

# Department of Chemistry

## *Short History*

Department of Chemistry at Institut Teknologi Bandung was established in 1948 and the postgraduate program was started in 1980.

## *Achievements*

Department of Chemistry was accredited A for the undergraduate program and the "Highest" for the postgraduate program. Being the oldest Department of Chemistry in the country, more than 1500 undergraduate, magister and Doctoral degree have been graduated from this study program. The high achievements of the study program are also evident from several prestigious grant obtained by the Study program, such as Center Grant, Quality of Undergraduate Education, and Competitive Based Funding Program B.

Department of Chemistry has collaboration with several industries, research laboratories in Indonesia and overseas (such as UKM, Malaysia; RUG, the Netherlands).

## *Facilities*

The main facilities in the Department of Chemistry include:

1. Library equipped with newest collection of Chemistry books and primary references
2. Computers facilities and internet connections
3. Laboratories:

<i>No</i>	<i>Field</i>	<i>Laboratories</i>
1	General chemistry	General chemistry
2	Analytical chemistry	Lab. Analytical chemistry, Lab. Separation and Speciation
3	Inorganic chemistry	Lab. Inorganic chemistry, Lab. Inorganic Synthesis

4	Physical chemistry	Lab. Physical chemistry, Lab. Theoretical Chemistry, Lab. Chemistry of Material
5	Organic chemistry	Lab. Organic chemistry, Lab. Natural Product, Lab. Bio-Organic
6	Biochemistry	Lab. Biochemistry, Lab. Protein and Enzyme, Lab. Plant and Food Biochemistry, Lab. Nucleic Acid and Molecular Genetics.

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### ***Graduate Competences***

Graduate competences were divided into affective, cognitive, practical skills and transferable skills.

In term of affective ability, chemistry graduates should have robust social and academic character, such as curiosity, progressive longing and appreciation of the importance of chemistry in an industrial, economic, environmental and social context, awareness and responsive to the need of the community.

Chemistry graduate should have the following chemistry-related cognitive abilities and skills

1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to the subject areas identified above.
2. Ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems of a familiar and unfamiliar nature.
3. Ability to recognise and analyse novel problems and plan strategies for their solution.
4. Skills in the evaluation, interpretation and synthesis of chemical information and data.
5. Ability to recognise and implement good measurement science and practice.
6. Skills in presenting scientific material and arguments clearly and correctly, in writing and orally, to a range of audiences.
7. Computational and data-processing skills, relating to chemical information and data.

Emphasis of these cognitive skills in Sarjana (Bachelor) degree is in competence 5, magister is in 5 and 6 and doctoral degree is in 7.

Chemistry graduate should have practical skills

1. Skills in the safe handling of chemical materials, taking into account their physical and chemical properties, including any specific hazards associated with their use.
2. Skills required for the conduct of standard laboratory procedures involved in synthetic and analytical work, in relation to both inorganic and organic systems.
3. Skills in the monitoring, by observation and measurement, of chemical properties, events or changes, and the systematic and reliable recording and documentation there of.
4. Competence in the planning, design and execution of practical investigations, from the problem recognition stage through to the evaluation and appraisal of results and findings; this to include the ability to select appropriate techniques and procedures.
5. Skills in the operation of standard chemical instrumentation such as that used for structural investigations and separation.
6. Ability to interpret data derived from laboratory observations and measurements in terms of their significance and the theory underlying them.
7. Ability to conduct risk assessments concerning the use of chemical substances and laboratory procedures.

Chemistry graduate should have transferable skills:

1. Communication skills, covering both written and oral communication.
2. Problem-solving skills, relating to qualitative and quantitative information, extend to situations where evaluations have to be made on the basis of limited information.
3. Numeric and computational skills, including such aspects as error analysis, order-of-magnitude estimations, correct use of units and modes of data presentation.
4. Information-retrieval skills, in relation to primary and secondary information sources, including information retrieval through on-line computer searches.
5. Information-technology skills such as word-processing and spreadsheet use, data logging and storage, Internet communication, etc.
6. Interpersonal skills, relating to the ability to interact with other people and to engage in team working.
7. Time-management and organisational skills, as evidenced by the ability to plan and implement efficient and effective modes of working.

8. Study skills needed for continuing professional development.

In addition of these Bachelors competences, Magister and Doctoral graduates should have higher competences, so ready to work independently

### ***Body of Knowledge***

Education in Department of Chemistry includes:

1. Major aspects of chemical terminology, nomenclature, conventions and units.
2. The major types of chemical reaction and the main characteristics associated with them.
3. The principles and procedures used in chemical analysis and the characterisation of chemical compounds.
4. The characteristics of the different states of matter and the theories used to describe them.
5. The principles of quantum mechanics and their application to the description of the structure and properties of atoms and molecules.
6. The principles of thermodynamics and their applications to chemistry.
7. The kinetics of chemical change, including catalysis; the mechanistic interpretation of chemical reactions.
8. The principal techniques of structural investigations, including spectroscopy.
9. The characteristic properties of elements and their compounds, including group relationships and trends within the Periodic Table.
10. The properties of aliphatic, aromatic, heterocyclic and organometallic compounds.
11. The nature and behaviour of functional groups in organic molecules.
12. The structural features of chemical elements and their compounds, including stereochemistry.
13. Major synthetic pathways in organic chemistry, involving functional group interconversions and carbon-carbon and carbon-heteroatom bond formation.
14. The relation between bulk properties and the properties of individual atoms and molecules, including macromolecules.
15. The chemical principles of organism.
16. Awareness of major issues currently at the frontiers of chemical research and development.

**Curriculum Structure****Bachelor Program****First Year Courses**

<b>Semester I</b>				<b>Semester II</b>			
	<b>Code</b>	<b>Courses Name</b>	<b>Sks</b>		<b>Code</b>	<b>Courses Name</b>	<b>Sks</b>
1	MA112 2	Calculus I	4	1	MA1222	Calculus II	4
2	FI1101	Elementary Physics IA	4(1)	2	FI1201	Elementary Physics IIA	4(1)
3	KI1111	Basic Chemistry IA	3(1)	3	KI1211	Basic Chemistry IIA	3(1)
4	KU1011	Scientific Writing in Indonesian	2	4	KU102x	English	2
5	KU1131	Sport I	1	5	KU12xx	Sport II	1
6	KI1113	Introduction to Chemical Sciences	2	6	KI1213	Basic of Biological Chemistry	2
7	BI1101	Environmental Sciences	2	7	KU10T0 1	Concepts of Technology	2

**Second Year Mandatory Courses**

<b>Semester III</b>				<b>Semester IV</b>			
	<b>Code</b>	<b>Courses Name</b>	<b>Sks</b>		<b>Code</b>	<b>Courses Name</b>	<b>Sks</b>
1	MA2122	Science Mathematics	3	1	KI2221	Analytical Chemistry II: Separation, Methods & Electrometry Analysis	4(1)
2	FI2103	Modern Physics	3	2	KI2231	Inorganic Chemistry I: Main Groups	2
3	KI2121	Analytical Chemistry I: Basic Analytical Chemistry	4(2)	3	KI2241	Physical Chemistry II: Dynamics	4(1)
4	KI2141	Physical Chemistry I: Energetics	4(1)	4	KI2251	Organic Chemistry II: Polyfunctional Compounds	4(1)
5	KI2151	Organic Chemistry I: Monofunctional Compounds	3	5	KI2261	Biochemistry I: Structure and Functional Biomolecules	3(1)
6	KI2152	Organic Chemistry I Laboratory	2(2)				

### Third Year Mandatory Courses

Semester V				Semester VI			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KU206x	Religion & Ethics	2	1	KU2071	Pancasila and Civil Education	2
2	KI3121	Analytical Chemistry III: Spectrometric Analyses	4(1)	2	KI3211	Chemical Literature & Experimental Design	2
3	KI3131	Inorganic Chemistry II: Transition Metals and Catalyses	3(1)	3	KI3231	Inorganic Chemistry III: Structure and Reactivity	3(1)
4	KI3141	Physical Chemistry III: Structures	3	4	KI3251	Organic Chemistry III: Synthesis	3
5	KI3161	Biochemistry II: Metabolism & Genetic Information	4(1)	5	KI3212	Physicochemical Structure Elucidation	3(1)
6		Elective	2	6	KI3213	Environmental Chemistry	3
				7		Elective	2

### Third Year Elective Courses

	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI3142	Electrochemistry	2	1	KI3241	Nuclear and Radiation Chemistry	2
2	KI3113	Introduction to Diffraction Methods	2	2	KI3214	Symmetry and Group Theory	2
3	KI3151	Stereochemistry	2	3	KI3221	Chemometry	2
4	KI3114	Introduction to Computational Chemistry	2	4	KI3261	Introduction to Biochemistry Research	2(2)

### Fourth Year Mandatory Courses

Semester VII				Semester VIII			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI40Z1	Final Year Project I	4(4)	1	KI40Z2	Final Year Project II	4(4)
2	KI40S3	Seminar	1	2	KI40S4	Final Project Seminar & Oral Comprehensive Examination	1
3	KI4161	Molecular Biotechnology	3	3	KI4211	Project Lab	2
4	KI4141	Chemical Thermodynamics	2	4	KI4251	Physical Organic Chemistry	3
5	KI5112	Chemical Principles	3	5	KI4241	Chemical Kinetics	2
6		Elective	7	6	KI4242	Material Chemistry	2
				7		Elective	7

## Fourth Year Elective Courses

	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI5111	Experimental Chemistry Techniques	3	14	KI5211	Computational Chemistry	3
2	KI5012	Industrial Experience		15	KI5012	Industrial Experience	2
3	KI5121	Applied Analytical Chemistry	2	16	KI5212	Chemistry and Society	1
4	KI5122	Selected Topics on Analytical Chemistry	3(1)	17	KI5221	Special Methods in Analytical Chemistry	3(1)
5	KI5131	Coordination Chemistry	3	18	KI5222	Electrometric Analysis	3
6	KI5141	Polymer Chemistry	3	19	KI5231	Selected Topics on Inorganic Chemistry	2
7	KI5142	Structure and Chemical Properties of Material	3(1)	20	KI5232	Introduction to Inorganic Synthesis	3(1)
8	KI5143	Selected Topics on Physical Chemistry	3	21	KI5241	Surface Chemistry	3
9	KI5144	Corrosion and Its Inhibitions	3	22	KI5242	Ceramic Chemistry	3
10	KI5151	Natural Product Chemistry	3	23	KI5243	Polymer Degradation	3
11	KI5152	Organometallic Chemistry	3	24	KI5244	Sensors and Lithography	3
12	KI5161	Selected Topics on Biochemistry	3(1)	25	KI5251	Structure Elucidation of Natural Compounds by Spectroscopic Methods	2
13	KI5162	Medical Biochemistry	3	26	KI5252	Selected Topics on Organic Chemistry	3
				27	KI5261	Food Biochemistry	3

**Master Program**

**Program** : *Chemistry*  
**Specialty** : *Analytical Chemistry*

**First Year Mandatory Courses**

Semester I				Semester II			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI6111	Advanced Elucidation Structure	3	1	KI6211	Chem. Research Methodologies	2
2	KI6121	Analytical Separation	3	2	KI6221	Adv. Applied Analytical Chemistry	3
3	KI6122	Analytical Measurement	3	3	KI6222	Advanced Spectroscopic Analysis	3
4		Elective	4	4		Elective	3

**Second Year Mandatory Courses**

Semester III				Semester IV			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI7111	Chemical Philosophy	1	1	KI70Z2	Research Project II	4
2	KI70Z1	Research Project I	4	2	KI70S3	Research Seminar	1
3		Elective	6	3		Elective	3

**Program** : *Chemistry*  
**Specialty** : *Inorganic Chemistry*

**First Year Mandatory Courses**

Semester I				Semester II			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI6111	Advanced Elucidation Structure	3	1	KI6211	Chem. Research Methodologies	2
2	KI6131	Advanced Inorganic Chemistry	3	2	KI6231	Inorganic Chemistry Mechanism	3
3	KI6141	Quantum Chemistry	3	3	KI6232	Structure Determination	2
4		Elective	2	4		Elective	5

## Second Year Mandatory Courses

Semester III				Semester IV			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI7111	Chemical Philosophy	1	1	KI70Z2	Research Project II	4
2	KI70Z1	Research Project I	4	2	KI70S3	Research Seminar	1
3	KI6132	Inorganic Synthesis	3				

Program : Chemistry  
 Specialty : Physical Chemistry

## First Year Mandatory Courses

Semester I				Semester II			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI6111	Advanced Elucidation Structure	3	1	KI6211	Chem. Research Methodologies	2
2	KI6141	Quantum Chemistry	3	2	KI6243	Statistical Thermodynamics	3
3	KI6143	Solid State and Interfacial Chemistry	3	3	KI6242	Physical Chemistry of Polymer	3
4	KI6142	Math. Methods in Physical Chem.	3	4		Elective	4

## Second Year Mandatory Courses

Semester III				Semester IV			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI7111	Chemical Philosophy	1	1	KI70Z2	Research Project II	4
2	KI70Z1	Research Project I	4	2	KI70S3	Research Seminar	1
3		Elective	3				

**Program** : **Chemistry**  
**Specialty** : Organic Chemistry

**First Year Mandatory Courses**

Semester I				Semester II			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI6111	Advanced Elucidation Structure	3	1	KI6211	Chem. Research Methodologies	2
2	KI6151	Supramolecules	3	2	KI6251	Bioorganic	3
3	KI6152	Adv. Organic Chemistry Synthesis	3	3	KI6252	Advanced Natural Product Chemistry	3
4		Elective	3	4		Elective	3

**Second Year Mandatory Courses**

Semester III				Semester IV			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI7111	Chemical Philosophy	1	1	KI70Z2	Research Project II	4
2	KI70Z1	Research Project I	4	2	KI70S3	Research Seminar	1
3		Elective	3				

**Program** : **Chemistry**  
**Specialty** : Biochemistry

**First Year Mandatory Courses**

Semester I				Semester II			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI6111	Advanced Elucidation Structure	3	1	KI6211	Chem. Research Methodologies	2
2	KI6161	Enzymology	3	2	KI6261	Metabolism	3
3	KI6162	Physical Biochemistry	3	3	KI6262	Technique in Biochemical Research	3
4		Elective	3	4		Elective	2

**Second Year Mandatory Courses**

Semester III				Semester IV			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI7111	Chemical Philosophy	1	1	KI70Z2	Research Project II	4
2	KI70Z1	Research Project I	4	2	KI70S3	Research Seminar	1
3	KI7161	Molecular Genetics	3				

**Doctor Program****First Year Mandatory Courses**

Semester I				Semester II			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI7012	Research's Design	2	1	KI80Z1	Research Proposal	6
2	KI7013	Laboratory Techniques	2	2	KI80Z2	Qualification Examination	2
3	KI7014	Selected Topics in Chemistry	2				
4	KI7015	Recent Development in Chemistry	3				

**Second Year Mandatory Courses**

Semester III				Semester IV			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI80Z3	Method Development I	3	1	KI80Z4	Method Development II	3
2	KI80Z6	Experiments I	6	2	KI80Z7	Experiments II	6
3	KI80S3	Seminar I	1	3	KI80S4	Seminar II	1

**Third Year Mandatory Courses**

Semester V				Semester VI			
	Code	Courses Name	Sks		Code	Courses Name	Sks
1	KI90Z1	Experiments III	6	1	KI90Z5	Dissertation	6
2	KI90S3	Seminar III	1	2	KI90Z9	Final Qualification Examination	3

### ***Curriculum References***

References used in the 2003 Chemistry Curriculum development are Undergraduate Chemistry Curriculum of the American Chemical Society, the UK's Undergraduate Chemistry Curriculum, and Quality Assurance Agency for Higher Education in the UK.

References used in the 2003 Chemistry Study Program Curriculum development:

1. Undergraduate Chemistry Curriculum American Chemical Society
2. Undergraduate Chemistry Curriculum Quality Assurance Agency for Higher Education in UK.

### **KI10T1 Concept Technology (Compulsory, 2 credits)**

#### **Short Description**

History of science, science and technology development, model, system, feedback, stability, decision making, optimisation, application of science, technology and art, invention, innovation, intellectual property right.

#### **Reference**

### **KI1111 Basic Chemistry I A (Compulsory, 3(1) SKS)**

#### **Short Description**

Stoichiometry, energetics, structure of atom and molecules, periodic table of elements, appearance of substances : gas and solid state, equilibrium

#### **Reference**

1. Brady J.E. and Holum J.R, *Chemistry, the Study of Matter and Its Changes*, 2<sup>nd</sup> Edition, John Wiley, New York, 1996.
2. Chang, R., *Chemistry*, 5<sup>th</sup> Edition, WCB/McGraw-Hill, New York, 1998.
3. Mahan B.M. and Myers R.J, *University Chemistry*, Benjamin/Cummings, Singapore, 1987.
4. Chang, R., *Essential Chemistry*, 2<sup>nd</sup> Edition, McGraw Hill, New York, 2000

### **KI1112 Basic Chemistry I B (Compulsory, 2 SKS)**

#### **Short Description**

Stoichiometry, energetics, structure of atom and molecules, periodic table of elements, appearance of substances : gas and solid state.

#### **Reference**

1. Mahan B.M. and Myers R.J, University Chemistry, Benjamin / Cummings, Singapore, 1987.
2. Chang, R., Essential Chemistry, 2nd Edition, McGraw Hill, New York, 2000

### **KI1113 Introduction to Chemical Sciences (Compulsory, 2 SKS)**

#### **Short Description**

This course covers scope of chemistry study, scientific methods, some representative chemicals, safety, and chemical literature.

#### **Reference**

1. Elisabeth Kean, Catherine Middlecamp, "*The Success Manual for General Chemistry*", Random House, New York, 1986.
2. Kanare, Howard M. "*Writing the Laboratory Notebook*"; ACS: Washington, 1985.
3. Gordon Aylward, Tristan Findlay, "*SI Chemical Data*", 4th Edition John Wiley & Sons, 1999.

### **KI1211 Basic Chemistry II A (Compulsory, 3(1) SKS)**

#### **Short Description**

This course covers solution, colloid, oxidation reduction, electrochemistry, kinetics, radiochemistry, chemistry of the elements: hydrogen, oxygen and sulphur, nitrogen and phosphor, halogen, invest gases, alkali, and earth alkali, transition element, aluminium, heavy metals, important metals in Indonesia, organic chemistry, environmental chemistry and biochemistry.

#### **Reference**

1. Achmad, H., *Seri Penuntun Belajar Kimia Dasar*, Citra Aditya Bakti, Bandung, 1992.
2. Achmad H. dan Ratnaningsih, E., *Kimia Organik, Ilmu Kimia dan Ilmu Kimia Lingkungan*, Koordinator Kimia TPB, Jurusan Kimia FMIPA, ITB. 1997.
3. Brady J.E. and Holum J.R, *Chemistry, the Study of Matter and Its Changes*, 2<sup>nd</sup> Edition, John Wiley, New York, 1996.
4. Chang, R., *Chemistry*, 5<sup>th</sup> Edition, WCB/McGraw-Hill, New York, 1998.

5. Mahan B.M. and Myers R.J, *University Chemistry*, Benyamin/Cummings, Singapore, 1987.
6. Chang, R., *Essential Chemistry*, 2<sup>nd</sup> Edition, McGraw Hill, New York, 2000

### **KI1212 Basic Chemistry II B (Compulsory, 2 SKS)**

#### **Short Description**

This course covers chemical equilibrium, solution, colloid, reduction-oxidation reactions and electrochemistry, radiochemistry, organic chemistry, environmental chemistry and biochemistry.

#### **Reference**

1. Brady J.E. and Holum J.R, *Chemistry, the Study of Matter and Its Changes*, 2<sup>nd</sup> Edition, John Wiley, New York, 1996.
2. Chang, R., *Chemistry*, 5<sup>th</sup> Edition, WCB/McGraw-Hill, New York, 1998.
3. Mahan B.M. and Myers R.J, *University Chemistry*, Benyamin/Cummings, Singapore, 1987.
4. Chang, R., *Essential Chemistry*, 2<sup>nd</sup> Edition, McGraw Hill, New York, 2000

### **KI1213 Basic of Biological Chemistry (Compulsory, 2 SKS)**

#### **Short Description**

This course covers principles of chemical processes taking place in the living organisms, starting from cell type and subcellular components. These will be followed by cellular molecules, structure and function of cellular molecules, energetics and chemical processes. The last part of the course material will be common techniques for cell isolation and cultivation, lysis and fractionation of cell components, and application of modern biotechnology.

#### **Reference**

1. Albert, B., Bray, D., Ratt, M., Robert, K. and Watson, J.D. (1994). *Molecular Biology of The Cell*. Garland Publishing, New York and London.
2. Darnell, J., Lodisk, A., and Baltimore, D. (1990). *Molecular Cell Biology*, A Scientific American Books, New York.

### **KI2051 Organic Chemistry (Compulsory, 4 SKS)**

#### **Short Description**

Organic chemistry II (Pharmacy): aldehyde and ketone, carboxylic acid and derivatives, enolate and carbanion: organic synthesis (preview), amine and derivatives, aromatic polycyclic aromatics and heterocyclic, carbohydrate,

amino acid and protein, lipids and natural products, spectroscopy: UV-VIS, IR, NMR and MS.

#### Reference

1. Fessenden, R.J., and Fessenden, J.S., "Organic Chemistry" Willard Grant Press, Boston.
2. Volhardt, K.P.C., and Schore, N., "Organic Chemistry: Structure and Function", 3<sup>rd</sup> edition, W.H. Freeman and Co., New York,

### **KI2053 Organic Chemistry (Compulsory, 3 SKS)**

#### **Short Description**

This course, which is offered to Biology students, covers physical and chemical properties of main organic compound, alkane, alkene, alkyne, alcohol, alkyl halide, ether, aldehyde, ketone, carboxylic acid, ester, amine and amino acid. Mainly based on understanding of structure, drawing and structure identification by UV-VIS spectroscopy, IR, NMR and MS. Physical and chemical properties of compounds as consequence of their on structure and ionic charge distribution in the molecule. The examples of chemical compounds will be stressed on simple natural products. This course includes lab work which is stressed on the basic practical organic chemistry, such as, distillation, extraction, separation and purification.

#### Reference

1. Fessenden, R.J., and Fessenden, J.S., "Organic Chemistry" Willard Grant Press, Boston.
2. Volhardt, K.P.C., and Schore, N., "Organic Chemistry: Structure and Function", 3<sup>rd</sup> edition, W.H. Freeman and Co., New York,

### **KI2121 Analytical Chemistry I: Basic Analytical Chemistry (Compulsory, 4(2) SKS)**

#### **Short Description**

This course covers (1) the principles of analyses including analytical processes, evaluation of analytical measurements, chemical calculation, overview of the chemical equilibrium, (2) qualitative analyses including methods of chemical identification, (3) conventional analytical methods such as gravimetry and volumetry, and (4) introduction to instrumental analyses including spectrophotometry and electrometry.

### Reference

1. Skoog, D.A.; West, D.M.; Holler, F.J. *Fundamentals of Analytical Chemistry* 7<sup>th</sup> ed., Saunders College Publisher, 1996.
2. Day R. A. and Underwood A.L., '*Quantitative Analysis*', 6<sup>th</sup> ed., Prentice Hall International, 1991.
3. Harvey D., *Modern Analytical Chemistry*, Mc Graw Hill, 2000

### **KI2122 Analytical Chemistry (Compulsory, 4(1) SKS)**

#### **Short Description**

This course covers description of the domains of analytical chemistry, steps of analysis, data analysis including error and data processing, conventional analytical methods including gravimetry and titrimetry, and instrumental analyses such as potentiometry, spectrometry and atomic absorption.

#### **Reference**

1. Skoog, D.A., West, D. M. and Holler, F. J., *Analytical Chemistry: An Introduction*, 7<sup>th</sup> ed., Saunder College, 1996...
2. Day R. A. and Underwood A.L., *Quantitative Analysis*, 6<sup>th</sup> ed., Prentice Hall International, 1991.

### **KI2141 Physical Chemistry I: Energetics (Compulsory, 4(1) SKS)**

#### **Short Description**

This course covers physical properties of gases, molecular theory of gases, energy in chemical systems, the first law of thermodynamics, entropy and the second law and the third law of thermodynamics, free energies and chemical equilibrium, solution, phase equilibria, electrolyte in solutions.

#### **Reference**

1. Barrow, G.M., *Physical Chemistry*, 6<sup>th</sup> ed. McGraw-Hill, Singapore 1996
2. Atkins, P.W., *Physical Chemistry*, 6<sup>th</sup> ed. Oxford University, Oxford, 2002
3. Alberty, R.A. and Silbey, R.J., *Physical Chemistry*, 1<sup>st</sup> ed. John Wiley, New York, 1992

### **KI2143 Physical Chemistry (Compulsory, 4(1) SKS)**

#### **Short Description**

This course covers (1) energetics; chemical equilibrium, solution thermodynamics, phase equilibria, and (2) dynamics of molecular systems; chemical kinetics, irreversible processes in the solutions.

### Reference

1. Barrow, G.M., *Physical Chemistry*, 6<sup>th</sup> ed. McGraw-Hill, Singapore 1996
2. Atkins, P.W., *Physical Chemistry*, 6<sup>th</sup> ed. Oxford University, Oxford, 2002
3. Alberty, R.A. and Silbey, R.J., *Physical Chemistry*, 1<sup>st</sup> ed. John Wiley, New York, 1992

## **KI2151 Organic Chemistry I: Monofunctional Compounds (Compulsory, 3 SKS)**

### Short Description

Atomic and molecular structure, orbital and its role in covalent bonding. Structural isomer, conformation, configuration, resonance and aromaticity, and stereochemistry of organic molecule. Chemical reaction: addition, nucleophilic substitution, electrophilic substitution, elimination, rearrangement and free radical reaction. Nomenclature, physical properties, spectroscopy, reactivity, reactions mechanism, synthesis and the use of alkane, cycloalkane, haloalkane, alcohol and ether, thiols and sulfides, alkene and alkyne, and aromatic compounds.

### Reference

1. Fessenden, R.J., and Fessenden, J.S., "Organic Chemistry", 5<sup>th</sup> edition, Pacific Grove, California.
2. Morrison R.t. and Boyd R.N., "Organic Chemistry", 4<sup>th</sup> edition, Allyn & Bacon, Boston.

## **KI2152 Organic Chemistry I Laboratory (Compulsory, 2(2) SKS)**

### Short Description

This course is laboratory work that comprises of several modules on separation and purification techniques of liquid and solid compounds, extraction of organic compounds, synthesis of cyclohexane, isomeric geometry, synthesis of *trans*-butylchloride, synthesis of cyclohexene, column chromatography, thin layer chromatography, reaction of hydrocarbons, aldehyde and ketone.

### Reference

1. Fessenden, R.J., and Fessenden, J.S., "Organic Chemistry", 5<sup>th</sup> edition, Pacific Grove, California.
2. Morrison R.t. and Boyd R.N., "Organic Chemistry", 4<sup>th</sup> edition, Allyn & Bacon, Boston.
3. Furniss, et. al., "Textbook of Practical Organic Chemistry", Longman Scientific & Technical.
4. Pasto, D.J., Johnson, C.R., Miller, M.J. "Experimental Organic Chemistry", Prentice-Hall, Engelwood Cliffs, New Jersey, 1992.

## **KI2221 Analytical Chemistry II: Separation Methods & Electrometric Analyses (Compulsory, 4(1) SKS)**

### **Short Description**

This course covers (1) separation methods including principles, classification of analytical separation, solvent extraction, chromatography such as planar chromatography, ion exchanger, liquid and gas chromatography; (2) electrolyses including principles of electrochemistry, potentiometry, electrolysis, electrographymetry, coulometry, voltametry, amperometry, and conductometry.

### **Reference**

1. Skoog, D.A.; West, D.M.; Holler, F.J. *Fundamentals of Analytical Chemistry* 7<sup>th</sup> ed., Saunders College Publisher, 1996.
2. Day R. A. and Underwood A.L., *Quantitative Analysis*, 6<sup>th</sup> ed., Prentice Hall International, 1991.
3. Skoog D.A., Holler F.J., Nieman T A., *Principles of Instrumental Analysis*, Saunders College Pub., 1998.
4. Harvey D., *Modern Analytical Chemistry*, Mc Graw Hill, 2000

## **KI2231 Inorganic Chemistry I: Main Groups (Compulsory, 2 SKS)**

### **Short Description**

This course covers the descriptive of main groups elements and common related compounds including their physical and chemical properties, the basic concepts of chemical bonding and chemical reactions applied to the groups 1–2 and 13 - 18 elements of the Modern Periodic Table.

### **Reference**

1. *Descriptive Inorganic Chemistry* Geoff Rayner-Canham 2-nd edition, W.H. Freeman and Company, New York, 2000.

## **KI2241 Physical Chemistry II: Dynamics (Compulsory, 4(1) SKS)**

### **Short Description**

This course covers rate equations, reaction rates and reaction mechanisms, collision and chemical reaction, transition state theory, surface processes, irradiative processes, macromolecular size and shapes, macromolecular dynamics.

### **Reference**

1. Barrow, G.M., *Physical Chemistry*, 6<sup>th</sup> ed. McGraw-Hill, Singapore 1996
2. Atkins, P.W., *Physical Chemistry*, 5<sup>th</sup> ed. Oxford University, Oxford, 1994

3. Alberty, R.A. and Silbey, R.J., *Physical Chemistry*, 1<sup>st</sup> ed. John Wiley, New York, 1992

### **KI2242 Physical Chemistry: Solution & Colloid (Compulsory, 4(1) SKS)**

#### **Short Description**

This course covers Energetics of Equilibrium Systems; Gases, The First and Second Laws of Thermodynamics, Phase Transition and Phase Diagrams, Solution, Chemical Equilibrium, Electrochemistry of Equilibrium Systems. Dynamics of Molecular Systems: Macromolecules, Colloids, Molecular Modes of Movement, Rates of Chemical Reaction, Kinetics of Complicated Reactions, Processes on the Solid Surfaces, Electrochemistry of Dynamics Systems.

#### **Reference**

1. P.W. Atkins, *Physical Chemistry*, 6<sup>th</sup> Ed, Oxford, Oxford, 1998

### **KI2251 Organic Chemistry II: Polyfunctional Compounds (Compulsory, 4(1) SKS)**

#### **Short Description**

This course covers reaction, synthesis and analysis of: carbonyl compounds, carboxylic acid derivatives, protein, nucleic acids, triglycerides and natural products.

#### **Reference**

1. Fessenden, R.J., and Fessenden, J.S., "Organic Chemistry" Willard Grant Press, Boston.
2. Fessenden, R.J., and Fessenden, J.S., "Organic Chemistry", 5<sup>th</sup> edition, Pacific Grove, California.
3. Solomon, T.W.G., "Organic Chemistry", 4<sup>th</sup> edition, John Wiley, New York.

### **KI2261 Biochemistry I: Structure & Function of Biomolecules (Compulsory, 3(1) SKS)**

#### **Short Description**

This course covers structure, organisation and function of living matter on the molecular level. This will include chemical structure of living material, and relationship between chemical structure and biological function of amino acids, protein, lipids, biological membrane, carbohydrates, nucleotides, and nucleic acids.

## Reference

1. Mathews, CK, van Holde, KE, and Ahern, KG (2000) *Biochemistry*, 3rd ed., Addison-Wesley Publ. Co., San Fransisco
2. Nelson, DL, and Cox, MM, (2000) *Lehninger Principles of Biochemistry*, 3rd ed., Worth Publ., New York
3. Stryer, L, (1995) *Biochemistry*, 4<sup>th</sup> ed., WH Freeman and Co., New York
4. Voet, D, Voet, JG, and Pratt, CW, (1999) *Fundamentals of Biochemistry*, John Wiley & Sons, New York
5. Devlin, TM, (Ed) (1997) *Textbook of Biochemistry with clinical correlations*, Wiley-Liss, New York

## KI3062 Biochemistry (Compulsory, 3 SKS)

### Short Description

This course covers introduction to philosophy of biochemistry; definition of living material; structure of cell, nucleic acids, protein and lipids; enzyme as biocatalyst and biological reaction controller; metabolism of nucleic acids, amino acids, carbohydrates and lipids; biosynthesis of protein; anaerobic processes; oxidation process; transport of electron, oxidative phosphorylation, and photosynthesis.

### Reference

1. Mathews, CK, van Holde, KE, and Ahern, KG (2000) *Biochemistry*, 3rd ed., Addison-Wesley Publ. Co., San Fransisco
2. Nelson, DL, and Cox, MM, (2000) *Lehninger Principles of Biochemistry*, 3rd ed., Worth Publ., New York
3. Stryer, L, (1995) *Biochemistry*, 4<sup>th</sup> ed., WH Freeman and Co., New York
4. Voet, D, Voet, JG, and Pratt, CW, (1999) *Fundamentals of Biochemistry*, John Wiley & Sons, New York
5. Devlin, TM, (Ed) (1997) *Textbook of Biochemistry with clinical correlations*, Wiley-Liss, New York

## KI3113 Introduction to diffraction methods (Elective, 2 SKS)

### Short Description

This course covers crystalline solids, symmetry of crystal, X-ray diffraction, structure determination, and application of X-ray diffraction.

### Reference

1. W. Clegg, *Crystal Structure Determination*, OSP, New York, 1998.
2. G. Giovazzo, *Fundamentals of Crystallography*, Oxford Science Publications, New York, 1991

3. Jenny Pickworth Glusker, Kenneth N. Trueblood, *Crystal Structure Analysis*, 2<sup>nd</sup> ed., OUP, New York, 1985.

### **KI3114 Introduction to Computational Chemistry (Elective, 2 SKS)**

#### **Short Description**

This course covers basic programming, numerical method and its application to Chemistry, molecular mechanics and its application, introduction to theory of electronic structure, statistical mechanics and simulation of macroscopic systems, biomolecular modelling, and ligand construction.

#### **Reference**

1. Guy H. Grant & W. Graham Richards, *Computational Chemistry*, Oxford Science Publishers, 1995

### **KI3121 Analytical Chemistry III: Spectrometric Analyses (Compulsory, 4(1) SKS)**

#### **Short Description**

This course covers interaction of electromagnetic radiation and material, principles of quantitative spectroscopic analysis, atomic absorption spectroscopy, UV-VIS spectroscopy, IR spectroscopy, Raman spectroscopy, spectrofluorometry, turbidimetry, nefelometry, and X-ray spectrometry.

#### **Reference**

1. Skoog, Holler and Nieman, *Principles of Instrumental Analysis*, 5<sup>th</sup> ed, Harcourt Brace & Co, Philadelphia, 1998
2. Willard, Merrit and Dean, *Instrumental Methods of Analysis*, 5<sup>th</sup> ed, EWP, New Delhi, 1974
3. Hollas, *Modern Spectroscopy*, 3<sup>rd</sup> ed, John Wiley & Sons, Chichester, 1996

### **KI3131 Inorganic Chemistry II: Transition Metals & Catalyses (Compulsory, 3(1) SKS)**

#### **Short Description**

This course covers the chemistry of transition metals and their applications, coordination chemistry, organometallic compounds of transition metals, reactions of coordination and organometallic compounds, and the role of organometallic compounds in catalysed reactions such as hydrogenation of unsaturated hydrocarbons, isomerisation, hydroformylation, and acetic acid process.

### Reference

1. F. A. Cotton and G. Wilkinson, *Advanced Inorganic Chemistry*, Wiley-Interscience, New York, 1988.
2. J. McCleverty, *Chemistry of the First-row Transition Metals*, Oxford University Press, Oxford, 1999.
3. C. E. Housecroft, *The Heavier d-Block Metals*, Oxford University Press, Oxford, 1999.
4. M. Gerlock and E. C. Constable, *Transition Metal Chemistry*, VCH, Weinheim, 1994.

### KI3141 Physical Chemistry III: Structures (Compulsory, 3 SKS)

#### Short Description

This course covers introductory mathematics, operator, symmetry, atomic structure, atomic theory, introductory waves, basic quantum theory, Schrodinger's equation, atomic spectra and atomic structure, covalent bonding, ionic bonding, hydrogen bonding, van der Waals forces, metallic bonding and structure of solids, coordination compounds, electron deficient compounds, basic molecular spectroscopies.

#### Reference

1. R. L. Deacock, *Chemical Structure and Bonding*, University Science Books, California, 1989.
2. N. M. Surdia, *Ikatan dan Struktur Molekul*, Direktorat Pendidikan Tinggi, Jakarta, 1993.
3. M. J. Winter, *Chemical Bonding*, Oxford University Press, Oxford, 1994.
4. D. F. Shriver, P. W. Atkins and C. H. Langford, *Inorganic Chemistry*, Oxford University Press, Oxford, 1990.
5. G. L. Miessler and D. A. Tarr, *Inorganic Chemistry*, Prentice Hall, New Jersey, 1999.

### KI3142 Electrochemistry (Elective, 2 SKS)

#### Short Description

This course covers mechanisms of redox processes on the surfaces, basic laws in electrochemistry, thermodynamical aspects, electrodes, electrical conductance and conductivity, application of electrochemistry in various fields.

#### Reference

1. P.H. Rieger, *Electrochemistry*, Ed.ke-2, Chapman & Hall, New York, 1994

2. D.T. Sawyer, A. Sobkowiak, J.I. Roberts, *Electrochemistry for Chemists*, Ed ke-2, John Wiley, New York, 1995.

### **KI3151 Stereochemistry (Elective, 2 SKS)**

#### **Short Description**

This course covers three-dimensional chemistry, stereoisomers, stereospecific and stereoselective reactions, regioselective reactions, stereochemistry of *syn*- and *anti*-addition, stereochemistry of *syn*- and *anti*-elimination, stereochemistry of photochemistry, separation techniques and structure elucidation of enantiomer and diastereomer.

#### **Reference**

1. Fessenden, R.J., and Fessenden, J.S., "Organic Chemistry", 5<sup>th</sup> edition, Pacific Grove, California.
2. Morrison R.T. and Boyd R.N., "Organic Chemistry", 4<sup>th</sup> edition, Allyn & Bacon, Boston.
3. Mc Murry, J., "Organic Chemistry", 5<sup>th</sup> edition, Brooks Cole Toronto.

### **KI3161 Biochemistry II: Metabolism & Genetic Information (Compulsory, 4(1) SKS)**

#### **Short Description**

This course covers (1) bioenergetics; principles of bioenergetics, glycolysis, nitrate acid cycle, oxidation of amino acids, urea production, biosynthesis of carbohydrates, lipid biosynthesis, amino acid biosynthesis, nucleotide biosynthesis, (2) genetic information; gene and chromosomes, replication of information, information transcription, recognising information-translation code, regulation of gene expression.

#### **Reference**

1. Mathews, CK, van Holde, KE, and Ahern, KG (2000) *Biochemistry*, 3<sup>rd</sup> ed., Addison-Wesley Publ. Co., San Fransisco
2. Nelson, DL, and Cox, MM, (2000) *Lehninger Principles of Biochemistry*, 3<sup>rd</sup> ed., Worth Publ., New York
3. Stryer, L, (1995) *Biochemistry*, 4<sup>th</sup> ed., WH Freeman and Co., New York
4. Voet, D, Voet, JG, and Pratt, CW, (1999) *Fundamentals of Biochemistry*, John Wiley & Sons, New York
5. Devlin, TM, (Ed) (1997) *Textbook of Biochemistry with clinical correlations*, Wiley-Liss, New York

### **KI3211 Chemical Literature & Experimental Design (Compulsory, 2 SKS)**

#### **Short Description**

This course covers information and communication, primary, secondary and tertiary literatures, literature searching, bibliography, principles of chemical experiments, basic statistics, sampling, quality control, and experimental data evaluation.

#### **Reference**

### **KI3212 Physicochemical Structure Elucidation (Compulsory, 3(1) SKS)**

#### **Short Description**

This course covers UV, VIS, and IR spectroscopies, NMR, MS, and X-ray diffraction, and their application in structure determination of simple compounds, natural product and polymer.

#### **Reference**

1. Silverstein and M. Robert, *Spectrometric Identification of Organic Compound*, 6<sup>th</sup> edition, John Wiley, 1998.
2. William Fleming, *Spectrometric Method in Organic Chemistry*, Fourth edition, Mc Graw-Hill 1989
3. Jeremy K M Sanders, *Modern NMR Spectroscopy*, Oxford Univ. Press, 1998.

### **KI3213 Environmental Chemistry (Compulsory, 3 SKS)**

#### **Short Description**

This course covers effect of the commonly used organic and inorganic compounds in atmospheric, water and soil environments, analytical methods for the compounds, standard procedure of handling chemicals wastes.

#### **Reference**

1. Colin Baird, *Environmental Chemistry*, 2<sup>nd</sup> ed, W.H. Freeman Company, NY 19982.
2. RM Harrison, *Pollution, Causes, Effects and control*, 3<sup>rd</sup> ed, Royal Soc. Chem., 1996

### **KI3214 Symmetry and Group Theory (Elective, 2 SKS)**

#### **Short Description**

This course covers symmetry elements and operations, point group, multiplication table, group properties, group representation, character table, and symmetry application to chemistry

#### **Reference**

1. F.A. Cotton, *Chemical Applications of Group Theory*, Wiley, New York, 1990.
2. M. F. C. Ladd, *Symmetry in Molecules and Crystals*, Wiley, New York, 1989.
3. B.E Douglas and C.A. Hollingsworth, *Symmetry in Bonding and Spectra; an Introduction*, Academic Press, Orlando, 1985

### **KI3221 Chemometry (Elective, 2 SKS)**

#### **Short Description**

This course covers (1) overview of the application of basic statistic method in Chemistry, (2) design of experiment and optimisation into designing of surface-respond and sampling methods, (3) identification and classification of trend in factorial method, analysis of cluster, and graphical method.

#### **Reference**

1. Otto, M, *Chemometric*, Wiley-VCH, Weinheim, 1999.

### **KI3231 Inorganic Chemistry III: Structure & Reactivity (Compulsory, 3(1) SKS)**

#### **Short Description**

This course covers principles of inorganic structure including atomic structure, crystal structure of ionic compounds, structure of simple inorganic compounds, structure of giant compounds, structure of coordination compounds, solvation and solvent system, acid-base reactions, reaction of coordination compounds, and relationship between structure and reactivity of inorganic and organometallic compounds.

#### **Reference**

1. Huheey J.E., *Inorganic Chemistry*, 3<sup>rd</sup> edition, Harper and Row, New York, 1983.

2. Shriver D.F., Atkins P. W. and Langford C.H., *Inorganic Chemistry*, 2<sup>nd</sup> edition, Oxford University, 1996.
3. Miessler G. and Tarr D.A., *Inorganic Chemistry*, Prentice-Hall International, Singapore, 1991.
4. Porterfield W.W., *Inorganic Chemistry*, 2<sup>nd</sup> edition, Academic Press, Toronto, 1993.

## **KI3241 Nuclear and Radiation Chemistry (Elective, 2 SKS)**

### **Short Description**

This course covers introduction, safety, nuclides and their classification, nuclear stability, nuclear models, nuclear reactions, type of radioactive decays, interaction of radioactive particles with matters, radiation detection methods, dosimetry, chemical and biological effects of radiations, protection from radiations.

### **Reference**

1. J. E. Turner, *Atoms, Radiation, and Radiation Protection*, Second Edition, John Wiley & Sons, New York, 1995
2. H.J. Arnikaar, *Essential of Nuclear Chemistry*, Second Edition, Wiley Eastern Limited, New Delhi
3. G. Friedlander and J.W. Kennedy, *Nuclear and Radiochemistry*, John Wiley and Sons, New York, 1955
4. B. Bundjali, *Kimia Inti*, Penerbit ITB, Bandung, 2002

## **KI3251 Organic Chemistry III: Syntheses (Compulsory, 3 SKS)**

### **Short Description**

To apply and compile previous organic reactions, which have been learnt. Molecule functionalisation, functional group interconversion and carbon-carbon bond formation, electrophilic and nucleophilic reagent in organic synthesis. Review on organic molecules, including hydrocarbon, unsaturated hydrocarbon C=C or C≡C, monofunctional compounds, containing C=C-C=X or C=C-C-X, and aromatic compounds. General review on organic reactions, including nucleophilic substitution, nucleophilic substitution on aromatic rings, nucleophilic addition, electrophilic addition, electrophilic substitution on aromatic rings, elimination, oxidation, reduction and rearrangement. Reagents for electrophilic carbon and nucleophilic carbon. Concept of target molecule, disconnection, retron, sinton, chiron, umpolung, disconnection of C-X and C-C bonds. Design and strategy in organic synthesis, linear and convergent synthesis, protecting group, regioselective and stereoselective synthesis.

### Reference

1. Mackie, R.K. and Smith, D.M., "Guidebook to Organic Synthesis", Longmans, London.
2. Laslo, P., "Organic Reactions Symplcity & Logic", John Wiley, New York.
3. Warren, S., "Organic Synthesis: The disconnection approach" John Willey, New York.
4. Warren, S., "Workbook for Organic Synthesis: The disconnection approach" John Willey, New York.

### **KI3261 Introduction to Biochemical Researches (Elective, 2(2) SKS)**

#### **Short Description**

This course covers principles of commonly used techniques in biochemical researches, designing and undertaking experiment in biochemistry.

#### **Reference**

1. Boyer, R. F., *Modern Experimental Biochemistry*, 2nd ed., New York Benjamin, 1993
2. Scopes, R. K., *Protein Purification, Principles and Practice*, 3rd., ed., Springer Verlag, New York, 1994
3. Becker, J. M., Caldwell, G. A. and Zachgo, E. A., *Biotechnology A Laboratory Course*, 2nd ed, Academic Press, 1996.

### **KI40S3 Seminar (Compulsory, 1 SKS)**

#### **Short Description**

In this course students are required to prepare and perform a presentation of chosen topic from recent chemistry journals. In this course students will learn many aspects of preparing a scientific paper, and presenting research result in seminar.

#### **Reference**

### **KI40S4 Final Project Seminar & Oral Comprehensive Examination (Compulsory, 1 SKS)**

#### **Short Description**

After completing the final project (usually a small research project), students are required to write a report describing result of the research, and give a

presentation on the result. This course ends with oral comprehensive examination, in which five staffs from five different field of Chemistry asking questions to probe the student's understanding of chemistry.

#### Reference

### **KI40Z1 Final Project I (Compulsory, 4 SKS)**

#### **Short Description**

In this course, final year student chooses an academic staff to supervise him/her in doing the final project, and then with the supervisor looks for a research topic for the final project. This will be followed by searching for relevant literature, designing and executing the research.

#### Reference

### **KI40Z2 Final Project II (Compulsory, 4 SKS)**

#### **Short Description**

This course is continuation of final project I, which comprises of data analysis and interpretation, and writing report of the whole results in a form of "skripsi".

### **KI4141 Chemical Thermodynamics (Compulsory, 2 SKS)**

#### **Short Description**

This course covers system definition, equilibrium states, temperature and its measurements, quasistatic processes, works, the first law of thermodynamics, heat, enthalpy and partial molar quantities, thermochemistry, reversible and irreversible processes, the second law of thermodynamics, reversible adiabatic processes, concept of entropy, direction of spontaneous processes, thermodynamic potential and stability of systems, application of thermodynamics in homogeneous single component systems (equation of states etc.),

#### Reference

1. Soesanto Imam Rahayu, *Termodinamika Kimia*, Penerbit ITB, Bandung, 2001.

### **KI4161 Molecular Biotechnology (Compulsory, 3 SKS)**

#### **Short Description**

This course covers overview of the biotechnology development, strategies in DNA recombinant technology, gene manipulation and expression, directed mutagenesis and protein engineering, application of biotechnology in micro

organism, plants, animal and human, industrial scale production of protein and other biological compounds, and regulation and patent in biotechnology.

### Reference

2. Glick and Pasternak (1994). *Molecular Biotechnology, Principles and Application of Recombinant DNA*, ASM Press, Washinton
3. Watson, et al (1992). *Recombinant DNA*, Freeman and Co, New York
4. Old and Primrose (1991) *Principles of Gene Manipulation*. Blackwell Scientific Publications, Oxford
5. Winnacker (1997) *From Gene to Clone: Introduction to Gene Technology*. VCH, New York.
6. Saunders and Saunders (1987). *Microbial Genetic Applied to Biotechnology*. Croom Helm, London.

## KI4241 Chemical Kinetics (Compulsory, 2 SKS)

### Short Description

This course covers definition of reaction rates, reaction order, rate constants, rate laws, experimental determination of reaction order, effect of temperature to rate of reactions, reaction mechanisms, chain reaction, theory of chemical reactions, unimolecular reactions, reactions within solutions, catalysis.

### Reference

1. J.H. Espenson, *Chemical Kinetics and Reaction Mechanisms*, McGrawHill, New York, 1995
2. S.R. Logan, *Fundamentals of Chemical Kinetics*, Longmans, Burnt Hill, 1996.
3. B.R. Gates, *Catalytic Chemistry*, John Wiley, New York, 1992

## KI4242 Material Chemistry (Compulsory, 2 SKS)

### Short Description

Exploration of various chemical aspects which are keys toward syntheses of future functional materials such as: photonic materials, information storage and processing materials, smart materials, biomaterials, biomedical materials, energy generating and storage materials, porous materials, ultra hard materials, advanced polymeric materials, surface and interfacial materials.

### Reference

1. Anthony West, *Solid State Chemistry*, Wiley
2. Ball, *Designing with Molecules*

### **KI4251 Physical Organic Chemistry (Compulsory, 3 SKS)**

#### **Short Description**

This course covers intra molecular properties related to physical properties of molecule, molecular structure, and molecular reactivity, determination of reaction mechanism (kinetics and non kinetic), inter molecular properties, electrophilic substitution reactions, elimination reactions, addition reactions, free radical reactions, and pericyclics.

#### **Reference**

1. Mc Mury, J., "Organic Chemistry", 5<sup>th</sup> edition, Brooks Cole, Toronto.
2. Isaac, N.S., "Physical Organic Chemistry", Longman Group UK.

### **KI5111 Experimental Chemistry Techniques (Elective, 3 SKS)**

#### **Short Description**

This course covers introductory laboratory experiment, safety in chemical laboratory work, treatment of experimental data, the usage of computer softwares, numerical analyses, interfacing equipments to computers, electronic devices and measurements, temperature measurements, vacuum techniques, basic measuring instruments, and curve fitting procedures by using least squares methods.

#### **Reference**

1. D.P. Shoemaker, C.W. Garland & J.W. Nibler, *Experiments in Physical Chemistry*, Ed.ke-6, McGrawHill, Singapore, 1990.

### **KI5121 Applied Analytical Chemistry (Elective, 3(1) SKS)**

#### **Short Description**

This course covers introductory on description of material types, objective of analyses, designing of analytical method including sampling and treatment of sample, measurements, treatment of data and evaluation of the result of analysis. The course also includes quality system, and development and validation of analytical methods.

#### **Reference**

1. Skoog, D.A., West, D.M. and Holler, F.J., *Principles of Instrumental Analysis*, 5<sup>th</sup> ed., Sounder College, 1998.
2. Bassett, J., *Vogel's Textbook of Quantitative Inorganic Analysis*, Longman.

3. Metode-metode standar analisis antara lain : SNI, ASTM, AOAC, JIS, USEPA, BS.

### **KI5122 Capita Selecta in Analytical Chemistry (Elective, 3 SKS)**

#### **Short Description**

This course covers choosing and designing method for analysis, and evaluation of the result. This course focuses on a special topic, namely forensic chemical analyses, environmental chemical analyses, or food analyses. Every year the three topics are alternately chosen.

#### **Reference**

1. Lundquist, F., *Method of Forensic Science*, vol. 1-2, Interscience Publ., John Wiley, 1963.
2. *Forensic Chemistry*
3. Skoog, D.A., West, D. M. and Holler, F. J., *Principles of Instrumental Analysis*, 5<sup>th</sup> ed., Saunder College, 1998.
4. Bassett, J., *Vogel's Textbook of Quantitative Inorganic Analysis*, Longman.
5. Standardised analytical methods such as SNI, ASTM, AOAC, JIS, USEPA, and BS.

### **KI5131 Coordination Chemistry (Elective, 3 SKS)**

#### **Short Description**

This course covers introduction to coordination chemistry, an overview of bonding theories of transition metal compounds and isomerism in transition metal complexes, concept of coordination reactions and their mechanism, structural determination of several common coordination compounds, and special features in clusters and cage chemistries.

#### **Reference**

### **KI5141 Polymer Chemistry (Elective, 3(1) SKS)**

#### **Short Description**

This course covers general survey on polymers, nomenclature and classification, the concept of relative molecular mass average of polymer and their techniques of determination, reaction mechanisms and kinetics of condensation as well as addition polymerisation which consists of radical polymerisation, cationic, anionic and coordination (Ziegler-Natta) polymerisations, copolymerisation reaction and its mechanisms, thermodynamics of polymeric solution, and

polymerisation techniques: mass polymerisation, solution polymerisation, emulsion polymerisation, suspension polymerisation.

### Reference

1. Billmeyer, F.W., *Textbook of Polymer Science*, 7<sup>th</sup> ed., John Wiley, 1995
2. Odian G., *Principles of Polymerization*, 3<sup>rd</sup> ed., John Wiley, 1991
3. Collins et al., *Experimentals in Polymer Science*, John Wiley, 1997
4. Challa G. , *Polymer Chemistry*, Ellis Horwood, U.K., 1993

## **KI5142 Structures & Chemical Properties of Materials (Elective, 3 SKS)**

### Short Description

This course covers introductory solid state chemistry, materials preparation techniques, solid materials characterisation techniques, structure of crystal defects, phase diagrams, electrical and electronic properties, magnetic and optical properties of solids, glassy materials, cement and concrete, refractory materials, and organic based materials.

### Reference

1. A.R. West, *Solid State Chemistry and Its Applications*, John Wiley, Chichester, 1984.

## **KI5143 Capita Selecta in Physical Chemistry (Elective, 3 SKS)**

### Short Description

This course covers latest development in physical chemistry, in particular those which included within the subfields of; computational chemistry, theoretical chemistry, materials science which cover polymer, membrane, ceramics, carbons and intermetallic compounds, and electrochemistry. One or 2 special topics will be selected every semester.

### Reference

1. Journal of Physical Chemistry, Both Section
2. Chemical Reviews
3. Chemistry and Industry
4. Journal of Membrane Science
5. Journal of Polymer Science
6. Relevant article to the chosen topics.

### **KI5144 Corrosion and Its Inhibitions (Elective, 3 SKS)**

#### **Short Description**

This course covers introductory corrosion, historical aspect of corrosion inhibition, electrochemical principles in corrosion tests, corrosion inhibition, general aspect of corrosion inhibition, chemical aspects of corrosion inhibition, biological aspects of corrosion inhibition, inhibitor film composition, local corrosion inhibition, stress corrosion cracking inhibition, corrosion inhibitor quality control, economic consideration, environmental consideration, and case study on various application of corrosion inhibitors in the real field.

#### **Reference**

1. V.S. Sastri, *Corrosion Inhibitors: Principles and Applications*, John Wiley, Chichesters, 1998.

### **KI5151 Chemistry of Natural Product (Elective, 3 SKS)**

#### **Short Description**

Natural product classification, secondary metabolite from natural product resources, such as plants, microorganism and animal, based on biogenesis approach. The story of biogenesis, specific reaction, interconversion, transformation, synthesis, physiology and the use of each group of compound, including terpenoid, especially monoterpene; steroid, phenylpropanoid, especially cinnamic acid and coumarine derivatives; poliketide, especially derivatives of chromon, xantone, and quinone; flavonoid group especially 1,3-diarylpropanoid; and alkaloid group, especially benzylisoquinoline derivative, and structure elucidation. Overlook on natural organic molecule including juvenile hormone, prostaglandin and tetracycline antibiotic.

#### **Reference**

1. Achmad, S.A., "Kimia Organic Bahan Alam, Modul 1-6", Universitas Terbuka.
2. Manitto, "Biosynthesis of Natural Products, John Willey.
3. Herbert, R.B., "The Biosynthesis of Secondary Metabolites", 2<sup>nd</sup> edition.
4. Nakanishi, N., Goto, T., Ito, S., Natori, S. and Nozoe, "Natural product Chemistry, Vol 1-3, Kodansha Academic Press.

### **KI5152 Organometallic Chemistry (Elective, 3(1) SKS)**

#### **Short Description**

This course covers (1) alkali and alkali earth organometallics, which include polarity of C-C bonds, reactivity, solvent effect on dimmer, trimmer and

polymer formation of organoaluminum, (2) structure and bonding; molecular orbital of three-centred bonds, hydrogen bridge, methyl bridge, (2) organosilicon and organogermanium; structure and bonding, synthesis and reaction of organosilicon and organogermanium, (4) organometallics compounds of the transition metals; the 18-electron rule, nomenclature, oxidation states, M-C and M-H bonds, stability of M-alkyl,  $\pi$ -bonded complexes, synthesis and characterisation, ligand substitution reactions, oxidative addition and reductive elimination reactions, homogeneous catalyses, and the application in organic syntheses.

### Reference

1. Simpson P., *Organometallic Chemistry of the Main Groups*, Longman, London, 1970.
2. Simpson P., *Organometallic Chemistry of Transition Metal*, Longman, London, 1970.
3. Green C., *Organometallic Compound, The Transition Elements*, Butler & Tannen, London, 1968.
4. Crabtree R.H., *The Organometallic Chemistry of The Transition Metals*, John Wiley, Singapore, 1987.

### KI5161 Capita Selecta in Biochemistry (Elective, 3 SKS)

#### Short Description

This course covers recent development in biochemistry, protein-enzyme and nucleic acid-genetic molecules, human proteomic-genomic, and model of organism.

#### Reference

### KI5162 Medical Biochemistry (Elective, 3 SKS)

#### Short Description

This course covers the relationship between protein mis-folding and mutation with diseases, the relationship between metabolic disorder and diseases, molecular view of cancer, mechanistic view of immune system, molecular design of gene therapy and medicine.

#### Reference

1. Lodish et al, *Molecular Cell Biology*, John Wiley and Sons, 2000
2. Voet and Voet, *Biochemistry*, W. H. Freeman, 2000

3. Mathews et al, Biochemistry, The Benyamin/Cumming, 1999
4. Journal, such as Drug Discovery, etc.

### **KI5211 Computational Chemistry (Elective, 3 SKS)**

#### **Short Description**

This course covers principles of computational science and computational chemistry, numerical method and parallel computation, force field methods, electronic structure and electronic correlation methods in the modelling of organic molecules, biomolecules and organometallics, transition state theory and kinetic modelling, simulation of gas, liquid and solid (md and monte carlo), introductory neural network and genetic algorithms, and recent development in computational chemistry.

#### **Reference**

### **KI5221 Special Methods In Analytical Chemistry (Elective, 3(1) SKS)**

#### **Short Description**

This course covers special topics in chemical analyses and recent development in analytical chemistry. The selected topics include ICP, DCP, PIP, thermal analyses (TGA, DTG, DTA, and DSC), Fluid Injection Analysis (FIA), and tandem techniques.

#### **Reference**

1. Skoog D.A., Holler F.J., Nieman T A., *Principles of Instrumental Analysis*, Saunders College Pub., 1998
2. Fifield F.W., and Kealey D, *Principles and Practice of Analytical Chemistry*, Blackie Academic & Professional, 1996
3. Zhaolun Fang, *Flow Injection Separation and Preconcentration*, VCH, 1995

### **KI5222 Electrometric Analysis (Elective, 2 SKS)**

#### **Short Description**

This course covers analytical methods based on (1) galvanic cell such as potentiometry, and selective electrode potentiometry, (2) electrolysis, which includes voltammetry, cyclic voltammetry, differential voltammetry, amperometry, etc, (3) and their application in chemical characterisation.

### Reference

1. Bard, *Electrochemical Methods: Fundamental and Application*, 2<sup>nd</sup> ed., John Wiley, 2000.
2. Wang, J, *Analytical Electrochemistry* 2<sup>nd</sup> ed., VCH, 2000

### KI5231 Capita Selecta in Inorganic Chemistry (Elective, 3 SKS)

#### Short Description

This course covers modern aspect and current development in inorganic chemistry related to solid state chemistry, transition metal compounds, and catalysis.

#### Reference

1. Inorganic Chemistry, ACS
2. Chemistry of Materials, ACS.

### KI5232 Introduction to Inorganic Syntheses (Elective, 3(1) SKS)

#### Short Description

This course covers the concept and synthesis strategies of synthesis inorganic compounds, thermodynamic and kinetic factors influencing inorganic reactions, and solvents influences in synthesis of some selected inorganic compounds.

#### Reference

1. Ian Dance, *Honours Course Inorganic Synthesis and Reactivity*, University of New South Wales, 1998
2. W. L. Jolly, *The Synthesis and Characterisation of Inorganic Compounds*, Prentice-Hall, N. J., 1970.

### KI5241 Surface Chemistry (Elective, 3 SKS)

#### Short Description

This course covers capillarity, liquid interfacial thermodynamics, surface films on liquid substrates, electrical aspects of surfaces, long range attractive forces, microscopy and spectroscopy of solid surface structure, crystal nucleation and growth, contact angle, solution adsorption, friction, lubrication and adhesion, wetting, floatation and detergency, emulsion, foam, froth and aerosols, macromolecular films, charged films, LB films, solid-gas interface, gas and vapours adsorption on solid surfaces, chemisorption and catalyses.

#### Reference

1. A.W. Adamson & A.P. Gast, *Physical Chemistry of Surfaces*, Ed.ke-6, Wiley Interscience, New York, 1997.

### **KI5242 Ceramic Chemistry (Elective, 3 SKS)**

#### **Short Description**

This course covers chemical aspects in the processing of traditional as well as advanced ceramic materials such as: ceramic raw materials, ceramic characterization, additives in the ceramic processing, particle packing, batch recipe and consistency, powder particle mechanics, ceramic dispersion rheology, ceramic powder beneficiation, ceramic body forming, and treatments in post ceramic body forming.

#### **Reference**

1. J.S. Reed, *Principles of Ceramics Processing*, 2<sup>nd</sup> Ed, Wiley, Melbourne, 1995.

### **KI5243 Polymer Degradation (Elective, 3 SKS)**

#### **Short Description**

This course covers introduction and definition of polymer degradation, detection and characterisation of polymer degradation, reaction and mechanisms as well as several important aspects in thermal degradation, mechanical degradation, photodegradation and chemicodegradation, biodegradation and biodegradable polymers, reaction and mechanisms of enzymatic degradation and microbial degradation, biopolymer and synthetic polymers, synthesis and properties of phb and its copolymers, various characterization methods for polymer biodegradation and their applications.

#### **Reference**

1. Schnabel, W., "*Polymer Degradation, Principles and Practical Degradation*", Macmillan Publisher Co. Inc., Yew York (1981)
2. Lenz, R.W., "*Biodegradable Polymers, Advance in Polymer Science*", Vol 107, Springer - Verlag, Berlin Heidelberg (1993)
3. Ranby, B. And Rabek, J.F., "*Photodegradation, Photo-oxidation and Photostabilization of Polymer, Principles and Applications*", John Wiley & Sons Ltd., Britain (1975)

### **KI5244 Sensors and Lithography (Elective, 3 SKS)**

#### **Short Description**

This course covers basic principles of information flow in measuring systems, signals and theory of systems, principles of chemical sensing, electronic measurement techniques, supportive technologies including photolithographic technologies, concept of smart sensors, sensor network and communication, and several examples on the physical realization of smart sensors.

## Reference

### **KI5251 Spectroscopic Elucidation of Natural Product (Elective, 2 SKS)**

#### **Short Description**

This course covers the use of spectroscopic methods (UV-VIS and IR spectroscopy,  $^1\text{H}$ - dan  $^{13}\text{C}$  NMR, and MS) in elucidation of structure of natural organic compounds.

#### **Reference**

1. Scott A.I., *Interpretation of the Ultraviolet Spectra of Natural Products*, Pergamon Press, London, 1964.
2. Bellamy L.J., *The Infra-red Spectra of Complex Molecules*, Methuen, London, 1966.
3. Budzikiewicz H.D., Jerassi C. and Williams D.H., *Structure Elucidation of Natural Products by Mass Spectrometry*, Vol. I & II, Holden-Day, San Francisco, 1964.
4. Jackman L.M. and Sternhell S., *Applications of Nuclear Magnetic Resonance Spectroscopy in Organic Chemistry*, Pergamon, New York, 1969.
5. Mabry T.J., Markham K.R. and Thomas M.B., *The Systematic Identification of Flavonoids*, Springer-Verlag, New York, 1970.
6. Webb G.A. (Ed.), *Annual Report on NMR Spectroscopy*, Vol. 8 (Alkaloids), Academic Press, London, 1978.

### **KI5252 Capita Selecta in Organic Chemistry (Elective, 3 SKS)**

#### **Short Description**

This course covers recent development in organic chemistry.

#### **Reference**

1. *J. Organic Chemistry*.

### **KI5261 Food Biochemistry (Elective, 3 SKS)**

#### **Short Description**

This course covers chemical aspect of foods, regulation on foods and drugs, nutrients, microorganism as biochemical product, food preservation and processes, food additives, food-related diseases.

### Reference

1. Frazier Q dan Westhoff D.C, *Food Microbiology*, McGraw-Hill International, Singapore, 1988
2. Harrigan W. F. & Park R.W.A., *Making Safe Food*, Academic Press Ltd., Sand Diego, 1991
3. Stryer, L, (1995) *Biochemistry*, 4th ed., WH Freeman and Co., New York

### **KI6111 Advanced Structure Elucidation (Compulsory, 3 SKS)**

#### **Short Description**

This course covers principles, techniques, and interpretation of visible, ultra-violet, infrared, nuclear magnetic resonance, and electron spin resonance spectroscopies.

#### **Reference**

### **KI6121 Analytical Separation (Compulsory, 3 SKS)**

#### **Short Description**

This course covers thermodynamics of chemical separation, complexes in analytical separation, separation based on physical properties (distillation and crystallisation), separation based on physico-chemical properties (solvent extraction, chromatography, liquid membrane extraction, and calliper-zone electrophoresis).

#### **Reference**

### **KI6122 Analytical Measurements (Compulsory, 3 SKS)**

#### **Short Description**

Information theory in analytical analysis, theory of measurement error, theory of noise in analytical measurements, basic electronics, electronics in analytical instrument and interface.

## Reference

### **KI6131 Advanced Inorganic Chemistry (Compulsory, 3 SKS)**

#### **Short Description**

This course covers several theories and concepts employed in inorganic chemistry as well as considerable descriptive chemistry, an overview of periodicity of elements in The Modern Periodic Table, properties of elements and related compounds, reaction and mechanism as well as methods of characterization of inorganic compounds, and introduction to the coordination chemistry related to the importance of transition metals and their stability.

#### **Reference**

1. *Advanced Inorganic Chemistry*, 6<sup>th</sup>.,ed. Cotton, F. Albert., New York: John Wiley & Sons.,1999
2. *Concept And Models Of Inorganic Chemistry*, 3<sup>rd</sup>., ed.. Douglas, Bodie New York: John Wiley, 1994
3. *Inorganic Chemistry Of Main Group Elements*, King, R Bruce., New York: Wiley-VCH, 1995
4. *Principles Of Descriptive Inorganic Chemistry*, Wulfsberg, Gary., California : University Science., 1991

### **KI6132 Inorganic Syntheses (Compulsory, 3 SKS)**

#### **Short Description**

This course covers current development and trends in synthesis of solid inorganic compounds and modern aspect of coordination chemistry.

#### **Reference**

1. Sloan, Thomas E (Ed) *Inorganic Synthesis: Collective Index* Volumes 1-30, New York: John Wiley & Sons, NY, 1997.

### **KI6141 Quantum Chemistry (Compulsory, 3 SKS)**

#### **Short Description**

This course covers Hamiltonian mechanics and definition of canonical variables, dynamical quantities operator and eigenvalue problems, Schroedinger's equation of simple systems and their solutions, spin angular momentum concept, hydrogen atom, formal approach in quantum theory, perturbation theory and variation techniques, multielectron atoms and SCF Method, symmetry and introduction to group theory, two electron molecules,

VB and MO approaches, polyatomic molecules, LCAO-MO approach in conjugated systems, time dependent perturbation and basic spectroscopy.

**Reference**

**KI6142 Mathematical Methods in Physical Chemistry (Compulsory, 3 SKS)**

**Short Description**

This course covers matrix reviewed, vector and tensor, ordinary differential equation with constant and variable coefficients, Sturm-Liouville equation and limit value problems, special functions: Legendre, Laguerre, Hermite, Bessel, Fourier series and its extension, Fourier and Laplace transforms, partial differential equations, and multidimensional vector space.

**Reference**

**KI6143 Solid State and Interfacial Chemistry (Compulsory, 3 SKS)**

**Short Description**

This course covers experimental methods, point defect thermodynamics, one and two dimensional crystal defects, basic concept in solid state kinetics, kinetics and dynamics of locally equilibrium systems, heterogeneous solid state reactions, metal oxidation, solid in thermodynamic potential gradient, internal reaction, interfacial reaction, phase transition morphology, solid state reaction under irradiation, effect of mechanical stresses, transport phenomena and reaction in various special systems.

**Reference**

1. H. Schmalzred, *Chemical Kinetics of Solids*, VCH, Weinheim, 1995.

**KI6151 Supramolecular (Compulsory, 3 SKS)**

**Short Description**

This course covers comparison of molecule, supermolecule and supramolecule; chemical aspect and molecular reactions (addition, substitution, elimination and radical), concept of supermolecule and supramolecule, molecular recognition, coreceptor, recognition of double molecules, reactivity of supramolecules, catalysis, transport process, and designing molecular carrier.

## **Reference**

### **KI6152 Advanced Organic Chemistry Syntheses (Compulsory, 3 SKS)**

#### **Short Description**

This course covers type of organic reaction, nucleophilic and electrophilic carbon resources, design and strategy of synthesis, sinton, analysis of retro-synthesis, and synthesis in chemical industries.

## **Reference**

### **KI6161 Enzymology (Compulsory, 3 SKS)**

#### **Short Description**

This course covers structure, organisation and function of living matters, . This course is divided into three parts, namely (1) structure of living matters and the relationship between structure and function, (2) metabolism and chemical reactions in living organism, and molecular genetics, chemical processes and molecules that can store and transmit biological information.

## **Reference**

### **KI6162 Physical Biochemistry (Compulsory, 3 SKS)**

#### **Short Description**

This course covers structure (primer, sekunder, tertier, and quartener), physicochemical properties of protein, structure of nucleic acids (DNA nad RNA), inter biomolecular interactions, biomembrane and transport processes.

## **Reference**

### **KI6212 Research of Methodology Chemistry (Compulsory, 2 SKS)**

#### **Short Description**

This course covers philosophy of science and research, process of research, topic selection, research planning, method of data collection, data analysis, sampling method, literature searching, and writing of research proposal and report.

## Reference

### **KI6221 Advanced Applied Analytical Chemistry (Compulsory, 3(1) SKS)**

#### **Short Description**

This course covers an overview of physical and chemical properties of organic and inorganic materials; survey of analytical techniques, methods, and procedures; effects of analytical steps (sampling, preservation, sample treatments, measurement, data processing) on results; searching of analytical methods and procedure from resources of national or international standardised procedures, and application of the selected methods.

## Reference

### **KI6222 Advanced Spectroscopic Analysis (Compulsory, 3 SKS)**

#### **Short Description**

This course covers principles, techniques and application of vibrational spectrometry (DSR and ATR), Raman spectroscopy, UV-VIS spectroscopy, NMR, ESR, X-RD, X-RF, EFS, EXAFS, ESCA, XPS, UPS, EELS, and Mossamer spectroscopy.

## Reference

1. Skoog D.A, Holler F.J., Nieman T.A, *Principles of Instrumental Analysis*, Holt Sounders Instrumental Edition, 5<sup>th</sup>.ed., 1998.
2. Solomon E.I., Mever A.B., *Inorganic Electronic Structure and Spectroscopy*, John Wiley and Son Inc., 1999
3. Savier A.M.C, Creaser C.S., *Analytical Applications of pectroscopy*, The Royal Society of Chem., 1991
4. Zyka T., *Instrumentation in Analytical Chemistry I & II*, Ellis Hoswood, 1991.

### **KI6231 Inorganic Reaction Mechanisms (Compulsory, 3 SKS)**

#### **Short Description**

This course consists of several topics such as classification, reaction mechanism, substitution reaction and redox reactions.

#### **Reference**

1. J.M. Atwood, *Inorganic and Organometallic Reaction Mechanism*, Wiley-VCH, New York, 1997
2. R.A. Henderson, *The Mechanism of Reaction at Transition Metal Sites*, Oxford University Press, Oxford, 2000.

### **KI6232 Penentuan Struktur Anorganik (Compulsory, 2 SKS)**

#### **Short Description**

This course consists of structure determination theory of solid and crystals Inorganic compounds. Symmetry of a molecule: how to recognize symmetry elements and operations, and how to determine point groups. Application of molecular symmetry in IR and Raman spectroscopy. Characterization by X-ray diffraction method, magnetic properties measurements and an introduction to Mossbauer spectroscopy. .

#### **Reference**

1. W. Clegg, *Crystal Structure Determination*, OSP, New York, 1998.
2. G. Giovazzo, *Fundamentals of Crystallography*, Oxford Science Publications, New York, 1991

### **KI6242 Physical Chemistry of Polymer (Compulsory, 3 SKS)**

#### **Short Description**

This course covers condensation polymerisation, statistics of condensation polymerisation, polymeric molecular mass control and its distribution, multichained polymers, polymer gelation phenomena, radical polymerisation, reaction rate as a function of degree of conversion, enthalpy and free energy of polymerization, effect of monomeric structure toward polymerisation enthalpy, ceiling and floor temperatures, autoacceleration reaction, ionic polymerisation: solvent and media effect toward rate of polymerisation, epoxide anionic polymerisation, transfer reactions, high-end specialty polymers: conductive polymers, biomaterials, nanocomposites, photonic polymers, hyperbranched polymers, polymer elasticity, polymeric classification based on elasticity, relaxation, & deformation, high-elastic, glassy and viscofluid polymer transition,

polymer thermal analyses: differential thermal analyses (DTA), differential scanning calorimetry (DSC), thermogravimetric analyses (TGA), thermomechanical analyses (TMA), polymeric structure analysis: X-ray diffraction (X-RD), scanning electron microscopy (SEM).

**Reference**

1. Odian, " *Principles of Polymerization*", John Wiley, 1990.
2. A. Tager, " *Physical Chemistry of Polymers*", Mir Publ. Moscow, 1972.
3. W.W.M. Wendtlandt, " *Thermal Methods of Analysis*", John Wiley, 1974.
4. R.G. Haward, " *Development on Polymerization*", Aml. Sci. Publ., 1979.
5. J.F. Rabek, " *Experimental Methods in Polymer Chemistry*", John Wiley, 1980

**KI6243 Statistical Thermodynamics (Compulsory, 3 SKS)**

**Short Description**

This course covers ensemble approach: various ensembles and their interrelationship with thermodynamics, monatomic ideal gas systems, classical and quantum statistics, multiatomic ideal gas systems, chemical equilibrium, crystal system: Einstein and Debye approaches, degenerate gas systems: helium-3 and helium-4, real/non-ideal gases, surface systems and adsorption/desorption, and polymeric systems.

**Reference**

**KI6251 Bioorganic (Compulsory, 3 SKS)**

**Short Description**

This course covers principles of bioorganic, techniques for screening of biologically active materials, isolation and characterisation of biologically active molecules, and working mechanism of the biologically active molecules.

**Reference**

**KI6252 Advance Natural Product Chemistry (Compulsory, 3 SKS)**

**Short Description**

This course covers the chemistry of terpenoide, steroide, fenipropanoide, poliketide, flavonoide and alkaloide.

## Reference

### **KI6261 Metabolisms (Compulsory, 3 SKS)**

#### **Short Description**

This course covers structure, organisation and function of living matter on the molecular level. This will include chemical structure of living material, and relationship between chemical structure and biological function, reactions involved in the metabolism, molecular genetics, chemical processes and compounds that can store and transmit biological information.

#### **Reference**

1. Mathews, CK, van Holde, KE, and Ahern, KG (2000) *Biochemistry*, 3rd ed., Addison-Wesley Publ. Co., San Fransisco
2. Nelson, DL, and Cox, MM, (2000) *Lehninger Principles of Biochemistry*, 3rd ed., Worth Publ., New York
3. Stryer, L, (1995) *Biochemistry*, 4th ed., WH Freeman and Co., New York
4. Voet, D, Voet, JG, and Pratt, CW, (1999) *Fundamentals of Biochemistry*, John Wiley & Sons, New York
5. Devlin, TM, (Ed) (1997) *Textbook Of Biochemistry With Clinical Correlations*, Wiley-Liss, New York

### **KI6262 Techniques in Biochemical Research (Compulsory, 3 SKS)**

#### **Short Description**

This course covers techniques for handling microorganism, relationship between cell growth and its activity, protein isolation from cells, techniques for purification and characterisation of protein, techniques for genetic engineering, recent techniques in molecular genetics.

#### **Reference**

### **KI7012 Experimental Designs (Compulsory, 2 SKS)**

#### **Short Description**

Steps in designing a research, choosing a research topic, research planning, data collection methods, data analysis techniques, and sampling method.

## **Reference**

### **KI7013 Skills for Chemical Research (Compulsory, 2 SKS)**

#### **Short Description**

In this course, a PhD student will be exposed to laboratory techniques and data interpretations that are closely related to his/her research topic.

#### **Reference**

### **KI7014 Capita Selecta in Chemistry (Compulsory, 2 SKS)**

#### **Short Description**

In this course, a PhD student will be exposed to the recent development in an area of Chemistry that is closely related to his/her research topic.

#### **Reference**

### **KI7015 Recent Development in Chemistry I (Compulsory, 3 SKS)**

#### **Short Description**

In this course, a PhD student is required to attend seminars on recent development of Chemistry related to his/her research topic.

#### **Reference**

### **KI70S3 Research Seminar (Compulsory, 1 SKS)**

#### **Short Description**

In this course, PhD students present their research result in or outside the department.

#### **Reference**

### **KI70Z1 Research I (Compulsory, 4 SKS)**

#### **Short Description**

Conducting a research in a certain topic in a chosen-specific field in chemistry and presenting the results in a thesis. The topic can be chosen under supervision of the supervisors. The student has to design and preparing the soft ware and hard ware required in this investigation. The research topic can be an

experimental or theoretical problem solving which is conducted using scientific methods.

**Reference**

**KI70Z2 Research II (Compulsory, 4 SKS)**

**Short Description**

Continuation of the Research I

**Reference**

**KI7111 Chemical Philosophy (Compulsory, 1 SKS)**

**Short Description**

This course covers trend in chemistry philosophy, basic knowledge and logic in Chemistry, basic elaboration in Chemistry, methods in obtaining knowledge and genuineness in Chemistry, tools in notion in Chemistry, value of morally and socially usage of Chemistry, language in chemistry, and essential of experiments in Chemistry.

**Reference**

**KI7161 Molecular Genetics (Compulsory, 3 SKS)**

**Short Description**

This course covers structure of gene, chemical synthesis of DNA, biosynthesis of DNA, genetic expression, controlling the genetic expression, genetic of cell and tissue, and recent development in technologies of DNA recombinant and their application.

**Reference**

**KI80S3 Progress Report Seminar I (Compulsory, 1 SKS)**

**Short Description**

In this course, PhD students regularly report their research progress in a departmental seminar, and produce written report.

## **Reference**

### **KI80S4 Progress Report Seminar II (Compulsory, 1 SKS)**

#### **Short Description**

Continuation of the Progress Report Seminar I.

#### **Reference**

### **KI80Z1 Research Proposal (Compulsory, 6 SKS)**

#### **Short Description**

Designing a research proposal under supervision of a team of promoter regarding a research topic and presenting the results according to the format released by ITB Post-Graduate Program.

#### **Reference**

### **KI80Z2 Qualification Exam (Compulsory, 2 SKS)**

#### **Short Description**

At the end of the first year, PhD students take an oral comprehensive examination before a team of examiners to evaluate the student's quality to do a dissertation. The evaluation is including the proposed research proposal.

#### **Reference**

### **KI80Z3 Method Development I (Compulsory, 3 SKS)**

#### **Short Description**

Development of the future research methodology as describe in the proposal under supervision of a team of promoter.

#### **Reference**

### **KI80Z4 Method Development II (Compulsory, 3 SKS)**

#### **Short Description**

Development of the future research methodology as describe in the proposal under supervision of a team of promoter. This course is a continuation of the KI80Z3 Method Development I.

**Reference**

**KI80Z6 Experiment I (Compulsory, 6 SKS)**

**Short Description**

In this course, PhD students carry out experiments as described in the research proposal under supervision of a team of promoter.

**Reference**

**KI80Z7 Experiment II (Compulsory, 6 SKS)**

**Short Description**

This course is a continuation of the KI80Z7 Experiment I.

**Reference**

**KI90S3 Progress Report Seminar III (Compulsory, 1 SKS)**

**Short Description**

Continuation of the Progress Report Seminar II.

**Reference**

**KI90Z1 Experiment III (Compulsory, 6 SKS)**

**Short Description**

Continuation of the Experiment II.

**Reference**

**KI90Z5 Writing Up (Compulsory, 6 SKS)**

**Short Description**

Writing a thesis based on research result according to guideline from graduate Program ITB.

**Reference**

**KI90Z9 Final Examination (Compulsory, 3 SKS)**

**Short Description**

Final oral examination to defend the thesis.

**Reference**