◆ Department of Organic and Polymeric Materials

1. Program Outline（プログラム概要）

This graduate school program provides study course to educate high skill experts having fundamental and application knowledge and technology, regarding research and development of organic and polymeric materials for creation of innovative structural and functional materials.

2. Course Outlines and Faculty（コース概要及び学習目標）

This course aims to build up the ability of followings;
to extract and appreciate the essence of scientific and technological problems on organic and polymeric materials;
to make use of expertise to solve the problems with creativeness;
to appreciate and systemize the special knowledge on organic and polymeric materials;
to logically explain, write and make discussion.

3. Guide to Study in Department of Organic and Polymeric Materials（学習内容）

A) Deepening the special knowledge on organic and polymeric materials based on the wide scope and literacy of science.
B) Acquisition of the ability to set up creative issues and give the original solutions that can be applied to the wide special area.
C) Training the practical research study for master thesis with the academic adviser for 2 years for acquiring the ability to set up creative issues and giving the original solutions.
D) Acquisition of the skills for logical expression.

4. Graduation Requirements（修了要件）

Department of Organic and Polymeric Materials

【Master's degree】

- 34 credits or more from the Graduate school courses. (大学院授業科目)
- Research Courses (研究科目群)
  - (1) 4 credits from the Seminar Courses. (講究科目)
  - (2) 4 credits from the Graduate Research Courses. (研究関連科目)
- Courses by Departments　(専門科目群)
  - (1) 12 credits or more from the Departmental Courses. (専攻専門科目)
  - (2) 2 credits or more from the Courses in Other Departments. (他専門科目)
- 2 credits or more from the Liberal Arts and General Education. (大学院教養・共通科目群)
- The student must complete a mater thesis research, submit a thesis for the degree and take and pass the final examination given after the submission of her/his thesis for the qualification. .

【Doctoral degree】

For a Doctoral degree a doctoral candidate must satisfy the following requirements:
(1) Seminar in each term must be taken.
(2) Beside the requirement (1), 26 credits or more must be acquired from the subjects provided in the Master's and Doctoral programs.
(3) The candidate must complete and upload a thesis for the degree, and take the final examination and evaluation of his/her thesis.

The candidate who satisfies the above requirements and passes the final examination is awarded a Doctoral

degree.

All students are strongly advised to consult with their own supervisors about the study plan.

4. Tables of Course Subjects

Research Courses (研究科目群)

Course Number	Remarks* (See footnotes)	Subject	Department Offering course**	Credit	Chair	Semester S: Spring A:Autumn	Opening year a: Annually e: Even o: Odd
25731 25733	R	Seminar in Organic and Polymeric Materials I, III	OPM	0-1-0	Academic Adviser	S	a
25732 25734	R	Seminar in Organic and Polymeric Materials II, IV	OPM	0-1-0	Academic Adviser	A	a
25831 25833 25855	R	Seminar in Organic and Polymeric Materials V, VII, IX	OPM	0-2-0	Academic Adviser	S	a
25832 25834 25836	R	Seminar in Organic and Polymeric Materials VI, VIII, X	OPM	0-2-0	Academic Adviser	S	a
25735 25737	R	Research Skills on Organic and Polymeric Materials 1, III	OPM	0-1-0	Academic Adviser	S	a
25736 25738	R	Research Skills on Organic and Polymeric Materials II, IV	OPM	0-1-0	Academic Adviser	A	a

*B: Basic, A: Applied, I: Interdisciplinary, R: Required, MP: Master's Program, DP: Doctoral Program

** OPM: Dept. Organic and Polymeric Materials

Courses by Departments (専門科目群)

Course Number	Remarks (See footnotes)	Subject	Department Offering course*	Credit	Chair	Semester S: Spring A:Autumn	Opening year a: Annually e: Even o: Odd
25022	B★	Advanced Course in Surface Properties of Organic Materials	OPM	2-0-0	T. Mori, Y. Ouchi K. Ishikawa H. Matsumoto	S	a
25023	B★	Advanced Course in Organic Materials for Photonics and Biosensing	OPM	2-0-0	M. Vacha Y. Hayamizu	A	a
25042	B★	Advanced Course in Organic and Soft Materials Chemistry	OPM	2-0-0	M. Kakimoto, T. Hayakawa, T. Michinobu	S	o
25008	B	Advanced Course in Functional Soft Materials	OPM	2-0-0	Y. Tezuka	S	e

25021	B★	Advanced Course in Physical Properties of Organic Materials	OPM	2-0-0	T. Kikutani M. Shioya J. Morikawa	A	a
25029	B★	Advanced Course of Polymer Chemistry	OPM	2-0-0	T. Takata T. Serizawa H. Otsuka T. Ishizone	A	o
19007	B★	Advanced Course of Organic Materials Design	OPM/CMS	2-0-0	T. Ougizawa S. Asai	S	o
25044	B☆	Specific Interdisciplinary Subject in Organic and Polymeric Materials A	OPM	0-2-0	R. Saito	S	a
25045	B☆	Specific Interdisciplinary Subject in Organic and Polymeric Materials B	OPM	0-2-0	R. Saito	A	e
35005	B	Advanced Separation Operation	CE	2-0-0	A. Ito	A	a
35031	B	Transport Phenomena and Operation for Advanced Materials and Chemicals Processing	CE	2-0-0	S. Yoshikawa	S	a
35032	B	Fine Particle Engineering	CE	2-0-0	W. Tanthapanichakoon, I. Taniguchi	S	a
35033	B	Material Science and Chemical Equipment Design	CE	2-0-0	M. Kubouchi S. Hashizume	A	a
35035	B	Chemical Engineering for Advanced Materials and Chemicals Processing II	CE	2-0-0	M. Masuko M. Kubouchi S. Oolawara Y. Shimoyama	S	a
24050	B	Advanced Course in Wettability Control of Solid Surface	MCS	2-0-0	A. Nakajima	S	o
71052	B	Nuclear Materials Science	NE	2-0-0	T. Yano	A	e
35002	A	Advanced Chemical Reaction Engineering	CE	2-0-0	K.Ohtaguchi	S	a
35008	A	Catalytic Process and Engineering	CE	2-0-0	W. Tanthapanichakoon,	S	a
35036	A	Plasma Chemistry and Plasma Processing	CE	2-0-0	H. Sekiguchi S. Mori	A	a
35030	A	Chemical Engineering and Global Business	CE	2-0-0	F. Ito	A	a
36037	A	Life Cycle Engineering	CE	2-0-0	T. Fuchino	A	a
96054	S	Advanced Course in Environmental Aspects and Porous Materials	MCS	2-0-0	K. Okada	S	o

*B: Basic, A: Applied, I: Interdisciplinary, R: Required, MP: Master's Program, DP: Doctoral Program

*Subjects marked with ★ are given in English biannually and acceptable for the credits of International Graduate Program and Academy for Co-creative Education of Environment and Energy Science. (One cannot get both credits of these subjects alternately given in Japanese and English)

*Subjects marked ☆: Only the ACEEES students can take this course. In order to promote interdisciplinary research on campus, students are required to take/register courses provided by designated other majors/programs rather than their own majors/programs.

* Students admitted to enroll the Academy for Co-creative Education of Environment and Energy Science should read the indication in the URL as follows; HP http://www.gakumu.titech.ac.jp/kyoumu/curriculum/guide.html

** OPM: Dept. Organic and Polymeric Materials

** CMS: Dept. Chemistry and Materials Science

** CE: Dept. Chemical Engineering

** MCS: Metallurgy and Ceramics Science

** NE: Dept. Nuclear Engineering

Liberal Arts and General Education (大学院教養・共通科目群)

	Remarks
International Communication（大学院国際コミュニケーション科目） **Interdisciplinary Courses（大学院総合科目）** **Interdepartmental Courses（大学院広域科目）** **Arts and Humanities（大学院文明科目）** **Career Development Courses（大学院キャリア科目）** **Courses for Developing Creativity（大学院創造性育成科目）** **Courses for International Students（大学院留学生科目）**	・Refer to VI.Liberal Arts and General Education

5. Syllabus of Course Subjects

25008

Advanced Course in Functional Soft Materials

Spring Semester (2-0-0)(Even years)

Prof. Yasuyuki TEZUKA

Fundamentals and advanced subjects in functional soft materials will be discussed from the viewpoints of synthetic chemistry and of topological polymer chemistry, in particular.

25022

Advanced Course in Surface Properties of Organic Materials

Spring Semester (2-0-0)

Prof. Takehiko MORI, Prof. Yukio OUCHI, Assoc. Prof. Ken ISHIKAWA, and Assoc. Prof. Hidetoshi MATSUMOTO

[Aims]

For understanding fundamental properties of organic materials (conducting, optical, and surface properties), fundamental concepts of energy bands, charge transfer, and optics are lectured.

[Outline]

1. Introduction
2. Energy Band of Organic Crystals
3. Organic Conductors and Organic Electronics
4. Optical Properties of Solids
5. Liquid Crystals
6. Surface Properties of Organic Materials
7. Organic Nanomaterials
8. General conclusions

[Evaluation]

25023

Advanced Course in Organic Materials for Photonics and Biosensing

Autumn Semester (2-0-0)

Prof. Martin VACHA, and Assoc. Prof. Yuhei HAYAMIZU

[Aims]

Organic materials are unique due to their molecular structures and organizations compared with inorganic materials. Physics of the soft materials will be presented particularly from the viewpoints of physics in organic molecules and biomaterials. Assoc. Prof. Vacha will talk about “Photophysics and Spectroscopy of Organic Molecules”. Assoc. Prof. Hayamizu will talk about “Self-assembly of Biomaterials and their Uses for Sensing”.

[Outline of Assoc. Prof. Vacha]

1. Quantum mechanics of the molecule-radiation interaction
2. Excited state of organic molecules and excited state relaxations
3. Molecular complexes
4. Intermolecular photophysical processes
5. External field effects
6. Principles of high resolution optical spectroscopy

[Outline of Assoc. Prof. Hayamizu]

1. Introduction of self-assembly
2. Biological self-assembly
3. Interaction between biomolecules and surfaces
4. Sensing platforms: Nanomaterials
5. Electrical and optical interactions at bio-nano interfaces
6. Recent topics in biomolecular self-assembly and sensing

[Evaluation]

25042

Advanced Course in Organic and Soft Materials Chemistry

Spring Semester (2-0-0) (Odd Years)

Prof. Masa-aki KAKIMOTO, Assoc.Prof. Teruaki HAYAKAWA, and Assoc. Prof. Tsuyoshi MICHINOBU

[Aims]

Fundamentals and advanced subjects in organic and soft materials chemistry will be discussed.

[Outline]

1. Introduction
2. Macromolecular and supramolecular chemistry (I)-- basic principles and concepts
3. Macromolecular and supramolecular chemistry (II) -- synthesis
4. Macromolecular and supramolecular chemistry (III) - functions and applications
5. Condensation polymers (I)-- fundamentals
6. Condensation polymers (II) -- synthesis
7. Condensation polymers (III) - functions and applications
8. Functional soft materials (I) - concepts and synthesis
9. Functional soft materials (II) -- applications
10. General conclusions

[Evaluation] Attendances and Reports

25021

Advanced Course in Physical Properties of Organic Materials

Autumn Semester (2-0-0) (Every year)

Assoc. Prof. Masatoshi SHIOYA, Prof. Takeshi KIKUTANI, and Prof. Junko MORIKAWA
[Aims]
Physical properties of organic materials are not determined only by their chemical structures. Various factors such as the morphology, structure of the crystalline and amorphous regions, processing history of the method used to form the product and environmental conditions have significant influences on the physical properties. This course discusses various factors influencing the physical properties of organic materials and fundamentals of the measurement and analysis of the physical properties.
[Outline]
1. Introduction
2. Fundamental theories for thermal properties of organic materials
3. Analysis methods of thermal properties for organic materials
4. Polymer composites
5. Fundamental theories for mechanical properties of organic materials
6. Carbon materials derived from organic materials
7. Structure development in fiber processing
8. Structure development in polymer processing
9. General conclusions

[Evaluation] Attendances and Reports

25029

Advanced Course of Polymer Chemistry
Autumn Semester (2-0-0) (Odd Years)
Prof. Toshikazu TAKATA, Prof. Takeshi SERIZAWA, Prof. Hideyuki OTSUKA, and Prof. Takashi ISHIZONE
[Aims]
This lecture mainly describes the fundamentals of polymer syntheses, reactions, and characterizations. In addition, some of recently advanced subjects in the related fields are introduced.
[Outline]
1. Polymer syntheses and reactions -Introduction-
2. Step-growth polymerization
3. Chain polymerization
4. Radical polymerization
5. Cationic polymerization
6. Anionic polymerization
7. Polymer reactions
8. Cross-linking of polymers
9. Biorelated Polymer Chemistry -Introduction-
10. Biomedical Polymer
11. Functional Biopolymer
12. Advanced Polymer Chemistry -Introduction-
13. Helical Polymer
14. Topological Polymer
15. Examination

[Evaluation] Examination

19007

Advanced Course of Organic Materials Design
Spring Semester (2-0-0) (Odd Years)
Prof. Toshiaki OUGIZAWA, and Assoc. Prof. Shigeo ASAI
[Aims]
The basic concept for design of functional organic and polymeric materials and methods to characterize their

structure and properties will be provided.
[Outline]
1. Introduction
2. Applications of polymer alloys
3. Morphology-properties relationship in polymer alloys
4. Phase behavior of polymer alloys
5. Thermodynamics of polymer alloys
6. Phase separation behavior of polymer alloys
7. Morphology control of polymer alloys
8. Interface of polymer alloys
9. Concept for design of functional organic materials
10. Structure and properties of polymer-filler composites
11. Electrical properties of carbon particle filled polymers
12. Theory of wide-angle X-ray diffraction
13. Structure analysis of polymer by wide-angle X-ray diffraction
14. Theory of small-angle X-ray scattering
15. Structure analysis of polymer by small-angle X-ray scattering

[Evaluation]

25044

Specific Interdisciplinary Subjects in Organic and Polymeric Materials A

Spring Semester (0-2-0) (EveryYears)

Assoc. Prof. Reiko SAITO

Microstructure design of organic and polymeric materials is a key concept to impart highly functional properties into substrates, and bring about technology breakthroughs relating to fundamental energy and environmental issues. This exercise/drill course utilizes a self-study approach on this subject for students seeking to broaden their knowledge on organic and polymeric materials and to help acquire sufficient problem-solving skills to conduct research on structural and functional materials in organic and polymeric materials.

[Evaluation]

25045

Specific Interdisciplinary Subjects in Organic and Polymeric Materials B

Autumn Semester (0-2-0) (Every Years)

Assoc. Prof. Reiko SAITO

Microstructure design of organic and polymeric materials is a key concept to impart highly functional properties into substrates, and bring about technology breakthroughs relating to fundamental energy and environmental issues. This exercise/drill course utilizes a self-study approach on this subject for students seeking to broaden their knowledge on organic and polymeric materials and to help acquire sufficient problem-solving skills to conduct research on structural and functional materials in organic and polymeric materials.

[Evaluation]

35005

Advanced Separation Operation

Autumn Semester (2-0-0)

Prof. Akira Ito

[Aims]

This course reviews conventional separation processes, distillation, absorption, drying etc., from a view point of

process modeling and simulation. All modeling of a separation process consists of equilibrium relation and mass balance for the process. The mathematical model of a separation process will reduce to equation set of non-linear simultaneous equations or differential equations. Tools for solving for these equations on the spread sheet are offered and used for individual separation process calculation.

[Outline]

1. Introduction, Model and simulation in chemical engineering
2. Distillation - Vapor-liquid equilibrium-
3. Distillation -Process models-
4. Extraction
5. Absorption
6. Membrane separation -Microfiltration and ultrafiltration-
7. Membrane separation -Reverse osmosis -
8. Membrane separation -Gas separation-
9. Adsorption
10. Chromatography
11. Humidity conditioning
12. Drying -Diffusion in material-
13. Drying -Drying process-

35031

Transport Phenomena and Operation for Advanced Materials and Chemicals Processing

Spring Semester (2-0-0)

Assoc. Prof. Shiro Yoshikawa

[Aims]

Momentum, heat and mass transfer in chemical equipment is one of the most fundamental subjects in chemical engineering field. The methods of the modeling of the transport phenomena including that in chemical reaction field are discussed in the course. In addition, the fundamentals of the numerical analysis are shown.

[Outline]

1. Introduction
2. Basic equations for transport phenomena (I)
3. Basic equations for transport phenomena (II)
4. Transport phenomena in a boundary layer (I)
5. Transport phenomena in a boundary layer (II)
6. Modeling of transport phenomena in chemical reaction field (I)
8. Modeling of transport phenomena in chemical reaction field (II)
9. Numerical simulation of transport phenomena (I)
10. Numerical simulation of transport phenomena (II)
11. Characteristics of Particles
12. Motion of Particles in Fluid and Fluid Flow in a Packed Bed and Fluidized Bed
13. Mechanical Separation and Classification: Sedimentation, Centrifugation and Filtration
14. Mixing Operation

35032

Fine Particle Engineering

Spring Semester (2-0-0)

Prof. Wiwut Tanthapanichakoon, Assoc. Prof. Izumi Taniguchi

[Aims]

There is currently considerable commercial and scientific interest in the production of fine particles employing aerosol-based methods. The objective of this course is to provide fundamentals on the behavior of fine particles in

gas phase. In addition, some of recent topics on materials processing by using aerosol-based method will be presented. Students have to prepare reading, bring and review the course textbook (Hinds, W. C., "AEROSOL TECHNOLOGY", John Wiley & Sons, New York (1999)) to every class.

[Outline]

1. Introduction
2. Topics of Material Processing Using Aerosol-based Method (I)
3. Topics of Material Processing Using Aerosol-based Method (II)
4. Motion of a Drop or Solid Particle in Gas Phase at $Re_P > 2$
5. Motion, Heat and Mass Transfer of a Group of Drops or Solid Particles in Gas Phase at $Re_p > 2$
6. Motion of Aerosols ($Re_p < 2$)
7. Brownian Motion and Diffusion in Aerosols
8. Condensation and Evaporation Phenomena in Aerosols
9. Introduction to Nanotechnology --> Nanomaterials --> Nanoparticles
10. Nanoparticles in Industrial Applications
11. Basic Properties of Nanoparticles: Size, Shape, Surface Area, Etc.
12. Manufacture of Nanoparticles: Top-down vs. Bottom-up. Examples of Manufacturing Processes
13. Synthesis of Nanoparticles
14. Nanoparticles in Composite Materials
15. Examples of Unit Operations in Fine Particle Collection & Classification: High-performance Air Cyclone

35033

Material Science and Chemical Equipment Design

Autumn Semester (2-0-0)

Prof. Masatoshi Kubouchi, Lecturer Shuji Hashizume

[Aims]

The class offers the basic knowledge of the designing method of cylindrical chemical equipments and materials strength. In addition, recent topics on materials science and technology will be presented.

[Outline]

1. Basic of materials science
2. Basic of strength of materials
3. Design of pipe and thermal stress problem
4. Design of thin-walled cylindrical vessel for internal pressure
5. Design of thick-walled cylindrical vessel for internal pressure
6. Design of external pressure vessel
7. Degradation of materials
8. Basic of fracture mechanics
9. Materials for chemical equipments
10. Other topics on material science and chemical equipment design

[Remark]

Students who have already taken or intend to take following subjects cannot attend this subject.

- "Chemical Equipment Design and Materials" (undergraduate subject)
- "Advanced Chemical Equipment Design" (graduate subject)

35035

Chemical Engineering for Advanced Materials and Chemicals Processing II

Spring Semester (2-0-0)

Prof. Masabumi Masuko, Prof. Masatoshi Kubouchi, Assoc.Prof. Shinichi Ookawara and Assoc.Prof.Yusuke

Shimoyama
[Aims]
This class covers essentials of transport phenomena, separation operations, material science, and thermodynamics.
[Outline]

1. Introduction

Part I Chemical Thermodynamics
Prof. Masabumi Masuko
Textbook: P. Atkins, et al., "Atkins' Physical Chemistry-8th Ed." Oxford University Press, Oxford (2002) Chapt.7.
Reference book: M. Abbott, et al., "Theory and Problems of Thermodynamics-2nd.Ed." McGrawhill, New York (1989)

2. Thermodynamics of Mixing, Chemical Equilibrium Part I (Reaction Gibbs Energy, Description of Equilibrium)
3. Chemical Equilibrium Part II (Response of Equilibria to Temperature)
4. Examination

Part II Material Science
Prof. Masatoshi Kubouchi
Textbook: William D. Callister, Jr.: "Material Science and Engineering 3rd Edition", John Wiley & Sons, Inc., New York (1994)

5. Atomic Structures and Interatomic Bonding, Structures of Crystalline Solids
6. Phase Diagrams and Phase Transformations
7. Examination

Part III Momentum Transport Phenomena
Assoc. Prof. Shinichi Ookawara
Textbook: R.Byron Bird, et al.: "Transport Phenomena 2nd Edition" Wiley New York (2002)

8. Newton's Law of Viscosity and Mechanism of Momentum Transfer
9. Momentum Balance
10. Navier-Stokes Equation and Energy Balance
11. Examination

Part IV: Mass Transport Phenomena and Mass Transfer Operations
Assoc. Prof. Yusuke SHIMOYAMA
Textbook: R.Byron Bird,et.al: "Transport Phenomena 2nd Edition" Wiley New York (2002)

12. Mechanism of mass transfer
13. Temperature and pressure dependence of mass diffusivity
14. Diffusion in gas and liquid phases
15. Examination

24050

Advanced Course in Wettability Control of Solid Surface

Spring Semester (2-0-0) (Odd Years)
Prof. Akira Nakajima
[Aims]
Wettability has been a research subject at the border between physics and chemistry, and is an important property of solid surface from both fundamental and practical aspects. This course provides fundamentals on surface wettability control for the understanding of surface phenomena and the designing surface functions of solids. Topics include environmental purification and energy saving by surface functional materials.
[Outline]

1. Introduction
2. Fundamentals of solid surface
3. Surface energy and contact angle (1)
4. Surface energy and contact angle (2)
5. Surface structure and wettability (1)
6. Surface structure and wettability (2)
7. Sliding of liquid droplets (1)
8. Sliding of liquid droplets (2)
9. Dynamic wettability
10. Anti-snow adhesion
11. Materials for wettability control and their coating technology
12. Superhydrophobicity
13. TiO_2 photocatalyst
14. Research proposal presentation (students)

71052

Nuclear Materials Science

Autumn Semester (2-0-0) (Even Years)

Prof. Toyohiko YANO

[Aims]

This is the only lecture concerning materials issues, including nuclear fuels and incore materials, of nuclear fission and fusion reactors. The basis is materials science. The topics including are: manufacturing methods of nuclear fuels, structures of fuels and fuel elements, moderators, control materials, blanket materials, and structural materials. Another emphasis is put on fundamentals of radiation damage and irradiation effects of nuclear reactor materials.

[Outline]

1. Components of LWR, HWR, LMFBR reactors and material selection
2. Radiation Damage of Materials
3. Physical and Chemical Properties of U, UO_2, and PuO_2
4. Fabrication Process of Nuclear Fuels
5. Fission and Fusion Reactor Materials

35002

Advanced Chemical Reaction Engineering

Spring Semester (2-0-0) (Every year)

Prof. Kazuhisa Ohtaguchi

[Aims]

This course is intended for Chemical Engineering majors. Pre-request of “Chemical Reaction Engineering-1” undergraduate-course recommended. The objective of this course is to provide a foundation for mathematical modeling the chemical and biochemical systems in terms of linear and nonlinear, ordinary and partial, differential equations. The main topics include: state space analysis; stability of dynamic models, conservation of mass, pollution in rivers; reaction-diffusion model for morphogenesis; cycles and bifurcation; cusp catastrophes, and chaos. Students have to prepare reading, bring and review the course textbook (Rutherford Aris, “MATHEMATICAL MODELLING TECHNIQUES”, Dover Pub. Inc, (1994)) to every class.

[Outline]

1. Introduction
2. Mathematical models for the tracer movement in a packed bed
3. The Taylor diffusion models with laminar flow
4. Models for the stirred tank reactor
5. A mathematical model

6. Comparison of the implications of a model with experience (chaos)
7. The different type of model
8. Formulation of a model
9. The principle of making the equations dimensionless (the stirred tank with a single first-orderirreversible reaction)
10. The phase plane analysis
11. Manipulation of a model into its most responsive form
12. Effective presentation of a model (catastrophe sets)
13. Models for diffusion and reaction in a catalyst pellet

35008

Catalytic Process and Engineering

Spring Semester (2-0-0) (Every year)

Prof.Wiwut Tanthapanichakoon

Textbook: Fundamentals of Industrial Catalytic Processes, C. H. Bartholomew & R. J. Farrouto, Wiley-Interscience, 2nd ed. (2006)

[Aims]

The course introduces the fundamental concepts of catalytic processes and selected examples of its industrial applications.

[Outline]

1. Guidance+General Introduction + Catalysis (I)
2. Catalysis (II)
3. Catalyst Materials, Catalyst Properties (I)
4. Catalyst Properties (II) + The Future
5. Principles and Objectives of Catalyst Characterization; Catalyst Selection; The Future
6. Definitions and Classification of Reactors; Fundamentals of Rector Design
7. Choosing Reactors in the Laboratory and Plant; The Future
8. Petroleum Refining & Processing: Hydrotreating (I)
9. Petroleum Refining & Processing: Hydrotreating (II)
10. Petroleum Refining & Processing: Hydrotreating (III)
11. Enzyme Catalysis (I)
12. Enzyme Catalysis (II)
13. Enzyme Catalysis (III)
14. Presentation of Individual Project Assignments (I)
15. Presentation of Individual Project Assignments (II)

35036

Plasma Chemistry and Plasma Processing

Autumn Semester (2-0-0) (Every year)

Prof. Hidetoshi Sekiguchi, Assoc.Prof.Shinsuke Mori

[Aims]

Characteristics of plasma chemistry, various plasma generation methods for chemistry and various applications of plasma technology to chemistry are lectured. Plasma generation methods include thermal equilibrium plasma; arc plasma, RF plasma microwave plasma and et al. and non equilibrium plasma; glow plasma, microwave plasma, DBD plasma, and atmospheric pressure non-equilibrium plasma. Applications of plasma include application of high temperature heat source, organic and non organic synthesis, decomposition technology of various materials, separation technology et al. Also current topics in this field are given.

[Outline]

1. Introduction

2. Basics of heat transfer in high temperature
3. Basics of thermal plasmas (I)
4. Basics of thermal plasmas (II)
5. Numerical simulation of thermal plasmas
6. Thermal equilibrium
7. Thermal plasma processing -Material synthesis (I)-
8. Thermal plasma processing -Material synthesis (II)-
9. Thermal plasma processing -Separation-
10. Thermal plasma processing -Chemical synthesis-
11. Thermal plasma processing -Wastes treatment-
12. Basics of non-thermal plasma
13. Non-thermal plasma processing

35037

Life Cycle Engineering

Autumn Semester (2-0-0) (Every year)

Assoc. Prof. Tetsuo Fuchino

[Aims]

To realize the sustainability in the chemical industry, activities through the lifecycles; plant lifecycle, product lifecycle, process lifecycle, should be designed to provide PCDA (Plan, Do, Check and Action) cycle properly, and the integrated information environment through the lifecycles is indispensable. In this class, the methodology to model the lifecycle activity is discussed, and on the basis of the model, the lifecycle safety management issue is considered.

[Outline]

1. Introduction (Lifecycle engineering perspective of chemical process industry)
2. Problems in lifecycle, -Case and causality
3. BPR (Business Process Reengineering) approach
4. Lifecycle activities of chemical process industry
5. Modeling lifecycle activities -Necessity and approach
6. Business model methodology: IDEF (Integrated Definition for Functional model) Family overview
7. IDEF0 modeling (Syntax, Template, Ontology)
8. IDEF0 modeling (Ontology)
9. IDEF0 modeling practice (I)
10. IDEF0 modeling practice (II)
11. IDEF0 modeling practice (III)
12. IDEF0 modeling practice (IV)
13. Integrated information environment design (Concept)
14. Integrated information environment design (Data Model)

96054

Advanced Course in Environmental Aspects and Porous Materials

Spring Semester (2-0-0) (Odd Years)

Prof. Kiyoshi Okada

[Aims]

Various aspects on geo-environmental aspects and porous materials applicable to these aspects, i.e., preparation methods, characterization and applications, will be explained.

[Outline]

1. Introduction
2. Geo-environmental aspects (I) -- energy and atmosphere

3. Geo-environmental aspects (II) -- water
4. Geo-environmental aspects (III) -- resources
5. Geo-environmental aspects (IV) -- ceramic materials
6. Porous materials (I) -- preparation methods by built up process
7. Porous materials (II) -- preparation methods by selective leaching process
8. Porous materials (III) -- characterization
9. Porous materials (IV) -- porous properties
10. Applications (I) -- purification of atmosphere
11. Applications (II) -- purification of waters
12. Applications (III) -- purification of soils

35030

Chemical Engineering in Global Business

Autumn Semester (2-0-0) (Every year)

Lecturer Fumihiro Ito

25731

Seminar in Organic and Polymeric Materials I

Spring Semester (0-1-0)

Academic Advisor

25732

Seminar in Organic and Polymeric Materials II

Autumn Semester (0-1-0)

Academic Advisor

25733

Seminar in Organic and Polymeric Materials III

Spring Semester (0-1-0)

Academic Advisor

25734

Seminar in Organic and Polymeric Materials IV

Autumn Semester (0-1-0)

Academic Advisor

25735

Research Skills on Organic and Polymeric Materials I

Spring Semester (0-1-0)

Academic Advisor

25736

Research Skills on Organic and Polymeric Materials II

Autumn Semester (0-1-0)

Academic Advisor

25737

Research Skills on Organic and Polymeric Materials III

Spring Semester (0-1-0)

Academic Advisor

25738

Research Skills on Organic and Polymeric Materials Iv

Autumn Semester (0-1-0)

Academic Advisor

25831

Seminar in Organic and Polymeric Materials V

Spring Semester (0-2-0)

Academic Advisor

25832

Seminar in Organic and Polymeric Materials VI

Autumn Semester (0-2-0)

Academic Advisor

25833

Seminar in Organic and Polymeric Materials VII

Spring Semester (0-2-0)

Academic Advisor

25834

Seminar in Organic and Polymeric Materials VIII

Autumn Semester (0-2-0)

Academic Advisor

25835

Seminar in Organic and Polymeric Materials IX

Spring Semester (0-2-0)

Academic Advisor

25836

Seminar in Organic and Polymeric Materials X

Autumn Semester (0-2-0)

Academic Advisor