. Graduate Programs

☐ Technology Management

Technology Management addresses the major issues necessary to understand production and service operations and provides a framework for the analysis of a wide range of managerial decision making processes in today's global economy.

☐ Finance

Finance is an area to study the ways in which individuals, corporations, and other business organizations allocate resources and make financial decisions in capital markets.

☐ Accounting

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.

☐ Marketing

Marketing studies the issues on acquiring and retaining customers for products and services so as to create a mutually beneficial exchange between a company and its customers.

☐ 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 32 credits	at least 18 credits	at least 14 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

□ Curriculum

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark
Elective	GMT511	Microeconomic Theory	3-3-0	1	
	GMT512	Macroeconomic Theory	3-3-0	2	
	GMT513	Econometrics	3-3-0	1	
	GMT521	Mathematical programming	3-3-0	2	
	GMT522	Probability Models with Applications	3-3-0	1	
	GMT523	Multivariate Statistical Analysis	3-3-0	2	
	GMT524	Forecasting Theory and Applications	3-3-0	1	
	GMT541	Organizational Behavior	3-3-0	2	
	GMT542	Strategic Management	3-3-0	1	
	GMT543	Consulting Methodology	3-3-0	2	
	GMT690	Master's Research	Value of Credit	1,2	
	GMT890	Doctoral Research	Value of Credit	1,2	
	GMT590	Seminars	1-1-0	1,2	
	TIE501	Decision Analysis Theory	3-3-0	1	
	TIE502	Supply Chain Management	3-3-0	2	
	TIE503	Optimization Theory	3-3-0	1	
	TIE504	Operations Strategy	3-3-0	2	
	TIE505	Management and Optimal Control Theory	3-3-0	1	
	TIE506	Management of Strategic Alliances	3-3-0	2	
	TIE509	Topics in Technology Management	3-3-0		
	TIE521	Management Information Systems	3-3-0	1	
	TIE522	Data Mining	3-3-0	1	
	TIE523	e-Business Strategy	3-3-0	2	
	TIE529	Topics in Information Systems	3-3-0		
	TIE541	Organization Change & Innovation	3-3-0	1	
	TIE542	Strategies for Technology Innovation & Entrepreneurship	3-3-0	2	
	TIE543	High Tech Management	3-3-0	1	
	TIE549	Topics in Entrepreneurship	3-3-0		
	TIE701	Economic Assessment of Technology	3-3-0	2	

Course is	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Remark
	FIA501	Corporate Finance	3-3-0	2	
	FIA502	Financial Markets and Institutions	3-3-0	1	
	FIA503	Derivative Securities	3-3-0	2	
	FIA504	Financial Risk Management	3-3-0	2	
	FIA505	Topics in Investment	3-3-0	1	
	FIA506	Topics in Financial Engineering	3-3-0	2	
	FIA521	Intermediate Accounting	3-3-0	1	
	FIA522	Accounting Information Systems	3-3-0	2	
	FIA523	Information System Audit	3-3-0	1	
	FIA529	Topics in Accounting	3-3-0		
	FIA701	Theory of Finance	3-3-0	1	
Elective	FIA702	Empirical Methods in Finance	3-3-0	2	
	MIB501	Marketing Strategy	3-3-0	2	
	MIB502	Marketing Channel Management	3-3-0	1	
	MIB503	Marketing Research Method	3-3-0	2	
	MIB504	Consumer Behaviors	3-3-0	1	
	MIB505	Advertising and Promotion Strategy	3-3-0	2	
	MIB509	Topics in Marketing	3-3-0		
	MIB521	International Business	3-3-0	1	
	MIB522	International Marketing	3-3-0	2	
	MIB523	Global Financial Markets	3-3-0	1	
	MIB524	Global Competition Strategy	3-3-0	2	
	MIB529	Topics in International Business	3-3-0		

□ Description

GMT511 Microeconomic Theory

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.

GMT512 Macroeconomic Theory

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.

GMT513 Econometrics

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.

GT521 Mathematical Programming

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.

GMT522 Probability Models with Applications

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.

GMT523 Multivariate Statistical Analysis

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.

GMT524 Forecasting Theory and Applications

This course aims to provide students a basic understanding of the principles and applications of alternative forecasting methods. Students will learn the essentials of effective statistical forecasting methods that are widely used in various areas including finance, marketing, accounting and international business. Topics covered will include smoothing and decomposition time series methods, regression methods, econometric models, univariate and multivariate autoregressive integrated moving average model (ARIMA), as well as forecasting expert systems.

GMT541 Organizational Behavior

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.

GMT542 Strategic Management

This course introduces concepts, theories, approaches and analytical models associated with the process of strategy formation and implementation in both profit and non-profit organizations. It also provides opportunities to make strategic analyses and to make decisions for strategic issues of real organizations through participation in class discussions and performing group term projects.

GMT543 Consulting Methodology

The purpose of this course is to provide the students with the theoretical and practical knowledge in consultation work. It deals especially with basic techniques for consulting and in-depth case studies so that the students can get consulting opportunities.

TIE501 Decision Analysis Theory

Managers are likely to make a decision in the presence of uncertainty, which could be events over which an individual does not have any control or about what other individuals will do. A framework is provided for structuring and analyzing such decisions, with applications to such scenarios as product development, litigation, the business of treasure-hunting and bidding. This course explores the following issues: development of tools for decision-making under uncertainty, construction and analysis of decision trees, quantification of judgments, degree of risk aversion and preferences, and subjective expected utility.

TIE502 Supply Chain Management

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

TIE503 Optimization Theory

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.

TIE504 Operations Strategy

This course aims to provide a unified framework for analyzing strategic issues in manufacturing and service operations. It also focuses on analyzing relationships between manufacturing and service companies and their suppliers, customers, and competitors. It further covers decisions in technology development and vertical integration in a value chain, and investigates and explores issues related to cost, quality, and innovativeness for competitive advantages.

TIE505 Management and Optimal Control Theory

The primary objective of this course is to teach the students the fundamental aspects of management system from an analytical perspective, and enable them to figure out dynamic interactions among key factors present in the complex management system. The physical configuration and technology of the system, the organizational control mechanism governing management principles, and the interaction of the two will be covered.

TIE506 Management of Strategic Alliances

Alliances among businesses are created by strategic needs. This course covers the theory and practice of business alliances. Although alliances are important for companies, ill-managed alliances sometimes create substantial problems for one or more participants in the alliance. The goal of this course is to understand the benefits and risks that alliances create for the individual partners and to learn how to manage alliances effectively.

TIE509 Topics in Technology Management

This course introduces graduate students with current and special topics in Technology Management.

TIE521 Management Information Systems

This course presents and uses frameworks, concepts, and guidelines for the effective use of information technologies, as well as obtaining business values from information technology investment. This course covers such issues as alignment of IT with organization strategies, operational efficiencies enabled by IT, implementations of the IT function, IT project management, and organizational change management.

TIE522 Data Mining

Firms are likely to use various techniques of data mining for credit ratings, fraud detection, database marketing, customer relationship management, investments, and logistics. 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.

TIE523 e-Business Strategy

E-business has been a viable conduit for businesses. This course covers the fundamental principles of e-business strategy with an emphasis on Internet technology and its use in business and e-commerce. This course covers the issues such as price strategy for digital goods(e.g., text, music, software, video and other types of content), advertising-based models, and search agents and auctions. In addition, this covers the managerial implications related to privacy and intellectual property.

TIE529 Topics in Information Systems

This course introduces graduate students with current and special topics in Information Systems.

TIE541 Organization Change & Innovation

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.

TIE542 Strategies for Technology Innovation & Entrepreneurship

This class 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.

TIE543 High Tech Management

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.

TIE549 Topics in Entrepreneurship

This course introduces graduate students with current and special topics in Entrepreneurship.

TIE701 Economic Assessment of Technology

This course is mainly concerned with economic analysis and evaluation in technological issues including environmental ones. Issues covered in the course include the cost-benefit analyses in science and technology, venture investment, environmental issues with water resources & pollution, and economic development.

FIA501 Corporate Finance

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.

FIA502 Financial Markets and Institutions

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.

FIA503 Derivative Securities

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.

FIA504 Financial Risk Management

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.

FIA505 Topics in Investment

The course covers various topics on the theory of investments. It will address theoretical foundations for the portfolio choice, valuation of financial securities, financing and investment decisions of firms, and structure of financial markets.

FIA506 Topics in Financial Engineering

This course addresses the current advances in financial engineering. The topics of the course include various research and numerical methods in financial engineering for the valuation of complex financial derivatives, techniques in risk measurement and management, simulations and risk hedging strategies.

FIA521 Intermediate Accounting

This course is designed to study the various issues related to intermediate financial accounting in more detail. The topics include the accounting procedures for assets, liabilities, shareholders'equity and special topics such as lease accounting, pension accounting, accounting for income taxes, cash flow statements, and accounting for derivatives.

FIA522 Accounting Information Systems

The objective of this course is to help students develop a level of competence so that they are capable of understanding the theoretical as well as practical issues in the application of up-to-date information technology for accounting. The topics include the analysis and design of accounting information systems, accounting databases, IS control and audit.

FIA523 Information System Audit

This course covers major concepts and techniques of information system audits and security. The topics include the design and evaluation of internal control and security systems under computerized environments, risk analysis and management of an information system, system development audit, the audit of system management functions, and security evaluation and management.

FIA529 Topics in Accounting

This course introduces graduate students with current and special topics in Accounting.

FIA701 Theory of Finance

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.

FIA702 Empirical Methods in Finance

This course covers econometric methods used in finance and recent developments in empirical research in finance.

MIB501 Marketing Strategy

This course focuses on strategic marketing planning and examines how environmental factors affect marketing strategies and how firms should adapt. This course explores a firm's opportunities and threats in dynamic environments to examine development of competitive advantages. Topics include segmenting markets, identifying customer needs, forecasting market environments, and allocating resources.

MIB502 Marketing Channel Management

A marketing channel represents a pathway through which products and services are delivered to end-customers. The course focuses on how manufacturers and service providers access markets through their design and management of marketing channels. Whether the Internet should be used as a sales channel as well as a communication mechanism is emphasized in the class.

MIB503 Marketing Research Method

This course will focus on both qualitative and quantitative aspects of marketing research. Marketing research is an organized way of developing and providing information for decision-making purposes. More specifically, this class 1) provides student with the skills for systematic problem analysis, 2) gives a critical eye for marketing research and appreciation for its potential contributions and limitations, and 3) help students gain a working "hands-on" experience with the full process of marketing research from the formulation of the research problem through the research design, data collection methods, questionnaire design, sampling schemes, and data analysis.

MIB504 Consumer Behaviors

The purpose of this course is familiarize students with the advanced analytic models managers are likely to employ to better understand their customers, and identify alternative theories for interpreting buyer and consumption behavior. In addition, students will learn the application of concepts and research methods to support marketing decision making.

MIB505 Advertising and Promotion Strategy

Advertising is the voice, the expression of marketing. It is communication. Although what is said is important, how it is said is equally as important. This class covers how to assess and evaluate the quality of companies' creative endeavors through case analyses, exercises and class discussions. This class also highlights the key principles of advertising and promotion by problem-solving and analytical and creative skills.

MIB509 Topics in Marketing

This course introduces graduate students with current and special topics in Marketing.

MIB521 International Business

This course considers the objectives and strategies of international businesses in the context of global competition. The course covers competitive advantages, competitive strategies, market entry, contracting with suppliers and distributors, and foreign direct investment (FDI) for strategy development. Case studies are used throughout to illustrate the basic principles of multinational business management and strategy.

MIB522 International Marketing

Markets in a wide variety of products and services are becoming increasingly global. Thus, opportunities for marketing globalization are elevating, and successful marketing can be achieved by appropriate responses to the specific needs of different countries along with global needs. This course focuses on how to balance between globalization and localization in product development, pricing, distribution, and advertisement. This course also shows students how to analyze the similarities and differences in customers and market conditions across countries and how to develop international and global marketing strategies and tactics.

MIB523 Global Financial Markets

The course applies principles of finance to the international setting. The course will discuss the foreign exchange markets, international money and capital markets, international equity and commodity markets, and the issues on international diversification and risk hedging strategies.

MIB524 Global Competition Strategy

This course examines the determinants and improvement measures for competitiveness of international business and successful economic development. Using various business cases of global companies, it allows students to gain a competitive mind set and capabilities to apply in the real world.

MIB529 Topics in Business

This course introduces graduate students with current and special topics in Business.

School of Natural Science

1. School Introduction

GNS was founded in 2010 to promote the basic science education and to facilitate the creative interdisciplinary research between science and engineering. Convergent research is a big keyword these days, but historically the convergence of basic science and engineering has always been a very natural procedure.

For example, early quantum mechanical studies led to the invention of the transistor, and, in turn, the so-called IT revolution. A recent Nobel prize in physics was awarded for the discovery of giant magnetoresistance, which is now the basis of high-capacity hard disks. Furthermore, particle accelerators, which were originally designed for the study of subatomic particles and the early universe, are currently used for biomedical technologies, such as cancer therapy. As we see from these examples, the most creative convergence and revolutionary scientific products may be realized when starting with basic science research.

We believe the natural convergence of science and engineering can be sped up by systematic interdisciplinary research, and, for this purpose, UNIST has an unprecedented and unique system in Korea. All the faculty members of GNS are jointly appointed to engineering divisions and recruit the graduate students, fellows, or post-docs from engineering as well as physics or mathematics backgrounds. Thanks to this system, all the researchers are systematically trained and naturally mingle in the environment of convergent research. From a practical point of view, such experience with people from different backgrounds will be a big advantage for their research and their future career paths.

Armed with a unique system for convergence alongside outstanding professors, and a self-motivated spirit for innovation, GNS is ready to soar to the apex of science and technology. Join us at the Graduate School of Natural Sciences at UNIST.

1. Graduate Programs

1) Physics

The physics research programs in the Graduate School of Natural Sciences at UNIST is at the forefront of both exploring fundamental sciences and establishing the links to various real-world applications in the central area of modern physics.

The area we focus includes theoretical particle physics and cosmology, hard and soft condensed matter physics, biophysics, and plasma and beam physics.

□ 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 32 credits	at least 18 credits	at least 14 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

□ Curriculum

Course	Course is	Course No.	Course Title	Cred.-Lec.-Exp	Semester	Prerequisite
Physics	Required	PHY501	Classical Mechanics	3-3-0		
		ECE571	Electrodynamics	3-3-0		
		ECE573	Quantum Mechanics	3-3-0		
		ECE576	Advanced Electrodynamics	3-3-0		
		ECE577	Advanced Quantum Mechanics	3-3-0		
		AME503	Statistical Mechanics	3-3-0		
		PHY590	Seminar	1-1-0		
		PHY690	Master's Research (1-4 credits)	Value of credit		
		PHY890	Doctoral Research (3-12 credits)	Value of credit		
	Elective	PHY711	Fundamentals of Theoretical Physics I	3-3-0		
		PHY721	Advanced Theoretical Physics I	3-3-0		
All Courses from other disciplines other than those assigned as required will be counted as elective.						

☐ Courses from other disciplines

Course	Course is	Course No.	Course Title	Cred.-Lec.-Exp	Semester	Prerequisite
Electrical & Computer Engineering	Elective	ECE551	Analog Filters	3-3-0		
		ECE553	Digital Integrated Circuits	3-3-0		
		ECE574	Plasma Physics	3-3-0		
		ECE575	Modern RF Engineering	3-3-0		
		ECE771	Thin Film Engineering	3-3-0		
		ECE772	Nanoscale Electronic Devices	3-3-0		
		ECE773	Compound Semiconductor Devices	3-3-0		
		ECE774	Plasma in Device Manufacturing	3-3-0		
Mechanical Engineering	Elective	MEN500	Advanced Numerical Methods	3-3-0		
		MEN501	Continuum Mechanics	3-3-0		
		MEN510	Advanced Thermodynamics	3-3-0		
		MEN511	Advanced Heat Transfer	3-3-0		
		MEN520	Advanced Fluid Mechanics	3-3-0		
		MEN521	Micro/Nanofluidics	3-3-0		
		MEN522	Computational Thermo-Fluid Engineering	3-3-0		
		MEN531	Finite Element Method	3-3-0		
		MEN533	Mechanics of Polymer Solids and Fluids	3-3-0		
		MEN534	Scanning Probe Microscopy	3-3-0		
Advanced Materials Engineering	Elective	AME504	Quantum Analysis and Modeling	3-3-0		
		AME530	Advanced Electric Ceramics	3-3-0		
		AME550	Physics in Semiconductor	3-3-0		
		AME580	Polymer Structures and Properties	3-3-0		
Nano-Bio Science and Chemical Engineering	Elective	NBC623	Advanced Transport Phenomena	3-3-0		
Color Science& Engineering	Elective	DHE560	Color Science	3-3-0		
		DHE561	Psychophysics	3-3-0		
Urban Engineering	Elective	URB506	Traffic Modeling	3-3-0		
Nuclear Energy	Elective	NUE501	Structural Mechanics in Energy Systems	3-3-0		
		NUE505	Modeling and Simulation in Energy System	3-3-0		
		NUE506	Fast Reactor Dynamics	3-3-0		
		NUE507	Nuclear Reactor Dynamics	3-3-0		
Technology Management	Elective	GMT521	Mathematical Programming	3-3-0		
		GMT522	Probability Models with Applications	3-3-0		
		GMT523	Multivariate Statistical Analysis	3-3-0		
		TIE503	Optimization Theory	3-3-0		
		TIE504	Operations Strategy	3-3-0		
		TIE522	Data Mining	3-3-0		
		FIA503	Derivative Securities	3-3-0		
		FIA504	Financial Risk Management	3-3-0		
		FIA506	Topics in Financial Engineering	3-3-0		
In addition, you can also take courses approved by the curriculum committee.						

□ Description

PHY501 Classical Mechanics

This course covers various aspects of Newtonian mechanics using advanced 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.

PHY711 Fundamentals of Theoretical Physics I

The main purpose of this course is to teach the basic knowledge of theoretical physics, the gauge symmetry and gauge theory, the general invariance and general relativity. In particular the course teaches the basic principles of Abelian and non-Abelian gauge theories and Einstein's theory of gravitation.

PHY721 Advanced Theoretical Physics I

The main purpose of this course is to teach important subjects in theoretical physics, monopoles, solitons, and knots.

PHY590 Seminar

The purpose of this course is to extend knowledge to 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

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

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.

AME503 Statistical Mechanics

This course provides the fundamental principles of many-body systems in terms of their physical properties such as heat, free energy, and entropy. 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.

2) Applied Mathematics

Applied mathematics have important connections with other disciplines that induce interesting mathematics, which lead again to useful applications and insights in the disciplines.

□ 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 32 credits	at least 18 credits	at least 14 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

□ Curriculum

Course	Course is	Course No.	Course Title	Cred.-Lect.-Exp	Semester	Prerequisite
Applied Mathematics	Elective	MTH501	Real Analysis	3-3-0		
		MTH503	Probability and Stochastic Processes	3-3-0		
		MTH505	Numerical Analysis and Applications	3-3-0		
		MTH507	Numerical Linear Algebra	3-3-0		
		MTH509	Partial Differential Equations	3-3-0		
		MTH511	Numerical Methods for Partial Differential Equations I	3-3-0		
		MTH512	Numerical Methods for Partial Differential Equations II	3-3-0		
		MTH513	Dynamical Systems	3-3-0		
		MTH515	Mathematical Methods for Engineers	3-3-0		
		MTH517	Stochastic Calculus and Applications	3-3-0		
		MTH519	Advanced Statistics	3-3-0		
		MTH521	Computational Statistics for Bioscience	3-3-0		
		MTH531	Scientific Computing	3-3-0		
		MTH532	Advanced Scientific Computing	3-3-0		
		MTH590	Seminar	1-1-0		
		MTH711	Selected Topics in Computational Mathematics I	3-3-0		
		MTH712	Selected Topics in Computational Mathematics II	3-3-0		
		MTH713	Selected Topics in Partial Differential Equations	3-3-0		
		MTH714	Selected Topics in Mathematical Biology	3-3-0		
		MTH715	Selected Topics in Probability and Statistics	3-3-0		
		MTH690	Master's Research (1-4 credits)	Value of credit		
		MTH890	Doctoral Research (3-12 credits)	Value of credit		

☐ Courses from other disciplines

Course	Course is	Course No.	Course Title	Cred.-Lec.-Exp	Semester	Prerequisite
Electrical & Computer Engineering	Elective	ECE515	Algorithm Design	3-3-0		
		ECE530	Image Processing	3-3-0		
		ECE532	Linear System Theory	3-3-0		
		ECE533	Advanced Linear Algebra	3-3-0		
		ECE572	Numerical methods in Electromagnetics	3-3-0		
		ECE730	Modern Probability Theory and Stochastic Processes	3-3-0		
		ECE731	Information Theory	3-3-0		
		ECE733	Optimal Control Theory	3-3-0		
		ECE735	Pattern Recognition	3-3-0		
Mechanical Engineering	Elective	MEN500	Advanced Numerical Methods	3-3-0		
		MEN501	Continuum Mechanics	3-3-0		
		MEN510	Advanced Thermodynamics	3-3-0		
		MEN511	Advanced Heat Transfer	3-3-0		
		MEN520	Advanced Fluid Mechanics	3-3-0		
		MEN522	Computational Thermo-Fluid Engineering	3-3-0		
		MEN531	Finite Element Method	3-3-0		
		MEN533	Mechanics of Polymer Solids and Fluids	3-3-0		
Advanced Materials Engineering	Elective	AME503	Statistical Mechanics	3-3-0		
Nano-Bio Science and Chemical Engineering	Elective	NBC502	Advanced Cell Biology	3-3-0		
Human Factors Engineering	Elective	DHE542	Advanced Multivariate Methods & Data Mining	3-3-0		
		DHE545	Operations Research	3-3-0		
Urban Engineering	Elective	URB506	Traffic Modeling	3-3-0		
Environmental Engineering	Elective	ENV517	Climate-environment Modeling	3-3-0		
Nuclear Energy	Elective	NUE501	Structural Mechanics in Energy Systems	3-3-0		
		NUE505	Modeling and Simulation in Energy System	3-3-0		
		NUE506	Fast Reactor Dynamics	3-3-0		
		NUE507	Nuclear Reactor Dynamics	3-3-0		
Technology Management	Elective	GMT521	Mathematical Programming	3-3-0		
		GMT522	Probability Models with Applications	3-3-0		
		GMT523	Multivariate Statistical Analysis	3-3-0		
		TIE503	Optimization Theory	3-3-0		
		TIE504	Operations strategy	3-3-0		
		TIE522	Data Mining	3-3-0		
		FIA503	Derivative Securities	3-3-0		
		FIA504	Financial Risk Management	3-3-0		
		FIA506	Topics in Financial Engineering	3-3-0		
In addition, you can also take courses approved by the curriculum committee.						

□ Description

MTH501 Real Analysis

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

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

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

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

This course covers the theory of 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

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. The associated theory will be discussed.

MTH512 Numerical Methods for Partial Differential Equations 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

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

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

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

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

Linear model, multivariate analysis, survival analysis and some machine learning methods for genome and clinical data analysis using R software

MTH531 Scientific Computing

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

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.

MTH590 Seminar

The purpose of this course is to extend knowledge to 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.

MTH711 Selected Topics in Computational Mathematics I

This course covers topics of current interest in computational mathematics for solving linear and nonlinear partial differential equations.

MTH712 Selected Topics in Computational Mathematics II

This course covers topics of current interest in computational mathematics for solving linear and nonlinear partial differential equations.

MTH713 Selected Topics in Partial Differential Equations

This course covers an introduction of L_p theory of elliptic and parabolic differential equations and theory of Navier-Stokes equations.

MTH714 Selected Topics in Mathematical Biology

This course covers advanced topics in mathematical biology including modeling in biochemical networks, population dynamics, and tumor cell growth.

MTH715 Selected Topics in Probability and Statistics

Special topics in probability & statistics and their recent applications in science

and engineering will be covered.

MTH690 Master's Research (1-4 credits)

This course is related to the students graduate thesis. As such, students should be actively working on their research.

MTH890 Doctoral Research (3-12 credits)

This course is related to the students graduate thesis. As such, students should be actively working on their research.