وحدات ومقررات قسم الهندسة الكيميائية

قسم الهندسة الكيميائية Chemical Engineering Department

Chemical Engineering Department

First Year **First Semester:**
Fall

No	Code	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	GS101	Mathematics I	رياضـــــيات 1	3	3	-	2
2	GS103	Physics I	فيـــــزياء 1	3	2	2	1
3	GS105	Chemistry	كيمـــــياء	4	3	2	-
4	GE101	Workshop Technology	هندسة ورش	2	1	2	1
5	GE103	Engineering Mechanics I	ميكانيكا هندسية 1	3	3	-	2
6	HS103	English Language I	لغـــة إنجليزية 1	2	2	-	-
	Total			17	14	06	06

First Year **Second Semester:**
Spring

No	Code	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	GS102	Mathematics II	رياضـــــيات 2	3	3	-	2
2	GS104	Physics II	فيـــــزياء 2	4	3	2	2
3	GE104	Computer Programming	برمجة حاسب	3	2	2	1
4	GE102	Eng. Drawing & Descriptive Geometry	رسم هندسي وهندسة وصفية	4	2	4	1
5	HS106	Arabic Language	لغـــــة عربية	2	2	-	-
6	HS104	English Language II	لغـــــة إنجليزية 2	2	2	-	-
	Total			18	14	08	6

Note:
Every theoretical hour means one unit.
Every practical hour means half unit.

GS	General Science
GE	General Engineering
HS	Humanities Science
EE	Electrical Engineering
ME	Mechanical Engineering
CE	Civil Engineering
CHE	Chemical Engineering
PE	Petroleum Engineering

Second Year **Third Semester : Fall**

No	Code	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	GS201	Differential equations	معادلات تفاضلية	3	3	-	2
3	GE201	Technical Report Writing	كتابة التقاريرالفنية	2	2	-	-
2	CHE201	Introduction to Chem. Eng. I	مقدمة هندسة الكيميائية 1	3	3	-	2
4	CHE203	Organic Chemistry	كيمياء عضوية	4	3	2	1
5	CHE207	Materials Science and Eng.	مقدمة في علم المواد	3	2	2	1
6	CHE209	Physical Chemistry	كيمياء فيزيائية	3	3	-	2
	Total			18	16	04	08

Second Year **Fourth Semester: Spring**

No	Code	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	GS202	Linear algebra	جبرخطي	3	3	-	2
2	GS204	Statistics &Probability	إحصاء واحتمالات	2	2	-	1
3	EE214	Electrical Engineering	هندسة كهربائية	3	3	-	2
4	GE204	Engineering Computation	برمجة هندسية	3	2	2	1
5	CHE206	Thermodynamics I	الديناميكا الحرارية 1	3	3	-	2
6	CHE208	Introduction to Chem. Eng. II	مقدمة الهندسة الكيميائية 2	3	3	-	2
	Total			17	16	02	10

Note:
Every theoretical hour means one unit.
Every practical hour means half unit.

GS	General Science
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Third Year — Fifth Semester: Fall

No	Code	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	CHE309	Petrochemical Industry	الصناعات البتروكيميائية	3	3	-	2
2	GE301	Numerical Analysis	تحليلات عددية	3	2	2	1
3	CHE301	Thermodynamics II	الديناميكا الحرارية 2	3	3	-	2
4	CHE303	Chemical Eng. Lab	معمل هندسة كيميائية	3	2	2	1
5	CHE305	Fluid Mechanics	ميكانيكا الموائع	3	2	2	1
6	CHE307	Mass Transfer I	انتقال الكتلة 1	3	3	-	2
	Total			18	15	06	09

Third Year — Sixth Semester: Spring

No	Code	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	CHE302	Mass Transfer II	انتقال الكتلة 2	3	3	-	2
2	GE306	Engineering Economy	اقتصاد هندسي	3	3	-	2
3	CHE306	Heat Transfer	انتقال الحرارة	3	3	-	2
4	CHE310	TE1:Instrumental Analysis	طرق التحليل الالي	3	3	-	2
5	CHE312	Electrochemical Engineering	هندسة كهروكيميائية	2	2	-	1
	Total			14	14	-	09

Note:
Every theoretical hour means one unit.
Every practical hour means half unit.

GS	General Science
GE	General Engineering
HS	Humanities Science
EE	Electrical Engineering
ME	Mechanical Engineering
CE	Civil Engineering
CHE	Chemical Engineering
PE	Petroleum Engineering

Fourth Year — Seventh Semester: Fall

No	Code	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	CHE401	Modeling in Chemical Eng.	النماذج الرياضية في الهندسة الكيميائية	3	3	-	2
2	CHE403	Unit Operations Lab I	معمل العمليات لموحدة 1	3	2	2	1
3	CHE405	Polymer Processing	تصنيع المواد البوليمرية	3	3	-	2
4	CHE407	Communication	الاتصال الفعال	2	2	-	-
5	CHE409	Chemical Reaction Eng. I	هندسة التفاعلات 1	3	3	-	2
6	CHE411	Process Dynamics &Control	عمليات التحكم	3	2	2	1
	Total			17	15	04	08

Fourth Year — Eighth Semester: Spring

No	Code	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	CHE402	Computer-aided Process Eng.	ورشة عمل تصاميم هندسية	3	3	-	2
2	CHE404	Unit Operations Lab II	معمل العمليات لموحدة 2	3	2	2	1
3	CHE406	Natural Gas Processes	عمليات الغاز الطبيعي	3	3	-	2
4	CHE408	Chemical Reaction Eng. II	هندسة التفاعلات 2	3	3	-	2
5	CHE410	Corrosion Engineering	هندسة التاكل	3	3	-	2
	Total			15	14	02	09

Note:
Every theoretical hour means one unit.
Every practical hour means half unit.

GS	General Science
GE	General Engineering
HS	Humanities Science
EE	Electrical Engineering
ME	Mechanical Engineering
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CHE	Chemical Engineering
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Fifth Year — Ninth Semester: Fall

No	Code	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	CHE 501	Process Analysis and Plant Design	تصميم عمليات المصانع	2	2	-	1
2	CHE 503	TE2:Petroleum Refinery	المصافي البترولية	3	3	-	2
3	CHE 505	Pollution Control	التلوث البيئي	3	3	-	2
4	CHE 5--	Elective course I	مقرر اختياري 1	3	3	-	2
5	CHE 529	Graduation Project part I	مشروع تخرج الجزء 1	-	-	-	3
	Total			11	11	-	10

Fifth Year — Tenth Semester: Spring

No.	Code.	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	CHE 502	TE3: Engineering Management	الإدارة الهندسية	2	2	-	1
2	CHE 5--	Elective course II	مقرر اختياري 2	3	3	-	2
3	CHE 5--	Elective course III	مقرر اختياري 3	3	3	-	2
4	CHE 530	Graduation Project part II	مشروع تخرج الجزء2	3	3	-	-
	Total			11	11	-	05

Total units	155

Note:
Every theoretical hour means one unit.
Every practical hour means half unit.

GS	General Science
GE	General Engineering
HS	Humanities Science
EE	Electrical Engineering
ME	Mechanical Engineering
CE	Civil Engineering
CHE	Chemical Engineering
PE	Petroleum Engineering

List of Elective Courses I:

No	Code.	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	CHE531	Nuclear and Modern Physics	الفيزياء النووية والحديثة	3	3	-	2
2	CHE533	Desalination	تحلية مياه البحر	3	3	-	2
3	CHE535	Chemical Industries	الصناعة الكيماوية	3	3	-	2
4	CHE537	Waste Water Treatment	معالجة مياه الصرف الصحي	3	3	-	2
5	CHE539	Industrial Wastewater Pollution Control	مكافحة تلوث مياه الصرف الصحي	3	3	-	2
6	CHE541	Water Quality Engineering	هندسة جودة المياه	3	3		2
7	CHE543	Combustion Phenomena	ظواهر الاحتراق	3	3	-	2
8	CHE545	Nano-technology	التقانه الدقيه	3	3	-	2
9	CHE547	Materials Resistance	مقاومة المواد	3	3	-	2

List of Elective Courses II:

No.	Code.	Subject		Units	Theoretical	Practical	Tutorial
		English	Arabic				
1	CHE532	Solar Energy	الطاقة الشمسية	3	3	-	2
2	CHE534	Adsorption Processes	عمليات الاهتزاز	3	3	-	2
3	CHE536	Transport Phenomena	ظواهر النقل	3	3	-	2
4	CHE538	Engineering for Solid Waste Management	الهندسة لادارة النفايات الصلبة	3	3	-	2
5	CHE542	Air Pollution Control	مكافحة تلوث الهواء	3	3	-	2
6	CHE544	Industrial Ecology	علم البيئة الصناعية	3	3	-	2
7	CHE546	Pulp and Paper Processes	علم البيئات الصناعية	3	3	-	2
8	CHE548	Food Engineering	الهندسة الغذائية	3	3	-	2

توصيف مقررات قسم الهندسة الكيميائية

HUMANITIES SCIENCES

HS 103 Cr. 2.0 (2/-/-)
English Language I
A short refresher course in ordinary English to help bridge the gap between school and university students ; the oral / oral approach and modern techniques are used. A lengthy intensive course in technical English to enable the students to understand their lectures and
textbooks on Engineering topics .

HS 104 Cr. 2.0 (2/-/-)
English Language II
A more advanced course in ordinary English to improve the students' standards .in the basic language skills; the oral/ oral approach and modern techniques are used. A still more
intensive course in technical English , advanced oral and written nglish; language laboratory
composition , specialized English (for civil, Electrical, Mechanical Engineering). Beginning
report writing , elementary research techniques.

HS 106 Cr. 2.0 (2/-/-)
Arabic Language
.Grammer, Conversation, sentences structure (Noun and verb), adjectives

GENERAL SCIENCE

GS 101 Cr. 3.0 (3/2-/-)
Engineering Mathematics I
Differential calculus: General introduction , sets , numbers , inequalities , limits , functions ,
continuity functions , derivatives , polynomials , standard functions , inverse functions , chain rule , increasing functions , decreasing functions , tracing , maximum points , minimum points , Roll's theorem , mean value theorem Integral calculus: Indefinite integrals , definite integrals and its applications , integration of inverse trigonometric functions , exponential function , logarithmic functions , methods of integration , integration by parts , integration by substitution .

GS 102 Cr. 3.0 (3/2/-)
Engineering Mathematics II
Sequences – Series – Convergence tests – Expansions of functions – Maclaurine and Taylor
expansions – Complex Numbers - Algebra of complex numbers – Cartesian representation -
polar form of complex numbers - Euler form – Demoivre theorem – Conjugate numbers -
Modulus – Argument – n-th roots of unity – roots of complex numbers – Functions of several
variables – partial differentiations – Duple and triple integrals – Applications – Lengths of
curves – surface area – volumes of solids – Center of gravity of some bodies – in different coordinate systems.

GS 201 Cr. 3.0 (3/2/-)
Engineering Mathematics III

Linear Algebra: Operations on determinants and matrices , basic concepts , addition of matrices , multiplication by numbers , transpose of matrices , spiral matrices , matrix multiplication, system of linear equations , Gaus elimination , rank of matrices, existence and
general properties of solution, the inverse of matrix , determinations, Cramer's rule, bilinear ,
quadratic , hermition, skew- hermitian forms, eigenvalues and eigenvectors, eigenvalue of
hermitian ,skew – hermition and unitary matrices. Vector spaces, sub- spaces, dependence
and independence, rank and dimension, eigenvalues and eigenvectors problem, Cayley –
Hamilton theorem. Scalar and vector field theory. Vector in 3- space, algebra of vectors ,
gradient, divergence, crul, curves, arc length, tangent, normal, binomial, curvature, torsion.

GS 202 Cr. 3.0 (3/2/-)
Engineering Mathematics IV
Ordinary differential equations: General Introduction, Definitions, order, degree, formation
of Ordinary differential equations by constants elimination, general solution, particular solution, initial conditions and boundary conditions, orthogonal trajectories.
First order differential equations: Variable separable equations , homogeneous equations ,
linear equations , Bernoulli's equations , Recatti's equation , total differential equations ,
Definition of the total differential equation , sufficient and necessary conditions , solution of
the total differential equations , integrating factors ,determination of the integrating factors .
Higher order linear differential equations: Linear dependence and independence of solutions , solution of linear equations with constant coefficients , solution of nonhomogeneous equations with constant coefficients by undetermined coefficients and variation
of parameters, solution of Cauchy – Euler's equations of variable coefficients
Laplace Transformations: Definition, properties and applications to solution of differential
equations and system of differential equations

GS 103 Cr. 3.0 (3/-/-)
Physics I
Units, Properties of matter (Atomic structure, elasticity, surface tension, fluid mechanics),
Heat and thermodynamics (heat quantity and specific heat, heat transfer, laws of thermodynamics, ideal gases), Mechanics (linear and circular motion, Newton’s Laws of
motion, work, energy, conservation laws), Vibration and waves (traveling and standing waves, properties and propagation of sound), Light (light waves, reflection, refraction, mirrors, lenses).

GS 104 Cr. 4.0 (3/-/3)
Physics II
Electricity and magnetism (charge, coulomb’s Law, electric field, Gauss’s Law, electric field,
Gauss’s Law and its applications, electric potential, capacitors and dielectrics, resistance, Emf
and circuits, magnetic field, magnetic induction effect, Ampere’s Law, Kirchhoff’s laws, Alternating currents and Active circuits.
Physics lab Experiments are taken out from the contents of physics I and physics II.

Prereq: GS 103

GS 105 Cr. 4.0 (3/-/3)
Engineering Chemistry
Chemical principles with applications in engineering. Stoichiometric calculations, properties of gases, properties of liquids and solutions, gas phase chemical equilibrium, ionic equilibrium in aqueous solution, oxidation-reduction reactions, chemical kinetics. Atomic structure, units and dimensions, combustions and fuels.
Engineering Chemistry Lab : Detection of acid radicals, Detection of basic radicals, Detection of Acid and basic radicals,volumetric analysis.

GS 301 Cr. 3.0 (3/1/-)
Statistics and Probability
Introduction to statistical methods for analyzing and interpreting process data. Introduction to statistical ideas, probability theory, distribution theory, sampling theory, confidence intervals and significance tests. Introduction to regression analysis. Introduction to design of experiments and statistical quality control.

GENERAL ENGINEERING

GE 101 Cr. 2.0 (1/-/2)
Technical Workshop
Part I: Industrial safety, Physical & Mechanical properties of Engineering Materials, Heat treatment of steel, Ferrous &non-ferrous Materials. Part II: Casting Processes, Hot-working Processes (Hot rolling, Forging ,Extrusion) Cold working Processes (Cold rolling, Drawing, Deep Drawing, Impact extrusion),Joining Metals by welding, Engineering Measurements, An idea About Inspection and quality control. Part III: The training Includes the following :
.(Measurement Instruments, Casting, Milling, turning, Shaping, Forging, carpentry)

GE 102 Cr. 3.0 (1/-/4)
Engineering Drawing
General introduction, Historical background, Drawing's scale, Lettering and lines, Drawing's layout, Use and maintenance of drawing's instruments, Geometrical constructions, Freehand sketching, The theory of projection orthographic, Multi-view orthographic projection, First and Third angle projections, Using of third angle projection, Founding the third view given two views, Auxiliary views, Sectional views, Dimensioning, , Isometric drawing, Isometric projection, Oblique projection, General applications.

GE 103 Cr. 3.0 (3/2/-)
Engineering Mechanics I
Introduction, concepts and basic definitions; force analysis in two dimensions & three dimensions, moments and moments of couple, force resultant , equilibrium (equilibrium requirements , free body diagram , types of supports , reactions of statically determinant beams), center of gravity and engineering centres of lines and areas, moment of inertia , trusses (nodes method- sections) ,friction .

GE 104 Cr. 3.0 (2/1/2)
Computer Programming
Introduction to computer hardware and software. Binary system. Windows system. Microsoft office, MS Word (Text writing, tables, equations, graphs), MS Excel (tables, graphs, arithmetic calculations, functions), MS PowerPoint (presentation preparations, sounds, videos, smart art, slides design, posters design). Problem solving techniques, C language programming, program structure, constants and variables, arithmetic calculations, input and output functions, control structures: sequential, selection, and repetition structures, one dimensional and two dimentional arrays, user-defined functions, review of important C language features.
Computer Programming Lab: to further enhance the computer skills through the use of computer aided problem solving, program coding in C, Program execution and debugging.
Engineering oriented exercises. Also to develop students skills on text writing through the use of MS office word, excel applications, and power point presentations

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GE 202 Cr. 1.0 (1/2/-)
Technical Report Writing
Definitions of scientific research (characteristics & steps of conducting research work. Types
of research and their objectives. Selection of research subject. Research plan). Using the library (Classification schemes, footnotes, numbering systems). Rules for writing the technical report (sentences, styles, numbering & summarizations). Presentations of data (tables, figures, charts & drawings). Report presentation and discussion. Guidelines for preparing a model technical report. Scientific english terminology.

GE 204 Cr. 2.0 (2/2/-)
Engineering Computation (Applications)
Introduction to digital computers, hardware and software organization. Programming fundamentals. Algorithms and control structures. Computer communication. Spreadsheets for
problem solving, plotting, fitting data, building new functions, and making iterations and loops. Problem solution, plotting, and creating complex programs in a programming environment (MathLab, C/C++, or Fortran). Elementary numerical methods (e.g. Taylorseries summations, roots of equations, roots of polynomials, system of linear and nonlinear
algebraic equations, integration .(

GE 301 Cr. 3.0 (3/1/-)
Electrical Enginecring
To introduce the students to the basic concepts and principles to analyze and design simple
electrical and electronic circuits. Electrical circuits : current, voltage, energy and power, Kritchove's law and its applications, theory of electrical network and its applications, the
magnetic circuit and its analysis, power factor and analysis of a.c circuits. Fundamentals and
principles of semi-conductors junctions, devices and their applications

RECOMMENDED ENGINEERING COURSES

CHE 201 Cr. 3.0 (3/1/-)
Introduction to Chemical Engineering I
Introduction to basic methods and principles in Chemical Engineering. The fundamentals of
engineering calculations (units and dimensions), behavior of gases (ideal gas law, real gas
relationships, vapor pressure, saturation, partial saturation and humidity), behaviour of fluids, mass balances, processes and process variables.

CHE 203 Cr. 3.0 (3/1/-)
Organic Chemistry for Engineering Students
Introduction, nomenclature, preparation and reaction of aliphatic hydrocarbons (alkanes, alkenes, alkynes and alicyclic hydrocarbons), alkylhalides, alcohols and glycols, ethers, aldehydes and ketones, carboxylic acides and its derivatives (acid anhydrides, esters and amides). Introduction to basic concepts, nomenclature, preparation and reaction of aromatic
hydrocarbons, benzene and its derivatives

CHE 205 Cr. 1.0 (-/-/3)
Organic Chemistry Lab
Determination of melting and boiling points, separation by extraction, simple and steam distillation, technique of sublimation, purification by crystallization, qualitative analysis for
the elements (Sodium fusion test). Preparation of: Methane, Ethylene, Acetylene, n.Butyl
chloride, Acetaldehyde, Acetone, Formic acid, Methylbenzoate, and Diazonium salts.

CHE 207 Cr. 3.0 (3/1/-)
Materials Science and Engineering
Fundamentals; atomic bonding, crystalline structure, crystal defects, non-crystalline materials;
structure and properties of metals. Amorphous materials. Processing and concepts of engineering design of materials. Mechanical properties of materials.

CHE 209 Cr. 3.0 (3/1/-)
Physical Chemistry
Thermodynamics: ideal solutions; non-ideal solutions, non-electrolytic and electrolytic solutions, phase equilibrium and phase diagrams, reaction equilibrium. Surface phenomena:
surface tension, capillarity, properties of small particles, adsorption, Gibbs adsorption equation, adsorption by solid, Loungmir theory of adsorption chromatography. Chemical kinetics: rate laws, reaction rates, mechanisms, catalysis, heterogeneous reactions.

CHE 202 Cr. 3.0 (3/1/-)
Polymer Chemistry
Scientific Principles, structure principles include chemical physical structure, synthesis and
reactions include addition and condensation polymers, classification of polymers includes
natural polymers such as cellulose acetate, cellulose nitrate, natural rubber, synthesis
polymers such as: thermoplastic polymers (polyethylene polymers, polyvinyl polymers, polyamide polymers), thermosetting polymers (phenol - formaldehyde polymers, urea - formaldehyde polymers, melamine - formaldehyde polymers).

CHE 204 Cr. 1.0 (-/-/2)
Chemical Engineering Lab I
The concept of the scientific experiments, technical report writing, descriptive and practical
experiments, preparation and use of computer software related to the following subjects: Polymer chemistry, polymer processing, physical chemistry.

CHE 206 Cr. 3.0 (3/1/-)
Thermodynamics I
Introduction: units, terms and definitions. Thermodynamic properties, temperature, work and
heat as forms of energy. State of pure substances. State equation of ideal Gases. The PVT
behavior of pure substances. First law of thermodynamics, internal energy and enthalpy. Heats of chemical and physical changes. Second law of thermodynamics, entropy, spontaneity and equilibrium, free energies. Thermodynamic relations Maxwell relations, relations involving: enthalpy internal energy and entropy. Third law of thermodynamics. Systems of variable composition, chemical equilibrium. Phase behaviour and critical conditions. Phase equilibrium and the phase rule. Ideal solutions, colligative properties. Introduction to electrochemistry. Thermodynamic tables.

CHE 208 Cr. 3.0 (3/1/-)
Introduction to Chemical Engineering II
An extension of the topics covered in CHE 201. Energy balances (concepts and units of energy, heat capacity, calculation of enthalpy changes with and without change of phase, general energy balance and the mechanical energy balance, heat of reaction, simultaneous use
of material and energy balances for the steady state, application of material and energy balances on chemical plants, introduction to unsteady state material and energy balances).

CHE 301 Cr. 3.0 (3/1/-)
Thermodynamics II
Real gases. Compressibility factors and other methods of accounting for non-ideality. Non
ideals behavior in systems of variable composition. Partial molal properties. Fugacity and
fugacity coefficient. Activity and activity coefficient. Excess properties, Heat effect on mixing, The phase rule and Duhem's theorem Criteria of equilibrium. Vapor - liquid equilibrium at low and high pressures. Dew point, bubble point and flash calculations. Chemical reaction equilibrium. Equilibrium constants and dependence on temperature, Single
and multiple reactions equilibrium conversions. Power cycles: Thermodynamic cycle carnot;
Ranking reheat; Otto Diesel Dual Brayton and vapor compression refrigeration cycles.

CHE 303 Cr. 1.0 (-/-/3)
Chemical Engineering Lab II
A selection of computer and laboratory exercises refreshing and reinforcing material covered
in the previous term. Topics may include: physical chemistry, mass and energy balances, thermodynamics, principles of design and safety.

CHE 305 Cr. 3.0 (3/1/-)
Fluid Mechanics

Fundamentals of fluid flow. Fluid statics, velocity and shear, continuity, momentum and energy equations. Bernoulli equation. Laminar and turbulent flow regimes, friction loss in
pipes. Transportation and metering of fluids. Pumps and Compressors. Agitation of liquids,
compressible flow, flow around submerged objects. Flow through beds of solids, fluidization.
Dimensional analysis.

CHE 307 Cr. 3.0 (3/1/-)
Mass Transfer
Introduction to mass transfer operations. Fundamentals of mass transfer by molecular diffusion. Microscopic mass balance. Steady-state diffusion: 1D and 2D problems. Transient
diffusion: 1D problems. Diffusion in gases, liquids, and solids, diffusion coefficient in gases
and liquids, shell mass balance with and without chemical reaction. Unsteady state diffusion,
mass transfer coefficients, theories of mass transfer, determination of mass transfer coefficients, interphase mass transfer. Convective mass transfer. Empirical correlations for
convective mass transfer. Mass transfer at fluid-fluid interfaces.

CHE 302 Cr. 3.0 (3/1/-)
Equilibrium Stage Operations

Equilibrium between phases; the equilibrium stage concept. Cascades of stages with and without reflux; group methods and stage-by-stage approaches; graphical solutions.
Applications in the separation of components by distillation, absorption, stripping, extraction
and leaching. Humidification and drying of solids. Evaporation.

CHE 304 Cr. 1.0 (-/-/3)
Communication
Each student will make a large number of very short speeches developing skills for speaking
to large and small groups. Many elements of public speaking are explored: voice, body language, timing, word selection, speech preparation, speech structure, audience and surroundings. Students will prepare and present overheads. Extemporaneous speeches. Questions and answers. Interviewing.

CHE 306 Cr. 3.0 (3/1/-)
Heat Transfer
Fundamentals of conductive heat transfer. Microscopic energy balance. Steady state heat conduction : 1D and 2D problems. Transient heat conduction: 1D problems. Convective heat
transfer. Analysis of convective heat transfer in external flows using boundary layer approach. Analysis of convective heat transfer in internal flows. Empirical correlations for
convective heat transfer. Heat exchanger design. Fundamentals of radiative heat transfer.

CHE 308 Cr. 3.0 (3/2/-)
Numerical Methods
Errors & approximation. Finding roots of equations : secant, Newton-Raphson & bisection
method. Solution of linear equation system : matrix inversion, Gauss-Seidel & jcobi methods,
matrix decomposition, and gauss elimination. Methods of approximation theory : LaGrange
Form, Newton divided differences, least square method (linear, nonlinear & multiple linear
approximations, approximation with least squares polynomial). Numerical integration : rectangular, trapezoidal & Simpson' rules, Romberge's equations, Gaussian quadrature. Numerical differentiation. Ordinary differential equation : Euler's formula, modified Euler's
method, Runga-Kutta method. Partial differential equations. Introduction to finite elements
method. Practical applications using computer.

CHE 310 Cr. 2.0 (2/2/-)
TE 1 (Special Topics in CHE)
Specialized Engineering Drawing
Flow sheet symbols: instrumentation drawings-flow, level, pressure& temperature-piping
drawings: types of lines are used in piping drafting-Equipment symbols: valves& storage tanks-pumps& compressors-heat exchanger& heaters-filters& evaporators-dryers& process
vessels-Flow sheet presentation: types of flow sheet-block flow sheet-process flow sheetExamples of: flow sheet of cumene plant-flow sheet of manufacture of HCL-flow sheet of
piping layout for a fuel oil system. Introduction to Autocad software.

CHE 312 Cr. 3 (3/1/-)
Electrochemical Engineering
Topics and applications of electrochemistry and electrochemical engineering. Industrial process examples. Environmental aspects. Ionic equilibria. Laws of electrolysis. Theory of
electrolytes. Transport properties of electrolytes. Reversible cell potentials. Irreversible electrode processes. Thermodynamic and kinetic aspects of corrosion. Common examples of
corrosion. Electrochemical energy conversion and storage.

CHE 401 Cr. 3.0 (3/2/-)
Modelling in Chemical Engineering
This course outlines the methodology for the mathematical modelling of physical systems and
its applications. Topics will include a review of physical laws, selection of balance space, compartmental versus distributed models, and applications of the conservation laws including
force, and energy balances for both discrete and continuous systems at the level of algebraic
and ordinary differential equations. The course covers a wide range of applications including
environmental issues, material science, transport phenomena, and unit operations.

CHE 403 Cr. 2.0 (-/-/6)
Unit Operations Lab I
The purpose of the lab is to cover the basic principles of fluid mechanics and heat transfer courses and comparing the experimental with theoretical data. Experiments in fluid mechanics are such as, study of compressible fluids through nozzles, incompressible fluid in
pipes with different diameters, agitation and mixing of liquids, screen analysis and filtration.
Experiments in heat transfer with and without change of phase through, free and forced convection, drop and film wise condensation, double pipe heat exchangers.

CHE 405 Cr. 3.0 (3/1/-)
Polymer Processing
An introduction to principles governing polymerization reactions and the resultant physical
properties of polymers. Molecular weight distribution. Crystallinity. Step-growth and chaingrowth polymerization and copolymerization. Selected additional topics in polymer
characterization properties.

CHE 407 Cr. 3.0 (3/1/-)
Corrosion Engineering
Introduction; form of corrosion (uniform attack, pitting corrosion, intergranular corrosion,
erosion corrosion, stress corrosion and hydrogen damage); thermodynamics aspects of corrosion (free energy, cell potential and EMF series, application of thermodynamics to corrosion); electrode kinetics (polarization, mixed potential theory, passivity and corrosion
rate measurement); corrosion testing and monitoring; methods of corrosion protections (cathodic protection, anodic protection, chemical inhibitors, coatings, and material selection).

CHE 409 Cr. 3.0 (3/1/-)
Reaction Kinetics
The rates of chemical processes. Topics include: measurement of reaction rates, reaction orders and activation energies; theories of reaction rates; reaction mechanisms and networks;
development of the rate law for simple and complex kinetic schemes; approach to equilibrium; homogeneous and heterogeneous catalysis. Performance of simple chemical
reactor types.

CHE 411 Cr. 3.0 (3/1/-)
Process Dynamics & Control
Laplace transform techniques; modelling of simple chemical processes; linear open loop systems; linear closed loop systems; block diagrams; transient response of simple control systems; root locus; frequency response methods; Bode diagrams; stability analysis of control
systems. Proportional-integral-derivative control; Controller tuning; Process control simulation and computer control systems; process applications; introduction to non-linear
systems.

CHE 402 Cr. 3.0 (3/1/-)
Computer-aided Process Engineering
This is an introductory course in chemical process simulation and design of different unit operations and important plant equipments design. Use of microcomputer based simulations;
or simulation software packages (i.e. gPROMS or AspenPlus) in the analysis of different chemical processes. Topics may include: Heat exchangers, Multi-tube reactor, Distillation
column, Adsorptive reactor, Pressure swing adsorption, Temperature swing adsorption, Absorption and regeneration processes, Heaters, Separators, Pumps and Compressors, Optimal operations of chemical process.

CHE 404 Cr. 2.0 (-/-/6)
Unit Operations Lab II
A selection of computer and laboratory exercises refreshing and reinforcing material covered
in the previous term. Topics may include: mass transfer unit operations, equilibrium stage
operations, and principles of design and safety. The lab covers the basic mass transfer operation experimentally, through various experiments such as, batch distillation, distillation
processes in packed and tray columns, liquid-liquid extraction, drying of solid materials, radiation, and double effect evaporators. This one term laboratory course involves experiments investigating thermodynamics, thermodynamic experiments may include: phase
equilibrium and calorimetry.

CHE 408 Cr. 3.0 (3/1/-)
Reactor Design

Covers the basics of simple reactor design and performance, with emphasis on unifying the concepts in kinetics, thermodynamics and transport phenomena. Topics include flow and residence time distributions in various reactor types as well as the influence of transport properties (bulk and interphase) on kinetics and reactor performance. The interplay of these facets of reaction engineering is illustrated by use of appropriate computer simulations.

CHE 410 Cr. 3.0 (3/1/-)
Engineering Economics
In this course we emphasize that an essential prerequisite of a successful engineering application is economic feasibility. Hence, investment proposals are evaluated in terms of economic cost concepts, including break even analysis, cost estimation and time value of money. Effective interest rates, inflation and deflation, depreciation and income tax all affect the viability of an investment. Successful engineering projects are chosen from valid alternatives considering such issues as buy or lease, make or buy, cost and benefits and financing alternatives.

CHE 501 Cr. 2.0 (2/1/-)
Process Analysis and Plant Design

Development and analysis of process flowsheets and chemical product design. Design and selection of common process equipment such as heat exchangers, pumps, piping, staged separations. Incorporation of pollution prevention and inherently safer design principles. Equipment and project cost estimation. Students work in teams to design plants for the chemical and process industries and examine their economic viability. Lectures concern the details of process equipment and design.

CHE 503 Cr. 3.0 (3/1/-)
TE 2 (Special Topics in CHE 2)
Introduction to Process Optimization
This first course in optimization uses a quantitative approach to problem solving involving, mathematical modelling and formulations, solution methods, and output analysis. Students are introduced to a variety of practical problem formulations in Chemical Engineering, a number of solution methods, including, but not limited to linear optimization. Introduction to advanced optimization techniques and applications.

CHE 505 Cr. 3.0 (3/-/-)
Pollution Control
Introduction to environmental engineering for water, air, and solid waste treatment. Source of
air pollution and pollution control. Solid and hazardous waste management. Disposal techniques.

CHE 551 Cr. 3.0 (3/1/-)
Elective I (Complementary Studies Elective)
The student is free to select one course from the available elective courses in the Department.

CHE 502 Cr. 2.0 (2/1/-)
TE 3 (Special Topics in non-CHE Subjects)
Engineering Management

An introduction to the methods and principles of management engineering. Written, graphical, and oral forms of technical communication. Engineering graphics fundamentals of projection, computer-aided design, freehand sketching, and the interpretation of technical drawings. Introduction to quantitative methods of data analysis, planning, forecasting, decision modeling, and work flow analysis.

CHE 552 Cr. 3.0 (3/1/-)
Elective II (Complementary Studies Elective)
The student is free to select one course from the available elective courses in the Department.

CHE 530 Cr. 3.0 (2/-/3)
B.Sc. Project
The course consists of a research project conducted under the supervision of a senior staff
member. The project may have an experimental, theoretical or design emphasis. This course
is open to students with permission of the Department and research project supervisor.

COMPLEMENTARY STUDIES ELECTIVE

Elective I

1) Nuclear and Modern Physics
2) Desalination
3) Chemical Industries
4) Waste Water Treatment
5) Industrial Wastewater Pollution Control
6) Water Quality Engineering
7) Combustion Phenomena
8) Nano-technology
9) Materials Resistance

Elective II

1) Solar Energy
2) Adsorption Processes
3) Petroleum Refining Engineering
4) Transport Phenomena
5) Engineering for Solid Waste Management
6) Air Pollution Control
7) Industrial Ecology
8) Pulp and Paper Processes
9) Food Engineering
10Petrochemical Industries

Elective Course Description

CHE xxx Cr. 3.0 (3/1/-)

NUCLEAR AND MODERN PHYSICS

Radiation quantum theory, blackbody radiation, cathodic ray, electron charge, isotopic mass,
Blanck's photon theory, Einstein's special theory of relativity, photoelectric effect, Compton
interaction, pair production and annihilation process, relativistic momentum – equivalence of
mass and energy, hydrogen's spectrum, Rutherford's model, Bohr' model and atomic theory,
Energy levels, resonance potential, quantum number, X-ray, particles and waves, Doppler
effect for wave and particle, nuclear energy.

CHE xxx Cr. 3.0 (3/1/-)
Air Pollution Control
Nature and sources of air pollutants. Transport of pollutants and dispersion modeling for regulatory purposes. Design of industrial particulate capture systems using cyclones, electrostatic precipitators, filters, scrubbers. Design of organic compound emissions control
using incineration, biofiltration, adsorption and absorption. Overview of NOx and SOx control. Indoor air quality assessment techniques.

CHE xxx Cr. 3.0 (3/1/-)
Engineering for Solid Waste Management
The engineering aspects of solid waste management are examined. Attention is given to the engineering design and operational aspects of the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in landfill site. Design of natural attenuation sites and system reliability features for landfill designs.

CHE xxx Cr. 3.0 (3/1/-)
Wastewater Treatment
Wastewater quantity and characteristics. Primary treatment and secondary treatment. Reverse osmosis, ultra filtration, adsorption, air stripping, air flotation, chemical precipitation. Sludge treatment and disposal. Groundwater and leachate treatment. Industrial wastewater management.

CHE xxx Cr. 3.0 (3/1/-)
Chemical Engineering Design Workshop
In this course, students study the design process including: problem definition and needs analysis; process synthesis, process debottlenecking and troubleshooting; safety and environmental protection in design; written and oral communication for design reports.

CHE xxx Cr. 3.0 (3/1/-)
Industrial Wastewater Pollution Control
Primary focus is on the control and treatment of inorganic aqueous waste from chemical process industries. Waste minimization methods with specific examples such as rinsewater
circuit design. Principles and design of treatment methods: chemical treatment, precipitation,
coagulation and flocculation, ion exchange and membrane separation. Treatment of organic
aqueous waste.

CHE xxx Cr. 3.0 (3/1/-)
Industrial Ecology
Industrial Ecology is a rapidly growing field that systematically examines local, regional, and
global uses and flows of materials and energy in products, processes, industrial sectors, and
economies. It focuses on the potential role of industry in reducing environmental burdens throughout the product life cycle from the extraction of raw materials to the production of
goods, to the use of those goods and to the management of the resulting wastes. This course
will review the environmental issues associated with chemical industries and the roles of
engineers to manage these issues. The principles and philosophy of green chemistry will be
addressed including pollution prevention in unit operations. The concepts and practices of
environmental life cycle analysis and accounting will be addressed in detail, together with the
basics of risk assessment, management and communication.

CHE xxx Cr. 3.0 (3/1/-)
Water Quality Engineering

Water sources and use. Characteristics of water: physical, chemical, and bacteriological parameters. Water quality management. Solid and hazardous waste management. Biodegradable waste disposal in streams. Water and waste treatment systems: sedimentation, biological treatment theory, design principles.

CHE xxx Cr. 3.0 (3/1/-)
Combustion Phenomena
Combustion thermodynamics, introduction to chemical kinetics of combustion, combustion properties of fuels, flammability of combustible mixtures. Flame propagation mechanisms, pre-mixed and diffusional; stability of flames; introduction to combustion aerodynamics, jet flames; atomization; droplet and spray combustion. Elementary ignition concepts and theory. Basic detonation theory.

CHE xxx Cr. 3.0 (3/1/-)
Pulp and Paper Processes
The processes of pulping, bleaching and papermaking are used to illustrate and integrate chemical engineering principles. Chemical reactions, phase changes and heat, mass and momentum transfer are discussed. Processes are examined on four scales: molecular, diffusional, unit operations and mill. In the tutorial each student makes several brief presentations on selected topics and entertains discussion

CHE xxx Cr. 3.0 (3/1/-)
Food Engineering
The quantitative application of chemical engineering principles to the large-scale production
of food. Food processing at the molecular and unit operation levels. The chemistry and kinetics of specific food processes. The application of chemical engineering unit operations
(distillation, extraction, drying) and food specific unit operations such as extrusion, thermal
processing refrigeration/freezing.

CHE xxx Cr. 3.0 (3/2/-)
Physical Metallurgy
Crystal structure, imprefections, voids and stacking sequence, plastic deformation and annealing, recovery, recrestalyzation and grain growth, solid solution, humepothery rules, binary phase diagrams, miscibility gap, eutectic, eutectoid, peritectic phase diagram, Fe-C systems, structure of steels, grading and classification of steels, solidification of metals, thermodynamics, kinetics and casting defects.

Technical Electives (1, 2, and 3)

CHE 310 Cr. 3.0 (3/2/-)
TE 1 (Special Topics in CHE)
1) Specialized Engineering Drawing
2) Physical Metallurgy
3) Instrumental Methods of Analysis

CHE 503 Cr. 3.0 (3/1/-)
TE 2 (Special Topics in CHE 2)
1) Intro to Process Optimization
2) Chemical Engineering Design Workshop
3) Nuclear and Modern Physics
4) Petroleum Refinery Engineering

CHE 502 Cr. 2.0 (2/1/-)
TE 3 (Special Topics in non-CHE Subjects)
1) Engineering Management
2) Law Culture
(3University Policies