



دليل
كلية الهندسة
2020

قسم الهندسة الكيميائية
Department of Chemical Engineering

**List of courses**The 1st: List of General courses

أولاً:- قوائم مسميات المقررات الدراسية للمرحلة العامة :-

Humanities courses**العلوم الإنسانية**

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
GH141	English I	Nil	3	اللغة الإنجليزية 1	ع 141
GH142	English II	GH141	3	اللغة الإنجليزية 2	ع 142
GH150	Arabic I	Nil	2	اللغة العربية 1	ع 150
GH151	Arabic II	GH150	1	اللغة العربية 2	ع 151
			9	المجموع	

General science courses**العلوم الأساسية العامة**

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
GS101	Mathematics I	Nil	3	الرياضيات 1	ع ع 101
GS102	Mathematics II	GS101	4	الرياضيات 2	ع ع 102
GS111	Physics I	Nil	3	الفيزياء 1	ع ع 111
GS112	Physics II	GS111	3	الفيزياء 2	ع ع 112
GS112L	Physics Lab	GS111	1	فيزياء معمل	ع ع 112 م
GS115	Chemistry	Nil	3	الكيمياء العامة	ع ع 115
GS115L	Chemistry Lab	Nil	1	الكيمياء معمل	ع ع 115 م
GS200	Computer Programming	Nil	3	برمجة حاسوب	ع ع 200
GS203	Mathematics III	GS102	3	الرياضيات 3	ع ع 203
GS204	Mathematics IV	GS102	3	الرياضيات 4	ع ع 204
GS206	Probability & Statistics	Nil	3	الإحصاء والاحتمالات	ع ع 206
			30	المجموع	

General engineering courses**العلوم الهندسية العامة**

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
GE121	Engineering Mechanics I	Nil	3	ميكانيكا هندسية 1	ه ع 121
GE127	Engineering Drawing	Nil	2	الرسم الهندسي	ه ع 127
GE129	Workshop Technology	Nil	2	تقنية الورش	ه ع 129
GE129 L	Workshop Technology Lab	Nil	1	معمل تقنية الورش	ه ع 129 م
GE133	Properties of Materials	GS101 GS111 GS115	3	خواص المواد	ه ع 133
GE222	Engineering Mechanics II	GE121	3	ميكانيكا هندسية 2	ه ع 222
EE280	Fundamentals of Elect. Eng.	GS102,GS112	3	أساسيات الهندسة الكهربائية	ه كه 280
			17	المجموع	

ثانياً :- قائمة مسميات المقررات الدراسية الملزمة لجميع طلبة القسم. The 2nd : **List of Departmental Compulsory Courses**

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
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	المتطلبات	الوحدات		
CHE201	Intro. To Chem. Eng. I	GS115	3	مقدمة للهندسة الكيميائية 1
CHE202	Intro. To Chem. Eng. II	CHE201	3	مقدمة للهندسة الكيميائية 2
CHE211	Physical chemistry I	GS115	3	كيمياء فيزيائية 1
CHE211L	Physical chemistry I Lab	CHE211	1	معمل كيمياء فيزيائية 1
CHE212L	Lab Physical chemistry II	CHE211L	1	معمل كيمياء فيزيائية 2
CHE212	Physical chemistry II	CHE211 GS115	3	كيمياء فيزيائية 2
CHE301	Thermodynamics I	CHE211 GS203	3	ديناميكا حرارية 1
CHE302	Thermodynamics II	CHE301	3	ديناميكا حرارية 2
CHE311	Fluid Mechanics	CHE202 GS203	4	ميكانيكا الموائع
CHE312	Heat transfer	CHE311 GS203 CHE202	4	انتقال الحرارة
CHE321	Numerical Methods	GS200 GS203	3	طرق التحليل العددي
CHE331	Organic chemistry I	GS115	3	كيمياء عضوية 1
CHE331L	Organic chemistry I Lab	GS115 GS115L CHE331	1	معمل كيمياء عضوية 1
CHE332	Organic chemistry II	CHE331	3	كيمياء عضوية 2
CHE332L	Organic chemistry II Lab	CHE331L CHE332	1	معمل كيمياء عضوية 2
CHE342	Instr. Method analysis	GS115 GS115L CHE331	3	طرق التحليل الآلي
CHE401	Petrochemical Industry	CHE332 CHE332L	4	الصناعات البتروكيميائية
CHE411	Chemical Eng. Kinetics I	CHE302 GS203	3	هندسة التفاعلات الكيميائية 1
CHE412	Chemical Eng. Kinetics II	CHE411	3	هندسة التفاعلات الكيميائية 2
CHE421	Mass Transfer I	CHE312 GS203 CHE302	3	انتقال المادة 1
CHE422	Mass Transfer II	CHE312 CHE421	3	انتقال المادة 2
CHE431	Unit Operation Lab. I	CHE311 CHE312	3	معمل العمليات الموحدة 1
CHE432	Unit Operation Lab. II	CHE422 CHE431	3	معمل العمليات الموحدة 2
CHE441	Eng. Economy	CHE421	3	مبادئ الاقتصاد الهندسي
CHE442	Corrosion	CHE411	3	هندسة التآكل
CHE452	Process Control	CHE411 GS204	3	تحكم آلي في العمليات
CHE501	Petroleum Refinery Eng.	CHE421	3	هندسة تكرير النفط
CHE511	Gas Cond. & Process	CHE421	3	صناعة الغاز
CHE521	Plant Design	CHE422 CHE441 HE412	3	تصميم عمليات المصانع
CHE531	Applied Mathematics Methods in chemical Engineering	CHE421 CHE411 GS204	3	تطبيقات رياضية في الهندسة الكيميائية
CHE541	Chem. Eng. Elective	CHE421	3	مقرر اختياري
CHE599	B.Sc. Project		5	المشروع
			93	المجموع

*** List of the Elective courses**

قائمة مسميات المقررات الاختيارية.

The student has to select 1 course From the List below which is 3 Credits

على الطالب إختيار مقرر دراسي واحد من قائمة المقررات الاختيارية المدرجة بالجدول ادناه بإجمالي عدد وحدات 3 وحدات

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
CHE 541	Cryogenics and Low-Temperature Processes.	CHE 301, CHE 311, CHE 312	3	العمليات تحت درجات منخفضة	هكم 541
CHE 541	Fundamental of Environmental Eng.	CHE 311, CHE 411, CHE 421	3	أساسيات الهندسة البيئية	هكم 541
CHE 541	Pollution and Pollution control	CHE 311, CHE 411, CHE 421	3	أساسيات الهندسة البيئية	هكم 541
CHE 541	Enhanced Oil Recovery	CHE 302, CHE 311, CHE 312, CHE 421	3	الاسترداد الإضافي للنفط	هكم 541
CHE 541	Desalination	CHE 301, CHE 311, CHE 312	3	التحلية	هكم 541
CHE 541	Polymer Engineering & Technology	CHE 332 CHE 401, CHE 441	3	هندسة وتقنيات البلمرة	هكم 541
CHE 541	Solar Energy Eng.	CHE 301, CHE 312	3	الطاقة الشمسية	هكم 541
CHE 541	Transport Phenomena	CHE 302, CHE 311, CHE 421	3	ظواهر الانتقال	هكم 541
CHE 541	Chemical Process Simulation and Design.	CHE 312, CHE 412, CHE 421	3	محاكاة وتصميم العملية الكيميائية	هكم 541
CHE 541	Biochemical Engineering Fundamentals	CHE 332, CHE 412	3	أساسيات الهندسة الكيمياء الحيوية	هكم 541
CHE 541	Molecular Biotechnology For Engineers	CHE 332, CHE 412	3	التقنية الحيوية الجزيئية للمهندسين	هكم 541
CHE 541	Eng. Management	CHE 442	3	الإدارة الهندسية	هكم 541

الجدول التالي يوضح تفاصيل متطلبات التخرج من حيث عدد الوحدة

القسم	الشعبة	العلوم الإنسانية		العلوم الأساسية العامة		العلوم الهندسية العامة		المقررات التخصصية المأزمة لجميع طلبة القسم		المقررات التخصصية الاختيارية لطلبة القسم		الإجمالي
		عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية	عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية	عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية	عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية	عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية	
الهندسة الكيميائية	القسم شعبة واحدة	10	6.6%	27	17.8%	19	12.5%	93	61.2%	3	2.0%	152

**General courses contents****المحتوي العلمي للمقررات الإنسانية العامة**

GH141	English I	3 Credits
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Pre-requisite: Nil

The main objective of this course (English I) is to encourage the learners to acquire the English language skills they need to pursue their specialized courses in different Departments of the Faculty. In order to achieve this purpose, emphasis should be relied upon the formal grammar of the language, reading and writing activities in the classroom and listening comprehension and note-taking practice in the language laboratory. Undoubtedly, this can help the students to express themselves freely while dealing with technical terminology, vocabulary items and structures related to their subject areas. The overall program is a complimentary and prerequisite course for all Engineering Departments (Four hours per week). It covers the following:-

Intensive Reading of different passages containing materials the students need to follow their departmental courses (vocabulary exercises, comprehension questions, contextual references, affixation, etc.).

- Description of the laboratory experiments.

Scientific vocabulary including the use of dictionary, punctuation, word-order, spelling, word-formation, etc.

- The study of English verb tenses, active forms and passive constructions.

The study of English nouns (kinds, functions, derivation) pronouns, adjectives, articles, adverbial phrases and so forth.

- Summary writing.

GH142	English II	3 Credits
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Pre-requisite: GH141

This program (English II) aims at developing the students' scientific and vocational skills. It is specially designed to introduce the learners to the basic patterns of technical terminology at the introductory stage and thereafter deals with more advanced topics. Thus the students can go further and become creative by way of discussion and various original contributions to the materials. It also offers an opportunity for the learners to evolve their communicative competence and comprehend their departmental contents with a restricted period of time.

However, this course tends to give instructions to the learners in a variety of subjects such as:-

Intensive Reading of passages (texts) including materials to students' needs with comprehension questions, contextual references, vocabulary exercises and affixation and so forth.

The study of scientific and technical vocabulary which involves the use of dictionary, spelling, picking up the meaning from the context, rules of affixation, etc.

Description of the laboratory experiments.

Revision and study of basic English verb tenses, active and passive voice in scientific technical



English.

The English noun phrases, relative clauses, deletion of relative relation in active and passive voice.

The study of English pronouns, adjectives, adverbial phrases, etc.

Summary Writing.

GH150	Arabic I	2 Credits
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Pre-requisite: Nil

Review of Arabic courses taken in high school, including construction of Arabic sentence, spelling and punctuation (Part one).

يهدف هذا المقرر إلى معرفة خصائص اللغة العربية وأهميتها وتوظيفها في الحياة العامة ، كما يهدف إلى تمكين الطلاب من معرفة ما يتركب منه الكلام من اسم وفعل وحرف النكرة والمعرفة إلى جانب دراسة بعض قواعد الإملاء بالتركيز عليها والاهتمام بها

GH151	Arabic II	1 Credit
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Pre-requisite: GH150

Review of Arabic courses taken in high school, including construction of Arabic sentence, spelling and punctuation (Part two).

يهدف هذا المقرر إلى تمكين الطلاب من معرفة الجملة بنوعيتها وأحكام المبتدأ والخبر ... تم الاهتمام بمعرفة المعاجم وكيفية الاستفادة منها في تفسير الكلمات ومعرفة معانيها.

GH152	Technical Writing Report	1 Credit
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Pre-requisite: GH151

Writing technical reports, Report preparation and presentation. Preparation of minutes of meetings. Translation of technical document.

تعريف وأهمية الكتابة التقنية وأهداف الكتابة التقنية وخصائصها ، أسس الكتابة التقنية ، عناصر التقارير الهندسية ومحتوياتها ، مراحل وطرق إعداد التقارير التقنية وإعداد الأشكال ، إعداد الجداول ، كتابة الأعداد ، إخراج وعرض التقارير ، مناقشة التقارير

General Science Courses Contents المحتوى العلمي للعلوم الأساسية العامة

GS101	Mathematics I	3 Credits
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Pre-requisite: Nil

- Review: sets, inequalities and absolute values inequalities.
- Functions: definition, limits, continuity, asymptotic lines, and derivatives (definition, theorems, chain rules, implicit differentiation, rates of change, derivative of higher order).
- Trigonometric functions and inverse trigonometric functions and their derivatives.
- Applications: slope of a tangent, the differential and approximations, the critical points, the relative and absolute maxima and minima, concavity and points of inflection, curve sketching, Roll's theorem, mean value theorem, and L'hospital's rule.



GS102	Mathematics II	4 Credits
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Pre-requisite: GS101

- Integration: definite and indefinite integrals, and their applications (area under a curve, area bounded by two curves, solids of revolution (disc method)).
- Transcendental functions: exponential, logarithm functions, the hyperbolic functions, hyperbolic inverse functions, and their derivatives and integrations
- Techniques of integration: (change of variables to find integrations, integration by parts, integration by substitutions, integration using partial fraction, reduction formulas).
- The complex numbers: (definition, properties, conjugates, absolute values, polar forms, and determining roots).
- Functions of several variables: (partial derivatives, implicit differentiation, chain rule and its applications, total differentiation and its applications, total differentiation of derivatives of second and higher order, maxima and minima, and Lagrange multiplier method).

GS111	Physics I	3 Credits
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Pre-requisite: Nil

Waves: Wave equations, traveling waves and stationary waves; principles of superposition, Doppler Effect.

Sound; Definitions, velocity of sound in air and material media and its variation, velocity of transverse & longitudinal vibration in wires and rods. Echoes briefly.

Optics: properties of light, the electromagnetic character of light; sources of light and their spectra, absorption & scattering, dispersion, polarization of light.

Heat, thermal equilibrium, Temperature measurement, heat as a form of energy, work, general gas Law, 1st Law of thermodynamics and its applications.

GS112	Physics II	3 Credits
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Pre-requisite: GS111

Electrostatics: changes and fields, the electric potential; electric current; the magnetic field, electric fields in matter. Photoelectric effect, Einstein's explanation and quantum theory of the hydrogen atom. Radioactive decay law derivation.

GS112L	Physics Lab	3 Credits
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Pre-requisite: GS111

Experiments about sound, light, electricity, magnetism, heat and electro-chemical conversion.



GS115	Chemistry	3 Credits
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Pre-requisite: Nil

Measurements and SI units; chemical equations and stoichiometry; structures of atoms and periodic relationships, chemical compounds:

The gaseous state; solutions-electrolytes and non-electrolytes; acids and bases; thermochemistry; chemical equilibrium; ionic equilibrium I and II; organic chemistry.

GS115L	Chemistry Lab	3 Credits
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Pre-requisite: GS115

Some experiments related to GS115 course.

GS200	Computer Programming	3 Credits
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Pre-requisite: Nil

Introduction to computer science; basic principles of computer structure; basic components of programming languages; problem solving steps; Algorithms; introduction to Programming Language; Tokens; Values & variables; Input & Output statements; Statements, Expressions and Operators; Flow of Controls (if, if..elseif, switch statements, ternary operator); Iteration and loops (while, do-while and for loop statements); Continue and Break statements; Built-in functions, User defined functions; Scope of variables (global, local and static variables); Arrays (one dimensional array, 2 dimensional array, multi-dimensional arrays); some arithmetic operations on arrays; Arrays and functions; File I/O, files and streams, opening and closing files, reading & writing text files; other data types (i.e. structures, pointers)

GS203	Mathematics III	3 Credits
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Pre-requisite: GS102

Linear Algebra.

- Definition of matrices, Types of matrices, and their properties.
- Operations on matrices and their properties.
- Elementary row operations and reduced row form (Echelon form)
- Systems of linear equations and their solutions using reduced matrix and matrix inverses.
- Determinants, their properties, and a determinant formula for matrix inverse.
- System of linear equations and their solutions using Cramer's rule and using elementary transformations.
- Eigenvalues and eigenvectors and the Hamilton Cayley theorem.
- Introduction to fields (Real, complex), vectors, linearly dependent and independent vectors, basis, and dimension. Dot product, cross product, and their applications.



- Calculus of vectors; functions of vectors and their derivatives, gradient, divergence and curl. The vector differential operator ∇ .

GS204

Mathematics IV

3 Credits

Pre-requisite: GS102

Ordinary differential equations

- Basic definitions, first order and first degree differential equations (Separable Equations, Homogeneous and nearly homogeneous equations, Exact equations, Integrating factors, linear equations, Bernoulli equation, Riccati equation, brief discussion of existence and uniqueness of a solution, orthogonal trajectories).
- Linear higher order differential equations: theoretical considerations, constant coefficient case, nonhomogeneous equation (variation of parameters method, undetermined coefficients method), and Euler's differential equation.
- Laplace transformations and its inverse, calculating Laplace transformation and its inverse, using Laplace transformation on solving linear equations.
- System of linear differential equations; solution of differential equations in series; gamma, beta function, Bessel function, modified Bessel function, Legendre polynomials; Spherical harmonics, hyper geometric functions.

GS206

Probability and Statistics

3 Credits

Pre-requisite: Nil

Probability: concept of a random experiment and sample space; addition and multiplication laws of probability; conditional probability and independence, Bay's theorem and its application. Random variables and their probability distribution; Binomial, Poisson, Normal, Gamma, Exponential, Uniform and Cauchy distributions and their properties.

Basic statistical concepts: Statistical data, measures of central simple linear regression, regression coefficient and correlation coefficient, non-linear regression. Fitting of linear and non-linear regression to data. Multiple linear regression and multiple correlation coefficient.

General Engineering Courses contents *محتويات العلوم الهندسية العامة*

GE121

Engineering Mechanics I

3 Credits

Pre-requisite: Nil

Statics of particles; forces in plane and space; statics of rigid bodies : Equivalent system of forces; equilibrium in two and three dimensions, work and energy, analysis of trusses, frames, and machines, free body diagram; kinematic; stability friction, centroids and center of gravity-lines,



area and volumes. Moment of inertia of areas and masses.

GE125	Eng. Graphics or “Descriptive Geometry”	2 Credits
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Pre-requisite: Nil

Introduction, the purpose of Descriptive Geometry, different types of projection. Representation of point, line and plane. Position problems. Metric problems. Projection on auxiliary views. Polyhedrons, development and intersections. Circle and sphere. Cone and cylinder. Curved surfaces, development and Intersection.

GE127	Engineering Drawing	2 Credits
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Pre-requisite: Nil

Introduction; definitions, conventions. Instrument, dimensioning, some geometrical constructions; e.g., drawing of some polygons, parallel lines, line and arc tangents. Projection; theory, types of projection, one view projection, multi-view projection, first and third angle projection, applications, including missing line views. Sectional views; complete section, half section, part section, removed sections, revolved section, and applications.

GE129	Workshop Technology	2 Credits
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Pre-requisite: Nil

Industrial safety; engineering materials and their mechanical and physical properties; classifications, ferrous and nonferrous metals, natural and synthetic materials; introduction to manufacturing processes: casting, welding, forging, rolling, extrusion; sheet metal working methods, metal machining.

GE129L	Workshop Technology Lab	1 Credits
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Pre-requisite: GE129

Some experiments related to GE129 course prepared by specified department.

GE133	Properties of Materials	3 Credits
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Pre-requisite: GS101 GS111 & GS115

Elastic and plastic behavior of metals, plastic deformation of metals; atomic structure of materials, crystal geometry of; electrical, magnetic and optical properties of materials; materials at high temperature; recovery, recrystallization, grain growth; fatigue of metals; corrosion of metals and alloys; oxidation of metals and alloys.

GE222	Engineering Mechanics II	3 Credits
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Pre-requisite: GE121

Introduction to dynamics. Kinematics of particles; Kinematics of rigid bodies. Three-dimensional motion of a particle relative to a rotating frame (Coriolis acceleration). D'Alembert's



principle. Kinetic energy of a rigid body in plane motion. Kinetics of rigid bodies in three dimensions; motion of a gyroscope. Introduction to mechanical vibrations.

Course Syllabus

Syllabus of Departmental Compulsory Courses



CHE201	INTRODUCTION TO CHEMICAL ENGINEERING I	<u>3 Credits</u>
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Pre-requisites: GS115

Introduction to engineering calculations; ideal gas law; real gas relationships; vapour pressure; saturation; partial saturation and humidity; principles of conservation of mass as applied to chemical units with or without chemical reaction (more emphasis on problems involving more than one unit).

CHE202	INTRODUCTION TO CHEMICAL ENGINEERING II	<u>3 Credits</u>
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Pre-requisite: CHE201

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.

CHE211	PHYSICAL CHEMISTRY I	<u>3 Credits</u>
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Pre-requisite: GS115

Behaviour of real and ideal gases; the first law of thermodynamics and its applications; the second law of thermodynamics; the third law of thermodynamics; electromotive force; thermodynamics of electrochemical cells; chemical kinetics; reaction rates including zeroth, first, second and third order reactions. Introduction to stability.

CHE211L	PHYSICAL CHEMISTRY I Lab	<u>1 Credit</u>
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**Pre-requisite: CHE211**

Measurements of density; viscosity; phase-equilibria; kinetics of first order reaction (inversion of sucrose); refractive index; equilibrium constant (by means of electrical conductivity, K_a of succinic acid; molecular weight determination (Victor Mayer); thermodynamics of galvanic cells (Zinc-Copper electrodes).

CHE212	PHYSICAL CHEMISTRY II	3 Credits
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Pre-requisite: GS115 AND CHE211

Phase equilibrium ; phase rule; systems of one, two and three components; the Clapeyron equation and Clausius equation; Henry's and Raoult's law; fractional distillation; congruently and incongruently melting compound; chemical equilibrium; derivation of the general equilibrium expression; determination of equilibrium constant; Gibbs free energy of formation; effect of temperature on chemical equilibrium; surface thermodynamics; surface tension: Gibbs adsorption equation; adsorption by solid; Langmuir theory of adsorption chromatography.

CHE212L	PHYSICAL CHEMISTRY II Lab	1 Credit
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Pre-requisite: CHE211L

Surface chemistry; adsorption on solid surface and adsorption at liquid surface; chemical kinetics, "First" and "Second" order reactions; boiling point of binary mixture; molecular weight determination by Rast's method; phase equilibrium; solvent extraction.

CHE221	COMPUTER PROGRAMMING	3 Credits
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Pre-requisite: GS200

Introduction to digital computers, computer hardware organization, memory, processing units, input and output units, FORTRAN language; introduction to FORTRAN; constants, variables, built-in functions, arithmetic expressions, executable and non-executable statements, arithmetic assignments statement. Numerical input/output read statement, write statement, format statement (I, F, E type of format). Elementary program organization, stop statement pause statement end statement, insertion of comments in FORTRAN program. The program. Preparing the program, the program package. FORTRAN deck, data deck. Control statement, GOT statement, arithmetic IF statement, logical IF statement DO statement, CONTINUE statement, nested DO loops, flow charts. Arrays, subscripted variables, DIMENSION statement, array INPUT/OUTPUT, implied DO loop character, input/output permissible FORTRAN characters, A- type format. Case studies.



CHE301	CHEMICAL ENG. THERMODYNAMICS I	3 Credit
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Pre-requisite: GS203 AND CHE211

Concepts of thermodynamic with definitions and units; conservation and transfer of energy; volumetric properties of pure fluids. Equations of state and their applications; industrial applications of heat effects calculations; concepts of entropy and the second law of thermodynamics; thermodynamic properties of single and two-phase systems; Maxwell's relations; thermodynamic diagrams; generalized correlations; power cycles and their applications; refrigeration, and liquefactions thermodynamic analysis of flow processes.

CHE302	CHEMICAL ENG. THERMODYNAMICS II	3 Credit
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Pre-requisite: CHE301

Partial molar properties; pure component vapour phase; fugacities from PVT data; generalized correlations and equations of state; pure component condensed phase fugacities; vapour-liquid mixtures fugacity's; ideal solutions; activity coefficients from excess Gibbs free energy; other excess properties, vapour-condensed phase equilibria for miscible and partially miscible systems; equilibrium of reacting systems; concepts of availability.

CHE311	FLUID MECHANICS	3 Credit
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Pre-requisite: GS203 AND CHE202

Fluid properties; fluid statics, velocity and shear; continuity, momentum and energy equations; Bernoulli Equation; laminar and turbulent flow regimes; frictional loss in pipes; transportation and metering of fluids; pumps and compressors; agitation of liquids; compressible flow; flow around submerged objects; fluidization.

CHE312	HEAT TRANSFER	3 Credit
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Pre-requisite: CHE311 - GS203 AND CHE202

Steady state heat conduction in one and two dimensions including extended surfaces; , illustration of methods of solutions for two dimensions problems; unsteady state conduction in solids; lumped heat capacity approach; illustration of methods of solution for selected geometries and boundary conditions; dimensional analysis in relation to heat transfer; boundary layers; empirical correlation for heat transfer coefficient inside and across pipes; natural and forced convection; boiling condensation double pipe and shell and tube heat exchangers; heat transfer by radiation.

4 :Commented [AAMM1]

4 :Commented [AAMM2]



CHE321	NUMERICAL METHODS IN CHEMICAL ENG.	3 Credit
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Pre-requisite: GS200 AND GS203

Non-linear curve fitting; numerical integration with equally and unequally spaced base points; numerical differentiation; solutions of systems of linear equations using Gaussian, Gauss-Jordan and Gauss-Seidel methods, solutions of systems of non-linear equations using alternative methods; solutions of ordinary differential equations using single and multiple methods; solutions of parabolic, hyperbolic and elliptic partial differential equations.

CHE331	ORGANIC CHEMISTRY I	3 Credit
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Pre-requisite: GS115

Introduction; nomenclature; preparation and reaction of aliphatic hydrocarbons (alkanes, alkenes, alkynes and alicyclic hydrocarbons); alkylhalides; alcohols and glycols; ethers; aldehydes and ketones; carboxylic acids and its derivatives (acid anhydrides, esters and amides).

CHE331L	ORGANIC CHEMISTRY I Lab	1 Credit
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Pre-requisite: GS115 GS115L CHE331

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).

CHE332	ORGANIC CHEMISTRY II	3 Credit
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Pre-requisite: CHE331

Introduction to basic concepts; nomenclature; preparation and reaction of: aromatic hydrocarbons, benzene and its derivatives, naphthalene, anthracene and phenanthrene; phenols and quinines; amines and diazonium salts; heterocyclic compounds-molecular rearrangements-stereochemistry; radicals and their reactions.

CHE332L	ORGANIC CHEMISTRY II Lab	1 Credit
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Pre-requisite: CHE331L AND CHE332

Preparation of: Methane, Ethylene, Acetylene, n-Butylchloride, Acetaldehyde, Acetone, Formic acid, Methylbenzoate, an-Dinitrobenzene, and Diazonium salts. Qualitative organic analysis: Qualitative analysis for elements, solubility, classification and class reactions.



CHE342	INSTRUMENTAL METHODS OF ANALYSIS	3 Credit
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Pre-requisite: GS115 - GS115L AND CHE331

Introduction; gravimetric analysis; precipitation and volatilization methods; volumetric analysis; standard solution; primary standards; molarity and normality with some applications; spectrophotometric; analysis visible-ultra violet; infrared; instrumentations; absorption laws with their applications; flame emission and atomic absorption methods; separation technique: Ion-exchange chromatography, Gas-liquid chromatography, HPLC and their applications; potentiometric analysis; PH-meter; oxidation reduction curves; ion selective electrode. Practical work involves applications on most of the topics mentioned above.

CHE401	PETROCHEMICAL INDUSTRY	4 Credit
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Pre-requisite: CHE332 CHE332L

This course provides a strong fundamental and practical (laboratory experimentation) concept of petrochemical industry stressing on raw materials, processes and technologies. The following topics are covered:

PART I –POLYMERS

Definitions, structure and MW distribution of polymers; polymer chemistry (polymerization reactions and polymerization techniques); processing of polymers (compounding and processing of plastics).

PART II- PETROCHEMICALS AND DOWN STREAM INDUSTRY

Olefins (production and downstream industry based on, ethylene, propylene, butenes and pentenes); Aromatics (production of BTX and downstream units based on benzene, toluene, and xylenes); Natural gas (production and downstream unit based on, ammonia, methanol and urea); Synthetic Gases, (production and utilization of hydrogen, oxygen, nitrogen, carbon dioxide, carbon monoxide, and C₂H₂); Salt and chloroal- kali; fertilizers; cement industries.

PART III- LABORATORY

Preparation; casting; testing and processing of some polymers (such as polystyrene, nylon 6.6, polyvinyl alcohol and polyamide).

CHE411	CHEMICAL REACTION ENGINEERING I	3 Credit
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Pre-requisite: GS203 AND CHE302

Introduction1-kinetics of homogeneous reactions (rate of reaction, concepts of kinetics, rate theories, analysis of rate equations); design fundamentals (mass and energy balances); homogeneous reactor design for isothermal conditions (ideal batch reactor, ideal plug flow reactors and ideal stirred tank reactors); temperature effects in homogeneous reactors (ideal batch, plug flow and stirred reactors).



CHE412	CHEMICAL REACTION ENGINEERING I	3 Credit
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Pre-requisite: CHE411

Heterogeneous reactions; heterogeneous catalysis (general characteristics, adsorption on solid surfaces, physical properties of catalysts); kinetics of fluid, solid catalytic reactions (rates of adsorption, desorption and surface reactions, qualitative analysis, quantitative analysis); external transport processes in heterogeneous reactions (fixed and fluidized beds); internal transport processes (mass and heat transfer with reaction, effectiveness factor, effect of internal resistance on selectivity and poisoning); design of heterogeneous catalytic reactors; deviation from ideal-reactor performance (residence time distribution).

CHE421	MASS TRANSFER I	3 Credit
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Pre-requisite: CHE312 - GS203 AND CHE302

Introduction to mass transfer and its operation; principles of diffusion; Fick's law of molecular diffusion; diffusion in gases; liquids and solids; diffusion coefficient in gases and liquids; shell mass balance with and without chemical reactions; unsteady state diffusion; mass transfer coefficients; theories of mass transfer; determination of mass transfer coefficients; interphase mass transfer; the principles of equilibrium stage processes; mass transfer operations; binary distillation; flash and differential vaporizations; batch and continuous rectification; McCabe and Theile method; Panchan Savarite method; analytical methods; special cases of distillation.

CHE422	MASS TRANSFER II	3 Credit
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Pre-requisite: CHE312 AND CHE421

Mass transfer operations; multicomponent distillation; short cut and stage by stage methods; isotropic and extractive distillation; gas absorption; plate and packed towers; dilute and concentrated systems; humidification's; vapour-gas mixtures in water cooling towers; liquid-liquid extraction; single and continuous multistage operations; leaching; multi-stage leaching for variable and constant under flow operators; adsorption in gases and liquids including chemical reduction; drying, principles, batch and continuous drying; drying time and rates; crystallization; principles and theory of crystallization.

CHE431	UNIT OPERATION LAB. I	3 Credit
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Pre-requisite: CHE311 AND CHE312

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.

CHE432	UNIT OPERATION LAB. II	3 Credit
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Pre-requisite: CHE422 AND CHE431

This course or 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.

CHE441	ENGINEERING ECONOMY	3 Credit
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Pre-requisite: CHE421

Introduction to investment analysis, concept of rate of return and capital investment, minimum rate of return, introduction to equivalence and its application, application of compound interest formulas, time diagram and concept of cash flow, rate of return analysis, present worth cost, annual worth cost, future worth cost analysis, net present value, net annual value, net future value, break even analysis, benefit cost ratio, and present value ratio analysis for equal and unequal project lives. Difference between cost and net present values, mineral and petroleum project analysis, evaluation of mutually and non-mutually exclusive projects before tax and after tax analysis, depreciation, cost depletion and percentage depletion calculations, income tax, cash flow, and discount cash flow analysis, replacement analysis, leasing versus purchasing analysis. Re-investment analysis.

CHE442	CORROSION ENGINEERING,	3 Credit
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Pre-requisite: CHE411

Introduction; forms 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 (cathode protection, anodic protection, chemical inhibitors, coatings, and material selection).

CHE452	PROCESS DYNAMICS AND CONTROL	3 Credit
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Pre-requisite: GS204 AND CHE411

Brief coverage of Laplace transforms; 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; Bode diagrams; stability of control systems; process applications; control of distillation columns; control of chemical reactors; introduction to non-linear



systems.

CHE501	PETROLEUM REFINERY	3 Credit
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Pre-requisite: CHE421

Refinery products; detailed discussion of specifications of refinery products. Methods and techniques for measurements (routine tests) and estimating the physical properties of various products. Evaluation of crude oils; detailed discussion of crude assay (TBP, ASTM and EFV) distillation techniques. Distillation and property (mid percent and yield) curves. Main Refinery operations; Desalting, atmospheric and vacuum distillations. Material balance on main units. Other important refinery units. Products blending. Estimation of properties of various blends.

CHE511	NATURAL GAS PROCESSES	3 Credit
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Pre-requisite: CHE421

Nature and occurrence of natural gas, dry natural gas. Associated gas. Importance of natural gas industries; physical and thermodynamic properties. Gas/oil separation facilities. Transportation, compression stations; dehydration, sweetening refrigeration cycles. Liquefaction process. LNG and LPG liquefaction plants. Storage facilities. Emphasis on the Libyan gas industries.

CHE521	PLANT DESIGN	3 Credit
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Pre-requisite: CHE422 - CHE441 AND HE412

Factors to be studied for plant design; types of studies; cost estimation, simple methods, item by item method; depreciation and profitability analysis; optimization, analytical and graphical analysis; material of construction and selection review and analysis of various.; factors considered for fluid flow: heat transfer and mass transfer equipment's; private and group design projects.

CHE531	APPLIDE MATHEMATICS METHODS IN CHEM. ENG.	3 Credit
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Pre-requisite: CHE421 - CHE411 AND GS204

This course stresses the application of mathematics to problems drawn from chemical engineering fundamentals such as material and energy balances, transport phenomena and kinetics. Formulation and solution of ordinary and partial differential equations arising in chemical engineering or related processes or operations are discussed. Mathematical approaches are restricted to analytical solutions or techniques for producing problems amenable to analytical solutions.

Objectives

This is a core course for all graduate students in the Chemical Engineering department. The purpose of the course is to develop the mathematical and modeling skills that needed in research projects and graduate courses subsequent to this course. A student completing this course should be able to:

- Describe chemical engineering processes in mathematical form by employing the appropriate microscopic and macroscopic balances
- Identify if an analytical solution to the differential equations is possible
- Derive and interpret physically the solution to differential equations amenable to analytical



solution

CHE599	B.SC. PROJECT	5 Credit
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A project is required by the student under the supervision of a staff member within two semesters. The project includes literature review, process selection, material and energy balances, equipment design and economic analysis. However, in some cases, the project can be experimental in nature.

CHE541	ELECTIVE COURSES	3 Credit
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Pre-requisite:

The following elective courses are given by the chemical engineering staff. The student should take any two of the following courses toward his B.Sc. degree. The courses could change depending on the availability of the staff members. Most of these courses are designed to be applied courses in the Libyan industries.

CHE541	CRYOGENICS AND LOW-TEMPERATURE PROCESSES	3 Credit
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Pre-requisite: CHE301 - CHE311 AND CHE312

Lecture, four hours; discussion, one hour; outside study, seven hours. Fundamentals of cryogenics and cryo-engineering science pertaining to industrial low-temperature processes. Basic approaches to analysis of cryo-fluids and envelopes needed for operation of cryogenic systems; low-temperature behavior of matter, optimization of cryo-systems and other special conditions.

CHE541	ENVIRONMENTAL REMEDIATION	3 Credit
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Pre-requisite: CHE311 - CHE411 AND CHE 421

In situ and ex situ methods of remediation or restoration of contaminated environmental sites. Emphasis is on hydrocarbon contaminants in soil, surface water, and groundwater.

CHE541	POLLUTION AND POLLUTION CONTROL	3 Credit
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Pre-requisite: CHE 311 - CHE411 AND CHE421

Introduction to environmental Engineering for water and waste water treatment. Source of air pollution and pollution control. Solid waste management and hazardous waste management and disposal techniques.



CHE541	ENHANCED OIL RECOVERY	3 Credit
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Pre-requisite: CHE302 - CHE311 - CHE312 AND CHE421

Enhanced oil recovery techniques. Fluid flow in porous media. Single and multiphase flow. Recovery methods; thermal methods; chemical methods. Miscible methods using LPG, rich gas, high pressure gas, injection processes. Emphasis on potential techniques suitable for Libyan oil reservoirs.

CHE541	DESALINATION	3 Credit
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Pre-requisite: CHE301 - CHE311 AND CHE312

Water saturation and hydrological cycle. Water supply and demand. Municipal and industrial/agricultural requirements. Compositions and economics of fresh water supply. Theoretical aspects of desalination. Minimum energy requirements. Evaluation of various desalination processes. Desalination plant design. Control of scale and corrosion.

CHE541	POLYMER PROCESS ENGINEERING	3 Credit
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Pre-requisite: CHE 332 - CHE401 AND CHE441

Basic structures of polymers. physical states and transitions. Polymer formation. Polymerization processes (bulk, solution, suspension and emulsion). Viscous flow, mechanical properties deformations. Degradation and stabilizations of polymer systems. Fabrication processes. Emphasis on the Libyan polymer industries.

CHE541	SOLAR ENERGY	3 Credit
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Pre-requisite: CHE301 And CHE312

Solar radiation; spectral distribution; beam and diffuse radiation; measurement of solar radiation; radiation transmission and absorption; flat plate collectors; concentrating collectors; energy storage; design of solar heating systems; passive and active systems; solar heating and cooling; economics of solar systems

CHE541	TRANSPORT PHENOMENA	3 Credit
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Pre-requisite: CHE302 - CHE311 And CHE421

Study of transport mechanisms of momentum, energy and mass; concept of viscosity, thermal conductivity and diffusivity; shell balances; equations of change; transport in laminar flow with two



independent variables; turbulent. flow; boundary layers' concept; transport. in large flow systems.

CHE541	CHEMICAL PROCESS SIMULATION AND DESIGN	3 Credit
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Pre-requisite: CHE312 - CHE412 & CHE421

Process conceptualization and design. Computer simulation of process and components. A major team design project with progress reports, oral presentation, and a technical report with engineering drawings and economics.

CHE541	BIOCHEMICAL ENGINEERING FUNDAMENTALS	3 Credit
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Pre-requisite: CHE332 & CHE412

Analysis and design fundamentals for biochemical process, reactor design, transport phenomena; applications of enzymes and microbial populations.

CHE541	MOLECULAR BIOTECHNOLOGY FOR ENGINEERS	3 Credit
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Pre-requisite: CHE332 & CHE412

(Same as Biomedical Engineering) Lecture, four hours; discussion, one hour; outside study, eight hours. Selected topics in molecular biology that form foundation of biotechnology and biomedical industry today. Topics include recombinant DNA technology, molecular research tools, and manipulation of gene expression, directed mutagenesis and protein engineering, DNA-based diagnostics and DNA micro arrays, antibody and protein-based diagnostics, genomics and bioinformatics, isolation of human genes, gene therapy, and tissue engineering.

CHE541	ENGINEERING MANAGEMENT	3 Credit
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Pre-requisite: CHE442

Enhanced oil recovery techniques. Fluid flow in porous media. Single and multiphase flow. Recovery methods; thermal methods; chemical methods. Miscible methods using LPG, rich gas, high pressure gas, injection processes. Emphasis on potential techniques suitable for Libyan oil reservoirs.