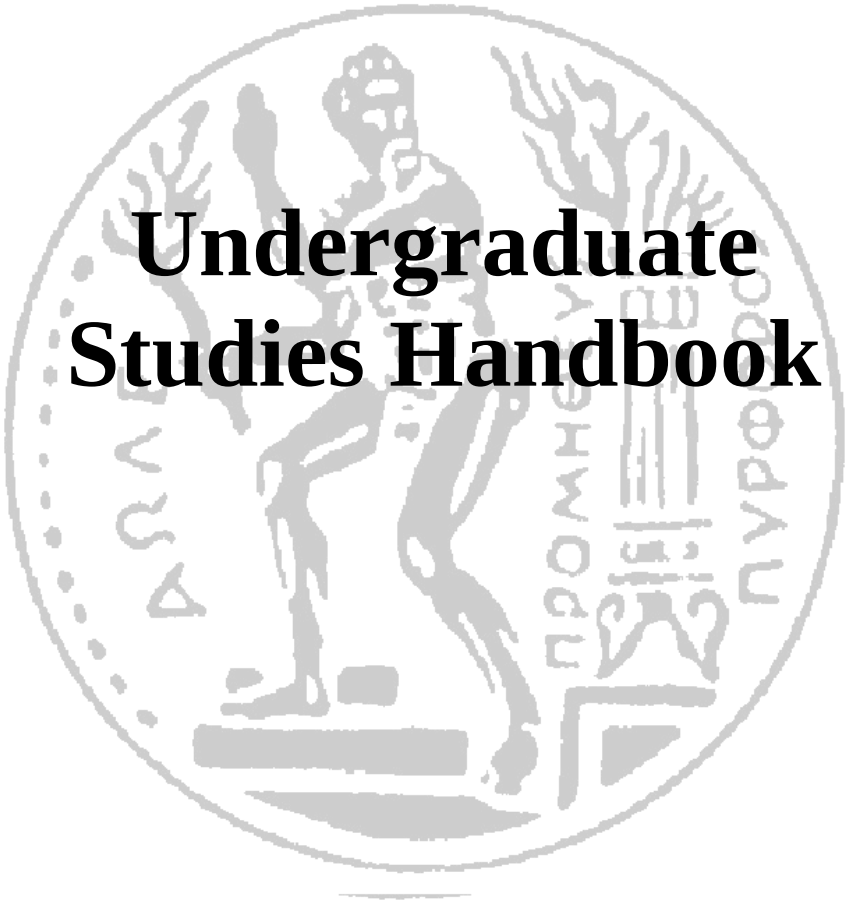
NATIONAL TECHNICAL UNIVERSITY OF ATHENS
Department of Chemical Engineering



Undergraduate Studies Handbook

ATHENS 2010

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1st Semester

Programming and P/C use- Basic software tools

Course Contents

Introduction to computing. Fundamental issues of the management and operation of computer systems. The hardware of computers. The software of computers. Computer programming. The computer's File System. Database information systems. Microchips and Microprocessors. Intranets. Computer communication. Introduction to Windows. Internet. Computing in our days. Computing Implementations. B. Introduction to programming – FORTRAN. Permissible characters. Constants of FORTRAN. FORTRAN variables. Operators. Mathematical expressions. Operation's Hierarchy. Functions. Page layout format. FORTRAN – basic commands. Control and Logic Commands. Tables and Organizational Commands. Functions and subroutines. Exercises. Laboratories

Duration:1 Semester

Contact Hours: 3hours/week, 3 hours lab

Mathematics I

Course Contents

Calculus I. Sequences and series of real numbers. Functions, limits and continuity. The derivatives. Applications of derivatives. The integrals. Techniques of integration. Indefinite, definite and improper integrals. Applications of definite integrals. Polar coordinates and parametric equations. Series of functions. Ordinary differential equations of order one. Linear Algebra and Analytic Geometry. Vectors and vector spaces. Determinant and linear systems. Matrices, determinants and systems of linear equations. Eigen values and Eigenvectors of a matrix. Lines and planes in 3-dimensional space. Conic sections. Quadric surfaces in 3-dimensional space.

Duration:1 Semester

Contact Hours: 6 hours/week

Inorganic Chemistry

Course Contents

The Genesis and Rise of Chemical Elements in the Universe - Atomic Theory and Atomic Structure: Big Bang Theory, Burning Processes in the Genesis of Chemical Elements, Processes α and e, Neutron Processes (s=slow, r=rapid). The Quantum Theory of the Atom. The Periodic System of the Chemical Elements under a Microscope: The Periodic Table and its Elements, Properties of the Elements in the Periodic Table, Ionization and Energy of Ionization, Electron Affinity, Electronegativity. The Atomic Size in the Periodic System of Chemical Elements, Ionic Radii Ratios r+/r-, Shielding and Slater Rules. Electrons, Structure and Reactivity of Molecules - Ionic and Covalent Bonds: Lewis Theory and Molecular Structure, VSEPR Theory, Unpaired Electrons and Lone Pairs of Electrons in the Structure of Molecules. Classical Theories on Bonds in Coordination Complexes: Valence Bond Theory, Crystal Field Theory, Molecular Orbital Theory. The Gaseous State: Laws of Gases, Kinetic Theory. Thermochemistry: The Heat of a Reaction, Hess's Law, Applications. Complexes in Chemistry - Past, Present and Future: Nomenclature in Complexes, Werner's Classical Theory, Ligands, Geometry in Coordination Compounds, Isomerism in Coordination Compounds, Chelate Effect and Chemical Properties. Introduction to the Solid State: Crystals and Crystal Defects, Conductivity in Solids, Covalent Solids. Modern Materials.

Duration:1 Semester

Contact Hours: 3hours/week, 5 hours lab

Design Techniques- P/C use (CAD/CAM flow charts)

Course Contents
Line drawing. The technique of drawing. Presentation of engineering. Views and appropriate selection of sides. Design Regulations. Introduction to designtwo-dimensional (2D) to the PC – Introduction to CAD/CAM. Design sections.Bedtime sides. Rules mounting dimensions. Thread. Design of mechanical parts inthe PC Introduction to design three-dimensional (3D) in the PC Springs.

Transmission gears. Bearings (bearings). Bearings. Symbols and surfacetreatment. Welding. Specific engineering plans. Pipes. Flow charts. Details of other types of project.

Duration:1 Semester

Contact Hours: 3hours/week

Physics I

Course Contents

Vector formulation of natural laws. Newton's laws. Forces: gravitational, electrical, magnetic. Equation of motion. Study of motion at 1 and 3 dimensions. Reporting
systems. Maintaining the momentum. Shocks. Systems with variable mass.
Kinetic energy. Conservative forces. Potential energy. Conservation of energy.
Moving particle systems. Torque. Spin. Moment of inertia. Conservation of angular momentum. Study of motion of rigid body.
Oscillations. Harmonic oscillator. Harmonic oscillator with damping. Forcedoscillations. Coupled oscil lations of two and many degrees of freedom. Wave equation. Wave motion in mechanical systems.

Duration:1 Semester

Contact Hours: 3hours/week, 2 hours lab

Introduction to Economics

Course Contents
Study the behavior of individual units of the economy, consumers and producers inthe markets function. Analysis of market distortions and the state's role

Duration:1 Semester

Contact Hours: 2 hours/week

2nd Semester

Advanced Mathematics II

Course Contents

Introduction to Euclidean chorous.Synartiseis many variables - surfaces.
Limits and synecheia.Vector Functions (producer-curve Frenet-
trihedral unitvectors in polar, cylindrical and spherical coordinates). Differentiable functions(partial-generation end-to-total production and applications of differential-Gradient-div-rot. Theorem Taylor entangled functions. About extremities and outer conditional.Double integral. Triple integral. Line inte grals. Surface integrals. Theorems Stokesand Gauss.

Duration:1 Semester

Contact Hours: 6 hours/week

Analytical Chemistry

Course Contents

Analytical Chemistry. Introduction to analytical chemistry – Principles. Volumetric methods of analysis. Chemical equilibrium – Solubility – Reaction rates – equilibrium constant – Activity/Ionic strength. Charge balance – Mass balance. Buffers – Indicators. Statistical treatment of Analytical Data. Instrumental methods of analysis – Introduction – Principles. Optical methods – Spectrophotometry – Applications. Atomic Spectroscopy – Absorption/Emission/ Fluorescence. Fundamentals of Electrochemistry – Potentiomery/Electrodes. Separation techniques – Chromatographic methods – Liquid Chromatography/Ion Exchange Chromatography.

Duration:1 Semester

Contact Hours: 3 hours/week, 5 hours lab

Physical Chemistry (Chemical thermodynamics)

Course Contents

Empirical properties of gases. Kinetic theory of gases. An introduction to the laws of Thermodynamics. Phase equilibria, phase rule, state diagrams. Colligative properties of solutions. Interfacial tension, wetting, capillarity. Micelles, films. Adsorption onto solids. Microheterogeneous systems. Optical properties of colloids. Kinetic and electric properties of colloids. Stability of colloidal systems. Emulsions and microemulsions.

Duration:1 Semester

Contact Hours: 3hours/week

Chemical Engineering

Course Contents

The first part of the course aims to offer an outline of the several areas involved in the Chemical Engineering Curriculum. The lectures deal mainly with the methods used in the study of physico-chemical processes. *Main contents*: History of chemical engineering. Introduction to plant, process and product design.

Duration:1 Semester

Contact Hours: 3hours/week

Physics II

Course Contents

Electric charge, Coulomb force, electric field and electric potential. Gauss' law. Magnetic field, Ampere's low. Motion of charge in electric and magnetic fields. Resistance and capacitance of conductors. Electromagnetic induction. Electric and magnetic properties of matter.

Duration:1 Semester

Contact Hours: 3hours/week, 2 hours lab

Macroeconomics

Course Contents

Introduction to the functioning of the
broader economicsystem(macro level). Full report in sections: national product andincome, domestic c onsumption and investment, economiccycles and multiplication, money and banking system, the phenomena of unemployment and inflation, views on the development and stability,
open economies and the global economy, comparative and competitive advantages.
References to examples of the Greek economy.

Duration:1 Semester

Contact Hours: 2 hours/week

3rd Semester

Technical Engineering

Course Contents

Introduction to Static, Charts Axis forces, cutting forces, bendingmoments. Introduction to Strength of Materials, tension, compression, resolution volume in space, Biaxial tension cycle
Mohr, Law Hooke, bending, moments of inertia, level of net bending Oblique pure bending, shear, bending to cutting, thin-walled beams with asymmetrical cross-
section, Center Shear,Torsion, Bending Advanced, Eccentric Loading, ProjectDeformation, Elastic Lin e Kelyfotoi Entities Thin Pressure Vessels.

Duration:1 Semester

Contact Hours: 3hours/week

Organic Chemistry I

Course Contents

Acyclic compounds: Carbonyl compounds. Carboxylic acids. Derivatives of carboxylic acids. Thiols and sulfides. Nitrogen compounds. Lipids. Peptides and proteins. Carbohydrates. Detergents. Industrial polymers. Cyclic compounds: General. Cycloalkanes. Aromatic character and substitution. Industrial aromatic hydrocarbons. Benzene derivatives. Nitrogen aromatic compounds. Dyes. Pigments. Drugs.

Duration:1 Semester

Contact Hours: 3hours/week, 4 hours lab

Mathematics III

Course Contents

Introduction - Connection problems Chemical Engineering (balance of mass diffusion and reaction, heat transfer). Ordinary differential equations of n-order with constant and non-constant coefficients. Solution of differential equations in a row. Various systems. Transformation Laplace. Boundary problems of Sturm-Liouville, Fourier series and their physical significance. Qualitative theory of differential equations and systems. Partial differential equations (separation of variables transforms Fourier). Introduction to Complex Functions.

Duration:1 Semester

Contact Hours: 4 hours/week

Physical Chemistry II (matter structures and states)

Course Contents

Chemical thermodynamics. Heat and enthalpy of reactions. The formation enthalpy. The free energy and enthalpy and their temperature dependence. The spontaneous changes. The condition for chemical equilibrium. Pressure and temperature dependence of equilibrium constant. Chemical kinetics. The rate of a chemical reaction. Experimental methods in kinetics. Order of a reaction. Molecularity of a Reaction. Opposing, consecutive and parallel reactions. Reaction mechanisms. The Rate-determining step. The kinetics of complex reactions. The temperature dependence of reaction rates. The Arrhenius equation. Rate constants and equilibrium constants. Collision theory of reactions between gases. Reaction rates and cross sections. Calculation of rate constants from collision theory. Activated complex theory. Catalysis. Electrochemistry. Ionics. Liquid solutions solvation. The standard thermodynamic functions of ion formation in solu tions. The Arrhenius and Debye-Hückel theory. The ionic strength. Faraday's laws and the electrochemical equivalent. Coulometers. Conductivity measurements. Molar conductances. Transport numbers and mobilities. Electrodics. Definition of electrochemical potentials. Galvanic cells. Electromotive force (EMF) of a Cell. Free energy and reversible EMF. Entropy and enthalpy of cell reactions. Types of Half-cells (Electrodes). Classification of Cells. Standard electrode potentials. Osmotic membrane equilibrium. Electrode kinetics. Polarization. Overpotential. Applied Electrochemistry. Some basic applications.

Duration:1 Semester

Contact Hours: 3hours/week, 3 hours lab

Business Administration

Course Contents

Introduction: Production operations, operations strategy. Forecasting: Short-term forecasts, intermediate-term forecasts, long-term forecasts, qualitative forecasting methods, time series and casual models, constant processes, linear trend processes, seasonal processes. Inventory management: The nature and importance of inventories, inventory-related costs, economic order quantity models, implementing inventory management systems. Design of production systems: Product design, process selection and capacity planning, facilities layout, design of work systems and organization. Operating and controlling the production system: Long, medium and short range production planning and control, quality management, maintenance and replacement. Feasibility study: Investment proposal, estimating cash flows, evaluation of investment proposal.

Duration:1 Semester

Contact Hours: 2 hours/week

Applied Thermodynamics

Course Contents

The first and Second Law. Relations among thermodynamic properties. The PVT behavior of real fluids. Thermodynamic properties of fluids. Heat effects. Thermodynamics of flow processes. Power cycles: refrigeration and liquefaction. Thermodynamic analysis of processes. Systems of variable composition. Ideal behavior. The chemical potential as a criterion of phase equilibrium. The ideal-gas mixture. The ideal solution. Rault's law. Systems of variable composition. Non ideal behavior. Partial properties. Fugacity. Excess Gibbs energy. Activity and activity coefficients. Phase equilibria. The phase rule. Duhem's theorem. Vapor-liquid equilibrium. Flash calculations. Henry's law. Evaluation of partial properties. Equilibrium and stability. Systems of limited liquid-phase miscibility. Chemical reaction equilibria. The reaction coordinate. Application of equilibrium criteria to chemical reactions. The standard Gibbs energy and the equilibrium constant. Evaluation of equilibrium constants.

The phase rule and Duhem's theorem for reacting systems multi reaction equilibria.

Duration:1 Semester

Contact Hours: 3hours/week

4th Semester

Chemical Engineering Thermodynamics

Course Contents

Material balances and definitions. Simple flow sheets. Combustion and excess air.
Elements of phase equilibria. Equations of state. Critical and reduced T and P.
Compressibility factor (Z). Pure gases and gas mixtures. Partial pressure. Humidity; steam tables; drying and humidification processes. Energy balances. Definitions (work, heat, energy, enthalpy, specific heat). Enthalpy calculations. Phase change and ΔH calculations. Generalized energy balance. Enthalpy of reaction. Reactions at T, P other than standard. Enthalpy of dilution and of mixing. Combined mass and energy balances. Distillation. Degrees of freedom. Enthalpy – concentration diagrams. Humidification – dehumidification – cooling diagrams. Applications. Non-steady state mass and energy balances. Simple non-steady state mass balances, mixing, distillation, reaction. Simple non-steady state energy balances, heat transfer. Simple applications and examples.
Students are required to attend a computer lab on the use of Aspen Plus. Students are required to submit 2-3 project reports. They count 20% in final grade. Estimated time per project, about 10 hours. A mid-term exam is optional, and counts 30% in final grade.

Duration:1 Semester

Contact Hours: 3hours/week

Organic Chemistry II

Course Contents

Acyclic compounds: Carbonyl compounds. Carboxylic acids. Derivatives of carboxylic acids. Thiols and sulfides. Nitrogen compounds. Lipids. Peptides and proteins. Carbohydrates. Detergents. Industrial polymers. Cyclic compounds: General. Cycloalkanes. Aromatic character and substitution. Industrial aromatic hydrocarbons. Benzene derivatives. Nitrogen aromatic compounds. Dyes. Pigments. Drugs.

Duration:1 Semester

Contact Hours: 3hours/week

Transfer phenomena I- Fluid Mechanics

Course Contents

Introduction to Transport Phenomena; molecular transport of momentum, heat and mass. Fluxes, molecular transport coefficients, correlations from kinetic theory. General property balance, derivation of differential equation for 3D transport of momentum, heat and mass. Laminar flow, examples. Exact solutions of the Navier-Stokes equations, viscometric flows. Introduction to laminar boundary layers of momentum, heat and mass. Mass fluxes in stationary and convected coordinates, induced velocity. Turbulence and turbulent transport; Reynolds' equations, eddy transport coefficients of momentum heat and mass. The closure problem of turbulence, phenomeno-logical theories (Boussinesq, Prandtl), Reynolds' analogies and applications. Dimensional analysis and π-theorem; inspection of the basic differential equations analysis; physical meaning of dimensionless groups, modeling.

Duration:1 Semester

Contact Hours: 4 hours/week

Physical Chemistry III (Chemical Kinetics - Electrochemistry)

Course Contents

Electrical conductivity. Numbers of transport. Electric double layer (creation, description, evaluation of electrical properties, structure models). Galvanic elements (formation, activities, resources, types of electrodes, types of galvanic elements). Electrodic polarization. Hypertension freight hypertension diffusion, chemical hypertension, hypertension phase. Anodic dissolution of metals. Hypertension hydrogen, oxygen hypertension. Techniques for taking polarization curves. Methods for study of electrochemical systems. Rate of reaction. Rate coefficient (constant speed). Reaction order. Molarity. Rate Theories based on thermodynamics. Rate Theories based on statistical mechanics. Kinetics of elementary reactions. Kinetics of non-elementary reactions. Methods for determining the order of reaction, the rate of the Rhythm. Effect of temperature on the rate of reaction. Conflict Theory. Theory of absolute speed. Expatriate Reaction Mechanisms. Approach to Steady State. Bringing Balance and. the slowest Stadium. Heterogeneous Reactions. Adsorption isotherms. Heterogeneous Reaction Kinetics. Heterogeneous Reaction Mechanisms. Catalysis. Mechanisms of catalytic reactions. Categories catalysts. Catalyst Preparation

Duration:1 Semester

Contact Hours: 4hours/week, 3 hours lab

Mathematics IV (Numerical Analysis - Applied Statistics)

Course Contents

Descriptive statistics. Data summary and presentation, frequency distribution, histogram, characteristic values. Probability and probability distributions. Basic concepts, events, conditional probability and Bayes theorem. Probability distributions, discrete and continuous random variables, expected value, variance and standard deviation, moment generating function. Important distributions. Binomial, geometric, Poisson, uniform, exponential, gamma, normal distribution and the central limit theorem, Student, X2 and F distributions. Statistical estimation. Sampling distributions, point estimation, properties of estimators, confidence intervals. Tests of statistical hypotheses. Type I and type II errors, hypotheses on parameters, goodness of fit tests.

Duration:1 Semester

Contact Hours: 5hours/week

Operations Research

Course Contents

At first an introduction to the scientific field of operations research and management science (operational research and management science). Emphasis is placed on optimization and how to design appropriate mathematical models for solving these problems. Then describe the problem of linear programming with examples from the field of engineering as on of most. Constructed a mathematical model of the problem is solved and the top graphics to make them better understand the basic concepts of the theory. Below is a description of the Simplex method which is the basic method of solving linear programming problems. Then develop the dual theory and its application in the sensitivity analysis accompanying the solving of problems. The next step is the integration of integer variables in the model and focus on how the problems of modeling (Integer Programming). The existence of integers or binary (0 or 1) variables Integer Programming significantly expands the scope of mathematical programming models. It also describes how to resolve problems integer programming (branch and bound method, etc.) and provides examples, mainly from the fields of engineering (fixed costs, logistics, etc.), introducing the student to combinatorial optimization.

Duration:1 Semester

Contact Hours: 2 hours/week

5th Semester

Electrotechnics

Course Contents

Fundamentals Electromagnetics, electrical quantities, circuit boards, labels, Laws Kirchoff, data circuits, Energy and Power, Linear data analysis Principles of electric circuits, theorems (voltage and current division, superposition, connecting resistors in series and parallel, balanced bridges Kennelly , Millman, Thevenin, Norton, Transforming sources) Elementary transients for first order circuits, sinusoidal permanent status (using phasors, complex root, real and reactive power, theorems), three-phase circuits (balanced loads, measurement of force).

Duration:1 Semester

Contact Hours: 3hours/week

Unit Operations I

Course Contents

The aim of the Unit Operations I course is the study of the principles involved in the preliminary design of distillation columns, absorption and extraction towers as well as, cooling towers. The design of distillation columns is performed as an example of a stagewise process. Analytical and graphical methods are employed to calculate the number of theoretical trays in continuous and batch binary distillation. Tray and column efficiencies are discussed, while simplified methods are employed for the design of multi component distillation. Differential-contact processes are examined in the chapter of absorption. The number and height of transfer units are calculated to obtain the height of the packing material in the column. Column efficiency is also discussed. For the design of liquid-liquid batch and continuous extraction processes of non-miscible and partially miscible solvents, analytic and graphical methods are again employed. The design of cooling towers is performed as a good example of simultaneous mass and energy transfer. Design of water-air cooling tower.

Duration:1 Semester

Contact Hours: 4hours/week, 3 hours lab

Instrumental Chemical Analysis

Course Contents

Sort instrumental analytical methods. Optical Methods: Absorption of radiation emission of radiation, instrumentation (monochromator, sample handling,sensors, gauges simple - double beam). Spectrophotometry uv - UV - VIS. Infrared spectroscopy IR. Atomic Absorption – Flamephotometer. Ray spectrometry X(absorption, diffraction, fluorescence). Thermal methods: Therm ovarymetriaDifferential Thermovarymetria, Differential Thermal Analysis, Differential Scanning Calorimetry. Electrometric methods: Categories electrodes Awards electrometricallyMethods electrode s concentration polar graphic. Chromatography - GC, High Performance Liquid Chromatography HPLC. Combined analytical techniques: Gas chromatography mass spectrometry- Mass Spectrometry (TG-MS). Atomic emission spectrometry withinductively conjugated plasma (ICP-AES). Methods for quality - quantitativemeasurements in chemical analysis. Selection of analytical method to problems of chemical processes and environmental control parameters.

Duration:1 Semester

Contact Hours: 3hours/week, 3 hours lab

Principles of Cell Biology and Biochemistry

Course Contents

Building blocks of the cell. Nucleic acids, proteins, polysaccharides, lipids. Cellularorganization, Biological membranes. Membrane transport. Energy production in the cell. Coding of genetic information. Storage-packing and decoding of genetic information. Protein synthesis. Post-translational modification. The technology ofDNA. Cloning organizations.

Duration:1 Semester

Contact Hours: 3hours/week

Transport Phenomena II - Heat and Mass Transfer

Course Contents

Integral methods of analysis. Integral balances of mass, momentum, energy and applications. Isothermal interphase momentum transport, friction factors, correlations for closed conduits, submerged bodies and packed beds; boundary layer separation, potential flow, ideal flow, vorticity, sources, sinks and circulation. Interphase transport of heat, heat transfer coefficients, turbulent analogies and j-factors. Natural convection. Heat transfer with phase change (boiling and condensation). Radiation heat transfer. Unsteady state transport. Heat exchangers. Non Newtonian phenomena; rheological characteristics of materials.

Duration:1 Semester

Contact Hours: 3hours/week, 1 hours lab

Metal Corrosion and Protection

Course Contents

The phenomenon of erosion (definition - economic impact, visual observations).Thermodynamics of looking at the phenomenon of erosion. Details Kinetic Approach of the erosion. Factors influencing the corrosion rate. Methods for measuring the speed of corrosion. Examination of the most common forms of corrosion. Key measures to address them. Methods of protection. Corrosion inhibitors. Anodicprotection. Cathodic protection. Metallic coatings. Nonmetallic and organic coatingsepistromata.Dokimes control. Testing and monitoring the effectiveness of protection. Non-destructive methods for testing facilities.

Duration:1 Semester

Contact Hours: 2hours/week

6th Semester

Chemical Reaction Engineering

Course Contents

Introduction: Basic principles. Classification of the variables in a chemical process. Incentives for chemical process control. Design elements of a control system. Time constants: Residence time. Time constant for mass transfer. Time constant for chemical reactions. Mathematical simulation of physical and chemical processes: Classification of mathematical models. The basic principle for mathematical simulation. Distillation column. Ideal binary mixture. Linearization and transient systems response: Formulation of the mathematical model with and without control. Linearization of systems. Solution of linear differential equations. Multipleinput multiple-output processes. Diagonalization. Transient

behavior of first-order systems: General description of a first-order system. Input functions. Transient response of first-order systems. Examples of first-order systems. Transient behavior of second-order systems: Description of a second-order system. Transient response of second-order systems. Two first-order systems in series. Non-interacting first-order systems in series. Laplace transforms. Definition and basic characteristics. Laplace transforms of some basic functions. Inverse Laplace transforms.

Duration:1 Semester

Contact Hours: 4hours/week, 2 hours lab

Environmental Science

Course Contents

Introduction to Environmental Science: Multidisciplinary dimension of environmental science, nature, environmental problems, information ecology, toxicology and ecotoxicology. Ecosystems and energy flow and material cycles of elements in the environment, human disturbance of the environment. Atmosphere and Air Pollution: the structure and composition of the atmosphere, the sun-earth relations, air pollutants, sources and effects of air pollution, types of air pollution, weather impact on air pollution, dispersion of pollutants in the atmosphere planetary scale atmospheric disturbances (reduction of stratospheric ozone, a phenomenon warming, acid rain, climate change). Water Environment and Water Pollution: Characterization of water, water cycle, aquatic ecosystems, water quality and uses, sources of pollution (sewage, industrial waste water), pollution of surface and groundwater, pollution, oceans, polluting parameters (organoleptic, physicochemical, undesirable substances, toxic, microbiological), eutrophication. Geosphere and Soil: Rocks, minerals, chemical processes, characteristics, soil organic matter, soil pollution sources and restoration. Solid waste and environmental pollution: types, sources, impacts on the environment, polluting aspects of waste management. Environmental Policy and Legislation - Environment and sustainable development (sustainability): Legislative framework and policies for tackling environmental pollution, environmental quality standards, economic considerations, information and citizen participation.

Duration:1 Semester

Contact Hours: 3hours/week, 1 hours lab

Unit Operations II

Course Contents

Pumping systems. Calculation of required total pump head. Net positive suction head (NPSH). Piping components (bends, transitions, valves, check valves, fittings). Classification of pumps. Positive displacements pumps, dynamic pumps. Characteristic curves. NPSH-required. Operating point. Similarity relations of centrifugal pumps. Parallel and in series connection of centrifugal pumps. Compression work on a gas. Characteristics of fans, blowers and compressors. Vacuum pumps. Classification of compression equipment and vacuum pumps. Ejectors. Diffusion pumps. Flow of compressed gases in pipes. Mixing processes. Basics in mixing processes. Geometrical characteristics of stirred tanks. Power consumption in stirred tanks. Mixing of miscible low viscosity liquids. Solid-liquid suspensions. Liquid-liquid dispersion. Gas in Liquid dispersion. Fundamentals of particle technology. Characterization of solid particles. Behavior of solid particles. Differential and cumulative particle size distribution. Sampling from heaps and conveyor belts. Sampling from dusty gases. Measurement of particle size distribution. (sieving, gravity sedimentation, centrifugal sedimentation. Coulter counter, light scattering and light absorption methods). Measurement of particle surface area. Mechanical particle separation methods. Solid-solid separation (sieving, elutriation, magnetic and electrostatic separation, flotation, hydrocyclones). Solid-liquid separation (screening, gravitational settling, centrifugal settling, cake filtration, deep bed filtration). Filtration equipment.

Duration:1 Semester

Contact Hours: 4hours/week, 2 hours lab

Science and Engineering Biological Systems and Products (Food - Biotechnology)

Course Contents

Introduction: Food Science, Technology and Engineering. Scope of Food Engineering. Heating and cooling processes: Modes of heat transfer. Thermal properties of foods. Thermal Processing: Introduction. Heat resistance of microorganisms. Kinetics of thermal inactivation of microorganisms. Determining the equivalent process time − F value. Methods for calculating the F value of a thermal process. Methods for calculating the required F value for commercial sterilization. Evaluation and design of thermal processes with mathematical procedures. Kinetics of quality degradation during thermal processing. Theoretical equations for heat penetration data. Conversion of heat penetration data obtained at certain conditions to different processing conditions. Food dehydration: Water as major food constituent. Basic principles of dehydration. Heat transfer during drying. Mass transfer during drying. Psychometrics. Drying processes (analysis). Methods of food dehydration and drying equipments.

Duration:1 Semester

Contact Hours: 4hours/week

Polymer Science and Engineering

Course Contents

Empirical properties of gases. Kinetic theory of gases. An introduction to the laws of Thermodynamics. Phase equilibria, phase rule, state diagrams. Colligative properties of solutions. Interfacial tension, wetting, capillarity. Micelles, films. Adsorption onto solids. Microheterogeneous systems. Optical properties of colloids. Kinetic and electric properties of colloids. Stability of colloidal systems. Emulsions and microemulsions.

Duration:1 Semester

Contact Hours: 3hours/week

7th Semester

Materials Science and Engineering

Course Contents

Introduction. Atomic Structure and Atomic Bonds. Structure of Crystalline Solids. Imperfections in Solids. Diffusion. Phase Diagrams. Interfacial Thermodynamics. Phase Transformations. Mechanical Properties of Materials. Electrical Properties of Materials. Thermal Properties of Materials.

Duration:1 Semester

Contact Hours: 3 hours/week, 2 hours lab

Chemical Reaction Engineering

Course Contents

Teaching: Introduction. Expression patterns of response. Key features of heterogeneous catalytic processes. Systems of biochemical reactions. Kinetics of enzymatic reactions and microbial fermentation. The main types of bioreactors. Non-ideal flow in reactive systems. Distribution of residence times. Dispersion models and containers in a row. Effect of non-ideal flow reactors in operation. Simulation of heterogeneous chemical reactors. Catalytic and non-catalytic reactors. Isothermal and non isothermal reactors. Formulate and solve mass and energy balance in multiphase reactors.
Laboratory: Heterogeneous Catalytic Decomposition of hydrogen peroxide in the aqueous phase in batch reactors. Sorption of toluene in the gas phase in Bed Natural Clinoptilolite. Catalytic Reactor

with Membrane Walls. Photochemical Oxidation of chlorinated organic compounds. Saponification of ethyl acetate into reactor stirring continuous task. Gas Absorption Column in filler. Distribution of time spent in a column filler. Absorption by Gas Liquid Chemical Reaction. Determination of Parameters reaction rates. Machining Workshop.

Duration:1 Semester

Contact Hours: 4 hours/week, 2 hours lab

Technology Fuels and Lubricants

Course Contents

Import, stock and fuel use. Solid fuels, creating carbon. Classification, properties, calorific value. Liquid fuels, oil and its products. Gasoline, unleaded gasoline, kerosene and aviation fuel. Diesel fuel. Properties, specifications, features battingengine. Gaseous fuels, additives, properties, classification, specification, synthetic oils, fats, environmental issues.

Duration:1 Semester

Contact Hours: 3 hours/week, 2 hours lab

Advanced Inorganic Chemistry

Course Contents

Depth on Inorganic Chemistry, mainly technological interest. Chemistry, Structure,Properties and Technological Applications of hydrides, the Elements of Group III(comparison of boron-aluminum) in Group IV (comparison of carbon-silicon-germanium) of Group VI (oxides, thermodynamic charts andEllingham). Introduction to Solid State Chemistry (crystal structures, chemical bondsin solids, structural disorder, non-stoichiometric compounds). Electronic and magnetic properties of non stoichiometric compounds. Semiconductors, high-temperature superconductors. Zeolites. Organometallic chemistry, metal-metal bondsand metal tuples. Details metaptoseos and Lanthanides. Contemporary theories and applications for the bonds in the complexes.

Duration:1 Semester

Contact Hours: 3 hours/week, 2 hours lab

Remediation of Contaminated Areas

Course Contents

Environmental protection is the set of measures aimed at maintaining the physical, chemical and biological characteristics, to ensure the functioning of a hospitable habitat for all current forms of life on the planet. As for the human species in particular environmental protection extends to avoid environmental disturbances that can adversely affect the aesthetics, mental condition, fun and spiritual and physical cultivation. Drainage environment is the set of techniques designed to restore normal levels of all environmental parameters are disturbed by human activities. The selection of the required technical consolidation is not predetermined, but depends on the specific characteristics and specialized in each specific case of pollution in the region. This course is the knowledge of the principles and methods remediation of contaminated sites under legal restrictions and protect public health and safety. Furthermore, the object lesson is the plant design and project management reorganization.

Duration:1 Semester

Contact Hours: 3 hours/week

8th Semester

Process control

Course Contents

Controllers, measuring devices and final control elements: The concept of feedback control. Measuring devices (sensors). Transmission lines. Final control elements. Types of feedback controllers. Closed-loop behavior of processes: Closed-loop transfer function. Effect of analog control on the response of a first order process. Effect of integral control. Effect of derivative control. Effect of composite control actions. Stability analysis of feedback systems: Notion of stability. The characteristic equation. Routh-Hurvitz criterion for stability. Root locus analysis: Analysis of the characteristic equation. Rules for plotting rootlocus diagrams. Use of root-loci in process control. Positive feedback control systems. Control of unstable processes. Frequency response analysis: Amplitude ratio and phase angle. Bode diagrams. Rules for plotting Bode diagrams. Bode stability criterion. Nyquist diagrams. Nyquist stability criterion.

Duration:1 Semester

Contact Hours: 4 hours/week

Economic Analysis of Manufacturing Decisions

Course Contents

The object lesson on the concepts, methods and techniques associated with the Feasibility Study and Business Plan. Objective: To familiarize the engineer with the conditions necessary for eventual economic exploitation of
technological knowledge by formulating and evaluating aproject and / or a business.

Duration:1 Semester

Contact Hours: 3 hours/week

Environmental Engineering

Course Contents

Presentation of procedures for dealing with environmental problems and protecting the environment from anthropogenic activities. Analysis of processes and design ofgas processing plants, liquid and solid waste.
TREATMENTOF WATER AND WASTEWATER: Balancing supply. Primarytreatment (flocculation, separation by gravity.) Secondary treatment (stabilizationprocesses: biological degradation of BOD - aerobic and anaerobic, nutrient removal-
nitrogen and phosphorus). Tertiary treatment (disinfection, iontoenallagi, reverseosmosis).
SOLID WASTE TREATMENT: Stabilization of organic sludge. Stabilization of
organic waste. Dehydration stabilized sludge. Treatment of solid waste.
TREATMENT OF WASTE GASES: Dispersion in the atmosphere by chimneys. Removal of suspended particles - traps, sedimentation, cyclones, bag filters, electrostatic filters. Removal of air pollutants - scrubbers, adsorption on activated carbon.

Duration:1 Semester

Contact Hours: 3 hours/week

Processes of Inorganic and Electrochemical industries

Course Contents

Physical processes in inorganic industry. Solid materials, size reduction, separationof solid / solid and dust extraction processes. Apply the cement industry.

Analysis of key theoretical principles and production process of sulfuric acid, nitric acid, ammonia, phosphoric acid and fertilizers. Batteries and galvanic elements. Electrolytic production of caustic soda, chlorinedioxide and manganese. Plating. Anodic oxidation of aluminum. Electrophoreticpaint. Production of aluminum.

Duration:1 Semester

Contact Hours: 3 hours/week

High Temperature Proccesses

Course Contents

Introduction - Definitions - Measurement of high temperatures.
Thermodynamics and phase
equilibria. Definitions. Standard modes. Onecomponent systems. Binary systems. Methods and method ologies drafting phase diagrams. Trilateral diagrams. Phases and reactions in non-equilibrium state.
Processes at high temperatures. Diffusion. Nucleation -
Developing grains. Sintering.Vitrification. Chemical reactions.
Corrosion at high temperatures.
Technological applications and case studies. Glass. Refractory. Cement. Traditional ceramics.

Duration:1 Semester

Contact Hours: 3 hours/week, 3 hours lab

9th Semester

Design of Chemical Industry

Course Contents

The Design of Chemical Industries combines virtually all knowledge of Chemical Engineering in Mechanical guiding the formation of production units operating on financial and environmental terms. Especially in nowadays, the search for new products is becoming more common as oil and natural gas (main raw materials of our industry) runs out, leaving gaps in the markets (fuels, chemicals), and encouraging experimentation with alternative raw materials. The role of chemical engineering is to translate the available chemistry laboratories (alternative or conventional, 'Green or not, new or old) into viable products and factories ensuring efficient and cost effective solutions in each case. The course material is presented in two sections. The first introduces the general design problem and explain details about the cost and evaluation of industrial investment. Presented selection of chemical reactors, natural selection-chemical separation processes, principles of integration with parametric analysis and compensation studies, and data on plant safety

Duration:1 Semester

Contact Hours: 4 hours/week, 2 hours lab

Project Management and Decision Support

Course Contents

A) Project Management: Basic knowledge, techniques and tools applicable to the successful completion of complex actions involving several interrelated activities, designed to create one;; units;; product or service.
Basic concepts, organizational structures, project lifecycle Planning
Structural Analysis Project Scheduling Planning Resources Project Budget
Monitor & Control Project Risk Management

B) B) Decision Support: Basic concepts, methodological approaches, techniques andtools for choosing the appropriate solution that will satisfy a new need or improve the existing situation Basic concepts Decision making under uncertainty and risk - decision trees Decision making with multiple criteria

Duration:1 Semester

Contact Hours: 3 hours/week

Health & Safety Facility

Course Contents

Understanding the principles of Occupational Safety and Health at Work. Education in recognition of workplace hazards, preventing accidents and dealing with their consequences. Lessons from major industrial accidents. Designing safe plant.Occupational diseases and institutional framework. Microclimate workplaces and health effects and safety of workers. Occupational noise and effects on health and safety of workers. Toxic substances and health effects of workers.

Duration:1 Semester

Contact Hours: 3 hours/week

Processes of advanced inorganic materials

Course Contents

Introduction to new ceramics. Molding techniques. Raw materials for the new ceramic production. Techniques for the production of fine powders. Sintering techniques. Evaluation of the advanced ceramics. Mechanical, electrical, chemical and thermal properties of the advanced ceramics. Electroceramics. Point defects in ionic crystals. Brouwer diagrams. Electric conduction in mixed conductors. Applications of ceramics with electrical properties. Structures of the ceramic oxides with ionic and/or electronic conductivity. Allotropic forms of Carbon. Introduction to fullerenes, synthetic techniques and characterization. Chemical and physical properties. Alkali and alkaline earth metal fullerides. Carbon Nanotubes. Introduction to nanotubes, multi wall and single wall nanotubes, structures, production techniques, and characterization. Chemical, physical, mechanical, electrical and thermal properties of carbon nanotubes. Applications.

Duration:1 Semester

Contact Hours: 3 hours/week, 3 hours lab

Inorganic industries (Case studies)

Course Contents

Depth articles on cutting-edge field of Inorganic and Electrochemical Industries.Indicative topics which engage with corresponding case studies are: Standardization of procedures and products, impact of manufacturing on the properties of products, waste treatment, alternative fuels, energy conservation, recovery and recycling ofindustrial by-products, design Inorganic Industries legislative framework for the establishment industrial plant, studies on the development of industrial space

Duration:1 Semester

Contact Hours: 3 hours/week, 3hours lab

Technology and Business Strategy

Course Contents

The purpose of this course is to familiarize students with the overview of policy and course of business through the development and implementation of its strategy to focus on the utilization of technology, knowledge and innovation. It also considers the creation of new enterprises based on knowledge. In the course strategy (technology and business) is treated as a dynamic process of exploitation of resources and capabilities and interaction with the wider environment.

Duration:1 Semester

Contact Hours: 2 hours/week

10th Semester

Diploma Thesis

The diploma thesis work is conducted within the Faculty in consultation with and under the supervision of one of the faculty members. The examiner has the final responsibility for the extent and the quality of the work. The diploma thesis is performed within one of the areas listed in the course program. The diploma work is an application to and a summary of knowledge acquired during education. Therefore it constitutes the final part of the work towards graduation. The defense of the diploma thesis is accomplished in the presence of a faculty members committee.