University of Split

Faculty of Chemical Technology

PROPOSAL FOR THE ACADEMIC UNDERGRADUATE STUDY PROGRAMME

Chemical Technology

Split, February 1, 2005

STUDY PROGRAMME / CURRICULUM

Academic undergraduate study:

Chemical Technology

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1. Introduction

1.1. General information on the programme

By the undergraduate study of chemical technology, the Faculty of Chemical Technology of Split, as a high-education and scientific institution, is trying to offer a new impetus for economic development and rational economizing on natural resources. The undergraduate study of chemical technology provides basic engineering knowledge required for leading sustainable chemical processes in the production of materials and products for specific purposes, as well as the knowledge on the methods of quality investigations and the analysis of processes. Students are qualified for the involvement in quick changes of technological development and work in small and medium-size businesses. During the study special attention is paid to practical work, which enables the students, as soon as they finish the study, to join in the working process of various industrial branches (chemical, metal, shipbuilding, construction, food, pharmaceutical and other industries). After they finish the study, the students can continue their education at the graduate study of the Faculty of Chemical Technology or at some other graduate studies of related faculties.

All the programmes of this study are founded on the scientific knowledge of the scientific fields of chemistry and chemical engineering, which contributes considerably to modern education of young people.

When elaborating the programmes, special care was taken to harmonize the subjects and their teaching programmes with related studies at other high-school institutions. In that way the programmes are mutually comparable and, also, they stimulate the student and teacher mobility. The proposed programme can be compared with the programmes of the following high-school institutions: Universita degli Studi di Roma “La Sapienza”, Rome, Italy; Universtad Rey Juan Carlos, Madrid, Spain; Politecnico di Torino, Torino, Italy.

During the first year of the study, the emphasis is put on mastering the basic knowledge of chemistry and related natural sciences. Gradually, the contents on chemical engineering are being introduced and they prevail in the last three semesters of the study. In the last semester students can choose a certain number of optional subjects relevant to their profession and also those out of their profession. The study finishes when the final project is completed.

1.2. Previous experience in the field

The Faculty of Chemical Technology of Split was founded in 1960, responding to the economic demands of the region and aiming at fulfilling its personnel and professional needs. Since then the

Faculty organizes and carries out the study of chemical technology. On the grounds of the acquired scientific knowledge and economic demands, the teaching programmes have been continually improved and up-dated. Close cooperation between this region economy and the Faculty has resulted in great number of projects, expertise, elaborates and, in particular, in opening the new courses at the undergraduate study and the postgraduate studies as well, the content of which is exactly the result of this region needs. The proposed undergraduate study represents the existing study of chemical technology with the study orientations: Chemical-Technological Processes (classes: Polymer Materials, Inorganic Materials, Corrosion and Protection of Materials), Environmental Protection, and Chemistry and Technology of Mediterranean Cultures.

1.3. Student mobility scheme

The proposed programme of undergraduate study and its comparability with the related studies in the Republic of Croatia and the EU countries enables the student and teacher mobility. It can be realized through the enrolment of particular subjects, or the whole semesters, on other undergraduate studies, or through the work on the final project. The students will be also given an opportunity to enroll in a certain number of courses out of their profession. The studies suitable for the realization of that mobility are the components of the University of Split, but also of other Croatian universities (Faculty of Chemical Engineering and Technology of Zagreb, Faculty of Food and Biotechnology of Zagreb and Osijek, Faculty of Textile Technology of Zagreb, Faculty of Graphic Arts of Zagreb, etc.) as well as of some high-schools in the EU countries.

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1.4. Other elements

The possible partners outside the high-school education system interested in continuation of the study of chemical technology are the economy and public services of the Split-Dalmatian County, as well as: cement industry, shipbuilding industry, processing of polymer materials, metal-working industry, Prerada, Jadran Brewery, Dalmacijavino, Adriacink, AD Plastic, Dal-koning, Water and Sewage-System Company, Office for Public Health and other Council and City services. It is important to point out that due to geographic position of Split there is a growing presence of students not only from Dalmatia but also from Bosnia and Herzegovina, so that such a trend is expected to continue in the future.

2. General description

Type of programme	Academic Undergraduate Study	
Programme title	Academic Undergraduate Study of Chemical Technology Study Orientation: Chemical Engineering	
Institution	**Proposed by**	Faculty of Chemical Technology of the University of Split
	Participating institutions	Faculty of Chemical Technology of the University of Split
Duration	3 years	
ECTS	180	
Admission requirements	Four-year secondary school completed	
Learning outcomes and competences	Work in manufacturing plants of chemical and food industries, work in small and medium-size businesses; controlling and leading of manufacturing processes; quality control of raw materials and products; work in laboratories of various institutes, faculties and other public institutions.	
Access to further studies	Graduate study of chemical technology at the Faculty of Chemical Technology of Split or a graduate study at other related faculties.	
Qualification awarded	Baccalaureus/Baccalaurea of Chemical Technology (Study Orientation - Chemical Engineering)	

3. Study/Degree programme

3.1. Programme structure with credits

1st Semester			
Course code	**Course title** ***Obligatory courses***	**Type of course** **L+S+P***	**ECTS**
	Mathematics I	45+45+0	9.0
	Physics I	45+30+30	10.5
	General chemistry	45+30+30	10.5
Total:		**135+105+60**	**30**
*L-lectures; S-seminars; P-laboratory exercises			

2nd Semester			
Course code	**Course title** ***Obligatory courses***	**Type of course** **L+S+P***	**ECTS**
	Mathematics II	30+60+0	7.0
	Physics II	30+15+30	6.0
	Inorganic chemistry	30+15+30	6.0
	Analytical chemistry	60+30+45	11.0
Total		**150+120+105**	**30**
*L-lectures; S-seminars; P-laboratory exercises			

3rd Semester			
Course code	**Course title** ***Obligatory courses***	**Type of course** **L+S+P***	**ECTS**
	Organic chemistry	60+15+45	10.0
	Physical chemistry	60+15+30	9.0
	Material and energy balances	30+30+0	5.0
	Mass and energy transfer	45+15+15	6.0
Total		**195+75+90**	**30**
*L-lectures; S-seminars; P-laboratory exercises			

4th Semester			
Course code	**Course title** ***Obligatory courses***	**Type of course** **L+S+P***	**ECTS**
	Electrochemistry	45+15+30	7.0
	Thermodynamics	45+15+15	6.0
	Unit operations	45+15+30	7.0
	Measurement and process control	45+0+15	4.5
	Catalysis	30+15+0	3.0
	Practical work in companies, public or private institutions		2.5
Total		**210+60+90**	**30**
*L-lectures; S-seminars; P-laboratory exercises			

5th Semester			
Course code	**Course title** ***Obligatory courses***	**Type of course** **L+S+P***	**ECTS**
	Reaction engineering	30+15+15	4.5
	Construction materials	30+0+30	4.5
	Industry and environment	30+0+15	4.0
	Technological processes in inorganic industry	45+15+45	8.5
	Technological processes in organic industry	45+15+45	8.5
Total		**180+45+150**	**30**
*L-lectures; S-seminars; P-laboratory exercises			

6th Semester

Course code	Course title	Type of course L+S+P*	ECTS
	Optional course		18**
	Optional course		
	Optional course		
	Optional course		
	Final project		12
Total			**30**

* L-lectures; S-seminars; P-laboratory exercises
** Minimum ECTS credits that need to be obtained from optional courses. Student has to choose one of the optional courses in accordance with mentor of Final project.

6th Semester – Optional courses			
Course code	**Course title- optional course**	**Type of course L+S+P***	**ECTS**
	Chemical sources of energy	30+0+30	5.0
	Electrodeposition	30+0+30	5.0
	Engineering of selected inorganic materials	30+0+30	5.0
	Preparation of technological waters	30+0+30	5.0
	Mathematical tools in chemical engineering	30+15+0	4.0
	Seawater as sources of mineral raw materials	30+0+15	4.0
	Water protection	30+15+15	5.0
	Polymer chemistry	30+0+30	5.0
	Polymeric materials	30+0+30	5.0
	Fundaments of mechanical engineering	30+15+0	4.0
	Sociology of modern society	30+0+0	2.0
	Introduction to microeconomics	30+0+0	2.0
	Electrical engineering	30+0+30	5.0
	Introduction to management	30+0+0	2.0
	Safety at work	30+0+30	5.0
	English language	15+15+0	2.0
	German language	15+15+0	2.0
	Introduction to computing	30+0+15	4.0
L-lectures; S-seminars; P-laboratory exercises			

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3.2. Course information

Mathematics I

Course title	Mathematics I		
Course code			
Type of course	Lectures, seminars (45+45)		
Level of course	Basic level course		
Year of study	1st year of undergraduate study	**Semester**	I.
ECTS (Number of credits allocated)	9.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Meri Mirošević Anzulović, senior lecturer		
Learning outcomes and competences	Competent to employ the acquired knowledge of linear algebra, solid analytic geometry and calculus.		
Prerequisites			
Course contents	Set of real numbers. Set of complex numbers. Functions of one real variable. Elementary functions. Sequences. Limit of a sequenc. Limit and continuity of a function. Derivative. The slope of a curve. Instantaneous velocity. Differential .Derivatives and differentials of higher orders. Fundamental theorems of a differential calculus. Indeterminate forms. Curve skeching: local extrema, points of inflection, asymptotes. Matrices and determinants. Systems of linear equation .Vectors. Solid analytic geometry.		
Recommended reading	T. Bradić, R. Roki. et al, Matematika za tehnološke fakultete, Element, Zagreb, 2003.; Ž. Pauše, Zbirka teorijskih pitanja iz matematike za studente tehnike, Školska knjiga, Zagreb 1995.; B. P. Demidovič, Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb (više izdanja)		
Supplementary reading	S. Kurepa, Matematička analiza I i II dio, Školska knjiga, Zagreb, 1997.; L. Krnić, Z. Šikić, Račun diferencijalni i integralni, I dio, Školska knjiga, Zagreb, 1992.; Hughes-Hallett, Gleason et al., Calculus, John Wiley and Sons, Inc., New York, 2000.; McCallum, Hughes-Hallett, Gleason et al., Multivariable Calculus, John Wiley and Sons Inc., New York, 2002.		
Teaching methods	Lectures, seminars.		
Assessment methods	Written and oral examination		

Language of instruction	Croatian
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level

Physics I

Course title	Physics I		
Course code			
Type of course	Lecture, seminar, laboratory exercise (45+30+30)		
Level of course	Basic level course		
Year of study	1st year of undergraduate study	**Semester**	I.
ECTS (Number of credits allocated)	10.5 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Magdi Lučić Lavčević, assistant professor		
Learning outcomes and competences	On completion of this course student is expected to be able to describe and explain the presented concepts and laws of physics and to demonstrate the use of the theoretical fundamentals on solving practical problems. Furthermore, s/he should know the methods of measurements of selected physical quantities and fundamentals of numerical and graphical presentation of measurement data.		
Prerequisites			
Course contents	Measurement. Motion along a straight line. Motion in two and three dimensions. Force and motion. Work and energy. Conservation of energy. Mass and energy. Systems of particles. Collisions. Rotation. Torque and angular momentum. Oscillations. Mechanical waves. Fluids.		
Recommended reading	N. Cindro, Fizika I, Školska knjiga, Zagreb, 1985; E. Babić, R. Krsnik, M. Očko, Zbirka riješenih zadataka iz fizike, Školska knjiga Zagreb, Zagreb, 1990.		
Supplementary reading	D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, John Wiley&Sons, New York, 1993; V. Lopac, P. Kulišić, M. Pavičić, Zbirka zadataka iz fizike, FGZ Zagreb, 1983.		
Teaching methods	Lectures, supported by demonstration experiments and/or computer simulations; exercise course designed for developing student's problem-solving skills; exercise course designed for developing student's measuring skills.		
Assessment methods	Continuous assessment, written and oral examination		
Language of instruction	Croatian and English		

Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level

General chemistry

Course title	General chemistry		
Course code			
Type of course	Lectures, seminars, laboratory exercises (45+30+30)		
Level of course	Basic level course		
Year of study	1st year of undergraduate study	**Semester**	I.
ECTS (Number of credits allocated)	10.5 Number of allocated credits is based on the lecturer's estimation and inquiry among students		
Name of lecturer	Dr. Slobodan Brinić, assistant professor; Dr. Zoran Grubač, assistant professor.		
Learning outcomes and competences	The course will provide the knowledge of basic chemical laws and principles. The students will master the nomenclature of chemistry, introduce basic laboratory skills. Involve students in critical thinking about laboratory experiments and involvement chemistry in everyday life. Prepare students for upper level chemistry courses.		
Prerequisites			
Course contents	Introduction to Chemistry. Atoms, Molecules, and Ions. Stoichiometry, Chemical Calculus. The Gas Laws, The Kinetic Molecular Theory of Gas. Thermochemistry. Energy Changes in Chemical Reactions. Quantum Theory and Electronic Structure of Atom. Periodic Relationships among the Elements and Periodic Table Molecular structure of substances. Chemical bond. Intermolecular Forces and Liquids and Solids. Homogenous and Heterogeneous Mixtures, Physical Properties of Solutions. Chemical reactions. Chemical kinetics. Chemical Equilibrium, Heterogeneous and Homogeneous equilibrium. In frame of laboratory exercises student will make experiments from the content of above mentioned topics.		
Recommended reading	I. Filipović, S. Lipanović, 1995. Opća i anorganska kemija I. dio, Školska knjiga, Zagreb.; M. Sikirica, 2001. Stehiometrija, Školska knjiga, Zagreb.		
Supplementary reading	R.Chang, Chemistry, McGraw-Hill, Inc., New York, 1991.; J. W. Hill, R. H. Petrucci, General Chemistry, Prentice-Hall, New Jersey, 2002.; J. C. Kotz, P. Treichel Jr., Chemistry & Chemistry reactivity, Sounders College Publishing, New York, 1999.		
Teaching methods	Lectures, seminar, laboratory exercises.		
Assessment methods	Written and oral exam		

Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level

Mathematics II

Course title	Mathematics II		
Course code			
Type of course	Lectures, seminars (30+60)		
Level of course	Basic level course		
Year of study	1st year of undergraduate study	**Semester**	II.
ECTS (Number of credits allocated)	7.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Meri Mirošević Anzulović, senior lecturer		
Learning outcomes and competences	Competent to employ the acquired knowledge of calculus and theory of ordinary differential equations.		
Prerequisites			
Course contents	Indefinite integral. Methods of integration. Definite integral. Fundamental theorem of integral calculus. Applications to geometry and physics. Improper integrals. Functions of several variables. Limit and continuity. Partial derivatives of the first order. Directional derivatives Differentiability. Differential. Tangent plane and normal line. Partial derivatives of higher orders. Maxima and minima. Double integrals. Applications to geometry and physics. Series. Convergence of numeric series. Power series. Taylor series. First order differential equations. Second order differential equations.. Applications to physics and chemistry.		
Recommended reading	T. Bradić, R. Roki et al, Matematika za tehnološke fakultete, Element, Zagreb, 2003.; Ž. Pauše, Zbirka teorijskih pitanja iz matematike za studente tehnike, Školska knjiga, Zagreb 1995.; B. P. Demidovič, Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb (više izdanja)		
Supplementary reading	S. Kurepa Matematička analiza I i II dio, Školska knjiga, Zagreb,1997.; Hughes-Hallett, Gleason et al., Calculus, John Wiley and Sons, Inc. New York, 2000.; McCallum, Hughes-Hallett, Gleason et al., Multivariable Calculus, John Wiley and Sons Inc., New York, 2002.		
Teaching methods	Lectures, seminars.		

Assessment methods	Written and oral examination
Language of instruction	Croatian
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Physics II

Course title	Physics II		
Course code			
Type of course	Lecture, seminar, exercise (30+15+30)		
Level of course	Basic level course		
Year of study	1st year of undergraduate study	**Semester**	II.
ECTS (Number of credits allocated)	6.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Magdi Lučić Lavčević, assistant professor		
Learning outcomes and competences	On completion of this course student is expected to be able to describe and explain the presented concepts and laws of physics and also to demonstrate the use of the theoretical fundamentals on solving basic practical problems, especially in topics of chemical technology student's interest. S/he should also know the methods of measurements of selected physical quantities.		
Prerequisites			
Course contents	Electric charge. The electric field. Electric potential. Capacitance. Current and resistance. The magnetic field. Ampere´s law. Faraday´s law. Inductance. Magnetism and matter. Electromagnetic oscillations. Alternating currents. Electromagnetic waves. Geometrical optics. Physical optics.		
Recommended reading	N.Cindro, Fizika II, Školska knjiga, Zagreb, 1988; E. Babić, R. Krsnik, M. Očko, Zbirka riješenih zadataka iz fizike, školska knjiga Zagreb, Zagreb, 1990.		
Supplementary reading	D.Halliday, R.Resnick, J.Walker, Fundamentals of Physics, John Wiley&Sons, New York, 1993; V. Henč-Bartolić, P.Kulišić, Valovi i optika, Školska knjiga Zagreb, Zagreb, 1989; V.Lopac, P.Kulišić, M. Pavičić, Zbirka zadataka iz fizike, FGZ Zagreb, 1983.		
Teaching methods	Lectures, supported by demonstration experiments and/or computer simulations; seminar designed for developing student's problem-solving skills; laboratory exercise course designed for developing student's measuring skills.		
Assessment methods	Continuous assessment, written and oral examination		

Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level

Inorganic chemistry

Course title	Inorganic chemistry		
Course code			
Type of course	Lectures, seminar, laboratory exercises (30+15+30)		
Level of course	Basic level course		
Year of study	1st year of undergraduate study	**Semester**	II.
ECTS (Number of credits allocated)	6.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Slobodan Brinić, assistant professor; Dr. Zoran Grubač, assistant professor.		
Learning outcomes and competences	A student will know: the chemical reactivity across the periodic table and properties, compositions of common chemical substances and the roles of inorganic chemistry in industry and in everyday life.		
Prerequisites			
Course contents	Classification of the inorganic substances according to the atomic properties and Periodic Table. Structure and symmetry in solids, bonding theories. General atomic and chemical properties of elements and their compounds, according to oxidation state in the group. In frame of laboratory exercises student will make experiments from the content of above mentioned topics.		
Recommended reading	I. Filipović, S. Lipanović, Opća i anorganska kemija 1. i 2. dio, Školska knjiga, Zagreb, 1995.		
Supplementary reading	F. Albert Cotton et al., Basic Inorganic Chemistry, New York, John Wiley and Sons, 1995.		
Teaching methods	Lectures, seminar, laboratory exercises.		
Assessment methods	Written and oral exam		
Language of instruction	Croatian and English		
Quality assurance	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level		

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Analytical chemistry

Course title	Analytical chemistry		
Course code			
Type of course	Lectures, seminars, laboratory exercises (60+30+45)		
Level of course	Basic level		
Year of study	1st year of undergraduate study	**Semester**	II.
ECTS (Number of credits allocated)	11.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Njegomir Radić, full professor		
Learning outcomes and competences	After completion of a process of learning in analytical chemistry (Courses: Analytical Chemistry or Analytical Chemistry I and II) learner is able for independent work in general analytical laboratory. Also, accepted knowledge and skills in fundamentals of analytical chemistry provide competence for continuation of education at higher level. After that higher education process learner is able for independent work in specific analytical laboratory important for natural science and other scientific areas.		
Prerequisites			
Course contents	Introduction. Importance and aims of analytical chemistry (AC). The role of analytical chemist in selection of analytical technique. The analytical chemist as a problem solver. AC in industrial practice and environmental control. The total analytical process, stepwise phases. Errors in AC. Reporting of analytical data. Quality assurance and quality control. Methods based on chemical reactions. Systematic treatment of equilibrium. Equilibrium in homogeneous systems. Acid-base equilibrium, pH, acid-base indicators. Buffers. Complex formation equilibrium. Chelates and polynuclear complexes. Kinetics of complex formation. Fundamentals of electrochemistry. Electrochemical cells. Redox reactions. Electrode potential. Standard and formal potentials. Heterogeneous equilibrium. Gas-liquid systems. Solid-liquid systems. Solubility and solubility product. Effects of secondary reactions in solution: hydrolysis and complexation. Methods of chemical analysis and their application. Gravimetric analysis. Titrimetry (Volumetry). Titration curves. Precipitation titration. Acid-base titration. Acid-base titration in nonaqueous solvents. Complexometric titrations. Redox titration. Electrochemical titrations: potentiometric, amperometric and conductometric titrations. Thermochemical methods. Elemental organic analysis. Kinetic and catalytic methods.		
Recommended	D. A. Skoog, D. M. West and F. J. Holler, Fundamentals of Analytical		

reading	Chemistry, Seventh Edition, Saunders College Publishing, New York, London, 1996. {6th Ed. (englesko) 1992, 1st Ed. (hrvatsko), Školska knjiga, Zagreb, 1999.}; R. Kellner, J. M. Mermet, M. Otto, M. Valcarcel and H. M. Widmer (Editors), Analytical Chemistry (A Modern Approach to Analytical Science, Second Edition) Wiley-VCHVerlag Gmbh & Co. KGaA, Weinheim, 2004.; T. H. Hadjiioannou, G. D. Christian, C. E. Efstathion and D. P. Nikolelis, Problem Solving in Analytical Chemistry, Pergamon Press, Oxford, New York, 1988.
Supplementary reading	D. A. Skoog, D. M. West, F .J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, Eighth Edition, Brooks/Cole, London, 2004.; G. D. Christian, Analytical Chemistry, Sixth Edition, John Willey & Sons, INC, 2004.; D. C. Harris, Quantitative Chemical Analysis, Fifth Edition, W. H. Freeman and Company, New York, 1999.; M. Valcarcel, Principles of Analytical Chemistry, Springer-Verlag, Berlin Heidelberg, 2000.
Teaching methods	Lectures, problem solving, laboratory experiments.
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level

Organic chemistry

Course title	Organic chemistry		
Course code			
Type of course	Lectures, seminars (60+15+45)		
Level of course	Basic level course		
Year of study	2nd year of undergraduate study	**Semester**	III.
ECTS (Number of credits allocated)	10.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Josip Mastelić, assistant professor		
Learning outcomes and competences	Basic knowledge about structure-properties relationships of organic compounds, understanding the basic laws of compound transformation. Knowledge about constitutional isomers and stereomers, their separation and structure determination by spectroscopy (IR, NMR, UV/VIS, MS). This course is basic for understanding other courses, especially Organic chemistry II, Biochemistry etc.		
Prerequisites	Competence required by course General chemistry.		
Course contents	Chemical bonding. Intermolecular bonding. Functional groups.		

	Nomenclatures. Molecular formula. Index of hydrogen deficiency. Structure and resonance. Constitutional isomers. Conformation. Three-dimensional molecular shapes. Chirality. Stereoisomers. Optical activity. Enantiomers and diastereomers. R-, S-, E-, Z-isomers. Stereoisomers of allenes, spiranes, biphenyls. Resolving racemic mixtures. Spectroscopy and structure. IR. UV. H^{1}-NMR and C^{13}-NMR. MS. GC/MS. Bond energy. Reaction enthalpy. Kinetics. Reaction mechanism. Oxidation state and redox reactions. Acid-basic equilibriums. Reaction classification. Alkanes. Substitution. Halogenation. Cracking. Cycloalkanes. Conformation. Configuration. Alkenes. Addition. Carbonium ions and free radicals. Polymerization. Alkynes. Alkadienes. Conjugated compounds. 1,2- and 1,4-Additions. Nucleophilic substitution at saturated carbon. Elimination. Organometallic compounds. Electrophilic aromatic substitution.
Recommended reading	Stanley H. Pine, Organska kemija, Školska knjiga, Zagreb, 1994.; R. T. Morisson, R. N. Boyd, Organska kemija, Liber, Zagreb, 1979.; K. P. C. Vollhardt and N. E. Schore, Organic Chemistry, 3rd edit., W. H. Freeman and Company, New York, 1999.
Supplementary reading	S. E. Meislich, H. Meislich & J. Scharefkin, 3000 Solved Problems in Organic Chemistry, The McGraw-Hill, 1994.; S. Borčić, O. Kronja, Praktikum preparativne organske kemije, Školska knjiga Zagreb, 1991.
Teaching methods	Lectures, seminars.
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level

Physical chemistry

Course title	Physical chemistry		
Course code			
Type of course	Lectures, seminars, laboratory exercises (60+15+30)		
Level of course	Basic level course		
Year of study	2nd year of undergraduate study	**Semester**	III.
ECTS (Number of credits allocated)	9.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Ivo Tominić, assistant professor		
Learning outcomes and	Through numerous examples student is learning about basic principles of the thermodynamic and kinetic approach to the physical and chemical		

competences	changes.
Prerequisites	
Course contents	The properties of gases, The First Law, The Second Law, Physical transformations of pure substances, Properties of simple mixtures, Phase diagrams, Chemical equilibrium, The electric and magnetic properties of molecules, Molecules and ions in motion, Rates of chemical reactions.
Recommended reading	P. W. Atkins, Physical Chemistry, Fifth Edition, Oxford University Press, 1994.; A. M. Halpern, Experimental Physical Chemistry, A Laboratory Textbook, Second Edition, Prentice Hall, New Jersey, 1997.
Supplementary reading	S. H. Maron, J. B. Lando, Fundamentals of Physical Chemistry, Macmillan, New York, 1974.; I. Mekjavić, Fizikalna kemija 1, osnovni pojmovi, primjeri i zadaci, Školska knjiga, Zagreb, 1996.; I. Mekjavić, Fizikalna kemija 2, osnovni pojmovi, primjeri i zadaci, Golden marketing, Zagreb, 1999.
Teaching methods	Lectures, seminars – numerical problems are solved, laboratory exercises – by working out 9 exercises student evidences in practice some of the principles presented through lectures.
Assessment methods	Written and oral examinations
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level

Material and energy balances

Course title	Material and energy balances		
Course code			
Type of course	Lectures, seminars (30+30)		
Level of course	Basic level course		
Year of study	2nd year of undergraduate study	**Semester**	III.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Nenad Kuzmanić, associate professor		
Learning outcomes and competences	The purpose of this course is to acquaint the student with the manner in which the lows of conservation of mass and energy can be applied to industrial chemical processes, and to give a systematic approach to the solution of problems relate the inputs and outputs of manufacturing systems.		
Prerequisites	Competence required by courses Mathematic I and General chemistry.		

Course contents	Introduction to engineering calculations. Process classification and process variables. General balance equation. Differential and integral types of material balances. Material balances in non-reactive systems. Material bilances on continuous, semibatch and batch processes. Balances on multiple-unit processes. Recycle and bypass calculations. Material balances in reactive systems. Combustion reactions. Material balances in multiphase systems. Energy and energy balances. Energy balances on open and closed systems. Energy balances on nonreactive and reactive processes. Simultaneous material and energy balances.
Recommended reading	R. M. Felder, R. W. Rousseau, Elementary Principles of Chemical Processes, 3rd edition, John Wiley & Sons, Inc., New York, 2000.; D.M. Himmelblau, Basic Principles and Calculations in Chemical Engineering, 6th edition, Prentice-Hall Inc., New Jersey, 1996.; R. H. Perry, D. W. Green, J.O. Maloney, Perry's Chemical Engineer's Handbook, 7th edition, McGraw-Hill, New York, 1999.
Supplementary reading	W. L. Luyben, L.A. Wenzel, Chemical Process Analysis: Mass and Energy Balances, Prentice Hall, Englewood Cliffs, New Jersey, 1988.; T. Bradić et al., Matematika za tehnološke fakultete, Sveučilište u Zagrebu, Multigraf - Zagreb, Zagreb, 1994.
Teaching methods	Seminars thematically follow the lectures. They include methods for organizing known information about process variables, setting up material and energy equations, and solving these equations for unknown variables applying mathematical methods.
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Mass and energy transfer

Course title	Mass and energy transfer		
Course code			
Type of course	Lectures, seminars, laboratory exercises (45+15+15)		
Level of course	Basic level course		
Year of study	2nd year of undergraduate study	**Semester**	III.
ECTS (Number of credits allocated)	6.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Edita Mitrović Kessler, full professor		
Learning	Outcomes and competences necessary for work in manufacturing facilities		

outcomes and competences	in chemical industry and congenial industries, as well as for work in various institutes, universities and other public service laboratories.
Prerequisites	Competence required by course Material and energy balances.
Course contents	Viscosity and momentum transfer mechanism. Low of continuity. Bernoulli theorem. Laminar and turbulent fluid flow. Velocity distribution, pressure drop and fiction loss factor in straight pipes. Fittings. Moody diagram. Flow meters. Particles falling through fluid. Particle falling velocity and particle diameter determination. C_D – Re diagram. Fluid flow through beds of particles. f_p – Re diagram. Fluidisation. Heat transfer. Heat transfer by conduction. Heat transfer by forced and natural convection. Heat transfer by radiation. Important examples of heat transfer in industry. Mass transfer. Molecular diffusion. Mass transfer by convection. Packed towers for mass transfer. Mass transfer equation. Interphase mass transfer
Recommended reading	E. Mitrović – Kessler Edita: Prijenos tvari i energije, Tehnološki fakultet Split, Split, 1985.; E. Mitrović – Kessler: Tehnološke operacije kemijske industrije, Tehnološki fakultet Split, Split, 1986.; R. Byron Bird, Warren E. Stewartet et all,: Transport Phenomena, 2nd edition, John Wiley and Sons, New York, 2001.
Supplementary reading	Chosen articles from journals and reviews recommended by course lecturer.
Teaching methods	Every theoretical chapter is followed by exercises, which will be held in a half - industrial laboratory.
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Electrochemistry

Course title	Electrochemistry		
Course code			
Type of course	Lectures, seminars, laboratory exercises (45+15+30)		
Level of course	Basic level course		
Year of study	2nd year of undergraduate study	**Semester**	IV.
ECTS (Number of credits allocated)	7.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Jagoda Radošević, full professor		
Learning	Students are acquire knowledge about fundamental laws and problems of		

outcomes and competences	electrolysis, kinetic principles of electrochemistry, electroorganics and inorganic synthesis systems based on charge transfer on interface boundary solid/solvent. Obtain knowledge is base for understanding electrochemical engineering, electroanalytical methods, energy conversion and corrosion.
Prerequisites	
Course contents	Introduction to the fundamental concepts of electrochemistry. Electrochemical systems. Electrochemical stoichiometry. Ionica. Ion-solvent, ion-ion interaction. Conception of ionic atmosphere. Electrified phase boundaries. Electrodica. Potential jumps at phase boundaries. Thermodynamic of electrified phase boundary. Double-layer structure and models conceptions. Electrokinetic's phenomenon and Φ-potential. Methods of investigation electrified phase boundary. Electrode kinetics. Electrochemical systems in disequilibrium conditions. Electrochemical reaction mechanism and slow step reaction. Polarization and over potential. Buttler-Volmer equation. Diagnostic criteria's. Investigating methods of electrochemical reaction mechanism – stationary, unstationary. Analysis of mechanism selected electrode reactions – evolution and reduction of hydrogen and oxygen. Passivity phenomenon. Electrochemical aspects environmental protection. Electrochemical treatment of municipal sewage. Waste treatment by electrodialysis. Waste removal by electroflotation and electroflocculaton. Electrostatic precipitators.
Recommended reading	J. O'M. Bockris, A. K. N.Reddy, M. E. Gamboa-Aldeco, Modern Electrochemistry 2A and 2B, Kluwer Academic Publishers, Dordrecht, 2000.; J. O'M. Bockris, S. U. M. Khan, Surface Electrochemistry , Plenum Press, New York, 1993.; C. M. A. Brett, A. M. O. Brett, Electrochemistry , Oxford University Press, New York, 1993.
Supplementary reading	C. H. Hamann, A. Hamnett, W. Vielstich, Electrochemistry, Wiley-VCH Weinheim, 1998.
Teaching methods	Lectures, seminars, laboratory exercises
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Thermodynamics

Course title	Thermodynamics
Course code	
Type of course	Lectures, seminars, exercises (45+15+15)

Level of course	Basic level course		
Year of study	2nd year of undergraduate study	**Semester**	IV.
ECTS (Number of credits allocated)	6 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Vanja Martinac, associate professor		
Learning outcomes and competences	Students acquire the knowledge of the general thermodynamics principles and their engineering application, which will help them in their further study as well as in their work.		
Prerequisites			
Course contents	General consideration. Heat and energy parameters in the thermodynamics processes. Laws of thermodynamics: The first law, mathematical expressions using internal energy and enthalpy; The second law, reversibility, irreversibility, cyclic processes, Carnot and thermal efficiency degree, refrigerating factor. The second law of thermodynamics applied to the energetic transformation - exergy and anergy. Maximum work of the system. Thermodynamic properties of fluids. Real gases: liquid state, evaporation, wet and dry saturated steam, superheated steam, fundamental processes, thermodynamic diagrams and tables for variables of state, thermal equations of state – correlations for pVT systems. Water vapor - thermodynamic parameters of state, vapor power cycles. Thermodynamic fundamentals of cooling processes. Heat pump. Liquefaction of gases. Thermodynamics of solutions – theory and application. Thermodynamic fundamentals of vapor-liquid equilibrium. Standard state of solutions. Gibbs-Duhem equation for solutions.		
Recommended reading	M. J. Moran, H. N. Shapiro, Fundamentals of Engineering Thermodynamics, 3rd Ed., Wiley, New York, 1995.; R. E. Sonntag, G. J. Van Wylen, Introduction to Thermodynamics, 3rd Ed., Wiley, New York, 1995.; N. Petric, I. Vojnović, V. Martinac, Tehnička termodinamika, Hinus, Zagreb, 1999; J. M. Smith, H. C. Van Hess, M. M. Abbott, Introduction to Chemical Engineering Thermodynamics, 6th Ed., McGraw-Hill, New York, 2000.		
Supplementary reading	G. J. Van Wylen, R. E. Sonntag, C. Borgnakke, Fundamentals of Classical Thermodynamics, 4th Ed., Wiley, New York, 1994.; Y. A. Cengel, M. A. Boles, Thermodynamics an Engineering Approach, 4th Ed., McGraw-Hill, New York, 2001.; R. Budin, A. Mihelić-Bogdanić, Osnove tehničke termodinamike, Školska knjiga, Zagreb, 2001.		
Teaching methods	Lectures, seminars - solving numerical examples and problems treated in lectures. Exercises – on-site demonstration in industrial plants: Croatia plin (Messer) – Dugi Rat: Liquefaction of gases.		
Assessment methods	Written and oral examination		
Language of instruction	Croatian and English		
Quality assurance	Quality assurance will be performed at three levels: (1) University Level,		

methods	(2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Unit operations

Course title	Unit operations		
Course code			
Type of course	Lectures, seminars, laboratory exercises (45+15+30)		
Level of course	Basic level course		
Year of study	2nd year of undergraduate study	**Semester**	IV.
ECTS (Number of credits allocated)	7.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Edita Mitrović – Kessler, full professor		
Learning outcomes and competences	Outcomes and competences necessary for work in manufacturing facilities in chemical industry and congenial industries, as well as for work in various institutes, universities and other public service laboratories.		
Prerequisites	Competence required by course Material and energy balances		
Course contents	Fluid transport. Centrifugal pumps. Operating characteristics of centrifugal pumps. Especial purposes pumps. Gas transport. Particulate separation. Classification. Separation. Classification and separation equipement. Sedimentation. Thickeners. The determination of minimum area of thickener. Kynch equation. Filtration.. Cake resistance. 2nd Ruth equation. Specific cake resistance. Filtration equipment. Centrifugation. Theory. Ambler's characteristic. Centrifugation equipment. Mixing. Mixing power. Mixing of liquids. Mixing of non - Newtonian fluids. Heat transfer operations. Heat exchangers. Heat transfer equipment dimensioning. Mass transfer operations. Absorption. Theory. Absorption equipment. Number and height of transfer units determination. Drying. Theory. Psychrmetric diagram. Drying velocity. Drying equipment. Distillation. Vapour – liquid equilibrium. Batch distillation. Differential distillation. Rectification.		
Recommended reading	E. Mitrović – Kessler: Tehnološke operacije, Tehnološki fakultet Split, Split, 1986; F.P. Incropera, D. P. De Witt, Introduction to Heat Transfer, John Wiley and Sons, New York Inc., 1996.; A. H. P. Skelland, Diffusional Mass Transfer, John Wiley and Sons, 1974.		
Supplementary reading	Chosen articles from journals and reviews recommended by course lecturer.		
Teaching methods	Every theoretical chapter is followed by exercises, which will be held in a half - industrial laboratory. Also visits to existing industry facilities in the neighboring area are foreseen		
Assessment methods	Written and oral examination		

Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Measurement and process control

Course title	Measurement and process control		
Course code			
Type of course	Lectures, laboratory exercises (45+15)		
Level of course	Basic level course		
Year of study	2nd year of undergraduate study	**Semester**	IV.
ECTS (Number of credits allocated)	4.5 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Ratimir Žanetić, full professor		
Learning outcomes and competences	Student will acquire competences for measurement with different transducers at measurement singles sizes in purpose of process control. Also, students acquire the knowledge from theory of process control, choose instruments, transfer information and application computer for such exercises.		
Prerequisites	Competence required by courses Mathematic I, Mathematic II and Physics.		
Course contents	Significance and importance instrumentation in chemical engineering. Generals characteristics transducers. Pressure measurements. Temperature measurements. Fluid flow measurements. Level measurements. Humidity and moisture measurements. Introduction to control. System and his characteristics. Types of control and division systems for control: control (open loop), forward control, control engineering, adaptive control, automat, process control with digital computer. Behavior control process: mathematical modeling. Procedures of analysis linear models. Control loop. Example graphic analysis of closed - loop control system. Synthesis of closed - loop control system.		
Recommended reading	J. Božičević, Temelji automatike I, Školska knjiga, Zagreb, 1992; J. Božičević, Temelji automatike II, Školska knjiga, Zagreb, 1992;		
Supplementary reading	J.W. Dally, W.F.Riley, K.G. McConnell, Instrumentation for Engineering Measurements, J.Wiley, New York, 1993; D.E. Seborg, T.F. Edgar, D.A. Mellichamp, Process Dynamics and Control, J. Wiley, New York, 1989.; J.W. Dally, W.F. Riley, K.G. McConnell, Instrumentation for engineering measurements, J. Wiley, New York, 1994.		
Teaching methods	Lectures, laboratory exercises, presentation exercises		
Assessment	Oral examination		

methods	
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Catalysis

Course title	Catalysis		
Course code			
Type of course	Lectures, seminars (30+15)		
Level of course	Basic level course		
Year of study	2nd year of undergraduate study	**Semestar**	IV.
ECTS (Number of credits allocated)	3.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Tonka Kovačić, full professor		
Learning outcomes and competences	Fundamental knowledge about homogeneous and heterogeneous catalysis, as well as about their industrial applications is obtained. Furthermore, students are acquainted with processes of catalyst research and development.		
Prerequisites	Competence required by courses Physics and General chemistry.		
Course contents	History of catalytic discoveries. General concept of catalysis. Mode of action of catalysts. Fundamentals of homogeneous catalysis. Transition metal analysis. Acid-base reactions. Redox reactions. Kinetics and mechanisms of homogeneously catalysed reactions. Fundamentals of heterogeneous reactions. Physisorption and chemisorption. Kinetics and mechanisms of heterogeneously catalysed reactions. Langmuir-Hinshelwood and Eley-Rideal mechanisms. Energetic aspect of catalytic activity. Steric factors. Electronic factors (metals, semiconductors, isolators). Selectivity. Deactivation (poisoning, deposits on catalyst surface, sintering, evaporation of active component) and regeneration. Components of catalysts: catalytically active materials, supports, promoters. Characterisation of heterogeneous catalysts. Economic importance of catalysts.		
Recommended reading	J. Hagen, Industrial Catalysis: A Practical Approach, Wiley-VCH., Weinheim, 1999.; S. Bhaduri and D. Mukesh, Homogeneous Catalysis: Mechanisms and Industrial Applications, Wiley-Interscience, New York, 2000.		
Supplementary reading	J.M. Thomas, W.J. Thomas, Principles and Practice of Heterogeneous Catalysis, VCH, Weinheim, 1996.		

Teaching methods	Lectures, laboratory exercises.
Assessment methods	Oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Reaction engineering

Course title	Reaction engineering		
Course code			
Type of course	Lectures, seminars, laboratory exercises (30+15+15)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	V.
ECTS (Number of credits allocated)	4.5 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Davor Rušić, associate professor		
Learning outcomes and competences	Basic knowledge in the field of chemical reaction engineering is acquired.		
Prerequisites	Competence required by courses Mathematics I and Mathematics II.		
Course contents	Notion of chemical reactor. Mathematical description of general balance equations for matter and heat. Reactor models of ideal reactor types. Kinetics of chemical reactions in homogeneous systems. Purposes of kinetic studies. Selection of experimental reactor. Selection of kinetic model. Selection of method for assessment of kinetic parameters. Kinetics of reactions in heterogeneous systems. Problem of presence of physical transport processes accompanying chemical reaction. Experimental methods in kinetic examinations in reaction systems fluid-solid, gas-liquid, and reaction with solid catalysts. Factors affecting selection of reactor.		
Recommended reading	Z. Gomzi, Kemijski reaktori, HINUS, Zagreb, 1998.; O. Levenspiel, Chemical Reaction Engineering, J. Wiley, N.Y., 1972.; G. F. Froment and K. B. Bischoff, Chemical Reactor Analysis and Design, J. Wiley, N.Y., 1977.		
Supplementary reading	S. G. Fogler, Elements of, Chemical Reaction Analysis and Design, Prentice-Hall, Englewood, N.J., 1986.		
Teaching methods	Lectures, laboratory exercises – work in smaller groups, demonstration exercises; seminars using PCs and available software (Mathcad, Matlab, Mathematica).		

Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Construction materials

Course title	Construction materials		
Course code			
Type of course	Lectures, laboratory exercises (30+30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	V.
ECTS (Number of credits allocated)	4.5 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Maja Kliškić, associate professor		
Learning outcomes and competences	Modern educated engineer in the field of materials will be able to know the link of structure and properties of the material and reasons for specific behaviour construction materials in real term of application. Using data about material properties he will be able to see the opportunities of using all groups of technical materials, and he will know how to communicate with people of different occupations and professions (he will be capable for teamwork).		
Prerequisites			
Course contents	The role of construction materials in modern technological processes. Classification of construction materials in respect of composition, characteristics and applications. Materials structure. Physical and chemical properties of construction materials. Mechanical properties. Norms. Materials for metal constructions. Iron. Construction steels. Coloured metals and alloys. Treatment and properties for improvement of metal materials. Non-metal constructing materials. Carbonic and silicate materials. Glass. Asbestos. Building construction materials. Organic materials. Polymer materials. Composite materials. Wood. Synthetic rubber.		
Recommended reading	F. Kovačiček, Đ. Španiček, Materijali, osnove znanosti o materijalima, FSB, Sveučilište u Zagrebu, Zagreb, 2000.; M. Franz, Mehanička svojstva materijala, FSB, Sveučilište u Zagrebu, Zagreb, 1998.; T. Filetin, Pregled razvoja i primjene suvremenih materijala, Hrvatsko društvo za materijale i tribologiju, Zagreb, 2000.		
Supplementary	W. D. Callister, Jr., Material Science and Engineering, An Introduction 3rd		

reading	Edition, J. Wiley & Sons, New York, 1994.; D. R. Askeland, The Science and Engineering of Materials, Van Nostrand Reinhold, London, 1998.; T. Filetin, Izbor materijala pri razvoju proizvoda, FSB, Sveučilište u Zagrebu, Zagreb, 2000.
Teaching methods	Lectures, laboratory exercises
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Industry and environment

Course title	Industry and environment		
Course code			
Type of course	Lectures, laboratory exercises (30+15)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	V.
ECTS (Number of credits allocated)	4.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Jelena Perić, full professor		
Learning outcomes and competences	The students get insight into the problems of industrial environmental pollution, as well as into the procedures of prevention of emissions to the environment.		
Prerequisites			
Course contents	Industrial development and environment. Principles of sustainable development. Technology, raw materials and energy in the process of production planning. Ecosystems in nature. Industrial sources of pollutants in atmosphere, hydrosphere and lithosphere. Properties of atmosphere. Air pollutants and global climate changes. Methods and equipment for prevention of atmospheric pollution. Solid waste. Waste management. Waste disposal. Recycling and recovery. Energetic value of solid wastes. Hydrological cycle. Pollution and contamination of natural waters. Depuration and eutrophication. Physical, chemical and biological indicators of water pollution. Sources of wastewaters. Methods and procedures of wastewater treatment. Mechanical, physicochemical and biological treatments. Examples of technological solutions for wastewater treatments in chemical industry.		
Recommended	H.S. Peavy, et al., Environmental Engineering, McGraw Hill, Singapore,		

reading	1987; H.D. Sharma and S.P. Lewis, Waste Containment System, Waste Stabilization, and Landfills, John Wiley & Sons Inc., New York, 1994; S. Tedeschi, Zaštita voda, HDGI, Zagreb, 1997.; B. Tušar, Ispuštanje i pročišćavanje otpadne vode, Croatiaknjiga, Zagreb, 2004.
Supplementary reading	D. Mayer, Voda od nastanka do upotrebe, Prosvjeta, Zagreb, 2004.; R.T. Wright and B.J. Nebel, Environmental Science, 9th edition, Prentice Hall Inc, New Jersey, 2004.; Journals: Industry and Environment, Gospodarstvo i okoliš.
Teaching methods	Lectures, laboratory exercises, visits to industrial plants.
Assessment methods	Written and oral examination.
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Technological processes in inorganic industry

Course title	Technological processes in inorganic industry		
Course code			
Type of course	Lectures, seminars, laboratory exercises (45+15+45)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	V.
ECTS (Number of credits allocated)	8.5 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Petar Krolo, full professor		
Learning outcomes and competences	Knowledge of basics of technological processes in inorganic industry and their importance for economy and their practical application with special consideration of economic efficiency and sustainable development		
Prerequisites			
Course contents	Technological processes and technology. Importance and role of inorganic processes in modern economy. Basic phases of a chemical process. Types of reaction systems. Homogeneous and heterogeneous systems. Operating conditions and process development. Equilibrium and reaction rate. Reactors. Modern technology and sustainable development. Basic inorganic processes and their systematisation. Oxidation and reduction processes. Energy, fuels and burning processes. Processes and procedures of refining of solid fuels. Electrochemical processes. Cementation. Technical electrolysis. Catalytic processes and catalysis. Heterogeneous catalysis in inorganic processes. Processes of settling and crystallization. Ion exchange		

	processes. Softening of water. Demineralised and deionised water. Aqueous dispersion of colloids, flocculation and settling of colloids. Milti-component systems and phase rules. Processes of causticization. Dissolution and decomposition of natural raw materials in industrial practice. Hydro-metallurgic processes. Obtaining and separating mineral salts and salt mixtures.
Recommended reading	R. Krstulović, Tehnološki procesi anorganske industrije, Sveučilište Split, Tehnološki fakultet u Splitu, Split, 1986.; V. Hopp, Grundlagen der chemischen Technologie, VCH, Weinheim, 1993.; Encyclopedia of separation technology, vol I-II., Ed., D. M. Rurhven, A. Kirk-Othmer Encyclopedia, John Wiley & Sons, Inc., New York, 1997.; I. Mukhlyonov et al., Chemical Technology, Mir Publishers, Moskow, 1974.; F. Matthers, G. Wehner, Anorganisch-Technische Verfahren, WEB Deutscher Verlag fur Grundstoffindustrie, Leipzig, 1989.
Supplementary reading	F. Goodridge, K. Scott, Electrochemical Engineering, Plenum Press, New York,1995.; M. E. Pozin, Tehnologija mineralnih soli, I. i II. dio Izdateljstvo Himia, Kiev, 1990.; G. C. Bond, Heterogeneous Catalysis, 2nd etition, Oxford University Press, Oxford, 1987.; S. Joksimović-Tjapkin, Procesi sagorevanja, Univerzitet u Beogradu, TMF, Beograd, 1981.; Z. Supek, Tehnologija s poznavanjem robe, Školska knjiga, Zagreb 1982.; Tehnička enciklopedija, Leksikografski zavod "Miroslav Krleža", Zagreb; Članci iz znanstvenih i stručnih časopisa.
Teaching methods	Lectures, seminars, laboratory exercises, field teaching
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Technological processes of organic industry

Course title	Technological processes of organic industry		
Course code			
Type of course	Lectures, seminars, laboratory exercises (45+15+30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	V.
ECTS (Number of credits allocated)	8.5 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Ivka Klarić, full professor		
Learning	Knowledge of technological processes in the processing of petroleum and		

outcomes and competences	natural gas for the production of fuels, lubricating oils and petrochemicals. Transfering petrochemicals to intermediate and/or final products by respecting of economic, ecological and safety condition of production.
Prerequisites	Competences acquired by courses Organic chemistry, Physical chemistry and Unit operations
Course contents	Definition and classification of technological processes in organic chemical industry. Natural gas and petroleum (oil) as power sources and petrochemicals. Processes of the processing of petroleum: Primary (distillations; other methods for hydrocarbons separation - absorption, adsorption, extraction) and secondary processes (thermal processes - cracking, visbreaking, coking; and catalytic processes - cracking, hydrocracking, reforming, isomerization, oligomerization, alkylation). Treatment of petroleum fractions (by physical and chemical methods), specially treating of the fuels and lubricating oils (sweeting, deasphalting, dewaxing, furfural extraction, hydrofining process). Processes for production of components for organic synthesis: Paraffins. Olefins. Aromatic hydrocarbons. Acetylene. Synthesis gas. Alternative (nonconventional) methods for raw materials production for organic synthesis. Processes in organic synthesis according the criteria of similar chemical reactions (thermodynamics, kinetics and catalysts): Hydrogenation, dehydrogenation and synthesis on the base of carbon monoxide. Halogenation. Oxidation reactions. Sulphonization and sulphating processes. Nitration and amination processes. Alkylation. Hydrolysis and hydrolytical degradation. Esterifications. Polymerization and technological processes for production of industrial the most famous polymers.
Recommended reading	G. D. Hobson, Modern Petroleum Technology, 5th edition, J. Wiley, New York 1984; G. M. Wells, Handbook of Petrochemicals and Processes, Ashgate Publishing Ltd, Aldershot, 1999; N. P. Cheremisinoff, Handbook of Chemical Processing Equipment, Buterworth Heinemann, Boston, 2000; S. Matar, L. F. Hatch, Chemistry of Petrochemical Processes, 2nd edition, Gulf Publ.Co., Boston, 2001;
Supplementary reading	Časopisi: Hydrocarbon Processing (SAD), Nafta (INA-Zagreb); E. Beer, Svojstva nafte i njezinih derivata, Graphis, Zagreb, 1999; B. Labudović, Ukapljeni naftni plin, Gafika, Hrašće, 2000; I. Dekanić, S. Kolundžić, D. Karasalihović, Stoljeće nafte, Naklada Zadro, 2003.
Teaching methods	Lectures, seminars, laboratory exercises.
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Chemical sources of energy

Course title	Chemical sources of energy		
Course code			
Type of course	Lectures, laboratory exercises (30+30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Senka Gudić, assistant professor		
Learning outcomes and competences	Student will acquire basic knowledge about batteries, battery processes and about their usage. Also, they will be able to understand reasons why and how batteries cause accidents and what can be done to prevent them.		
Prerequisites			
Course contents	Introduction. Primary batteries. Fundamentals of primary cells. Thermodynamic studies. Losses in batteries. IR losses. Electrode interface losses. Discharge potential and current capacity of cell. Efficiency. Self – discharges. Multicell battery packs design. Dry cell Leclanche's type. Alkaline primary cells. Secondary cells. Accumulators. Lead/acid accumulator. Alkaline systems. Ni-Cd, Ni-Fe, Ag-Zn, Ag-Cd, Ni-Zn alkaline cells. Comparison of different secondary systems. Fuel cells. Review of realised systems and systems in development. Accident prevention in operations with batteries. Safety evaluation. Safe handling procedure.		
Recommended reading	S. C. Levy and P. Bro, Battery Hazards and Accident Prevention, Plenum Publishing Corporation, New York, 1994.; R. Decher, Direct Energy Conversion, Oxford University Press, Inc., New York, 1997.		
Supplementary reading	A.J. Appleby, Fuel Cells: Trends in Research and Applications, Hemisphere Publishing Corporation, New York, 1987.		
Teaching methods	Lectures, laboratory exercises.		
Assessment methods	Written and oral examination		
Language of instruction	Croatian and English		
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.		

Electrodeposition

Course title	Electrodeposition
Course code	

Type of course	Lectures, laboratory exercises (30+30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Jagoda Radošević, full professor		
Learning outcomes and competences	Student will understand completely what galvanization is. He will acquire proficiency in knowledge that allowed him independent realization and monitoring of electroplating process.		
Prerequisites			
Course contents	Introduction. Technological process of production galvanic and chemical coating. Metal deposition on cathode. Electrocrystallization. Distribution of current and metal sediment on cathode. Sedimentary power of electrolyte. Preparation of specimen for metallic coatings deposition. Mechanical and chemical preparation. Galvanization. Composition of bath. Material and shape of anodes for electroplating. Temperature and bath convection. Current types and current densities. Current sources and facilities for electroplating. The most important processes of metal electroplating. Tin-plating. Zinc-plating. Nickel-plating. Copper plating. Chromium plating. Causes of coating errors in metals plating. Plating with noble metals. Manufacturing of metallic coatings by spraying with melting metal. Coatings which was produced by diffusion processes. Electroplating of non-metal substrates. Electroplating of product made by plastic ABS-materials. Electroplating of product of porous materials. Electroforming.		
Recommended reading	W. J. Lorenz, E. B. Budevski, G. T. Staikov, Electrochemical Phase Formation and Growth: An Introduction to The Initial Stages of Metal Deposition, Germani, 1996.; O. P. Solonenko, M. F. Zhukov, Advanced Surface Coating and Hardening Technologies, Cambridge International Science Publishing, UK, 1996.		
Supplementary reading	S. F. Kistler, P. M. Schweizer, Liquid Films Coating: Scientific Principles and Their Technological Implications, Chapman and Hall, UK, 1996.; M.M. Maksimović, Galvanotehnika, Tehnološko-metalurški fakultet, Beograd, 1995.		
Teaching methods	Lectures, laboratory exercises, field teaching.		
Assessment methods	Written and oral examination		
Language of instruction	Croatian and English		
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.		

Engineering of selected inorganic materials

Course title	Engineering of selected inorganic materials		
Course code			
Type of course	Lectures, laboratory exercises (30+30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Jelica Zelić, izv. prof.		
Learning outcomes and competences	Familiarizing with chemical engineering aspect of the raw materials, production, control and applications of the commercial inorganic non-metallic materials. Development of understanding influence of production parameters on products properties and quality.		
Prerequisites			
Course contents	Historical overview, development and meaning of the commercial inorganic non-metallic materials industry (claywares, refractories, porcelain, technical glasses, cement, concrete, etc.). Raw materials and demands for their quality. Phase diagrams of the silicates, oxides and other systems. Thermal decomposition processes, solid-state reaction and silicate forming processes. Hydration processes. Properties of fresh and hardened colloidal systems (setting, rheology, plasticity, porosity, mechanical strengths, resistance, durability, etc.). The water-clay system. Forming processes of ceramic slurries. A high-temperature reactions and sintering processes in the tradicional and advanced ceramic materials production. Properties of glass-melts. Glass forming operations and equipment. Flow diagrams of chosen inorganic material production, from raw materials to final products, with special reference to the physical and chemical base of the processes, equipment and environmental aspects.		
Recommended reading	Y-M. Chiang, D. P. Birnie, W.D. Kingery, Physical Ceramics, Principles for Ceramic Science and Enginerring, J. Wiley & Sons, Inc., New York, 1997.; M. Tecilazić-Stevanović, Osnove tehnologije keramike, Tehnološko-metalurški fakultet, Beograd, 1990.; W. Vogel, Kemija stakla, SKTH, Zagreb, 1985. ; J. Bensted, P. Barnes, Structure and performance of cement, E&FN Spon, London, 2002.		
Supplementary reading	S. Marković, Hrvatske mineralne sirovine, Institut za geološka istraživanja, Zagreb 2001.		
Teaching methods	Lectures, laboratory exercises, field teaching.		
Assessment methods	Written and oral examination		
Language of instruction	Croatian and English		

Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Preparation of technological waters

Course title	Preparation of technological waters		
Course code			
Type of course	Lectures, laboratory exercises (30+30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Petar Krolo, full professor		
Learning outcomes and competences	Knowledge of properties of natural waters and possible processes and procedures of preparation of water for specific technological applications.		
Prerequisites			
Course contents	Importance of water in technological processes. Physical-chemical and thermodynamic properties of water. Application and quality conditions for specific technological applications. Classification of water impurities. Origin and phase-disperse state of admixtures in natural waters. Processes and procedures of water preparation based on the classification of present impurities. Physical and physical-chemical processes and processes based on ion exchanges. Coagulation and flocculation of colloids and chemical clarification of waters. Ion exchangers in water preparation processed. Selection of ion mass and calculation of ion exchanger columns. Equipment and quality control of water prepared. Demineralisation and deionisation with decarbonising. Membrane processes and procedures. Reverse osmosis and electro-dialysis. Other water preparation processes.		
Recommended reading	S. T. Powell, Water Conditioning for industry, McGraw-Hill, New York-Toronto, 1980.; The NALCO Water Handbook, McGraw-Hill, New York, 1995.; Water Treatment Handbook, Degremont, Rueil-Malmaisons, 1991.; G. Belfort, Synthetic Membrane Processes, Fundamentals and Water Applications, Academic Press, New York, 1984.		
Supplementary reading	J. Mallevialle, P.E. Odendaal, M. R. Wiesner (edts.) Water treatment membrane processes, McGraw-Hill, New York,1996.; A. P. Sincero, G. A. Sincero, Physical–Chemical Treatment of Water and Wastewater, CRC Press, New York, 2002.; Water Quality Monitoring, Edited By J. Bartram and R. Ballance, E & FN SPON, London 1996.; Water Pollution Control, Edited by R. Helmer and I. Hespanhol, E & FN SPON, London 1997.		
Teaching methods	Lectures, laboratory exercises, field teaching		

Assessment methods	Oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Mathematical tools in chemical engineering

Course title	Mathematical tools in chemical engineering		
Course code			
Type of course	Lectures, seminars (30+15)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate studies	**Semester**	VI.
ECTS (Number of credits allocated)	4.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Davor Rušić, associate professor		
Learning outcomes and competences	Basic knowledge in the field of use of programming packages Mathcad, Matlab and Mathematica is acquired.		
Prerequisites	Competence required by courses Mathematics I and Mathematics II		
Course contents	Mathcad, Matlab and Mathematica as support to chemical engineering. (mathematical models in analysis of chemical processes, modelling of transfer of mass, energy, movement and chemical reaction, modelling of chemical reactors). Linear algebraic equations /direct methods (Gauss elimination method, Gauss-Jordan method), iterative methods (Jacobi and Gauss-Seidel method)/, Non-linear algebraic equations / Jacobi method, Mewton-Raphson method, Wegstein method/. Systems of non-linear equations. Polynomials. Interpolation of functions /Lagrange and Newton interpolation. Problem of approximation. Numerical differentiation. Numerical integration / The trapezoidal and Simpson formulas, Newton and Gauss square formulas/. Common differential equations /Euler method, Runge-Kutta method, Adams method, Milne-Simpson method/. Data analysis (application of tools to estimate parameters of chosen models). Application of tools to solving problems in chemical engineering where numerical methods occur.		
Recommended reading	J. Villadsen, M. L. Michelsen, Solution of Differential Equation Models by Polynomial Approximation, Prentice – Hall, Inc. Englewood Cliffs, New Jersy, 1978.; T. J. Akai, Applied Numerical Methods for Engineers, J. Wiley, N.Y., 1994.		

Supplementary reading	G. H. Phillips and P. J. Taylor, Theory and Application of Numerical Analysis, Academic Press, N. Y. 1996.
Teaching methods	Lectures, seminars using PCs and available software (Mathcad, Matlab, Mathematica).
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Seawater as sources of mineral raw materials

Course title	Seawater as sources of mineral raw materials		
Course code			
Type of course	Lectures, laboratory exercises (30+15)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	4.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Vanja Martinac, associate professor		
Learning outcomes and competences	Students acquire knowledge of basic properties of seawater and methods of its exploitation.		
Prerequisites			
Course contents	Seawater – a source of mineral raw materials. The basic properties of seawater. Physical and chemical characteristics of the seawater. Composition of seawater. Classification of components dissolved in seawater. Concentration and chemical forms of elements in seawater. Constant ratios of major components of seawater. Minor components of seawater. Isothermal evaporation of seawater and separation of individual salts. The effect of climactic and other factors on the evaaporation process. Evaporation of concentrated sea bittern. Possibilities of technological exploitation of seawater. Extraction of common salt. Recovery of magnesium and magnesium compounds from seawater. Extraction of fresh water from the seawater – desalination processes.		
Recommended reading	F. J. Millero, Chemical Oceanography, 2nd edition, CRC Press, Boca Raton, 1996.; K. Stowe, Exploring Ocean Science, Wiley, New York, 1995.; O. V. Bonney, Recovery of magnesium as magnesium hydroxide from seawater, US Pat. 43 149 85 (to Amstar Corporation, New York), 9		

	Feb. 1982., Chem. Abstr. 96 (1982) 124449.; S. Kalogiron, Survey of solar desalination systems and system selection, Energy, 22(1997)69-81.
Supplementary reading	E. Brown et al., Seawater: Its compositions, properties and behaviour, Butterworth Heinemann in association with The Open University, 2nd edition, Walton Hall, Milton Keynes, 2000.; M. J. Kennish, Practical Handbook of Marine Science, 3rd edition, CRC Press, Boca Raton, 2000.; M. E. Q. Pilson, Introduction to the Chemistry of the Sea, 1st edition, Prentice Hall, 1998.
Teaching methods	Lectures, laboratory exercises.
Assessment methods	Oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Water protection

Course title	Water protection		
Course code			
Type of course	Lectures, seminars, laboratory exercises (30+15+15)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	D. Jelena Perić, full professor		
Learning outcomes and competences	Students get to know the types, distribution and quality of waters in nature, properties of aquatic ecosystems, and methods and legislation for their conservation. Also they learn about wastewater treatment methods and disposal into natural recipients.		
Prerequisites			
Course contents	Ecosystem, biotope, ecological factors. Fresh waters and seawater. Physicochemical properties of water. Factors of water quality. Disorders in aquatic ecosystems quality. Depuration and eutrophication. Water management. Water legislation. Classification of fresh waters and coastal seas. The state plan for water protection. Environmental management. Conservation and improvement of water quality. Monitoring of natural waters quality. Legislation for effluent disposal. Wastewaters treatment. Preliminary treatment. Primary, secondary and tertiary treatment. Waste management and conservation of aquatic environment..		

Recommended reading	S. Tedeschi, Zaštita voda, HDGI, Zagreb, 1997.; D. Mayer, Kvaliteta i zaštita podzemnih voda, HDZVM, Zagreb, 1993.; B. Tušar, Ispuštanje i pročišćavanje otpadne vode, Croatijaknjiga, Zagreb, 2004.; D. Đikić et al., Ekološki leksikon, Ministarstvo zaštite okoliša i prostornog uređenja RH, O.P. Springer (ed), Zagreb, 2001.
Supplementary reading	H.D. Sharma and S.P. Lewis, Waste Containment System, Waste Stabilization, and Landfills, John Wiley & Sons Inc., New York, 1994; D. Mayer, Voda od nastanka do upotrebe, Prosvjeta, Zagreb, 2004.
Teaching methods	Lectures, seminar tasks, laboratory exercises, visits to facilities for conditioning of water and wastewater treatment.
Assessment methods	Written and oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Polymer chemistry

Course title	Polymer chemistry		
Course code			
Type of course	Lectures, laboratory exercises. (30+30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Branka Andričić, assistant professor		
Learning outcomes and competences	Students get acquainted with structure of natural and synthetic polymers as well as with fundamentals needed for polymer synthesis and analysis.		
Prerequisites			
Course contents	Introduction to structure of polymers (stereochemistry, molecular interactions, crystalline state, amorphous state). Relations between structure and properties. Rheology and solubility. Molecular weight. Fractionation of polydisperse systems. Polymer analysis methods. Determination of molecular weight using viscometry and gel permeation chromatography. Determination of thermal properties using differential scanning calorimetry. Determination of structure and interactions using infrared spectroscopy. Naturally occurring polymeric materials. Structure of cellulose. Modification of cellulose. Cellulose fibres. Miscellaneous		

	polysaccharides. Proteins (natural polyamides). Protein fibres. Structure and characteristics of natural cautchouc. Synthetic cautchouc. Biosynthetic polymers. Synthesis of polymers. Addition reactions. The use of Ziegler-Natta and metallocene catalysts. Condensation reactions. Polymerisation methods.
Recommended reading	D. J. David, A. Misra, Relating Materials Properties and Structure, Technomic Publ. Co. Basel, 1999; B. Andričić, Prirodni polimerni materijali, Interna skripta, Kemijsko-tehnološki fakultet, Split, 2003; Z. Janović, Polimerizacije i polimeri, HDKI-Kemija u industriji, Zagreb, 1997.
Supplementary reading	C. E. Carracher, Seymour/Carraher's Polymer Chemistry, 4th Ed., Marcel Dekker, New York, 1996; J. Mitchel, Ed., Applied Polymer Analysis and Characterization, Hanser Publ.,Munich, 1987.
Teaching methods	Lectures, laboratory exercises.
Assessment methods	Oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Polymeric materials

Course title	Polymeric materials		
Course code			
Type of course	Lectures, laboratory exercises. (30+30)		
Level of course	Advanced level course		
Year of study	3rd year of undergraduate study	Semester	VI.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Branka Andričić, assistant professor		
Learning outcomes and competences	Students get acquainted with polymeric materials, their properties and application.		
Prerequisites			
Course contents	Polymers, polymeric materials. Molecular structure of polymers. Super-molecular structure. Polymer solutions. Polymeric materials: natural, modified natural, synthetic organic and inorganic. Polymeric materials for different applications. Thermoplastics, thermosets, elastomers, elastoplastics. Fibres. Coatings. Adhesives. Liquid crystalline polymers.		

	Multi-component systems (blends, composites). Stabilization and modification of polymers. Biodegradable polymers. Ecological problems concerning polymeric materials. Recycling.
Recommended reading	Z. Janović, Polimerizacije i polimeri, HDKI-Kemija u industriji, Zagreb, 1997; T. A. Oswald, G. Menges, Material Science of Polymers for Engineers, Hanser Publ., Munich, 1995; I. M. Campbell, Introduction to Synthetic Polymers, Oxford Univ. Press, Oxford, 2000.
Supplementary reading	B. Andričić, Prirodni polimerni materijali, Interna skripta, Kemijsko-tehnološki fakultet, Split, 2003.
Teaching methods	Lectures, laboratory exercises.
Assessment methods	Oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Fundaments of mechanical engineering

Course title	Fundaments of mechanical engineering		
Course code			
Type of course	Lecture, exercise course (30+15)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	Semester	VI.
ECTS (Number of credits allocated)	4.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Željko Domazet, full professor		
Learning outcomes and competences	The course brings the basis of technical drawing, strength of material and parts of machinery in engineering studies.		
Prerequisites			
Course contents	Introduction to mechanical structures. National codes. Technical drawing (basis, surface roughness, tolerances). Bases of Mechanics (Static, Cinematic, Dynamic) needed as basis to Strength of materials, stress concentrations, dimensioning. Parts of mechanical machinery used in engineering (bolts, springs, welding, transducers of rotation, pipes, tanks).		
Recommended reading	Ž. Domazet, Skripta iz osnova mehaničkih konstrukcija i osnova strojarstva, in revision.		
Supplementary	V. Hrgešić i J. Baldani, Mehaničke Konstrukcije, Sveučilište u Zagrebu -		

reading	Elektrotehnički Fakultet, Zagreb, 1990.; E. Hercigonja, Tehnička grafika, Školska knjiga, Zagreb, 1994.; K.-H. Decker, Elementi strojeva, Tehnička knjiga, Zagreb, 1980.
Teaching methods	Lectures, exercise course.
Assessment methods	Continuous assessment (technical programmes) Exam: written and oral
Language of instruction	Croatian
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Sociology of modern society

Course title	Sociology of modern society		
Course code			
Type of course	Lecture (30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	Semester	VI.
ECTS (Number of credits allocated)	2.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Zoran Malenica, senior lecturer		
Learning outcomes and competences	Fundamental knowledge about functioning of modern societies (economic, political, demographic, ecological and cultural aspects).		
Prerequisites			
Course contents	Definition and characteristics of modern societies; changes in economic system functioning; economic, political and cultural aspects of globalisation; family in crisis and demographic world trends; fundamental characteristics and changes in stratification of modern societies in second half of 20. century.		
Recommended reading	M. Haralambos, M. Holborn, Sociologija,2002; J. Kregar, Z. Malenica and others, Sociologija, Školska knjiga 2003.		
Supplementary reading	M. Meštrović /ed./, Globalizacija i njene refleksije u Hrvatskoj, Ekonomski institut, Zagreb 2001.; U. Beck, Moć protiv moći u doba globalizacije, Školska knjiga, Zagreb 2004.; G. Bežovan, Civilno društvo, 2004.; M. Castells, Uspon umreženog društva I., II. i III., Golden marketing, Zagreb 2000., 2002. i 2003.		
Teaching	Lectures.		

methods	
Assessment methods	Written and oral examination
Language of instruction	Croatian
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Introduction to microeconomics

Course title	Introduction to microeconomics		
Course code			
Type of course	Lectures (30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	2.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr.Ivan Pavić, full professor		
Learning outcomes and competences	After the completion of the course, the student should be able to understand the principles of economic behaviour of individuals such as consumers and firms. The student is expected to have knowledge about how to analyse and deal with different forces that have impact on individual and market supply and demand. S/he should be able to use different concept and tools while making business decisions. The student should be able to identify, analyse and understand what, when and how to produce. S/he is expected to understand different concept of costs that figure in firm decision making. The student is also expected to have developed the ability to apply the knowledge of the course and find solution of various practical problems related to economic elements of business organizations.		
Prerequisites			
Course contents	Basic microeconomics approach (firm level approach): What is microeconomics about? Basic economics concepts. Types of firms. Supply and demand: Supply and demand (definition, low, curve). Determinants of supply and demand. Concept of market equilibrium. Production: Some basic concept of production theory. What, when and how to produce? Relationship between total, average and marginal product. Cost: Definition, types and the nature of costs. Functions and cost curves in short and long run. Relations between costs and production. Implementing the profit-maximizing output decision. Market for goods and price determination: market equilibrium, quantity and price determination in different market		

	structures, market for goods in practice.
Recommended reading	Salvatore, D. Ekonomija za menedžere u svjetskoj privredi, Mate, Zagreb, 1993.
Supplementary reading	Roger, A. A., Essentials of Microeconomics, South-Western, New York 2005.; Slavin, S.L., Microeconomics: Economics, 5th edition, McGraw-Hill, Boston, 2004.
Teaching methods	Lectures, advisory hours.
Assessment methods	Continuous assessment. Exam: written and oral.
Language of instruction	Croatian
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Electrical engineering

Course title	Electrical engineering		
Course code			
Type of course	Lectures, laboratory excesses (30+30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Slavko Vujević, full professor		
Learning outcomes and competences	Basic knowledge about electrostatics, chemical sources of electrical energy, direct current circuits, magnetostatics and alternating current circuits.		
Prerequisites			
Course contents	Electrostatics: basic quantities, basic laws, capacitors, static electricity. Chemical sources of electrical energy: primary souces, secondary sources. Magnetism: basic quantities, basic laws, magnetic circuits, electromagnetic force. Alternating currents: characteristic factors, symbolic method, RLC circuits, power, energy, resonance, three-phase currents.		
Recommended reading	Maletić, A., Osnove elektrotehnike, ELMAP, Split, 1993.		
Supplementary	Pinter, V., Osnove elektrotehnike - knjiga prva, Tehnička knjiga, Zagreb,		

reading	1978.; Pinter, V., Osnove elektrotehnike - knjiga druga, Tehnička knjiga, Zagreb, 1978.
Teaching methods	Lectures, laboratory exercises.
Assessment methods	Oral examination
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Introduction to management

Course title	Introduction to management		
Course code			
Type of course	Lectures (30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	2.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Marin Buble, full professor		
Learning outcomes and competences	At the end of the course the student should be able to: recognise and use specific theories, paradigms, concepts and principles of management, collect, analyse, synthesise and summarise relevant information on management problems, apply such knoweledge to solve simple management problems, prepare, process, interpret and present the solution in written, verbal and graphical forms, evaluate performance as an individual and a team member, develop an adaptable and flexible approach to study and work.		
Prerequisites			
Course contents	Introduction: Management – theory and practice. Management theory development. Entreprise environment. Ethnics and management social responsability. Planning: The nature and purpose of planning. Vision, mission and objectives of enterprise. Forecasting. Strategy and strategic planning. Decision making. Organizing: The nature of organizing. Organizational structure designing. Internal economy. Organization of governance. Choosing of organizational structure. Organization improvement approaches. Human resources management: Human resources determination. Recruiting and selection. Trainning and development. Performance appraisal and feedback. Compensation and benefits. Labor relations. Leading: Leading approaches. Motivation. Leadership. Interpersonal processes, groups and conflict. Communication in		

	organizations. Controlling: The nature of controlling. Operations management. Control methods and techniques. Management information systems.
Recommended reading	Buble, M., Management, Ekonomski fakultet, Split, 2000.; Weihrich, H., Koontz, H., Menadžment, Deseto izdanje, Mate, Zagreb, 1994.
Supplementary reading	Daft, L. R., Management, 7th edition, South Western College Pub, 2004.Griffin, W.R., Fundaments of Management, 3rd edition, Houghton Mifflin Company, 2002.; Griffin, W.R., Management, 7th edition, Houghton Mifflin Company, 2001.
Teaching methods	Lectures, seminars, advisory hours.
Assessment methods	Continuous assessment. Exam: written and oral.
Language of instruction	Croatian.
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Safety at work

Course title	Safety at work		
Course code			
Type of course	Lectures, laboratory exercises (30+30)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	5.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Petar Krolo, full professor		
Learning outcomes and competences	Knowledge of possible dangers when working in laboratory and plant. Safe work, protection measures and means.		
Prerequisites			
Course contents	Possible dangers for health and environment in the work process. Physical-chemical properties of matter. Designation of matter, signs and worldwide standards, systematisation of substances. Safe work with chemicals. Basic notions of toxicology. Effect of harmful and dangerous substances on human organism, entry points and defence of the organism. Means of personal protection. Conditions for burning and extinguishing equipment. Electrical danger and protective measures. Protective measures when		

	working with high pressures and high temperatures. Preparation of chemical cards for selected harmful and dangerous substances (inorganic acids, bases, organic substances). Danger diamond, MDK values, relative evaporability, high and low explosive limit, harmful effects for health.
Recommended reading	Grupa autora, Zaštita od požarno opasnih, toksičnih i reaktivnih tvari, Hrvatsko društvo kemijskih inženjera, Zagreb, 1998.; H. O. Chang, Hazardous and Radioactive Waste Tretment Technologies Handbook, CRC Press, London, 2001.
Supplementary reading	Zakon o zaštiti na radu, Zavod za istraživanje i razvoj sigurnosti, Zagreb, 1996.; Pravilnik o izradi procjene opasnosti (NN 48/97)
Teaching methods	Lectures, laboratory exercises, field teaching
Assessment methods	Oral examination
Language of instruction	Croatian and German
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

English language

Course title	English language		
Course code			
Type of course	Lectures, seminars (15+15)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	2.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Eldi Grubšić Pulišelić, M. A.		
Learning outcomes and competences	Students should become trained for using English for Special Purposes (ESP) in their own profession.		
Prerequisites	Learning experience in English as a Foreign Language is a prerequisite for going into ESP.		
Course contents	Introduction to Chemistry. Elements, Compounds and Mixtures. Solutions and Water. Suspension, Colloidal Suspensions, Emulsions. Crystals. Purification of Water. Oxygen. Hydrogen. Atomic structure. Man and the Ecosystem. Metals and Non-Metals. The Periodic Table. Symbols, Formulas and Equations. Ionization. Acids. Bases. Neutralization and Salts. The Halogens and their Compounds.		

Recommended reading	Pervan, M.: English for Students of Chemistry, Kemijsko-tehnološki fakultet Split (skripta), Split, 1970.; Jovanović, T.: English for Chemistry, Prirodoslovno-matematički fakultet Zagreb, Zagreb, 1989.
Supplementary reading	Hercezi-Skalicki, Marela: Reading Technical English for Academic Purposes, Školska knjiga, Zagreb, 1993.
Teaching methods	Text-analysis method, verbal presentation, demonstration, communicative method.
Assessment methods	Written and oral examination.
Language of instruction	English.
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

German language

Course title	German language		
Course code			
Type of course	Lectures, seminars (15+15)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	2.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Eldi Grubšić Pulišelić, M. A.		
Learning outcomes and competences	Students should become trained for using German for Special Purposes in their own profession.		
Prerequisites	Learning experience in German as a Foreign Language is a prerequisite for going into GSP.		
Course contents	German lessons: Unsere Welt im Jahr 2000. Energie. Energie aus Atomen. Der Chemiker Otto Hahn. Energiepolitik. Energie aus Brennstoffen. Regenerative Energiequellen. Strom aus Sonnenlicht. Pflanzen. Tiere. Energiepolitik. Atomwirtschaft. Aufgaben und Bedeutung der Mechanik. Fluide. Industrieroboter.		
Recommended reading	Zettl, E.: Aus moderner Technik und Naturwissenschaften, Hueber Verlag, Ismaning, 2002.; Štambuk, Z. i Marinić, D.: Deutsch und Technik, Školska knjiga, Zagreb, 1993.		
Supplementary	Schade, G.: Einführung in die deutsche Sprache der Wissenschaften, E.		

reading	Schmidt, Berlin, 2002.; Raab, O.: Texte aus den Wissenschaften, E. Schmidt, Berlin, 1990.
Teaching methods	Text-analysis method, verbal presentation, demonstration, communicative method.
Assessment methods	Written and oral examination.
Language of instruction	German.
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.

Introduction to computing

Course title	Introduction to computing		
Course code			
Type of course	Lectures, exercises (30+15)		
Level of course	Basic level course		
Year of study	3rd year of undergraduate study	**Semester**	VI.
ECTS (Number of credits allocated)	4.0 Number of allocated credits is based on the lecturer's estimation and inquiry among students.		
Name of lecturer	Dr. Slavomir Stankov, associate professor		
Learning outcomes and competences	Objective of this course is acquiring basic knowledge about computer as system. Given objective is achieved by learning and teaching about: computer as a system, operating systems for personal computer, computer programming system for office management, basic terms for computer networks.		
Prerequisites			
Course contents	Information and communication technology (basic terms). Computer as a system. Basic function for computer system (input, output, processing). Computer system decomposition (hardware, software). Computer system categories (microcomputers, minicomputers, mainframe). Personal computers Application domains of computer systems. Operating systems with textual user interface - MS - DOS. Operating systems with graphical user interface - MS - Windows. Computer programming system for office management. Basic terms for computer networks.		
Recommended reading	S. Stankov: Introduction to computing, Faculty of Natural Sciences, Mathematics and Education, University of Split, October, 2003. (http://www.pmfst.hr/~stankov). (in Croatian)		

Supplementary reading	V. Čerić, M. Varga, H. Birolla: Business computing, Znak, Zagreb, 1998.
Teaching methods	Lectures, laboratory exercises, seminar.
Assessment methods	Practical exam and oral exam.
Language of instruction	Croatian and English
Quality assurance methods	Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by Quality Control Committee, (3) Lecturer's Level.