2010 Course Catalog

UNIST Academic Calender 2010

Year	Month	Date	Schedule
2010 1st Semester	3	1(Mon)	2010 Spring Semester Begins Holiday-Independence Movement Day
		2(Tue)	Matriculation Ceremony
		4(Thu) ~ 9(Tue)	Confirmation and Changes of Registered Courses for the 2010 Spring semester
		19(Fri)	Deadline for Course Drop for the 2010 Spring Semester
		26(Fri)	First Quarter of the Semester
	4	16(Fri)	Submission Due Date for the List of Courses to Open during the 2010 Summer Session and the Fall Semester
		19(Mon) ~ 23(Fri)	Mid-term Exams
		30(Fri)	Deadline for Course Withdrawal for the 2010 Spring Semester
	5	5(Wed)	Holiday-Children's Day
		11(Tue) ~ 13(Thu)	Preliminary Course Registration for the 2010 Summer Session
		13(Thu) ~ 14(Fri)	UNISTAR Spring Festival (no classes for undergraduates)
		18(Tue) ~ 20(Thu)	Preliminary Course Registration for the 2010 Fall Semester
		20(Thu)	Deadline for Registering Official Absence
		21(Fri)	Holiday-Buddha's Birthday Third Quarter of the Semester
	6	1(Tue) ~ 3(Thu)	Course Registration for the 2010 Summer Session
		6(Sun)	Holiday-Memorial Day
		8(Tue) ~ 10(Thu)	Preliminary Registration for the Interdisciplinary Track
		14(Mon) ~ 18(Fri)	Final Exams
		21(Mon) ~ 27(Fri)	Summer Vacation
		28(Mon) ~ 6(Fri)	Summer Session : 6 weeks
	7	2(Fri)	Due Date for Submitting Students' Grades for the 2010 Spring Semester Deadline for Course Withdrawal for the 2010 Summer Session
		9(Fri)	Deadline for Grade Changes
		28(Wed) ~ 30(Fri)	Registration of Official Absence/Return
	8	3(Tue) ~ 5(Thu)	Course Registration for the 2010 Fall semester
		13(Fri)	Due Date for Submitting Students' Grades for the 2010 Summer Session
		15(Sun)	Holiday-Independence Day

Year	Month	Date	Schedule
2010 2nd Semester	8	30(Mon)	2010 Fall semester Begins
	9	2(Thu) ~ 7(Tue)	Subject Confirmation and Changes of Registered Courses for the 2010 Fall Semester
		13(Mon)	University Foundation Day
		17(Fri) ~ 18(Sat)	UNISTAR Autumn Festival (no classes for undergraduates)
		17(Fri)	Deadline for Course Drop for the 2010 Fall Semester
		21(Tue) ~ 23(Thu)	Holiday-Chuseok
		24(Fri)	First Quarter of the Semester
	10	3(Sun)	Holiday-National Foundation Day
		15(Fri)	Submission Due Date for the List of Courses to Open during the 2010 Winter Session and the 2011 Spring Semester
		18(Mon) ~ 22(Fri)	Mid-term Exams
		29(Fri)	Deadline for Course Withdrawal for the 2010 Fall Semester
	11	9(Tue) ~ 12(Fri)	Preliminary Course Registration for the 2010 Winter Session
		16(Tue) ~ 19(Fri)	Preliminary Course Registration for the 2011 Spring Semester
		19(Fri)	Third Quarter of the Semester Deadline for Registering Official Absence
		30(Tue) ~ 3(Fri)	Course Registration for the 2010 Winter Session
	12	7(Tue) ~ 9(Thu)	Registration for the Interdisciplinary Track
		13(Mon) ~ 17(Fri)	Final Exams
		20(Mon) ~ 2. 25, 2011(Fri)	Winter Vacation
		20(Mon) ~ 1. 28. 2011(Fri)	Winter Session : 6 weeks
		25(Sat)	Holiday-Christmas
		31(Fri)	Due Date for Submitting Students' Grades for the 2010 Fall Semester Deadline for Course Withdrawal for the 2010 Winter Session
	2011 1	1(Sat)	Holiday-New Year's Day
		7(Fri)	Deadline for Grade Changes
		26(Wed) ~ 28(Fri)	Registration for Official Absence/Return
	2	2(Wed) ~ 4(Fri)	Holiday-Lunar New Year's Day
		8(Tue) ~ 10(Thu)	Course Registration for the 2011 Spring Semester
		11(Fri)	Due Date for Submitting Students' Grades for the 2010 Winter Session
		15(Tue) ~ 18(Fri)	Registration for the 2011 Spring Semester

Contents

Division of General Studies

□ Introduction

The 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 the trainings 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 the freshmen with the basic courses. And the sophomores and the higher will have opportunities of taking 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.

1. Math & Science

The Math & Science area is designed to provide a solid basic knowledge the student's specialities by opening General Science courses like Mathematics, Physics, Chemistry, Biology, and also make the students to study more effectively and efficiently by harmonizing theoretical studies and laboratory works. By following UNIST's vision, which is completing multidisciplinary courses, we are opening a course named ‘Introduction to disciplines’ to provide sufficient information (each department, open track, and multidisciplinary studies, etc) to the students, before they start their specialities.

2. IT

The IT area is designed to learn applications and potential of IT ; and practical IT skills. The course of Dynamics of IT presents the concept, operation and application of Information system for business purposes. This course is designed to help students

understand and use fundamental Information System principles, so that they will function more efficiently and effectively 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 security.

3. Management

Management is focused on cultivating fundamental knowledge of Business Administration by opening courses like Leadership and Teamwork, Innovation and Entrepreneurship, and Microeconomics.

4. English

The main goal of the English courses is to cultivate fundamental knowledge about 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 off-line 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 personal by cultivating fundamental knowledges about languages except English. Open courses are Chinese Foundation, 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 the 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 open various courses, so the students can attend the courses more freely.

8. UNIST Leadership Program

The goal of Leadership program is building up students' character as UNISTARS such as honesty, sincerity, cooperative spirit, mutual respect, and etc. by participating into team activities following a creative planning process. It also aims to foster students' qualities to be leaders 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		27/27	
		Internship		3	
		Free major elective		6	
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	Dynamics of IT		3	
		Engineering Programming		3	
		Practical IT		2	
	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		27/27	
		Internship		3	
		Free major elective		6	
Subtotal					63
Fundamental	Math & Science	Calculus/Applied Linear Algebra		6	
		Statistics		3	
		General Physics		3	
		General Chemistry		3	
		General Biology		3	
	IT	Dynamics of IT		3	
		Business Programming		3	
		Practical IT		2	
	MGT	Leadership and teamwork		3	
		Innovation and entrepreneurship		3	
		Microeconomics		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

Field	Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Engineering	Fundamental	M&S	MTH111	Calculus I	3-3-0	1-1	
			MTH112	Calculus II	3-3-0	1-2	
			MTH103	Applied Linear Algebra	3-3-0	2-1	
			MTH201	Differential Equations	3-3-0	2-2	MTH111 or MTH101
			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	
			MTH211	Statistics	3-3-0	2-2	
		IT	ITP105	Practical IT	2-2-0	1-2	
			ITP107	Engineering Programming	3-2-2	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	2-1-3	2-2	
			LNG202	Chinese Forward	2-1-3	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	

Field	Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Management	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	
			ITP105	Practical IT	2-2-0	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	
			GMT105	Microeconomics	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 of Each Track [For 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-Biotechnology and Chemical Engineering	Nano/Polymer Science & Engineering	Applied Linear Algebra Differential Equations
	Fine 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 & Ecological Engineering	Differential Equations Choose One Between: Applied Linear Algebra Statistics
Interdisciplinary School of Green Energy	Solar Energy	Applied Linear Algebra Differential Equations
	Energy Conversion & Storage	Applied Linear Algebra Differential Equations
	Bio Energy	Applied Linear Algebra Differential Equations
	Nuclear Energy	Applied Linear Algebra Differential Equations

□ How to take Math courses : (for students who entered in 2009)

○ 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' and cannot register it can register 'ENG110' or 'ENG111' as a substitution → In this case, you must apply for the substitution by visiting Academic Affairs Team.

Required Fundamentals when students choose tracks from the other field

☐ Fundamentals required to 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-Biotechnology and Chemical Engineering			
	CSE	CCS	EDA	DPH	TFP	SDM	AME	NPS	FCE	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	SLE	ECS	BIE	NCE
Calculus I	A	A	A	A	A	A	A	A	A	A
Calculus II	O	R	R	O	O	O	R	R	R	R
Applied Linear Algebra	A	A	A	A	A	A	A	A	A	A
Differential Equations	O	O	O	R	R	R	R	R	R	R
Statistics	A	A	A	A	A	A	–	–	–	–
General Physics I	A	A	A	A	A	A	R	R	A	R
General Physics II	O	O	O	O	O	O	R	R	A	R
General Chemistry I	A	A	A	A	A	A	R	R	R	R
General Chemistry II	O	O	O	R	R	O	R	R	R	R
General Physics Lab	O	O	O	O	O	O	R	R	O	R
General Chemistry Lab	O	O	O	R	R	O	R	R	R	R

☐ Fundamentals required to 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
Microeconomics	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 each other's similar course)
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)

5. Description

MTH101 Calculus

Calculus is the branch of mathematics dealing with change, e.g. rate of change, 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 variable and their applications. The topics include trigonometric, logarithmic, 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, e.g. rate of change, 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 variable and their applications. The topics include trigonometric, logarithmic, hyperbolic functions and their inverse functions, limits, sequence, series and convergence as well as differentiation and integration.

MTH112 Calculus II

Beyond the 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

Solving systems of linear equations, matrix algebra, linear transformations, determinants, rank, vector spaces, eigenvalues and eigenvectors and diagonalization.

MTH201 Differential Equations

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 college physics course intended for the students who plan to major in science and engineering fields. 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 the 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 college physics course intended for the students who plan to major in science and engineering fields. 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. E-educational system will be actively used in conjunction with class lectures.

PHY104 General Physics II H

Students, who take this course driven by the famous experts, can 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 college physics course intended for the students planning to major in technology management. This course focuses basically on providing the students with the fundamental idea of general physics area to help them understand modern technology from 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 in classical mechanics, thermodynamics, electricity and magnetism, optics, and modern physics. E-educational system will be actively used in conjunction with class lectures.

PHY106 General Physics Lab

General Physics Lab is a one-semester introductory college physics laboratory course intended for the students who plan to major in science and engineering fields. It provides the students with hands-on experiences on performing the actual experimental activities for the topics selected in classical mechanics, thermodynamics, optics, wave mechanics, and electrodynamics. This lab course is aiming at helping the students improve their understanding on the 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 effective

management of organization and for improving leadership capability. The main topics includes 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 a 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.

GMT105 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.

ITP105 Practical IT

Introduction to major components of MS Office software for personal and organizational productivity improvement. Focusing on MS Excel and MS Access for spreadsheet and database applications by 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.

ITP107 Engineering Programming

This course introduces the fundamental concepts and methodology of computer programming in C++. C++ is the most extensively used OOP(object-oriented programming) language today. This course aims at providing attendees with C++ programming skills along with clear understanding of the OOP concept. The scope

of this course includes the syntax of ANSI standard C++, which covers pointers, single and multiple inheritance, virtual functions, templates, run-time type identification (RTTI), exceptions, and STL, as well as the basic elements of the OOP concept such as objects, classes, functions, and data types.

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

Presents information systems concepts from a managerial perspective to understand how information systems work and how they are used for business purposes. This course 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.

English Foundation (no-credit)

This course is offered for the 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 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 the foreign language 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 for the practice of speaking. The students are expected to develop fluency and accuracy of English speaking by learning on-line materials and participating in classroom activities.

ENG110 English language and culture

This course introduces 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 specific situation "business." Students will learn and practice how to function in business-related contexts in English appropriately and effectively.

LNG201 Chinese Foundation

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 four basic language skills speaking, listening comprehension, reading, and writing.

LNG202 Chinese Forward

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 certain listening and speaking skills in Mandarin or other Chinese dialects at elementary levels. Training in all four basic language skills (speaking, listening, reading, and writing).

AHS101 Arts and Creativity

Arts and creativity are inseparable, inasmuch 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 mechanism 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 economy and market as the 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 serve them to get prepared 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 i s 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 c lass will give students the opportunity to practice these two skills. Also critiques a nd feedback of all oral and written performances will be given to them.

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

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

School of Electrical and Computer Engineering

1. School Introduction

The School of Electrical, and Computer Engineering aims to educate the 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 new growth-engine industries of interdisciplinary complex systems including automotive, shipbuilding and large-scale energy plants. In order to help the students in the School to design the curriculum for themselves, the broad range of study in the course works 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 the "student-centeredness" as its educational banner, the School of ECE is determined to be one of the most excellent places to study the 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 utlize 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. 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. CCS track draws students with keen interests on enabling technologies to bring a future way of life today so that our students can be futuristic system and robot designers, statistics and signal processing experts, and pioneers of human computer interfaces work 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. 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 19'th 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)
Computer Science&Engineering	Required	15
	Elective	12
Communication, Control and signal processing	Required	15
	Elective	12
Electronic Design and Applications	Required	15
	Elective	12
Device Physics	Required	15
	Elective	12

○ Curriculum

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Computer Science& Engineering	Required	CSE201	Digital System Lab	2-1-2	2-1	
		EDA201	Basic Circuit Theory	3-3-1	2-2	
		CSE231	Data Structures	3-3-0	2-1	
		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	
	Elective	CSE211	Introduction to Programming Languages	3-3-0	2-2	
		CSE232	Discrete Mathematics	3-3-0	2-2	CSE231
		CSE311	Introduction to Operating Systems	3-3-0	3-2	
		CSE321	Introduction to Database	3-3-0	3-2	CSE231
		CSE351	Introduction to Computer Network	3-3-0	3-2	
		CSE431	Introduction to Artificial Intelligence	3-3-0	4-1	CSE331
		CSE441	Introduction to Computer Graphics	3-3-0	4-1	
		CCS401	Probability and Introduction to Random Processes	3-3-0	4-2	
		CSE461	Embedded Systems	3-1-4	4-2	
Communication, Control and signal processing	Required	CSE201	Digital System Lab	2-1-2	2-1	
		EDA201	Basic Circuit Theory	3-3-1	2-2	
		EDA301	Microelectronics I	3-3-0	3-1	
		CCS301	Signals and Systems	3-3-0	3-1	
		CCS401	Probability and Introduction to Random Processes	3-3-0	2-2	
		CCS490	Interdisciplinary Project	1-0-2	4-2	
	Elective	DPH201	Electrodynamics I	3-3-0	2-1	
		TFP301	Numerical Analysis	3-3-0	3-1	
		CCS302	Introduction to Control	3-3-0	3-2	CCS301
		CCS402	Introduction to Communications	3-3-0	4-1	CCS30, CCS401
		CCS403	Digital Signal Processing	3-3-0	3-2	CCS301
		CCS404	Advance Digital System Lab	3-1-4	4-1	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Electronic Design and Applications	Required	CSE201	Digital System Lab	2-1-2	2-1	
		DPH201	Electrodynamics 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	
		EDA490	Interdisciplinary Project	1-0-2	4-2	
	Elective	CCS301	Signals & Systems	3-3-0	3-1	
		EDA303	Microelectronics II	3-3-0	3-2	EDA301
		EDA401	Analog Integrated Circuits	3-3-0	4-1	EDA201, EDA301
		CCS402	Introduction to Communications	3-3-0	4-1	
		DPH403	Semiconductor engineering	3-3-0	4-1	
		EDA403	Electronics Experiment Laboratory	3-3-0	4-2	EDA201, EDA301
		DPH404	RF engineering	3-3-0	4-2	
Device Physics	Required	CSE201	Digital System Lab	2-1-2	2-1	
		DPH201	Electrodynamics I	3-3-0	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	
	Elective	DPH202	Electrodynamics II	3-3-0	2-2	
		DPH304	Quantum mechanics II	3-3-0	3-2	
		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	
		DPH402	Plasma engineering	3-3-0	4-1	
		DPH403	Semiconductor engineering	3-3-0	4-1	
		DPH404	RF engineering	3-3-0	4-2	
		DPH405	Optoelectronics	3-3-0	4-2	

○ 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.

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.

EDA201 Basic Circuit Theory

The aims of this course are to make the student 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; 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. LabView tool will be introduced and used for basic experiments. Focused for both hands-on experience and design practice with the following experiments.

DPH202 Electrodynamics II

This course is the second half of the one-year electrodynamics course. The subjects covered are the 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.

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 the 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.

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.

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.

TFP301 Numerical Analysis

This course introduces numerical methods with emphasis on algorithm construction, analysis and implementation. 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.

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.

CCS302 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, state space method.

EDA303 Microelectronics II

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

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.

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 the basic experiences of database programming. The relational model, relational algebra, and SQL, and object-relational databases. XML data, and relational design principles are the scope of this course.

CSE331 Introduction to Algorithm

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.

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.

EDA401 Analog Integrated Circuits

This course covers basic concepts of fabrication, operation and design techniques related with CMOS integrated circuits. Analysis and design of analog ICs unsing analytic techniques and CAD tools. Topics include amplifiers, current sources, output circuits, and other analog blocks.

DPH401 Solid state physics

As an introductory course of 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.

CCS402 Introduction to Communications

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

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.

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.

CCS403 Digital Signal Processing

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

EDA403 Electronics Experiment Laboratory

Experiments related to circuit theory and electronic circuits are performed. Focused for 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.

CCS404 Advance 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.

DPH404 RF engineering

This course is designed to provide in-depth understanding and knowledge on the theory and applications of microwave circuits, components, and systems used in Microwave and RF wireless communication systems.

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.

CSE431 Introduction to Artificial Intelligence

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

CSE441Introduction to Computer Graphics

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

CSE461 Embedded Systems

The aim of this course is obtaining the development skills of embedded systems by designing and implementing diverse embedded applications which are commonly used to control consumer electronics and machineries.

CSE490 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 undergraduate level. Lastly, students will present their work in public for evaluation.

CCS490 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 undergraduate level. Lastly, students will present their work in public for evaluation.

EDA490 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 undergraduate level. Lastly, students will present their work in public for evaluation.

DPH490 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 undergraduate level. Lastly, students will present their work in public for evaluation.

3. Graduate Programs

1) Electrical & Computer engineering

Degrees in Electrical and Computer Engineering: The school of electrical and computer engineering offers studies leading to the master of science and doctor of philosophy degrees. Course works are designed to balance the emphasis on basic professional knowledge and creative problems solving in novel research activities. Based on the "student-centeredness" philosophy, students can designed their course works under the supervision of their advisors in the following areas: computer science and engineering (CSE), communication, control, and signal processing (CCS), electronic design and applications (EDA), and device physics (DPH).

○ 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

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Electrical & Computer engineering	Elective	SLE501	Organic Electronics	3-3-0		
		ECE510	Software Engineering	3-3-0		
		ECE511	Computer Architecture	3-3-0		
		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		
		ECE529	Special Topics in CSE	3-3-0		
		ECE530	Image Processing	3-3-0		CCS301, CCS401
		ECE531	Intelligent Systems	3-3-0		CCS301, CCS401
		ECE532	Linear Systems	3-3-0		CCS301, CCS302, CCS401
		ECE533	Advanced Linear Algebra	3-3-0		CCS301, CCS401
		ECE534	Communication Theory	3-3-0		CCS301, CCS401, CCS402
		ECE535	Robotics	3-3-0		CCS301, CCS302, CCS401
		ECE549	Special Topics in CCS	3-3-0		
		ECE550	Audio Engineering	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		
		ECE571	Advanced Electromagnetics	3-3-0		DPH201, DPH202
		ECE572	Numerical methods in Electromagnetics	3-3-0		DPH201, DPH202
		ECE573	Quantum and Optical Electronics	3-3-0		DPH303, DPH304
		ECE574	Plasma and Energy/Nano Technologies	3-3-0		DPH201, DPH 202
		ECE575	Modern RF Engineering	3-3-0		DPH201, DPH202
		ECE589	Special Topics in DPH	3-3-0		
		ECE710	Natural Language Processing	3-3-0		
		ECE711	Embedded System Software	3-3-0		
		ECE712	Internet Technology and Security	3-3-0		
		ECE713	Computer Networks	3-3-0		

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Electrical & Computer engineering	Elective	ECE714	Artificial Intelligence	3-3-0		
		ECE715	Computer Graphics and HCI	3-3-0		
		ECE716	Database Design	3-3-0		
		ECE729	Advanced Special Topics in CSE	3-3-0		
		ECE730	Modern Probability Theory and Stochastic Processes	3-3-0		CCS301, CCS401
		ECE731	Information Theory	3-3-0		CCS301, CCS401, CCS402, ECE730
		ECE732	Advance Digital Signal Processing	3-3-0		CCS301, CCS401, CCS403, ECE730
		ECE733	Optimal Control Theory	3-3-0		CCS301, CCS401, ECE730
		ECE734	Estimation &Decision Theory	3-3-0		CCS301, CCS401, CCS403, ECE730
		ECE735	Pattern Recognition	3-3-0		CCS301, CCS401, ECE730
		ECE736	Channel Coding Theory	3-3-0		CCS301, CCS401, CCS402, ECE730
		ECE737	Data Compression	3-3-0		CCS301, CCS401, 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
		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

SLE501 Organic Electronics

This course will cover the basic concepts, mechanisms, and special issues on 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.

ECE510 Software Engineering

This course provides the concept of software specification, testing, and verification for developing high quality software. Emphasis is on current best practices and technology for developing reliable software at reasonable cost.

ECE511 Computer Architecture

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

ECE529 Special Topics in CSE

This course introduces new research topics in CSE.

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.

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 system with their real-life applications for automation system control and data/information processing including gesture and facial expression recognition.

ECE532 Linear Systems

This course provide 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, stereo vision.

ECE549 Special Topics in CCS

This course introduces new research topics in CCS.

ECE550 Audio Engineering

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.

ECE551 Analog Filters

An introduction to the theory, design techniques, and applications of analog passive, active, and switched-capacitor filters.

ECE552 Operational Amplifier Design

Analysis and design techniques for the utilization of integrated circuit operational amplifiers for applications in electronic systems.

ECE553 Digital Integrated Circuits

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.

ECE571 Advanced Electromagnetics

Students study the radiation by charged particles and its interaction with materials. The Linerd-Wiechert Potential, Synchrotron radiation, Reflection, Transmission, Absorption of the electromagnetic wave to materials 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 and Optical Electronics

Advanced quantum theory is offered. As its applications, the students learn about the LED basics, semiconductor lasers, and various modern optoelectronic devices.

ECE574 Plasma and Energy/Nano Technologies

The cutting-edge technologies in nano-scales strongly require proper tools of diagnostics, the highly coherent and high-brightness X-ray. In this course 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.

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.

ECE711 Embedded System Software

This course provides the development techniques for application-specific embedded operating systems and development tools for multimedia players, digital TVs, wireless phones, GPS navigators and other popular electronics.

ECE712 Internet Technology and Security

This course examines the design and implementation of the internet-based

services and explore the possible security vulnerability of those services. Also, the basic information security technology such as cryptography, system security, digital signatures, DRM, and social engineering techniques are covered in this course.

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 relational model, object-oriented model, distributed model and embedded model.

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 theory 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 beamforming 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, 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

Succession from the Analog Integrated Circuits course to cover 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

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 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

A study of the sources of noise found in electronic instrumentation. 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 material processings. In this course, the plasma processings of semiconductors and other electronic devices are introduced.

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 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.

ECE890 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 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 will 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 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 designand 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, aircrafts, 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 and 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 general concept of understanding various materials such as metals, ceramics, semiconductors, polymers, and so on. This track enables students 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 on materials. Students will learn advanced materials based on structural materials covering cars, ships, aerospaces, and civil, telecommunication materials covering semiconductor, and display, 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)
Mechanical System Design & Manufacturing	Required	24
	Elective	3
Thermo-Fluid & Power Engineering	Required	18
	Elective	9
Advanced Materials Engineering	Required	16
	Elective	11

○ Curriculum

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Mechanical System Design & Manufacturing	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	3-3-0	2-2	-
		SDM270	Dynamics	3-3-0	2-2	-
		TFP300	Mechanical Engineering Lab	2-0-4	3-2	-
		SDM350	Manufacturing Processes and Lab	3-2-2	3-1	SDM230 or equivalent
		SDM490	Multi-track project	1-0-2	4-2	
		SDM352	Creative Engineering Design I	3-0-3	3-2	SDM250 or equivalent
	Elective	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	GP(or GP I or GP II) and GC(or GC I or GC II)
		SDM231	Applied Solid Mechanics	3-3-0	2-2	SDM230 or equivalent
		SDM302	Introduction to finite element method	3-3-0	3-2	SDM230 or equivalent
		TFP310	Heat Transfer	3-3-0	3-1	TFP210 & TFP220
		TFP320	Applied Fluid Mechanics	3-3-0	3-1	TFP220 or equivalent
		SDM351	Mechanical System Design	3-3-0	3-1	-
		SDM370	System Dynamics and Control	3-3-0	3-1	SDM270 or equivalent
		SDM431	Introduction to plastic deformation	3-3-0	4-1	SDM230 or equivalent
		BEN432	Introduction to Biomechanics	3-3-0	3-2	-
		SDM451	Introduction to MEMS	3-3-0	4-1	-
		SDM470	Mechanical vibration	3-3-0	4-1	SDM270 or equivalent
		SDM472	Introduction to sensors	3-3-0	4-2	-
		SDM473	Acoustics	3-3-0	4-2	-
		SDM452	Creative Engineering Design II	3-0-3	4-1	SDM352 or equivalent
		SDM453	CAD/CAM/CAE	3-0-3	4-2	SDM250 or equivalent
		SDM454	Optimal Design	3-0-3	4-2	-
		TFP455	Multiscale System Design	3-3-0	4-1	TFP220 or equivalent

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Thermo-Fluid & Power Engineering	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 Laboratory	2-0-4	3-2	-
		TFP490	Multi-track project	1-0-2	4-2	-
		SDM352	Creative Engineering Design I	3-0-3	3-2	SDM250 or equivalent
	Elective	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	GP(or GP I or GP II) and GC(or GC I or GC II)
		NUE211	Fundamentals of Nuclear Engineering	3-3-0	2-1	-
		TFP211	Applied Thermodynamics	3-3-0	2-2	TFP210 or equivalent
		SDM231	Applied Solid Mechanics	3-3-0	2-2	SDM230 or equivalent
		SDM250	Mechanical Drawing and Lab	3-3-0	2-2	-
		TFP301	Numerical Analysis	3-3-0	3-1	-
		TFP310	Heat Transfer	3-3-0	3-1	TFP210 and TFP220 or equivalent
		TFP311	Internal Combustion Engine	3-3-0	3-2	TFP210 or equivalent
		TFP312	Mechatronics and Thermofluid control	3-3-0	3-2	-
		TFP320	Applied Fluid Mechanics	3-3-0	3-1	TFP220
		FCE303	Transport Phenomena	3-3-0	3-1	-
		SDM350	Manufacturing Processes and Lab	3-2-2	3-1	-
		SDM370	System Dynamics and Control	3-3-0	3-1	SDM270
		TFP411	Combustion	3-3-0	4-1	TFP210 and TFP220
		TFP412	Air-conditioning and Refrigeration	3-3-0	4-1	TFP210
		BEN432	Introduction to Biomechanics	3-3-0	3-2	-
		SDM451	Introduction to MEMS	3-3-0	4-1	-
		SDM470	Mechanical vibration	3-3-0	4-1	SDM270 or equivalent
		SDM472	Introduction to sensors	3-3-0	4-2	-
		TFP455	Multiscale System Design	3-3-0	4-1	TFP220 or equivalent
		TFP456	Energy System Design	3-3-0	4-1	TFP210 and TFP220 or equivalent
		SDM351	Mechanical System Design	3-3-0	3-1	-
		SDM452	Creative Engineering Design II	3-0-3	4-1	SDM352 or equivalent

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Advanced Materials Engineering	Required	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	GP(or GP I or GP II) and GC(or GC I or GC II)
		AME203	Physical Chemistry of Materials	3-3-0	2-1	GP(or GP I or GP II) and GC(or GC I or GC II)
		AME230	Introduction to Crystallography	3-3-0	2-2	AME202
		AME300	Materials Laboratory I	3-0-6	3-1	-
		AME350	Electronic Properties of Materials	3-3-0	3-1	AME202
		AME490	Multi-track project	1-0-2	4-2	-
	Elective	AME210	Phase Transformation of Materials	3-3-0	2-1	GP(or GP I or GP II) and GC(or GC I or GC II)
		AME211	Thermodynamics of Materials	3-3-0	2-2	AME203
		AME212	Mechanical Properties of Materials	3-3-0	2-2	AME202
		AME250	Modern Physics of Materials	3-3-0	2-2	GP(or GP I or GP II)
		TFP301	Numerical Analysis	3-3-0	3-1	-
		AME302	Transmission Electron Microscopy	3-3-0	3-2	AME230
		AME310	Dislocation Theory	3-3-0	3-1	AME202
		NPS202	Introduction to Nanoscience and Nanotechnology	3-3-0	4-2	-
		SLE354	Introductory electrochemistry	3-3-0	3-2	-
		AME400	Materials Laboratory II	3-0-6	4-1	-
		AME450	Thin Film Technology	3-3-0	4-1	AME202, AME350
		AME451	Semiconductor Materials and Devices	3-3-0	4-1	AME350
		AME452	Display Materials and Devices	3-3-0	4-2	AME350
		NPS301	Instrumental Analysis for Materials	4-2-4	3-2	-
		NPS332	Inorganic Chemistry	3-3-0	3-2	-
		NPS432	Surface & Colloids	3-3-0	4-2	-
		NPS201	Organic Chemistry I	3-3-0	3-1	-
		NPS302	Introduction to Polymer Science and Engineering	3-3-0	3-1	-
		AME453	Soft Materials Engineering	3-3-0	4-1	-

○ Description

NPS201 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.

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 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

This course is one of 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.

TFP210 Thermodynamics

Thermodynamics is the most fundamental course in mechanical 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.

AME210 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.

AME211 Thermodynamics of Materials

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

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.

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.

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.

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.

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.

SDM231 Applied Solid Mechanics

This course builds upon Solid Mechanics and introduce the mechanical behavior of various materials, including metals, ceramics, polymers, and composites. A rigorous definition of three-dimensional stresses and strains are 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 perform 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.

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.

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.

TFP300 Mechanical Engineering Laboratory

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.

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.

TFP301 Numerical Analysis

This course introduces numerical methods with emphasis on algorithm construction, analysis and implementation. 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.

NPS301 Instrumental Analysis for Materials

Course description: This course introduces principles of analytical instruments which are needed for characterization of various materials, and provides 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).

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.

AME302 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; phase contrast analysis of crystal lattice structures. With laboratory.

AME310 Dislocation Theory

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

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.

NPS332 Inorganic Chemistry

This course is designed to give an introduction into inorganic chemistry with a good balance between theory, descriptive chemistry, and applications. This course will deal with the fundamental concepts regarding chemical bonds, molecular symmetry, physical methods in inorganic chemistry, coordination, organometallic chemistry of transition elements, and periodic trends for the elements, simple compounds and more complex compounds.

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.

FCE303 Transport Phenomena

This course provides an understanding about how momentum, mass and heat are transferred. These disciplines are then used for designing reactors and fluidic devices.

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.

AME350 Electronic Properties 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).

NPS202 Introduction to nanoscience and technology

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

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.

SLE354 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 later part of the class, applications related to electrochemical energy conversion, characterization of materials, and electrochemical sensors are covered.

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.

NPS302 Introduction to Polymer Science and Engineering

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

AME400 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 AME211 Mechanical Properties of Materials and AME350 Electronic Properties of Materials. The laboratory subject combines experiments illustrating mechanical and electrical/optica l/magnetic properties of materials and structure-property relationships through practical materials examples including metals, alloys, ceramics, and semiconductors.

NPS432 Surface & Colloids

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 the essential part of the current nanotechnology.

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 machineries.

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, 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.

NUE211 Fundamentals of Nuclear Engineering

This course covers the basic engineering principles of the nuclear power plant design and operation. Specific topics include various types of nuclear energy utilization(nuclear fission/fusion for electricity generation, nuclear ship propulsion, nuclear rocket, nuclear battery, etc.), introduction to nuclear power reactors commercially available and future nuclear rectors. It also discusses nuclear fuel cycles, fundamentals of nuclear reactor theory and heat transer of nuclear reactors.

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.

BEN432 Introduction to Biomechanics

Biomechanics is based on physiology, physics, mechanics and kinesiology. In this course, students learn how to apply physical/mechanical principles to living organisms to understand and analyze their structures, functions and kinetic mechanisms. The course introduces the use of continuum mechanics and experimental and analytical methods that are available at molecular level to tissue and organ level.

AME450 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.

AME451 Semiconductor Materials and Devices

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.

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 lectured 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.

AME452 Display Materials and 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.

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 value 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 Multi-track 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 undergraduate level. Lastly, students will present their work in public for evaluation.

TFP490 Multi-track 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 undergraduate level. Lastly, students will present their work in public for evaluation.

AME490 Multi-track 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 undergraduate level. Lastly, students will present their work in public for evaluation.

SDM454 Optimal Design

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

SDM453 CAD/CAM/CAE

In this course, the theories and algorithms of CAD/CAM/CAE used in design and manufacture of various products. Through these studies, the students will develop

their capability to design, analysis, and manufacture of various products using CAD/CAM/CAE techniques.

SDM352 Creative Engineering Design I

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

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.

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 that 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 consisted of heat exchanger, burner, compressor and pump, 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.

AME453 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.

3. Graduate Programs

1) Mechanical Engineering

The graduate program in Mechanical Engineering aims at preparing students for successful careers in their respective fields by educating them in mathematical, computational, and experimental skills required for formulating and solving engineering problems. The curriculum is designed to foster students' idea generating and critical thinking capabilities through a balance between theoretical studies, hands-on experiments, and interdisciplinary interactions. Both breadth and depth are emphasized in the students' major fields of study, including thermo-fluids, solid mechanics, mechanical system design, manufacturing, controls, MEMS, and bioengineering. Students are provided opportunities to work closely with faculty members on funded research projects with competitive financial support.

2) Advanced Materials Engineering

Graduate study in Advanced Materials Engineering (AME) at UNIST provides the fundamental knowledges, practical skills, and professional experiences necessary to enter a successful career involving advanced materials. Faculty members in AME carry out research in many different areas, and students may choose to specialize in various aspects of materials science and engineering, including metals, ceramics, electronic materials, semiconductors, polymers, biomaterials and composites, etc. Since the science of materials branches into other fields of study, the AME emphasizes interdisciplinary research in collaboration with other departments.

○ 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

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Mechanical Engineering	Elective	MEN500	Applied Numerical Methods	3-3-0		Graduate standing in engineering or related discipline
		MEN501	Continuum Mechanics	3-3-0		SDM230 or equivalent
		MEN510	Advanced Thermodynamics	3-3-0		TFP210 or equivalent
		MEN511	Advanced Heat Transfer	3-3-0		TFP220, TFP310, or equivalent
		MEN520	Advanced Fluid Mechanics	3-3-0		[TFP210 or equivalent] and [TFP220 or equivalent] and Multi-Variable Calculus
		MEN521	Micro/Nanofluidics	3-3-0		TFP220 o r TFP310 or equivalent
		MEN522	Computational Thermo-Fluid Engineering	3-3-0		[TFP220 or equivalent] and programming experience
		MEN523	Advanced Thermofluid Measurement	3-3-0		Graduate standing in engineering or related discipline
		MEN531	Finite Element Method	3-3-0		SDM230 or equivalent
		MEN532	Failure Analysis and Design for Reliability	3-3-0		SDM230 or equivalent
		MEN533	Mechanics of Polymer Solids and Fluids	3-3-0		Graduate standing in engineering or related discipline
		MEN534	Scanning Probe Microscopy	3-3-0		Graduate standing in engineering or related discipline
		MEN551	Computer-Aided Design	3-3-0		Graduate standing in engineering or related discipline
		MEN552	Manufacturing Processes and Systems	3-3-0		[SDM230 or equivalent] and [SDM350 or equivalent]
		MEN553	Manufacturing and Process ngineering	3-3-0		SDM350 or equivalent
		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		Graduate standing in engineering or related discipline
		MEN558	Micro and Nanofabrication	3-3-0		Graduate standing in engineering or related discipline
		MEN559	BioMEMS	3-3-0		Graduate standing in engineering or related discipline
		MEN590	The Seminars	1-1-0		Graduate standing in engineering or related discipline
		MEN690	Master's Research	Value of Credit		
		MEN890	Doctoral Research	Value of Credit		

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Advanced Materials Engineering	Elective	AME500	Advanced Transmission Electron Microscopy	3-3-0		Transmission Electron Microscopy (AME302) or related discipline
		AME501	Advanced Thin Film Technology	3-3-0		Electronic Properties of Materials (AME350) or related discipline
		AME502	Vibrational Spectroscopy for Materials Chacterization	3-3-0		Graduate standing in engineering or related discipline
		AME503	Statistical Mechanics	3-3-0		Undergraduate level Physical Chemistry or related discipline
		AME510	Advanced Synthesis for Ceramic-Metal Composite Materials : Hard Materials	3-3-0		Mechanical Properties of Materials (AME202) or related discipline
		AME511	Structural Mechanics in Energy Systems	3-3-0		Mechanical Properties of Materials (AME202) or related discipline
		AME512	Special topics in structural materials in energy systems	3-3-0		Physical Chemistry of Materials(AME203) or related discipline
		AME530	Dielectric Thin Film Materials	3-3-0		Thin Film Technology (AME450) or related discipline
		AME531	Light Emitting Diodes	3-3-0		Optoelectronics (DP300) or related discipline
		AME550	Physics in Semiconductor	3-3-0		Introduction to Solid State Physics (DP300) or related discipline
		ECS505	Nanochemistry	3-3-0		-
		AME552	Advanced Nanoscience and Nanotechnology	3-3-0		-
		AME570	Polymer Materials Chemistry	3-3-0		-
		AME571	Organic Optoelectric Materials and Devices	3-3-0		-
		AME580	Polymer Structure and Properties	3-3-0		-
		BEN701	BiologyandMicro/ nanotechnology	3-3-0		-
		AME590	The Seminars	1-1-0		Graduate standing in engineering or related discipline
		AME690	Master's Research	Value of Credit		
		AME890	Doctoral Research	Value of Credit		

○ 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.

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. We further discuss the cooling system using nanofluids, applications of heat transfer to biomedical devices, micro-/nano heat transfer system, 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 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 cell.

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 on 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.

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 area SPM (scanning probe microscope) works as a powerful reaserch tool capable of providing spatially/temporally resolved diverse surface properties through 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, and 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 manufacture 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 on 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 the 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 up for biologists/scientists and what they require us to develop.

MEN590 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.

MEN690 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.

MEN890 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.

AME500 Advanced Transmission Electron Microscopy

The need for micro- and nano-structure characterizations is now increasing as both the structural and electronic materials become getting smaller and smaller. In this course we study the advanced principles and techniques for transmission electron microscopy analysis including 1) Imaging theory and experiments of 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 can 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 Vibrational Spectroscopy for Materials Characterization

This course presents principle of vibrational spectroscopy and various accessories for measurement of various samples. Topics include structural and thermal characterization by using FTIR 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.

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

This course is designed to provide professional understanding in the synthesis of ceramic-metal hard materials composites, such as TiC, Ti(CN), and WC along with Ni, Fe, and Co binder metals. In this course solution thermodynamics, phase formation phenomena and phase growth occurring in the liquid-phase sintering will be intensively discussed based on current research activities.

AME511 Structural Mechanics in Energy Systems

Structural components in energy systems, their functional purposes, operating conditions, and mechanical/structural design requirements. Combines mechanics techniques with models of material behavior to determine adequacy of component design. Considerations include mechanical loading, brittle fracture, inelastic behavior, elevated temperatures, neutron irradiation, vibrations and seismic effects.

AME512 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 system including nuclear.

AME530 Dielectric Thin Film Materials

This course will offer the basic understandings 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.

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 the detailed phenomenological study on transistor, metal-semiconductor contact, PN junction, MOS capacitor, JFET, and FRAM etc. will be offered.

ECS505 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 of chemistry, physics, and material science.

AME552 Advanced Nanoscience and Nanotechnology

This course presents the 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.

AME570 Polymer Materials Chemistry

In this class I will introduce the fundamentals of polymers, including their structure and synthesis as well as their chemical and physical properties based on polymer synthesis, polymerization and polymer reaction. I will also deal with the thermodynamics of polymer solutions and melts, including chain conformations in those states and also explain mechanical properties of polymer such as the characteristic of configuration and conformation, glass transition temperature, viscoelasticity, and so on. I will deal with the application using polymer materials, specially conjugated polymers.

AME571 Organic Optoelectric Materials and Devices

This course will provide the characteristic of electro-optic organic materials, such as conjugated polymers, liquid crystals, and device will be reviewed and discussed. I will explain their applications for organic optoelectronics such as organic LEDs, solar cells and laser diodes.

AME580 Polymer Structure and Properties

This course presents physical properties of polymers such as the chain confirmation, fluctuation, entanglements, etc. The macroscopic property of polymeric materials is dramatically influenced by this microscopic state change. 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 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.

AME690 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.

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.

BEN701 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 discussions of current literature. Students will learn how to make devices and operate them, how to do group discussion (oral presentations) and how to critically review articles (writing).

School of Nano-Biotechnology and Chemical Engineering

1. School Introduction

School of Nano-Biotechnology 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 in 21st century. The field of Nano-Biotechnology 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) Nano/Polymer Science and Engineering (NPS)

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 advance enables us to create and control nanometer scale structures, and polymeric material is also useful in its creation because of its ability to self-assemble into nanostructures. In this track, students will learn the physics and chemistry of polymers, with an emphasis on their application of developing new materials and nanostructures.

2) Fine Chemical Engineering (FCE)

The fine chemical engineering track is a discipline that prepare global leaders in the

application of chemical engineering to a variety of specific areas including energy and environment, catalysis, reaction engineering, systems and process design, nanotechnology, polymers and colloids, and biotechnology. It is a multi-scale engineering program that students can exercise creative design of new chemicals, materials, processes, and systems by translating molecular level information into novel engineering principles. The required courses are physical chemistry, organic chemistry, thermodynamics, and kinetics. The electives include catalysis, transport phenomena, unit operation, bioengineering, electrochemistry etc.

3) Bioengineering (BEN)

We lead the way in interdisciplinary research and education at the intersection of engineering, medicine, and the natural sciences to improve health and quality of life and to solve global crises related with energy and the environment. To train future creative leaders for both academia and various biotechnology industries, the Bioengineering track is offering a number of pertinent courses. These courses 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 their area. Required courses: biochemistry and biochemistry laboratory, physiology, physical chemistry, Transport phenomena, and multi track project, Elective courses: molecular biology, protein engineering, metabolic engineering, organic chemistry, cell biology, materials for biomedical applications, Introduction to biomechanics, Introduction to biomedical engineering.

4) Biomedical Science (BMS)

Biomedical Science offers interdisciplinary research training based on 1) Biology, where fundamental understanding on 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 young, brilliant, and creative scientific minds, with world-class renown, by educating them, and thus, they are fully equipped and familiar with the basic knowledge of Biology as well as cutting-edge research techniques in the state-of-the-art facilities provided by UNIST.

○ Credit Requirement

Track	Required/Elective	Credit(minimum)
Nano/Polymer Science and Engineering	Required	17
	Elective	10
Fine Chemical Engineering	Required	15
	Elective	12
Bioengineering	Required	15
	Elective	12
Biomedical Science	Required	15
	Elective	12

○ Curriculum

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Nano Polymer Science and Engineering	Required	NPS201	Organic Chemistry I	3-3-0	2-1	
		FCE201	Physical Chemistry I: Thermodynamics	3-3-0	2-1	
		NPS202	Introduction to Nanoscience and Nanotechnology	3-3-0	2-2	
		NPS302	Introduction to Polymer Science and Engineering	3-3-0	3-1	
		NPS301	Instrumental Analysis for Materials	4-2-4	3-2	
		NPS490	Interdisciplinary Project	1-0-2	4-2	
	Elective	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	GP(or GP I or GP II) and GC(or GC I or GC II)
		NPS231	Organic Chemistry II	3-3-0	2-2	NPS201
		FCE202	Physical Chemistry II: Kinetics	3-3-0	2-2	FCE201
		NPS261	Organic/Physical Chemistry Laboratory I	2-0-4	2-2	
		AME211	Thermodynamics of Materials	3-3-0	2-2	
		TFP301	Numerical Analysis	3-3-0	3-1	
		NPS361	Organic/Physical Chemistry Laboratory II	1-0-2	3-1	NPS201, FCE201
		NPS331	Physical Chemistry III: Quantum/Statistical Mechanics	3-3-0	3-1	FCE201
		NPS332	Inorganic Chemistry	3-3-0	3-2	
		NPS333	Polymer Material Science	3-3-0	3-2	
		NPS431	Application of Polymers & Nano Materials	3-3-0	4-1	
		AME302	Transmission Electron Microscopy	3-3-0	4-2	
		AME452	Display and Devices	3-3-0	4-2	
		NPS432	Surface & Colloids	3-3-0	4-2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Fine Chemical Engineering	Required	NPS201	Organic Chemistry I	3-3-0	2-1	
		FCE201	Physical Chemistry I: Thermodynamics	3-3-0	2-1	
		FCE202	Physical Chemistry II: Kinetics	3-3-0	2-2	FCE201
		FCE302	Fine Chemical Engineering Laboratory	2-0-4	3-1	
		FCE303	Transport Phenomena	3-3-0	3-1	
		FCE490	Interdisciplinary Project	1-0-2	4-2	
	Elective	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	GP(or GP I or GP II) and GC(or GC I or GC II)
		NPS202	Introduction to Nanoscience and Nanotechnology	3-3-0	2-2	
		NPS231	Organic Chemistry II	3-3-0	2-2	NPS201
		NPS261	Organic/Physical Chemistry Laboratory I	2-0-4	2-2	
		NPS302	Introduction to Polymer Science and Engineering	3-3-0	3-1	
		NPS361	Organic/Physical Chemistry Laboratory II	2-0-4	3-1	NPS201, FCE201
		TFP301	Numerical Analysis	3-3-0	3-1	
		NPS331	Physical Chemistry III: Quantum/Statistical Mechanics	3-3-0	3-1	FCE201
		NPS301	Instrumental Analysis for Materials	4-2-4	3-2	
		FCE331	Unit Operation	3-3-0	3-2	
		BIE302	Biochemical Engineering	3-3-0	3-2	TFP301
		FCE332	Process Control	3-3-0	3-2	
		BIE301	Metabolic System Engineering	3-3-0	4-1	BEN231
		AME450	Thin Film Technology	3-3-0	4-1	AME202, AME350
		AME451	Semiconductor Materials and Devices	3-3-0	4-1	AME350
		ECS504	Electrochemical Energy Conversion & Storage	3-3-0	4-1	
		NPS432	Surface & Colloids	3-3-0	4-2	
		SLE301	Introduction to Solar Cells	3-3-0	4-2	
		EDA201	Basic Circuit Theory	3-3-1	4-2	
		FCE431	Catalysis	3-3-0	4-2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Bio Engineering	Required	BEN201	Biochemistry	3-3-0	2-1	BIO101
		BEN261	Biochemistry Laboratory	2-0-4	2-1	BIO101
		FCE202	Physical Chemistry II: Kinetics	3-3-0	2-2	FCE201
		FCE303	Transport Phenomena	3-3-0	3-1	
		BEN301	Physiology	3-3-0	3-2	BIO101
		BEN490	Interdisciplinary Project	1-0-2	4-2	
	Elective	NPS201	Organic Chemistry I	3-3-0	2-1	
		BEN231	Microbiology	3-3-0	2-1	BIO101
		FCE201	Physical Chemistry I: Thermodynamics	3-3-0	2-1	
		NPS261	Organic/Physical Chemistry Laboratory I	2-0-4	2-2	
		BMS201	Molecular Biology	3-3-0	2-2	BIO101
		BIE261	Molecular Biology Laboratory	2-0-4	2-2	BIO101
		BIE301	Metabolic System Engineering	3-3-0	3-1	BEN231
		TFP301	Numerical Analysis	3-3-0	3-1	
		BMS301	Cell Biology	3-3-0	3-1	BEN201
		BMS361	Cell biology & Genetics laboratory	2-0-4	3-1	BEN201
		BIE302	Biochemical Engineering	3-3-0	3-2	TFP301
		BEN342	Mathematical Biology	3-3-0	3-2	MTH201 or MTH103
		NPS432	Surface & Colloids	3-3-0	3-2	
		NPS301	Instrumental Analysis for Materials	4-2-4	3-2	
		BIE431	Protein Engineering	3-3-0	4-1	TFP301
		BMS433	Systems Biology	3-3-0	4-1	BIO101 and MTH201 or MTH103
		SDM451	Introduction to MEMS	3-3-0	4-1	
		SDM250	Mechanical Drawing and Lab.	3-3-0	4-2	
		EDA201	Basic Circuit Theory	3-3-1	4-2	
		BEN431	Materials for Biomedical Applications	3-3-0	4-2	BIO101
		BEN432	Introduction to Biomechanics	3-3-0	4-2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Bio medical Science	Required	BEN201	Biochemistry	3-3-0	2-1	BIO101
		BEN261	Biochemistry Laboratory	2-0-4	2-1	BIO101
		BMS201	Molecular Biology	3-3-0	2-2	BIO101
		BMS301	Cell Biology	3-3-0	3-1	BIO101
		BMS302	Developmental Biology	3-3-0	3-2	BIO101
		BMS490	Interdisciplinary Project	1-0-2	4-2	
	Elective	NPS201	Organic Chemistry I	3-3-0	2-1	
		BEN231	Microbiology	3-3-0	2-1	BIO101
		BIE232	Microbial Physiology	3-3-0	2-2	BIO101
		BIE261	Molecular Biology Laboratory	2-0-4	2-2	BIO101
		TFP301	Numerical Analysis	3-3-0	3-1	
		BMS361	Cell Biology & Genetics Laboratory	2-0-4	3-1	BEN201
		BIE302	Biochemical Engineering	3-3-0	3-2	TFP301
		FCE202	Physical Chemistry II: Kinetics	3-3-0	3-2	FCE201
		BEN342	Mathematical Biology	3-3-0	3-2	MTH201 or MTH103
		BEN301	Physiology	3-3-0	3-2	BIO101
		BMS433	Systems Biology	3-3-0	4-1	BIO101 and MTH201 or MTH103
		BIE431	Protein Engineering	3-3-0	4-1	TFP301
		BMS332	Genetics	3-3-0	4-1	BIO101
		BIE301	Metabolic System Engineering	3-3-0	4-1	BEN231
		BEN431	Materials for Biomedical Applications	3-3-0	4-2	BIO101
		BEN432	Introduction to Biomechanics	3-3-0	4-2	
		BMS432	Immunology	3-3-0	4-2	BIO101 and BEN201

○ Description

NPS201 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 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.

NPS202 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.

NPS231 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 of 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.

NPS261 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 into 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.

NPS301 Instrumental Analysis for Materials

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).

NPS302 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.

NPS331 Physical Chemistry III: Quantum/Statistical Mechanics

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.

NPS332 Inorganic Chemistry

This course is designed to give an introduction into inorganic chemistry with a balance between theory, descriptive chemistry, and its applications. This course will deal with the fundamental concepts regarding chemical bonds, molecular symmetry, physical methods in inorganic chemistry, coordination, organometallic chemistry of transition elements, and periodic trends for the elements, simple compounds and more complex compounds.

NPS333 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.

NPS361 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.

NPS431 Application of Polymers & Nano Materials

Nano-polymer materials are regarded as indispensible materials in nanotechnologies, IT-technologies (electronics-telecommunication), and bio- engineering fields. The students will study various industrial application fields with respect to the characteristics of the materials and the current research trends in nano, polymer materials.

NPS432 Surface & Colloids

In this course, common concepts, such as the van der Waals force and surface tension, are discussed from first principles along with other important microscopic forces. Subsequently, the students will learn the roles of various intermolecular and interparticle forces when determining the properties of simple systems, such as gases, liquids, and solids, and of more complex colloidal, polymeric, and biological systems. This class is essential since the self-assembly of micro- and nano-components through surface interactions are an integral part of current nanotechnologies.

FCE201 Physical Chemistry I : Thermodynamics

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 (1) for calculating energy conversion, for example, in engines and (2) for determining the equilibrium composition of a chemically reacting system.

FCE202 Physical Chemistry II: Kinetics

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.

FCE302 Fine 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.

FCE303 Transport Phenomena

This course provides an understanding about how momentum, mass and heat are transferred. These disciplines are then used for designing reactors and fluidic devices.

FCE331 Unit Operation

A unit operation is a single basic step in chemical engineering processes. As such, a process can consists of multiple unit operations to obtain the desired products. This course covers principal unit operations, which are classified as fluid flow processes, heat transfer processes, mass transfer processes, thermodynamic processes and mechanical processes.

FCE332 Process Control

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 metholodogy of optimizing processes by controlling physical devices vis mathematical algorithms.

FCE431 Catalysis

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

BEN201 Biochemistry

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.

BEN261 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.

BEN231 Microbiology

This course provides basic concepts and the fundamental aspects of microscopic organisms at a molecular and cellular level. The topics that will be presented include genetics, physiology, and classification of microorganisms as well as the basics in general, applied, environmental, medical and industrial microbiology. The class will discuss the impacts of microorganisms on human life and health, such as in fermentation, disease, etc, and the techniques currently used in microbiology labs world-wide.

BEN301 Physiology

Students will learn about the physical, mechanical, and biochemical functions of the human body. A series of lectures on the anatomical structures and functions of each organ, and the integration, communication, and homeostasis among the various organ systems, including the circulatory, nervous, excretory, musculoskeletal, respiratory, gastrointestinal and reproductive system, will be given.

BEN342 Mathematical Biology

This course intends to provide students with quantitative tools for understanding biological systems ranging from molecular biology to population genetics. Various analytical and numerical methods will be introduced. Though not a mandatory prerequisite, students are assumed to be familiar with basics of calculus, differential equations, or linear algebra.

BEN431 Materials for Biomedical Applications

This course discusses the critical role of biomaterial in biomedical applications, ranging from the selection of materials, processing and 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.

BEN432 Introduction to Biomechanics

Biomechanics is based on physiology, physics, mechanics and kinesiology. In this course, students learn how to apply physical/mechanical principles to living organisms to understand and analyze their structures, functions and kinetic mechanisms. The course introduces the use of continuum mechanics and experimental and analytical methods that are available at molecular level to tissue and organ level.

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.

BMS301 Cell Biology

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

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.

BMS332 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.

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.

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.

BMS433 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, recent trend is to integrate each specific area of biological sciences and to interpret data by utilizing various methods including genomics, proteomics, metabolics for the better grasp of biological processes.

BIE232 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.

BIE261 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.

BIE301 Metabolic System 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.

BIE302 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.

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 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.

AME211 Thermodynamics of Materials

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

AME302 Transmission Electron Microscopy

The theoretical and practical aspects of conventional and high-resolution transmission electron microscopy and related techniques will be covered in this class, including imaging theory and kinematical and dynamical diffraction theory. Other topics that will be covered are diffraction contrast analysis of imperfect crystals and phase contrast analysis of crystal lattice structures. This class includes a laboratory section.

AME450 Thin Film Technology

The need for thin films is now increasing as electronic devices decrease in size, become lighter and are integrated. In addition, the 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 methods used in characterization and the final applications of thin films.

AME451 Semiconductor Materials and Devices

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.

AME452 Display and Devices

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

EDA201 Basic Circuit Theory

The aims of this course are to make the student 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; 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. LabView tool will be introduced and used for basic experiments. Focused for both hands-on experience and design practice with the following experiments.

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 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.

TFP301 Numerical Analysis

This course introduces numerical methods with an emphasis on algorithm construction, analysis and implementation. Other topics include programming, rounding-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.

SLE301 Introduction to Solar Cells

Humans need energy to live. 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.

SDM451 Introduction to MEMS

This course introduces MEMS, 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-devices, including micro-mechanical sensors (accelerometer, pressure sensor, flow sensor, temperature sensor), micro-actuators, and microfluidics.

NPS490 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 undergraduate level. Lastly, students will present their work in public for evaluation.

FCE490 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 undergraduate level. Lastly, students will present their work in public for evaluation.

BEN490 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 undergraduate level. Lastly, students will present their work in public for evaluation.

BMS490 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 undergraduate level. Lastly, students will present their work in public for evaluation.

ECS504 Electrochemical Energy Conversion & Storage

This course (EECS) covers topics from basic electrochemistry to electrochemistry-based energy devices. Based on the understanding of electrochemistry, seniors and graduates will learn about the principles and state-of-the-art technologies used in energy devices, including batteries, fuel cells, electrochemical capacitors and biofuel cells.

3. Graduate Programs

1) Nano-Bio Technology and Chemical Engineering

School of Nano-Biotechnology 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 in 21st century. The field of Nano-Biotechnology 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.

○ 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

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Nano-Bio Technology and Chemical Engineering	Pre-Requisite	BEN201	Biochemistry	3-3-0	1	
		AME202	Introduction to Materials Science and Engineering	3-3-0	1	
		FCE202	Physical Chemistry II: Kinetics	3-3-0	1	
	Elective	FCE501	Advanced Kinetics	3-3-0	1	
		MEN558	Micro and Nanofabrication	3-3-0	2	
		BMS501	Advanced Biochemistry	3-3-0	1	
		NBC502	Special Topics in Nano/Biotechnologies and Chemical Engineering A~Z	3-3-0	1, 2	
		FCE502	Advanced Thermodynamics	3-3-0	1	
		BMS502	Current Topics in Immunology	3-3-0	2	
		BEN502	Bioanalysis	3-3-0	1	
		BMS503	Advanced Microbial Physiology	3-3-0	1	
		ECS504	Electrochemical Energy Conversion & Storage	3-3-0	2	
		FCE503	Advanced Transport Phenomena	3-3-0	2	
		NBC503	Design and Analysis of Experiments	3-3-0	2	
		BMS504	Advanced Cellular and Molecular Biology	3-3-0	2	
		NBC531	Technical writing in English	3-3-0	2	
		NBC532	Inventions and Patents	3-3-0	1	
		MEN533	Mechanics of Polymer Solids and Fluids	3-3-0		
		ENV505	Advanced Environmental Engineering	3-3-0	1	
		ECS505	Nanochemistry	3-3-0	2	
		AME552	Advanced Nanoscience and Nanotechnology	3-3-0		
		MEN557	Polymer and Composite Manufacturing	3-3-0		
		AME570	Polymer Materials and Properties	3-3-0		
		AME571	Organic Optoelectric Materials and Devices	3-3-0		
		AME580	Polymer Structure and Properties	3-3-0	2	
		FCE601	Advanced Process Control	3-3-0	2	
		MEN534	Scanning Probe Microscopy	3-3-0	1	
		FCE701	Biorefinery	3-3-0	1	
		BEN701	Biology and Micro/Nanotechnology	3-3-0	1	
		BMS701	Signal Transductions in Cells	3-3-0	1	
		BEN702	Current Topics of Biomedical Research	3-3-0	2	
		BEN703	Current Topics of Advanced Molecular Biology	3-3-0	1	
		NBC590	The Seminars	1-1-0	1,2	
		NBC690	Master's Research	Value of Credit	1,2	
		NBC890	Doctoral Research	Value of Credit	1,2	

○ Description

BEN201 Biochemistry

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.

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 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.

FCE202 Physical Chemistry II: Kinetics

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.

AME580 Characterization of Polymer Structures

This course is to understand polymer properties such as crystalline polymer, polymer blend, and block copolymers. And also graduate students will study what kinds of structures these polymers can be prepared, and how you can characterize the polymers by using small and wide x-ray scattering, transmission electron microscopy, atomic force microscopy, grazing incidence small angle x-ray scattering, neutral scattering,

birefringence, optical microscopic techniques.

FCE501 Advanced Kinetics

Based on the understanding of basic kinetics from the microscopic viewpoint, chemical reactions is modelled mathematically to control them in chemical reactors. Functions of catalysts are discussed in an advanced level to enhance kinetics of chemical reactions.

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

BMS501 Advanced Biochemistry

This is an intensive course of 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.

NBC502 Special Topics in Nano/Biotechnologies and Chemical Engineering A~Z

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.

BMS502 Current Topics in Immunology

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 an independent researcher.

BEN502 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.

FCE502 Advanced Thermodynamics

This course covers an in-depth and advanced level of thermodynamics including mathematical models of phase equilibra and statistical thermodynamics. Various physicochemical properties can be predicted by the thermodyamic methodology.

NBC503 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.

FCE503 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.

ECS504 Electrochemical Energy Conversion & Storage

This course (EECS) covers topics from basic electrochemistry to electrochemistry -based energy devices. Based on the understanding of electrochemistry, seniors and graduates will learn about the principles and state-of-the-art technologies used in energy devices, including batteries, fuel cells, electrochemical capacitors and biofuel cells.

BMS503 Advanced Microbial Physiology

This class will be an in depth look at the mechanisms that regulate the expression of genes and the production of biomolecules within bacteria. Some of the topics that will be covered include the formation of different macromolecules and their roles in cellular metabolism, the different pathways involved in catabolism and the effects of gene knock-outs on the pathways and the redox balance and how it effects secondary metabolite formation, as well as other topics.

BMS504 Advanced Cellular and Molecular Biology

This is an intensive course of Cellular and Molecular Biology. In addition to lectures, graduate students will also be trained to criticize and interpret experimental data on various cellular and molecular biology topics including up-to-date research achievements on cancer biology as well as stem cell field.

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 Inventions and Patents

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

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.

ENV505 Advanced Environmental Engineering

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

ECS505 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 of chemistry, physics, and material science.

AME552 Advanced Nanoscience and Nanotechnology

This course presents the 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.

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 on 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.

AME570 Polymer aterials and Properties

In this class I will introduce the fundamentals of polymers, including their structure and synthesis as well as their chemical and physical properties based on polymer synthesis, polymerization and polymer reaction. I will also deal with the thermodynamics of polymer solutions and melts, including chain conformations in those states and also explain mechanical properties of polymer such as the characteristic of configuration and conformation, glass transition temperature, viscoelasticity, and so on. I will deal with the application using polymer materials, specially conjugated polymers.

AME571 Organic Optoelectric Materials and Devices

This course will provide the characteristic of electro-optic organic materials, such as conjugated polymers, liquid crystals, and device will be reviewed and discussed. I will explain their applications for organic optoelectronics such as organic LEDs, solar cells and laser diodes.

AME580 Polymer Physics

This course presents physical properties of polymers such as the chain confirmation, fluctuation, entanglements, etc. The macroscopic property of polymeric materials is dramatically influenced by this microscopic state change. Macromolecules beyond the simple polymers such as membranes, gels, polyelectrolytes and biopolymers and the formation of block copolymer nanostructures will also be studied.

FCE601 Advanced Process Control

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

MEN534 Scanning Probe Microscopy

In variety of research area SPM (scanning probe microscope) works as a

powerful research tool capable of providing spatially/temporally resolved diverse surface properties through 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.

BMS701 Signal Transductions in Cells

All aspects of signal transduction pathway will be introduced. A series of lectures on cell division and its mechanisms following extracellular signals in both healthly 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.

FCE701 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.

BEN701 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 can learn how to make device and operate it, how to do group discussion (oral presentation), how to do critical review (writing).

BEN702 Current Topics of Biomedical Research

This course is designed to cover the state-of-the-are technologies and the future direction in the field of biomedical engineering. Special interests are focused on artificial tissues to replace that of human and diagnostic devices for medical applications.

BEN703 Current Topics of 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.

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.

School of Design and Human Engineering

1. School Introduction

The School of Design and Human Engineering (DHE) focuses on theoretical and practical studies on innovative design creation by investigating humans' physical, cognitive and emotional needs. DHE emphasizes synthetic thought processes that require interdisciplinary and convergent knowledge from (but not limited to) art, engineering and cultural & natural sciences. DHE provides three specialized tracks – Integrated Industrial Design(IID), Affective & Human Factors Engineering (AHE), and Engineering & Systems Design (ESD) including color science. A wide range of curricula will help students become global experts performing creativity in diverse areas across design and engineering.

2. Undergraduate Programs

○ Track Introduction

1) Integrated Industrial Design (IID)

In the Integrated Industrial Design track, students develop the ability to deal with design language and the principles of form development for industrial product design based on mass production system. This course is also designed to foster designers to lead for innovative product development and differentiation through the education of the entire process of product development in industrial system and businesses environment. In these competitive global business world and high concept society, students will play roles as integrative design thinkers, who are able to integrate user centered design and scientific methodology in design putting creative values on businesses.

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 the 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 & 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 the new product development projects.

○ Credit Requirement

Track	Required/Elective	Credit(minimum)
Integrated Industrial Design	Required	15
	Elective	12
Affective & Human Factors Engineering	Required	15
	Elective	12
Engineering & Systems Design	Required	15
	Elective	12

○ Curriculum

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Integrated Industrial Design	Required	IID201	Introduction to Industrial Design	3-3-0	2-1	
		IID221	Product Design Fundamentals	3-0-6	2-2	IID222
		IID321	Product Design I	3-0-6	3-1	IID223
		IID322	Product Design II	3-0-6	3-2	
		DHE401	Creative Design	3-0-6	4-2	Multi-track project
	Elective	IID222	Design Elements and Principles	3-1-4	2-1	
		IID223	Design Graphics	3-1-4	2-2	
		IID323	CAD & 3D Modeling	3-2-2	3-1	
		IID341	Design Research Methodology	3-2-2	3-2	
		IID342	Interface Design	3-2-2	3-1	
		IID343	Multimedia Design	3-2-2	3-2	
		AHE390	Introduction to Color Science	3-2-1	3-1	
		AHE201	Introduction to Human Factors Eng.	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	AHE390
		ESD301	Creativity and Innovation	3-3-0	3-2	
		IID490	Design Seminar	3-3-0	4-1	
		IID421	Design System	3-0-6	4-1	
		IID443	Color Design	3-3-0	4-1	
		IID442	Design Portfolio & Communication	3-1-4	4-1	
		IID441	Design Professional Practice	3-2-2	4-2	
		IID495	Undergraduate Thesis Project	3-0-3	4-2	
		ESD401	Management of Design	3-3-0	4-2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Affective & Human Factors Engineering (AHE)	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	
		DHE401	Creative Design	3-0-3	4-2	Multi-track project
	Elective	IID201	Introduction to Industrial Design	3-3-0	2-1	
		ESD201	Introduction to Engineering Design	3-3-0	2-1	
		AHE203	Engineering Economy	3-3-0	2-2	
		AHE202	Engineering Psychology	3-3-0	2-2	
		AHE390	Introduction to Color Science	3-2-2	3-1	
		AHE320	Work Measurement & Methods	3-3-0	3-1	
		AHE391	Color Image Engineering	3-2-2	3-2	AHE390
		AHE321	DHM	3-3-0	3-2	
		ESD301	Creativity and Innovation	3-3-0	3-2	
		AHE440	UI&UX Design	3-3-0	4-1	
		AHE420	Safety Engineering	3-3-0	4-1	
		AHE400	Quality Engineering	3-3-0	4-1	
		AHE450	Brain Computer Interface	3-3-0	4-1	
		AHE490	Color Quality	3-3-0	4-1	
		AHE405	System Engineering	3-3-0	4-2	
		AHE455	Affective Engineering	3-3-0	4-2	
		ESD401	Management of Design	3-3-0	4-2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Engineering & Systems Design (ESD)	Required	ESD201	Introduction to Engineering Design	3-3-0	2-1	
		SDM250	Mechanical Drawing and Lab.	3-3-0	2-2	
		ESD321	Engineering Design Methods	3-3-0	3-1	MTH103
		ESD431	Engineering Design Projects I	3-0-6	4-1	
		DHE401	Creative Design	3-0-3	4-2	Multi-track project
	Elective	IID201	Introduction to Industrial Design	3-3-0	2-1	
		AHE201	Introduction to Human Factors Eng.	3-3-0	2-1	
		AHE301	Experimental Design	3-1-4	3-1	
		AHE390	Introduction to Color Science	3-2-2	3-1	
		TIE321	Database and Data Mining	3-3-0	3-1	
		CSE331	Introduction to Algorithms	3-3-0	3-1	
		SDM350	Manufacturing Processes and Lab	3-2-2	3-1	SDM230 or equivalent
		SDM351	Mechanical System Design	3-3-0	3-1	
		ESD322	Design for X	3-3-0	3-2	
		AHE391	Color Image Engineering	3-2-2	3-2	AHE390
		ESD301	Creativity and Innovation	3-3-0	3-2	
		SDM302	Introduction to Finite Element Method	3-3-0	3-2	SDM230 or equivalent
		SDM352	Creative Engineering Design I	3-0-3	3-2	SDM250 or equivalent
		ESD441	Manufacturing System Design & Simulation	3-3-0	4-1	
		ESD451	Introduction to Vehicle Design	3-3-0	4-1	
		AHE420	Safety Engineering	3-3-0	4-1	
		SDM453	CAD/CAM/CAE	3-0-3	4-2	SDM250 or equivalent
		ESD401	Management of Design	3-3-0	4-2	
		CSE461	Embedded Systems	3-1-4	4-2	
		AHE400	Quality Engineering	3-3-0	4-2	

○ Description

IID201 Introduction to Industrial Design

This course is an introduction to industrial design, and deals with its definition, objectives, and basic theories of design objects through design history and field researches.

IID222 Design Elements and Principles

This course is a basic course of cultivating form creation and creative presentation techniques. Basic elements and principles of 2D and 3D design are learnt through lectures and practices 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.

IID221 Product Design Fundamentals

This is an introductory course of product design. It deals with from observation technique of design problems to the design solving methods through design process. Through design projects of designing low-tech products, students learn abilities from solving the observed problems to constructing a prototype as a final result.

IID223 Design Graphics

This course focuses on form-creation practice related to visual design. Students learn Typography for editing and design composition. 2 dimensional computer graphic tools will be learnt. This course is designed to develop students' ability on graphic design sense and techniques including design reporting and presentation.

IID321 Product Design I

This course is a practical instruction in product design focusing on product innovation, production process and techniques, characteristics of materials, and things that should be considered regarding product design. It is designed to develop students' capacity to design products according to the mass production system

through practicing on creating product concepts and improving current design.

IID323 CAD & 3D Modeling CAD & 3D Modeling

In this course students learn the theory of CAD and practice techniques of advanced 3D graphic modeling tools. Mechanical drawing and 3D computer modeling is a major presentation technique of product design. Through learning various techniques of computer programs, students learn effective way of communication of their design concepts. RP for solid modeling are learned as well.

IID322 Product Design II

This course is designed to practice design focusing on marketing researches related to product design such as product life cycle, classification of markets, and consumer's motivation to purchase. This course cultivates students' ability to satisfy consumers needs through learning how to survey, gathering statistics, cultural anthropological approaching and design based scenario.

IID341 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.

IID342 Interface Design

This course is designed to study physical user interface design for digital information appliances. it covers various methods for user-interface design such as cognitive guidelines, task analysis, and usability testing. Students study the underlying philosophy and technique of interaction design for the design of hardware and software of computer enhanced interactive systems, and to explore the theories and the essential techniques for interaction design through practical design projects.

IID343 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 image, sound, and video editing techniques for creating multimedia title designs.

IID490 Design Seminar

This seminar is designed to construct a holostic view on design theories and issues. Students are asked to build perspectives of understanding current issues of design through readings and discussions on topics. The experts in design academia and industries are invited to cover the subject matter.

IID421 Product 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 which creates holistic design solution. The studio will emphasize the team work and collaboration to solve "big" problems.

IID441 Design Professional Practice

This course is an introduction to theories and practical knowledge in the modern business practice. This course aims at understanding the fundamentals of design practice in the real world, such as, understanding relations with various people including clients and others, running design consulting firm, practical knowledge of managing the corporate design group, setting design contract, learning verbal and visual presentations.

IID442 Design Portfolio & Communication

The course aims to allow students to learn how to make systematic communication of designer's concept, intention, and result by teaching various visual communication theories and skills. The course comprises of theoretical

lecture of fundamental theory of communication, various guidelines and principles of visual communication, and practical application of theories for designer's CV, portfolio, design proposal with diverse media.

IID443 Color Design

Principles of color-science-based color emotion scale developments are taught.

IID495 Undergraduate Thesis Project

This course is the final major project. Students undertake a design project from user study, concept development, form development, technology review, prototyping development and presentation. Final results are presented in the graduation exhibition.

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.

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.

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).

AHE390 Introduction to Color Science

Fundamentals of color science are taught such as CIE colorimetry, uniform color space, color measurements and color appearance.

AHE320 Work Measurement & Methods

The methods for assessing and improving performance of individuals and groups in organizations is surveyed. Techniques include various basic industrial engineering tools, work analysis, data acquisition and application, performance evaluation and appraisal, and work measurement procedures.

AHE340 Usability Engineering

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

AHE391 Color Image Engineering

Color reproduction characteristics and color matching methods are studied for the various imaging devices.

AHE321 DHM

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).

AHE440 UI&UX Design

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

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 accident investigation and epidemiological evaluation of safety, and principles and practices of safeguards and controls.

AHE400 Quality Engineering

This course is about application of statistical methods and probability models to the monitoring and control of product quality. The motivation for each method, its theoretical development, and its application are presented The focus is upon developing an ability to design effective quality control procedures.

AHE450 BCI Brain-Computer Interface

Fundamentals, and application areas of brain-computer interface (BCI) are addressed together with human factors issues to solve for designing better BCI systems.

AHE490 Color Quality

In this course, the color and image qualities are defined and the color and image quality measurement matrixes are introduced.

AHE405 System Engineering

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

and design techniques.

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 that 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 lifecycle issues. The student will study real-world design problems to obtain an overall knowledge of how the design process works both in theory and in practice. Engineering design projects will be undertaken during the semester.

ESD321 Engineering Design Methods

This course examines the 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 optimisation 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.

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.

ESD301 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.

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 programme 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.

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

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.

ESD411 Management of Design

This course teaches the student how to plan and manage the entire product development process. Contemporary topics in management of design such as a customer-focused quality management, quality controls along the value chain over the whole product lifecycle, product driven supplier configuration will be discussed. Furthermore, the course studies the concept and application of Product Lifecycle Management (PLM) based on a commercial PLM solution. The student will understand lifecycle engineering and the role of PLM in terms of definition, enablers and potentials.

DHE401 Creative Design

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

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 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.

CSE331 Introduction to Algorithm

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.

TIE321 Database and Data Mining

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

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.

SDM352 Creative Engineering Design I

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

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.

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, the theories and algorithms of CAD/CAM/CAE used in design and manufacture of various products. Through these studies, the students will develop their capability to design, analysis, and manufacture of various products using CAD/CAM/CAE techniques.

CSE461 Embedded Systems

The aim of this course is obtaining the development skills of embedded systems by designing and implementing diverse embedded applications which are commonly used to control consumer electronics and machineries.

3. Graduate Programs

1) Color Science & Engineering (CLR)

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.

2) Human Factors Engineering (HFE)

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

3) Integrated Industrial Design (IID)

The course of integrated industrial design in graduate programs is designed to help students to carry individual studies and projects as experts on design. This course improves students' ability as design coordinators to perform and manage design projects considering various problems in the complex and competitive environment of industry. It also provides interdisciplinary educational programs for developing the capacity of design thinking and innovative design development focusing on building design strategy. Students grow not only into experts who can apply their studies to design in real-world business, but also into researchers working on individual design studies.

4) Engineering Design (EDN)

The graduate programme in engineering design is designed to provide the student with advanced education and practical training to become skilled at the logical and systematic mapping process, through which basic science principles, engineering technologies and creative/innovative ideas are translated into products, process and other systems in reality. The programme 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 improvement while placing emphasis on advanced vehicle design/production and vehicle diagnostics. Furthermore, the programme 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 Maseter's-Doctoral Program	at least 60 credits	at least 42 credits	at least 18 credits

○ Curriculum

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Color Science & Engineering	Elective	CLR501	Color Science	3-3-0	1	
		CLR541	Imaging Devices and Color Communication	3-3-0	1	
		ECE530	Image Processing	3-3-0	1	
		CLR502	Psychophysics	3-3-0	1	
		CLR542	Cross-media color reproduction	3-3-0	2	
		CLR521	Color System	3-3-0	2	
		CLR522	Color Psychology	3-3-0	2	
		CLR543	Research Topics in Color Science & Engineering I	3-3-0	1	
		CLR544	Research Topics in Color Science & Engineering II	3-3-0	2	
		CLR511	Color Lab I	3-1-4	1	
		CLR512	Color Lab II	3-1-4	2	
		CLR701	Human Vision	3-3-0	1	
		CLR702	Advanced Color Science	3-3-0	1	
		CLR721	Image Quality Evaluation	3-3-0	2	
		CLR722	Color & Emotion	3-3-0	2	
		CLR741	Advanced Topics in Color Science & Engineering I	3-3-0	1	
		CLR742	Advanced Topics in Color Science & Engineering II	3-3-0	2	
		ECE735	Pattern Recognition	3-3-0		
		CLR600	Seminar	1-1-0	1,2	
		CLR690	Master's Research	2-2-0	1,2	
		CLR890	Doctoral Research	2-2-0	1,2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Human Factors Engineering	Elective	HFE500	Human Factors Research Design	3-3-0	2	
		HFE501	Human Factors System Design	3-3-0	1	
		HFE502	Advanced Multivariate Methods & Data Mining	3-3-0	1	
		HFE503	Human Performance in Transportation System	3-3-0	2	
		HFE504	Macroergonomics	3-3-0	2	
		HFE505	Operations Research	3-3-0	1	
		HFE506	Cultural Ergonomics	3-3-0	2	
		HFE520	Human Physical Capabilities	3-3-0	2	
		HFE521	Advanced Auditory display Design	3-3-0	1	
		HFE540	Usability Engineering II	3-3-0	2	
		HFE541	Human Information Processing	3-3-0	1	
		HFE700	Advanced Topics in Human Factors	3-3-0	1	
		HFE701	Techniques and Methodologies in Ergonomics	3-3-0	1	
		HFE590	The Seminars	1-1-0	1,2	
		HFE690	Master's Research	2-2-0	1,2	
		HFE890	Doctoral Research	2-2-0	1,2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Integrated Industrial Design	Elective	IID521	Design Project I	3-0-6	1	
		IID522	Design Project II	3-0-6	1	
		IID501	Design issues	3-3-0	1	
		IID502	Research Methodology	3-3-0	1	
		IID542	Design Policy & strategy	3-3-0	1	
		IID543	Contextual Design	3-3-0	2	
		IID523	Product- Environment System Design	3-0-6	2	
		IID544	Sustainable Design	3-3-0	2	
		IID741	Interaction Design	3-3-0	2	
		IID742	Design Marketing Informatics	3-3-0	2	
		IID545	Cross Cultural Design Studies	3-3-0	1	
		IID546	Future Design Studies	3-3-0	1	
		IID524	Transfortation Design	3-0-6	2	
		IID590	The Seminars	1-1-0	1,2	
		IID690	Master's Research	2-2-0	1,2	
Engineering Design	Elective	EDN520	Advanced Engineering Design Methods	3-3-0	1	EDN321
		EDN530	Digital Product Development	3-2-2	1	
		EDN521	Root Cause Analysis	3-3-0	2	
		EDN531	Reverse Engineering & Rapid Prototyping	3-3-0	2	
		MEN531	Finite Element Method	3-3-0		
		EDN541	Virtual Manufacturing System	3-2-2	1	
		EDN532	Product Lifecycle Management	3-2-2	2	
		EDN550	Modern Vehicle Design	3-3-0	1	
		EDN551	Vehicle Electronics	3-3-0	2	
		EDN720	Design Knowledge Management	3-3-0	1	
		EDN721	Eco-design	3-3-0	2	
		EDN723	Advanced Topics in Engineering Design	3-3-0	1	
		ECE711	Embedded System Software	3-3-0		
		EDN750	Advanced Topics in Vehicle Design	3-3-0	1	
		EDN590	The Seminars	1-1-0	1,2	
		EDN690	Master's Research	2-2-0	1,2	
		EDN890	Doctoral Research	2-2-0	1,2	

○ Description

CLR501 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.

CLR541 Imaging Devices and Color Communication

Color reproduction characteristics are studied for the various imaging devices along with various image signal standards. Also various color reproduction techniques are taught.

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.

CLR502 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.

CLR542 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.

CLR521 Color System

Various color order systems such as Munsell and NCS and the color harmony

theories are studied.

CLR522 Color Psychology

The psychological effects of colors are studied.

CLR543, CLR544 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.

CLR511, CLR512 Color Lab I, II

Color measurements and data analysis techniques are studied for color science researches. Also psychophysical experiments are studied.

CLF701 Human Vision

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

CLR702 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).

CLR721 Image Quality Evaluation

The image quality factors and quality evaluation methods are studied for the digital images on the monitors or printers. Also the research methods to develop the quality evaluation matric are discussed.

CLR722 Color & Emotion

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

CLR741, CLR742 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. To maintain flexibility in this course, the topics and the instructors will be changed every semesters.

CLR590 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.

CLR690 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.

CLR890 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.

HFE500 Human Factors Research Design

Procedures for conducting and analyzing human factors and ergonomics experiments, including fundamentals of research, design alternatives, fitting and testing stastical models, and data interpretation and presentation. Primary focus on linear regression (simple and multiple) and analysis of variance (single and multiple factor).

HFE501 Human Factors System Design

Human factors input into operator-system design, development, testing, and evaluation. Emphasis on the systems approach to human-machine interfacing, with discussion and application of specific methodologies and analytical techniques. Display and control design and selection fundamentals with engineering modeling of manual control systems.

HFE520 Human Physical Capabilities

Focuses on 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.

HFE502 Advanced Multivariate Methods & Data Mining

More in-depth study on methods of inference for multivariate distributions. 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.

HFE540 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.

HFE503 Human Performance in Transportation Systems

Contents of this course are 1) basic principles of human performance, human error, and human behavior applied to transportation systems, 2) principles of transportation systems design for human performance improvement, and 3) principles and practices of empirical evaluation for human/vehicle/infrastructure interaction.

HFE541 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.

HFE521 Advanced Auditory display Design

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.

HFE700 Advanced Topics in Human Factors

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

HFE504 Macroergonomics

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

HFE701 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.

HFE505 Operations Research (OR)

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.

HFE506 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.

HFE590 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.

HFE690 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.

HFE890 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.

IID521, IID522 Design Project I, II

In this course, students study various types and descriptions of new product design development. They explore concept development of new products, the progress of systematic design process, decision making, user centered design creation methods through chosen projects. This course will focus on corporate strategy. Students learn methods related with design strategy and project management through practical projects.

IID501 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.

IID502 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 lead them to conduct students' master or doctoral research.

IID542 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 study the design policies and strategies to strengthen the competitiveness of an organization.

IID543 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.

IID523 Product-Environment System Design

This course deals with relationships between products and the man-made environment. Products are considered as important factors in forming the man-made environment. Students will study the factors and the relationships to establish a new design system and opportunities to solve existing environmental problems.

IID544 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 deals with universal design, eco design and social design as a new business models.

ID741 Interaction Design

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

IID742 Design Marketing Informatics

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

IID545 Cross Cultural Design Studies

Design represent culture of everyday life. In this global world, local culture

represents the identity of the people and influences behaviors of the nation. Through the comparative study of various cultures, student will understand the characteristics of korean culture better. And this will influence students to develope empathetic understanding and design objets to meet the need of local people.

IID546 Future Design Studies

Design has been always user-centered and created lifestyle of the times. It is the most effective tool to envison and visualize future. The objective of this course is to learn the systematic design methods and scenarios to understand and describe future. It deals with cultural dynamics, technology trend, market context, target audience and etc.

IID524 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 the collaborative project with related industry and research institution, student will be equipped with the practical and systematic knowledge of creating new design direction and concept.

IID590 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.

IID690 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.

EDN520 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.

EDN530 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 modelling & system modelling 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.

EDN521 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.

EDN531 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 StereoLithography Apparatus (SLA), Selective Laser Sintering equipments (SLS) and 3D printing will be introduced.

EDN541 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.

EDN532 Product Lifecycle Management (PLM)

This course studies the concept and application of product lifecycle management (PLM), and covers Beginning of Lifecycle (BOL), Middle of Lifecycle (MOL), and End of Lifecycle (EOL) managements while placing emphasis on emerging information technologies and decision making issues. Through this course, the student will learn the in-depth understanding of lifecycle engineering.

EDN550 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 challenge; crashworthiness; vehicle control systems; suspension system & components; engine design; transmission & driveline; and braking system. Future trends in vehicle design will be discussed. External experts can be invited on some specific issues to provide practical lessons.

EDN551 Vehicle Electronics

This course introduces the student to automotive electronics focusing on sensor/actuators and control systems. Vehicle telemetry/diagnostics systems including required embedded systems will be studied.

EDN720 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 reuse

EDN721 Eco-design

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

EDN723 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.

EDN750 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.

EDN590 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.

EDN690 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.

EDN890 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 Urban and Environmental Engineering

1. School Introduction

Environmental pollution and climate change caused by industrialization are directly related to the survival of human beings. Therefore, studies on these issues are gaining in importance. Urban and environmental engineering is an interdisciplinary research field focusing on environmental protection, sustainable development and 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 modelling) and (3) Urban development and ecological engineering (urban planning, transportation, ecology).

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 modelling, environmental fate models, remote sensing, air/soil/water pollution monitoring and hydrology will all 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 & Ecological Engineering (UDE)

The aim of this tract is to provide the students with a comprehensive knowledge and capability as an expert in the planning, design and management of urban communities. The programs offered here include urban planning, intelligent transport systems and eco-friendly urban environments, as well as others.

○ Credit Requirement

Track	Required/Elective	Credit(minimum)
Environmental Analysis & Pollution Control Engineering (PCE)	Required	10
	Elective	17
Earth Science and Engineering (ESE)	Required	10
	Elective	17
Urban Development & Ecological Engineering (UDE)	Required	10
	Elective	17

○ Curriculum

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Environmental Analysis and Pollution Control Engineering	Required	PCE201	Introduction to Environmental Engineering	3-3-0	2-1	
		TFP220	Fluid Mechanics	3-3-0	2-2	
		ESE301	Environmental Impact Assessment	3-3-0	3-1	
		PCE490	Interdisciplinary Project	1-0-2	4-1	
	Elective	NPS201	Organic Chemistry I	3-3-0	2-1	
		BEN231	Microbiology	3-3-0	2-1	BIO101
		ESE201	Environmental Chemistry	3-3-0	2-1	
		FCE201	Physical Chemistry I: Thermodynamics	3-3-0	2-1	
		FCE202	Physical Chemistry II: Kinetics	3-3-0	2-2	FCE201
		PCE202	Air Pollution	3-3-0	2-2	
		NPS231	Organic Chemistry II	3-3-0	2-2	NPS201
		PCE203	Water Pollution	3-3-0	2-2	
		PCE301	Water Treatment Engineering	3-3-0	3-1	MTH201
		TFP301	Numerical Analysis	3-3-0	3-1	
		PCE302	Water and Wastewater Engineering	3-3-0	3-1	MTH201
		PCE303	Wastes Management	3-3-0	3-1	
		PCE304	Analysis of Pollutant	3-2-1	3-1	CHE102, CHE104
		ECS311	Instrumental Analysis	3-3-0	3-1	
		TFP320	Applied Fluid Mechanics	3-3-0	3-1	TFP220 or equivalent
		FCE303	Transport Phenomena	3-3-0	3-1	
		ESE302	Aquatic Chemistry Laboratory	3-1-2	3-2	CHE102, CHE104
		PCE305	Soil Pollution	3-3-0	3-2	
		FCE331	Unit Operation	3-3-0	3-2	
		PCE401	Sanitary Systems Engineering and Design	3-3-0	4-1	MTH201
		PCE402	Environmental Remediation	3-3-0	4-1	
		PCE403	Environmental Bioprocess	3-3-0	4-2	
		BIE421	Analytical Chemistry	3-3-0	4-2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Earth Science and Engineering	Required	PCE201	Introduction to Environmental Engineering	3-3-0	2-1	
		TFP220	Fluid Mechanics	3-3-0	2-2	
		ESE301	Environmental Impact Assessment	3-3-0	3-1	
		PCE490	Interdisciplinary Project	1-0-2	4-1	
	Elective	NPS201	Organic Chemistry I	3-3-0	2-1	
		BEN201	Biochemistry	3-3-0	2-1	BIO101
		BEN231	Microbiology	3-3-0	2-1	BIO101
		ESE201	Environmental Chemistry	3-3-0	2-1	
		FCE201	Physical Chemistry I: Thermodynamics	3-3-0	2-1	
		ESE202	Global Environment	3-3-0	2-1	
		FCE202	Physical Chemistry II: Kinetics	3-3-0	2-2	FCE201
		PCE202	Air Pollution	3-3-0	2-2	
		NPS231	Organic Chemistry II	3-3-0	2-2	NPS201
		PCE203	Water Pollution	3-3-0	2-2	
		TFP301	Numerical Analysis	3-3-0	3-1	
		ESE303	Environmental Ecology	3-3-0	3-1	
		PCE304	Analysis of Pollutant	3-2-1	3-1	CHE102, CHE104
		TFP320	Applied Fluid Mechanics	3-3-0	3-1	TFP220 or equivalent
		ESE302	Aquatic Chemistry Laboratory	3-1-2	3-2	CHE102, CHE104
		ESE304	Hydrology	3-3-0	3-2	MTH201
		PCE305	Soil Pollution	3-3-0	3-2	
		FCE303	Transport Phenomena	3-3-0	3-1	
		ESE401	Hydraulics	3-3-0	4-1	MTH201
		ESE402	Environmental Modeling	3-3-0	4-1	MTH201
		PCE402	Environmental Remediation	3-3-0	4-1	
		ESE403	Environmental Toxicology	3-3-0	4-2	
		ESE404	Introduction to Climate Change	3-3-0	4-2	MTH201
		ESE405	Groundwater Engineering	3-3-0	4-2	MTH201

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Urban Development and Ecological Engineering	Required	UDE201	Intro to Urban and Ecological 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	
	Elective	ESE202	Global Environment	3-3-0	2-1	
		UDE202	Environmental Design	3-3-0	2-1	
		GMT105	Microeconomics	3-3-0	2-2	
		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	
		TFP301	Numerical Analysis	3-3-0	3-1	
		UDE301	Transport System	3-3-0	3-1	
		UDE302	Urban Survey Analysis Techniques	3-3-0	3-1	
		ESE303	Environmental Ecology	3-3-0	3-1	
		PCE303	Wastes Management	3-3-0	3-1	
		PCE305	Soil Pollution	3-3-0	3-2	
		UDE304	Urban Transportation Planning	3-3-0	3-2	
		UDE305	Urban Renewal	3-3-0	3-2	
		UDE306	Urban Infrastructure Engineering	3-3-0	3-2	
		PCE401	Sanitary Systems Engineering and Design	3-3-0	4-1	MTH201
		ESE402	Environmental Modeling	3-3-0	4-1	MTH201
		PCE402	Environmental Remediation	3-3-0	4-1	
		ESE403	Environmental Toxicology	3-3-0	4-2	
		ESE404	Introduction to Climate Change	3-3-0	4-2	MTH201

○ Description

GMT105 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.

NPS201 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 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.

BEN201 Biochemistry

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 biochemical processes.

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.

FCE201 Physical Chemistry I: Thermodynamics

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 (1) for calculating energy conversion, for example, in engines and (2) for determining the equilibrium composition of a chemically reacting system.

PCE201 Introduction to Environmental Engineering

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

UDE201 Introduction to Urban Development and Ecology

This course instructs sophomore-level students in urban development & ecology engineering-related fields.

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.

FCE202 Physical Chemistry II: Kinetics

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.

PCE202 Air Pollution

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

UDE202 Environmental Design

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

NPS231 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 of 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.

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.

UDE203 GeographicInformation system

The geographic information system (GIS) is 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.

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.

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.

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.

TFP301 Numerical Analysis

This course introduces numerical methods with emphasis on algorithm construction, analysis and implementation. 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.

UDE301 Traffic System

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.

ESE302 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.

PCE302 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.

UDE302 Urban Survey Analysis Techniques

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

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.

PCE303 Wastes Management

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

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.

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.

PCE304 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.

UDE304 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 transportation problems in real world.

PCE305 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.

UDE305 Urban Renewal

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

UDE306 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.

ECS311 Instrumental Analysis

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 their color or other characteristics. These methods, however, takes long time without high sensitivity. Instead, the modern instrumental analysis tools will be introduced in the course. Instrumental analysis has higher sensitivity and takes relatively short time. Methods covered include FTIR, NMR, X-ray analysis, Raman, Voltammetry, etc.

TFP320 Applied Fluid Mechanics

In this course, based on the topics learned in TFP/SDM 220, advanced topics will be studied, including viscous flows, inviscid flows, lift and drag, basic turbulent flows, fundamentals of compressible flows and turbomachinery.

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.

FCE303 Transport Phenomena

This course provides an understanding about how momentum, mass and heat are transferred. These disciplines are then used for designing reactors and fluidic devices.

FCE331 Unit Operation

A unit operation is a single basic step in chemical engineering processes. As such, a process can consists of multiple unit operations to obtain the desired products. This course covers principal unit operations, which are classified as fluid

flow processes, heat transfer processes, mass transfer processes, thermodynamic processes and mechanical processes.

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.

PCE401 Sanitary Systems Engineering and Design

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

ESE402 Environmental Modeling

This aims of this course is to learn the basic concepts of environmental modeling. Topics include the chemical and dynamical processes engaged in the dispersion and long-range transport of gaseous pollutants and aerosols and how to formulate those processes for a numerical model. During the course, the class will practice a simple type of atmospheric pollution model.

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.

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 biosensors, and regulation policies will be covered.

PCE403 Environmental Bioprocess

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

ESE404 Introduction to Climate Change

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.

BIE421 Analytical Chemistry

This course provides juniors/seniors in chemistry with a rigorous background in chemical principles that is particularly important to analytical chemistry and gives an appreciation for the challenging task of judging the accuracy and precision of experimental data.

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.

3. Graduate Programs

1) Urban Engineering

Urban engineering focuses on providing infrastructures for our daily life and activities and improving human life. Students in urban engineering study the details about how to develop eco-friendly urban environments.

2) Environmental Engineering

Environmental engineering focuses on conserving nature, improving lives and studying sustainable development. Students in environmental engineering learn how to develop and maintain water resources, investigate the fates of pollutants and treat pollutants.

○ 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

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Urban Engineering	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		
		URB590	The Seminars	1-1-0		
		URB690	Master's Research	Value of Credit		
		URB890	Doctoral Research	Value of Credit		
Environmental Engineering	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		

○ Description

□ Urban Engineering

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 the traffic impact caused by the urban and regional development, also covers the analysis of the evaluation outcome and provides solutions for the problems detected.

URB504 Road Engineering

The basic concepts of road engineering including road planning, design, pavement and maintenance will be studied. After this course, students will be 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 simulation 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.

URB590 The Seminars

The purpose of this course 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.

□ Environmental Engineering

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 introduce the fundamentals of physical/chemical treatment processes and will help students learn how to design the 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, 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. In 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 biosenors, 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 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.

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.

Interdisciplinary School of Green Energy

1. School Introduction

Due to a limit in fossil fuels and increasing environmental pollution, along with the rapid increase in energy demand, various technologies are required to produce environmentally-friendly and economical energy sources, particularly in the fields of manufacture, supply, storage and usage. Therefore, in this division, the main focus is studying and researching environmentally-friendly solar energy, hydrogen energy, fuel cells, bio-energy, nuclear energy and energy economics. Solar energy is in the limelight as an environment-friendly and unlimited alternative energy source. As such, UNIST is carrying out research on the next generation solar cells. In the field of energy conversion and storage, studies focus on the use of batteries and fuel cells for electricity. In addition, a more effective use of hydrogen energy will be studied by developing better ways to produce and store hydrogen. Bio-energy research includes evaluating and improving the methods to efficiently produce liquid fuels, alcohols and hydrogen from renewable biomass. 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) Solar Energy (SLE)

This track will cover from a basic concepts to practical technology about solar

cells including theoretical parts, solar cell structures, various kinds of them, analysis tools, and fabrication skills. Based on the fundamentals, students will focus on studying the next generation solar cells.

2) Energy Conversion & Storage (ECS)

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.

3) Bio Energy (BIE)

Bio Energy (BIE) track provides students with the multidisciplinary backgrounds for discovering and mass-producing sustainable energy sources from biomass. Current research topics in synthetic and systems biology, and metabolic engineering, which are essential for replacing the fossil fuels with carbon-neutral biofuels and for converting petrol-based chemical industry into biorefinery, will be integrated into the curriculum.

4) Nuclear Energy (NUE)

This track will cover the advancement of safety in operating nuclear power plants, the development of advanced small and medium-sized nuclear reactors, the hydrogen production utilizing nuclear energy conversion, and the development of nuclear fusion reactors.

○ Credit Requirement

Track	Required/Elective	Credit(minimum)
Solar Energy	Required	15
	Elective	12
Energy Conversion & Storage	Required	15
	Elective	12
Bio Energy	Required	15
	Elective	12
Nuclear Energy	Required	16
	Elective	11

○ Curriculum

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Solar Energy	Required	NPS201	Organic Chemistry I	3-3-0	2-1	
		FCE201	Physical Chemistry I : Thermodynamics	3-3-0	2-1	
		SLE300	Electronic Devices	3-3-0	3-1	
		SLE301	Introduction to Solar cells	3-3-0	3-2	
		SLE401	Solar cells lab	2-0-4	4-1	
		SLE490	Interdisciplinary Project	1-0-2	4-2	
	Elective	AME202	Introduction to Materials Science and Engineering	3-3-0	2-1	GP(or GP I or GP II) and GC(or GC I or GC II)
		NPS231	Organic Chemistry II	3-3-0	2-2	
		FCE202	Physical Chemistry II : Kinetics	3-3-0	2-2	
		ECS254	Inorganic chemistry I	3-3-0	2-2	
		ECS311	Instrumental Analysis	3-3-0	3-1	
		SLE353	Solid State chemistry	3-3-0	3-1	
		DPH201	Electrodynamics I	3-3-0	3-1	
		SLE354	Introductory electrochemistry	3-3-0	3-2	
		SLE450	Advanced Solar cells	3-3-0	4-2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Energy Conversion & Storage	Required	FCE201	Physical chemistry I : Thermodynamics	3-3-0	2-1	
		ECS254	Inorganic chemistry I	3-3-0	2-2	
		SLE353	Solid State chemistry	3-3-0	3-1	
		SLE354	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	
	Elective	ECS213	Fundamentals of energy materials	3-3-0	2-1	
		NPS201	Organic Chemistry I	3-3-0	2-1	
		FCE202	Physical Chemistry II : Kinetics	3-3-0	2-2	
		ECS311	Instrumental Analysis	3-3-0	3-1	
		NPS202	Introduction to nanoscience and nanotechnology	3-3-0	3-2	
		ECS411	Fundamentals of fuel cell (systems)	3-3-0	4-1	
		TFP301	Numerical Analysis Electrochemical	3-3-0	4-1	
		ECS504	Electrochemical Energy Conversion & Storage	3-3-0	4-1	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prere quisite
Bio Energy	Required	BEN261	Biochemistry Lab	2-0-4	2-1	
		BEN201	Biochemistry	3-3-0	2-1	
		BMS201	Molecular Biology	3-3-0	2-2	
		BIE301	Systems Metabolic Engineering	3-3-0	3-1	
		BIE302	Biochemical Engineering	3-3-0	3-2	
		BIE490	Interdisciplinary Project	1-0-2	4-2	
	Elective	NPS201	Organic Chemistry I	3-3-0	2-1	
		BEN231	Microbiology	3-3-0	2-1	
		PCE201	Introduction to Environmental Engineering	3-3-0	2-1	
		PCE202	Air Pollution	3-3-0	2-2	
		FCE201	Physical chemistry I : Thermodynamics	3-3-0	3-1	
		BIE261	Molecular Biology Lab	2-0-4	2-2	
		BIE232	Microbial Physiology	3-3-0	2-2	
		TFP301	Numerical Analysis Electrochemical	3-3-0	3-1	
		BMS301	Cell Biology	3-3-0	3-1	
		BMS361	Cell biology & Genetics laboratory	2-0-4	3-1	
		ESE303	Environmental Ecology	3-3-0	3-1	
		BEN342	Mathematical Biology	3-3-0	3-2	
		BEN301	Physiology	3-3-0	3-2	
		NPS301	Instrumental Analysis for Materials	4-2-4	3-2	
		FCE202	Physical Chemistry II : Kinetics	3-3-0	3-2	
		FCE303	Transport Phenomena	3-3-0	4-1	
		BMS433	Systems Biology	3-3-0	4-1	
		BIE431	Protein Engineering	3-3-0	4-1	
		BMS332	Genetics	3-3-0	4-1	
		BEN432	Introduction to Biomechanics	3-3-0	4-2	
		NPS332	Inorganic Chemistry	3-3-0	4-2	
		BIE421	Analytical chemistry	3-3-0	4-2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Nuclear Energy	Required	NUE211	Fundamentals of Nuclear Engineering	3-3-0	2-1	
		NUE212	Introduction to Nuclear Reactor Theory	3-3-0	2-2	
		NUE321	Nuclear System Design & Experiment	3-3-0	3-1	
		NUE322	Nuclear Component Design & Material Experiment	3-3-0	3-2	
		NUE421	Nuclear Engineering Lab	3-0-6	4-1	
		NUE490	Interdisciplinary Project	1-0-2	4-2	
	Elective	TFP210	Thermodynamics	3-3-0	2-1	
		AME202	Introduction to Materials Science & Engineering	3-3-0	2-1	GP(or GP I or GP II) and GC(or GC I or GC II)
		SDM230	Solid Mechanics	3-3-0	2-1	
		NUE233	Nuclear Radiation engineering	3-3-0	2-2	
		AME211	Thermodynamics of Materials	3-3-0	2-2	
		TFP220	Fluid Mechanics	3-3-0	2-2	
		FCE201	Physical Chemistry I : Thermodynamics	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	
		NPS202	Introduction to nanoscience and nanotechnology	3-3-0	3-2	
		CSE211	Introduction to Programming Languages	3-3-0	3-2	
		AME212	Mechanical Properties of Materials	3-3-0	3-2	
		SLE354	Introductory electrochemistry	3-3-0	3-2	
		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	
		NPS301	Instrumental Analysis for Materials	4-2-4	4-2	

○ Description

NPS201 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.

FCE201 Physical Chemistry I: Thermodynamics

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 (1) for calculating energy conversion, for example, in engines and (2) for determining the equilibrium composition of a chemically reacting system.

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 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.

NPS231 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 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 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.

FCE202 Physical Chemistry II: Kinetics

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.

ECS254 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 and atomic structure. and chemical bonding. This course is designed for students who plan to major in one of the engineering schools.

SLE300 Electronic Devices

This course will cover the basic concepts, mechanisms, and applications on 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.

SLE301 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.

ECS311 Instrumental Analysis

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 any characteristics they have. These methods, however, takes long time without high sensitivity. Instead, the modern instrumental analysis tools will be introduced in the course. Instrumental analysis has higher sensitivity and takes relatively short time to complete the analysis. Methods include FTIR, NMR, X-ray analysis, Raman, Voltammetry, etc.

SLE353 Solid State chemistry

This course explores the basic principles of chemistry and their application to engineering systems. It deals with 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, e.g., batteries and fuel cells, and from superconductor.

DPH201 Electrodynamics I

This course first 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. 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.

SLE354 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 later part of the class, applications related to electrochemical energy conversion, characterization of materials, and electrochemical sensors are covered.

SLE401 Solar cells lab

This course gives 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. In the course, practice for characterization and analysis methods for solar cells will be provided.

SLE490, ECS490, BIE490, NUE490 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 undergraduate level. Lastly, students will present their work in public for evaluation.

SLE450 Advanced 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.

ECS213 Fundamentals of energy materials

This course covers the fundamentals of energy materials related to energy conversion and storage devices, such as batteries, supercapcitor and fuel cells. Also, this course will be open together with energy conversion and storage experiment, therefore, the focus of this course is the scientific background of each devices.

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 test its electrochemical performance with their final products.

NPS202 Introduction to nanoscience and nanotechnology

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

ECS411 Fundamentals of fuel cell (systems)

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

TFP301 Numerical Analysis Electrochemical

This course introduces numerical methods with emphasis on algorithm construction, analysis and implementation. 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.

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.

BEN261 Biochemistry Lab

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

BEN201 Biochemistry

This course is designed to teach students the various chemical processes occuring 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.

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.

BEN231 Microbiology

This course provides basic concepts and the fundamental aspects of microscopic organisms at a molecular and cellular level. The topics that will be presented include genetics, physiology, and classification of microorganisms as well as the basics in general, applied, environmental, medical and industrial microbiology. The class will discuss

the impacts of microorganisms on human life and health, such as in fermentation, disease, etc, and the techniques currently used in microbiology labs world-wide.

PCE201 Introduction to Environmental Engineering

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

PCE202 Air Pollution

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

BIE261 Molecular Biology Lab

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.

BIE232 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.

BMS301 Cell Biology

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

BIE301 Systems 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.

BIE302 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.

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.

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.

BEN342 Mathematical Biology

This course intends to provide students with quantitative tools for understanding biological systems ranging from molecular biology to population genetics. Various analytical and numerical methods will be introduced. Though not a mandatory prerequisite, students are assumed to be familiar with basics of calculus, differential equations, or linear algebra.

BEN301 Physiology

Students will learn about the physical, mechanical, and biochemical functions of the human body. A series of lectures on the anatomical structures and functions of each organ, and the integration, communication, and homeostasis among the various organ systems, including the circulatory, nervous, excretory, musculoskeletal, respiratory, gastrointestinal and reproductive system, will be given.

NPS301 Instrumental Analysis for Materials

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).

FCE303 Transport Phenomena

This course provides understanding of how momentum, mass and heat is transferred. The disciplines are used for designing reactors and fluidic devices.

BMS433 Systems Biology

This course will deals with the principles underlying the handling and intergration of large datasets derived from the different ~omics disciplines.

BIE431 Protein Engineering

This course provides seniors with an ability to understand modern protein folding and protein structure analysis. Topics include methods for determining protein structure, biological and biochemical methods in protein design, purposely modified proteins and their properties. Design of mutant proteins, structural analysis of mutant protein by NMR and X-ray crystallography, and applications to science medicine and industry are also included.

BMS332 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.

BEN432 Introduction to Biomechanics

Biomechanics is based on physiology, physics, mechanics and kinesiology. In this course, students learn how to apply physical/mechanical principles to living organisms to understand and analyze their structures, functions and kinetic mechanisms. The course introduces the use of continuum mechanics and experimental and analytical methods that are available at molecular level to tissue and organ level.

NPS332 Inorganic Chemistry

This course is designed to give an introduction into inorganic chemistry with a good balance between theory, descriptive chemistry, and its applications. This course will deal with the fundamental concepts regarding chemical bonds, molecular symmetry, physical methods in inorganic chemistry, coordination, organometallic chemistry of transition elements, and periodic trends for the elements, simple compounds and more complex compounds.

BIE421 Analytical Chemistry

This course provides juniors in chemistry with a rigorous background in chemical principles that is particularly important to analytical chemistry and gives an appreciation for the challenging task of judging the accuracy and precision of experimental data.

NUE211 Fundamentals of Nuclear Engineering

This course deal 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 Introduction to Nuclear Reactor Theory

This course covers fundamental theory of the nuclear fission reactor. 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.

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.

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

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. Also it deals with the design methods of radiation counting, timing and imaging system.

AME211 Thermodynamics of Materials

This course is designed to extend the concepts and knowledge learned from subject AME202 Physical Chemistry of Materials and provide fundamental knowledge of 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.

NUE321 Nuclear System Design & 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.

NUE322 Nuclear Component Design & Material 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 mechnical test and data analysis, phase transformation, observation by optical and electron microscopes, corrosion tests and irradiation effects.

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.

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.

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 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.

NUE421 Nuclear Engineering 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.

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.

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.

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.

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.

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 (spend fuel) techniques will be discussed in terms of economics, safety and public acceptance.

3. Graduate Programs

1) Solar Energy

This track will cover from a basic concepts to practical technology about solar cells including theoretical parts, solar cell structures, various kinds of them, analysis tools, and fabrication skills. Based on the fundamentals, students will focus on studying the next generation solar cells.

2) Energy Conversion & Storage

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.

3) Bio Energy

At the moment, only biofuels similar to petroleum-based transportation fuels allow the use of existing engines and infrastructure. Bio-energy research will focus on evaluating and improving the methods to efficiently produce liquid fuels and alcohols from renewable biomass. Nuclear energy is the largest carbon-free non-fossil energy source as well as the lowest cost supplier for electricity production in the world.

4) Nuclear Energy

This track 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.

○ 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

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
	Common	GEE590	The Seminars	1-1-0	1,2	
		GEE690	Master's Research	Value of Credit	1,2	
		GEE890	Doctoral Research	Value of Credit	1,2	
Solar Energy	Elective	SLE501	Organic Electronics	3-3-0	1	
		SLE502	Special Topics on Solar Cells	3-3-0	1	
		SLE601	Special Topics in Chemistry of Polymeric Materials	3-3-0	1	
		SLE602	Nanostructures and Nanomaterials	3-3-0	2	
		SLE701	Special Topics on Solid State Physics	3-3-0	2	
		SLE703	Special Topics on Nano Thin Films	3-3-0	2	
		SLE704	Special Topics on Organic Electronics	3-3-0	1	
Energy Conversion &Storage	Elective	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	
		ECS505	Nanochemistry	3-3-0	1	
		ECS601	Nanomaterials for Energy Storage	3-3-0	2	
		ECS701	Special Topics on Electronic Materials	3-3-0	1	
		ECS702	Fundamental of the Advanced Fuel Cells	3-3-0	2	
		ECS703	Special Topics on Fuel Cells	3-3-0	1	
		ECS704	Special Topics on Applied Electrochemistry	3-3-0	2	
		ECS705	Special Topics on Electrochemistry	3-3-0	2	
		ECS706	Special Topics on lithography	3-3-0	2	
		ECS707	Special Topics on Supramolecular Chemistry	3-3-0	2	
		ECS708	Special Topics on Nanomaterials analysis	3-3-0	1	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Bio Energy	Elective	BIE501	Special Topics on Biofuels Synthesis	3-3-0	1	
		BMS501	Advanced Biochemistry	3-3-0	1	
		BIE503	Synthetic Biology	3-3-0	2	
		BIE504	Advanced Energy and Environmental Engineering	3-3-0	1	
		BIE505	Energy Policy	3-3-0	2	
		BMS504	Advanced Cellular and Molecular Biology	3-3-0	2	
		BIE701	Current Topics of Synthetic Biology	3-3-0	2	
		BIE702	Systems Biotechnology	3-3-0	1	
		BEN703	Current Topics of Advanced Molecular Biology	3-3-0	1	
Nuclear Energy	Elective	NUE501	Structural Mechanics in Energy Systems	3-3-0	1	
		NUE502	Engineering of Nuclear Energy System	3-3-0	1	
		NUE503	Special Topics in Structural Materials in Energy Systems	3-3-0	2	
		NUE504	Advanced Energy Conversion	3-3-0	2	
		NUE505	Modeling and Simulation in Energy System	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	

○ Description

SLE501 Organic Electronics

This course will cover the basic concepts, mechanisms, and special issues on 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.

SLE502 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 kinds of them, 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. Presentation for each solar cells is required for the course.

SLE601 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.

SLE602 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 served.

SLE701 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.

SLE703 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 of chemistry, physics, and material science.

SLE701 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 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 be followed.

ECS501 Special Topics on Li-ion Batteries

This course will emphasize on the advanced technologies on electrode and battery system of the Li-ion cells. Recent technology updates for anode and cathode materials in terms of energy density and safety will be covered and in-depth discussion and presentation by reviewing patents and papers are the important class tools. Finally, future technologies on the Li-ion cells will be discussed also.

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 high temperature

superconductor (YBCO), a new form of carbon, C60 (fullerenes), the commercial development of rechargeable batteries, and fuel cells. It also examines their applications to real engineering systems.

ECS503 Electrochemisty

This course covers 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.

ECS505 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 of chemistry, physics, and material science.

ECS601 Nanomaterials for Energy Storage

This course will deliver the synthetic methods and characterization of nanomaterials for energy storage. Using different synthetic methods, dimension of the 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.

ECS701 Special Topics on Electronic Materials

This course will deliver the principle and applications of the electronic materials.

This advanced course on these materials covers the overall principles of the materials which take part of the most important 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 understanding recent advances on electronic materials.

ECS702 Fundamental of the 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 cell, Molten Carbonate fuel cell, and Solid Oxide fuel cell, etc. It also delivers the scientific information for their characterizations via ceramic engineering and solid state electrochemistry.

ECS703 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.

ECS704 Special Topics on Applied Electrochemistry

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

ECS705 Special Topics on Electrochemisty

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

ECS706 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" technique, and hybrid technique such as interference lithography), some basic optics and photoresist chemistry, and other advanced lithography techniques.

ECS707 Special Topics on Supramolecular Chemistry

This course presents concept 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 membrane, chemical sensor, and molecular recognition, template for fabrication of nanoparticles. This course is designed for graduate students with backgrounds of organic chemistry, inorganic chemistry, and materials science.

ECS708 Special Topics on Nanomaterials analysis

Nanomaterials shows different properties and characteristics from bulk, and so analytical methods of nanomaterials have been developed. This course surveys recent research trend for analytical methods of nanomaterials and their applications to energy-related materials.

BIE501 Special Topics on Biofuels Synthesis

This course includes sources and processing of biodesel (fatty acid methyl ester), bioethanol, and biogasoline (alkane, alkene) from plant biomass and social and economic considerations.

BMS501 Advanced Biochemistry

This is an intensive course of Biochemistry. Beside lectures, graduate students will also be trained to criticize and interprete experimental data on various biochemistry

topics by presenting recent research papers published in top quality journals.

BIE503 Synthetic Biology

Synthetic biology is an emerging field that hopes to redisign biological systems for engineering. This course will cover analysis of existing biological systems and design of new biological systems.

BIE504 Advanced Energy and Environmental Engineering

The use of different energy systems and their effect on our community are examined. Internal combustion engines and other machines using various fuels are put forth for analysis for their efficiency and impact on our society.

BIE505 Energy Policy

The various technical policies, energy economics and new trends in policy-making protocols are examined. National and international energy policies are reviewed with governmental statistics. The influence on energy market is also dealt with in some specifics. Fossil fuels and alternative sources of energy are compared for their contributions on our industrial world.

BMS504 Advanced Cellular and Molecular Biology

This is an intensive course of Cellular and Molecular Biology. In addition to lectures, graduate students will also be trained to criticize and interpret experimental data on various cellular and molecular biology topics including up-to-date research achievements on cancer biology as well as stem cell field.

BIE701 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 knowedge and techniques in the field of Synthetic biology, which improve their perfomance as an independent researcher.

BIE702 Systems Biotechnology

This course provides the principles, current progress, and future directions of systems biotechnology. Topics inculde genomics, transcriptomics, proteomics, metabolomics, and fluxomics to understand biological systems and to design new biological systems.

BEN703 Current Topics of 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.

NUE501 Structural Mechanics in Energy Systems

Structural components in energy systems, their functional purposes, operating conditions, and mechanical/structural design requirements. Combines mechanics techniques with models of material behavior to determine adequacy of component design. Considerations include mechanical loading, brittle fracture, inelastic behavior, elevated temperatures, neutron irradiation, vibrations and seismic effects.

NUE502 Engineering of Nuclear Energy System

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 system 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 System

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 and 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. Latest developments in the fast reactor and relevant issues are introduced. (Prerequisites: NUE501 and NUE502)

NUE507 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 reactor controllable, is investigated and derivation, validity, and solution of the point

reactor equation are studied. Principles of the reactivity measurement and the reactivity feedback effects are also investigated. In addition, the general space-time-dependent reactor dynamics is studied.

NUE508 Special topics in Nuclear Energy Engineering I

This course covers the special field of nuclear engineering such as nuclear battery, nuclear propulsion and space applications which are not covered by the given courses. The content can be variable and will be chosen by the instructor. (Prerequisites: NUE501 and NUE502)

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 reactor which are not covered by the given courses. The content can be variable and will be chosen by the instructor. (Prerequisites: NUE501 and NUE502)

GEE590 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.

GEE690 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.

GEE890 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 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 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. General Management area is designed to provide general management education and committed to enhancing knowledge of business and management issues on 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)

Students in 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.

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 process in today's global economy. Courses in Technology Management include the Technology Management, Process & Quality Management, Case Studies in Technology Management and other related courses.

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

Entrepreneurship is about identifying, valuing and capturing business opportunities in a new or existing organization. The area in Entrepreneurship provides the understanding of the entrepreneurial process and the knowledge and skills of the successful entrepreneur. 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 the careers in domestic and international corporations and financial institutions as well as careers in academia.

Finance is an area to study the ways in which individuals, corporations, and other business organizations allocate resources and make financial decisions in the 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 System, and Auditing which cover the principles and practices of accounting.

4) Marketing/International Business (MIB)

Students in Marketing/International Business area are trained for the 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 world economy, International Business ensures students to prepare for the challenges of operating business 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)
General Management	Required	30
	Elective	-
Technology Management / Information System / Entrepreneurship	Required	15
	Elective	12
Finance / Accounting	Required	15
	Elective	12
Marketing / International Business	Required	15
	Elective	12

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

○ Curriculum

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
General Management	Required	GMT201	Macroeconomics	3-3-0	1	
		GMT202	Organizational Behavior	3-3-0	2	
		GMT203	International Business	3-3-0	2	
		GMT204	Marketing	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	
		GMT210	Data analysis & Decision Making	3-3-0	2	
		GMT490	Interdisciplinary Project	1-0-2	2	
Technology Management/ Information Systems/ Entrepreneurship	Required	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	
		GMT210	Data analysis & Decision Making	3-3-0	2	
	Elective	TIE301	Technology Management	3-3-0	1	
		TIE302	Process & Quality Management	3-3-0	2	
		TIE321	Database and Data Mining	3-3-0	1	
		TIE322	e-Business	3-3-0	2	
		TIE323	Strategic Management of IT	3-3-0	1	
		TIE341	Managing innovation and Change	3-3-0	1	
		TIE401	Strategic Management of Technology	3-3-0	1	
		TIE409	Case Studies in Technology Management	3-3-0	2	
		TIE429	Case Studies in Knowledge & Information Management	3-3-0	2	
		TIE442	High Technology Entrepreneurship	3-3-0	2	
		TIE449	Case Studies in Entrepreneurship	3-3-0	1	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Finance/ Accounting	Required	GMT201	Macroeconomics	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	
		GMT210	Data analysis & Decision Making	3-3-0	2	
	Elective	FIA301	Investment Analysis	3-3-0	2	
		FIA302	Money and Banking	3-3-0	1	
		FIA321	Intermediate Accounting I	3-3-0	1	
		FIA322	Intermediate Accounting II	3-3-0	2	
		FIA323	Accounting Information Systems	3-3-0	1	
		FIA401	Financial Engineering	3-3-0	1	
		FIA409	Case Studies in Finance	3-3-0	2	
		FIA421	Auditing	3-3-0	2	
		FIA429	Case Studies in Accounting	3-3-0	1	
Marketing/ International Business	Required	GMT202	Organizational Behavior	3-3-0	2	
		GMT203	International Business	3-3-0	2	
		GMT204	Marketing	3-3-0	1	
		GMT207	Financial Management	3-3-0	1	
		GMT210	Data analysis & Decision Making	3-3-0	2	
	Elective	MIB301	Consumer Behaviors	3-3-0	1	
		MIB302	Digital Marketing	3-3-0	2	
		MIB321	International Marketing	3-3-0	1	
		MIB322	International Finance	3-3-0	2	
		MIB401	Marketing Strategy	3-3-0	1	
		MIB409	Case Studies in Marketing	3-3-0	2	
		MIB421	Global Business Strategy	3-3-0	2	
		MIB429	Case Studies in international Business	3-3-0	1	

○ Description

GMT201 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. Monetary and fiscal policies are also discusses. This course also provides an introduction to basic macroeconomic models that illustrate basic principles of macroeconomics.

GMT202 Organizational Behavior

Organizational behavior is about the study and application of knowledge about how individual or group of people acts within organization. This course introduces the basic concepts, theories, models, and cases of behavioral phenomena such as personality, learning, motivation, group process, leadership, organization design and culture, and organizational change.

GMT203 International Business

Companies compete in the international markets with the globalization of world economy. This course in International Business enables students to be equipped with the ability to analyze global issues in economics and to cope well with the rapidly changing international business environment. With the combination of theories and realistic international business cases, students are prepared to understand and deal effectively with the international business issues.

GMT204 Marketing

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 basic concepts of accounting and provides a basic framework to understand the financial statement in users'point of view. This course also provides overview of basic financial statements such balance sheets, income statement and cash flow statement 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 basic issues on 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.

GMT490 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 undergraduate level. Lastly, students will present their work in public 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 the new opportunities, business ecosystems, and decision-making and 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 process will be analyzed and discussed in class.

TIE321 Database and Data Mining

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

TIE322 E-Business

This course is intended to introduce students to the concept and practice of e-business. The principal topics include the internet and mobile e-business, e-business model, architecture of web systems, and communications and networking.

TIE323 Strategic Management of IT

This course is to focus on exploring and articulating the framework and methodology associated with the deployment of Information Technology to help formulate and execute business strategy.

TIE341 Managing Innovation and Change

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

TIE401 Strategic Management of Technology

This course covers current issues and theories on technology strategy, management of technology, and venture management. The major issues covered include principles of technology management, designing and implementing technology strategy, strategic management of innovation, and new product development. Some emerging issues will also be discussed.

TIE409 Case Studies in Technology Management

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

TIE429 Case Studies in Knowledge & Information Management

This course helps students understand the subjects in Knowledge & Information

Management, and gives opportunities to discuss the managerial and academic issues through practical cases in Knowledge & Information Management.

TIE442 High technology Entrepreneurship

This course is designed to introduce the 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.

TIE449 Case Studies in Entrepreneurship

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

FIA301 Investment Analysis

The course in Investment Analysis introduces the students with conceptual framework in the theory and practice of financial investment decision. 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, and 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.

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 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 best use of accounting information systems. Also, by having chances to use the ERP (Enterprise Resource Planning) software, studentswill be able to develop practical ability in their jobs and to provide reliable accounting information for people interested in the companies.

FIA401 Financial Engineering

Financial Engineering is a cross-disciplinary field which covers mathematical and computational finance, statistics, and numerical methods that are useful to making 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 managementto the practical business cases faced by corporations and financial institutions. Students can have opportunities to practice the problems of capital structure, capital budgeting, valuation of financial assets, and risk management.

FIA421 Auditing

This course presents basic concept, 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.

MIB301 Consumer Behaviors

This course deals with issues related to the purchase and consumption of the consumers, and how marketing managers make effective decision using those information. It also focuses on understanding and predicting consumer behavior based on theories of consumer psychology and cognitive theory.

MIB302 Digital 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, relevant sociological issues, etc.

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 environment.

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.

MIB401 Marketing Strategy

The objective of this course is to help students develop strategic marketing decision making skills after learning basic principles and knowledge of marketing. Realistic cases and recent research papers are to be utilized and discussed in class.

MIB409 Case Studies in Marketing

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

MIB421 Global Business Strategy

This course provides theoretical frameworks for strategic management to gainsustainable competitive advantage over rivals for a long period. Using various business cases of multinationalcompanies, 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 with the globalization of world economy, and gives opportunities to discuss the managerial and academic issues through practical cases in International Business.

3. Graduate Programs

1) Technology Management

The Graduate School of Technology Management educates students both in technology and management to be creative global leaders in the research and education of management theory and practice. The graduate school offers wide range of academic programs including Technology Management, Information Systems, Entrepreneurship, Finance, Accounting, International Business and Marketing as well as general knowledge in management. Graduate students are supported with scholarships and encouraged to participate in academic research and teaching. After graduation, they can be placed in universities, research institutes, government organizations, and other private sectors.

○ 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

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Technology Management	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	The 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	2	
		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	1	
		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	2	
		TIE701	Economic Assessment of Technology	3-3-0	2	

Course	course are	Course No.	Course Title	Cred.-Lect.-Exp.	Semester	Prerequisite
Technology Management	Elective	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	1	
		FIA701	Theory of Finance	3-3-0	1	
		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	2	
		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	1	

○ 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 variable (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 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.

GMT521 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 the 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 related special 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), and 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, and dyadic, 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 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 for creating innovative ways to move products from raw materials through 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. In the based level, this course focuses on models built using spreadsheets and, in particular, concentrates on optimization of spreadsheet models. Then, this course focuses 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 most 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 student with the 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, 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 are. This course introduces methods for data mining that help managers recognize patterns and use electronic data collected via the internet, e-commerce, electronic banking, point-of-sale devices, bar-code readers, and intelligent machines. This course covers the techniques such as subset selection in regression, collaborative filtering, tree-structured classification and regression, cluster analysis, and neural network methods.

TIE523 e-Business Strategy

E-business has been a viable conduit for business. This course covers fundamentals 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), and 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 student with the current and special topics in Information Systems.

TIE541 Organization Change & Innovation

Successful companies are transforming themselves to innovation models that involve everyone in the organizations. Leaders who understand how to enable a cadence of innovation though/along with others will create a competitive advantage. This class Students will learn and apply three levels of knowledge: 1) innovation best 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 innovations.

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 analyzing 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 that their competitors take 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 student with the current and special topics in Entrepreneurship.

TIE701 Economic Assessment of Technology

This course is mainly concerned on the 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 overview the financial system and financial service industry, and addresses the various issues concerning the 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 the 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 focused 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 the 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, and 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 applications of the most up-to-date information technology for accounting. The topics include the analysis and design of accounting information systems, accounting database, and IS control and audit.

FIA523 Information System Audit

This course covers major concepts and techniques of information system audit and security. The topics include the design and evaluation of internal control and security system 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 student with the 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 the 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, the data collection methods, the questionnaire design, the sampling schemes, and the 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 student with the current and special topics in Marketing.

MIB521 International Business

This course considers the objectives and strategies of international business in the context of global competition. The course covers competitive advantage, competitive strategies, market entry, contracting with suppliers and distributors, and foreign direct investment (FDI) for the 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 the 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 cover show 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 competitive mind set and capabilities to apply in real world.

MIB529 Topics in Business

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