جامعة الأنبار ـ قسم الهندسة الكيميائية والبتروكيماوية
UNIVERSITY OF ANBAR
CHEMICAL & PETROCHEMICAL ENGINEERING

جامعة الأنبار ـ قسم الهندسة الكيميائية والبتروكيماوية
UNIVERSITY OF ANBAR
CHEMICAL & PETROCHEMICAL ENGINEERING

COURSE SYLLABUS

Chemical and Petrochemical Engineering

Abstract

Updated syllabus for undergrad program of Chemical and Petrochemical Engineering Department

Omar Mustafa Al-Kubaisi
omalkuba@uoanbar.edu.iq

1 About the Department

1.1 Preface

The Department of Chemical and Petrochemical Engineering is one of the important departments in the College of Engineering - University of Anbar, despite its recent opening in 2012. Its importance comes due to its close connection with the development of industry in various fields, especially in the oil and gas industry, petrochemicals, pharmaceutical, food, plastics, ceramics, fertilizers and detergents. Paints, batteries, environmental decontamination processes, water treatment…etc. The Department of Chemical Engineering is also a basis for study in other engineering disciplines, such as nuclear engineering, energy engineering, environmental engineering, genetic engineering, medical engineering, and biochemistry.

1.2 Vision

The Department of Chemical and Petrochemical Engineering believes that the importance of studying in it stems from providing a quality of engineering education that contributes to its outputs year after year by qualifying students scientifically and technically to serve the development process in the sectors related to the Department of Chemical Engineering, which leads to contributing to the country's progress by graduating qualified chemical engineers and through Carrying out applied scientific research that helps to recognize the program at the local, regional and international levels as a competitive teaching program.

1.3 Objectives:

The Department of Chemical and Petrochemical Engineering aspires to prepare specialized engineering staff to advance the scientific and industrial movement in all its institutions, equipment and curricula, according to the latest approved international curricula and make it able to meet and cover all the country's needs in these areas and achieve harmony and integration between the goals of the scientific movement, and the general plans of Iraq in the fields And industrial activities in the light of the reconstruction and development projects that Iraq is currently witnessing, and according to the successive discoveries and the rapid progress of science and technology, and the preparation of a generation strong in its structure, personality and morals, proud of its loyalty to its homeland and armed with the scientific, technical and technological achievements of the era and knows how to use and develop them in order to build a better future for Iraq.

1.4 Course Coding:

The course coding is follow the rule as shown in the table below (CHE 0000):

0	0	0	0
Stage 1: 1st level 2: 2nd level 3: 3rd level 4: 4th level	Requirement Category 1: University requirement 2: College Requirement 3: Department Requirement	Number of subjects	

1.5 Credits and hours distribution

Subject Category	Credits	Hours
University requirement	14	14
College requirement	38	54
Department Requirement	94	120
Total Credits and Hours	146	188

1.6 Courses distribution

The set of the courses below are the curriculum of chemical and petrochemical engineering department for different courses and their description for four years of study.

1.6.1 First level

1.6.1.1 Semester 1

No.	Code	Course Title	Credits	Hours/Week			
				Theo.	Prac.	Tut.	Prerequisite
1	CHE 1101	Human rights	2	2	0	0	None
2	CHE 1102	English language I	2	2	0	0	None
3	CHE 1201	Computer Science	2	1	2	0	None
4	CHE 1202	Physics	3	2	2	1	None
5	CHE 1203	Calculus I	3	3	0	1	None
6	CHE 1204	General Chemistry	3	2	2	1	None
7	CHE 1301	Principles of chemical Engineering I	3	2	0	1	None
Total			18	14	6	4	
				24			

1.6.1.2 Semester 2

No.	Code	Course Title	Credits	Hours/Week			
				Theo.	Prac.	Tut.	Prerequisite
1	CHE 1103	Arabic language	2	2	0	0	None
2	CHE 1205	Calculus II	3	3	0	0	None
3	CHE 1206	Eng. Drawing	3	2	2	0	None
4	CHE 1207	Engineering Mechanics (Static)	3	3	0	0	None
5	CHE 1208	Fundamentals of electric circuit	2	1	2	0	None
6	CHE 1302	Practical Physics	3	3	0	1	None
7	CHE 1303	Principles of Chemical Engineering II	3	2	0	2	None
Total			17	16	4	3	
				23			

1.6.2 Second level

1.6.2.1 Semester 1

No.	Code	Course Title	Credits	Hours/Week			
				Theo.	Prac.	Tut.	Prerequisite
1	CHE 2104	Democracy	1	1	0	0	None
2	CHE 2209	Calculus III	3	3	0	1	None
3	CHE 2304	Organic chemistry	3	2	2	0	None
4	CHE 2305	Fluid Mechanics (I)	3	2	0	2	None
5	CHE 2306	Physical Chemistry	3	2	2	0	None
6	CHE 2307	Technology of Chemical Industry	2	2	0	0	None
7	CHE 2308	Mass Transfer I	3	2	0	2	None
Total			18	14	4	5	
				23			

1.6.2.2 Semester 2

No.	Code	Course Title	Credits	Hours/Week			
				Theo.	Prac.	Tut.	Prerequisite
1	CHE 1105	English Language II	3	2	2	0	None
2	CHE 1210	Calculus IV	3	3	0	0	None
3	CHE 1309	Engineering Materials	3	2	2	0	None
4	CHE 1310	Petrochemical Industry	2	2	0	0	None
5	CHE 1311	Fluid Mechanics II	3	2	2	0	None
6	CHE 1312	Mass Transfer II	3	3	0	1	None
7	CHE 1313	Thermodynamics I	3	2	2	0	None
Total			20	16	8	1	
				25			

1.6.3 Third level

1.6.3.1 Semester 1

No.	Code	Course Title	Credits	Hours/Week			
				Theo.	Prac.	Tut.	Prerequisite
1	CHE 3106	English Language III	3	2	2	0	
2	CHE 3211	Engineering Statistic	3	3	0	0	None
3	CHE 3314	Heat transfer I	3	2	2	1	None
4	CHE 3315	Unit operation I	3	3	0	1	
5	CHE 3316	Char. Petroleum and Natural Gas	3	2	2	0	None
6	CHE 3317	Thermodynamic II	3	2	2	0	None
7	CHE 3318	Reactor Design I	3	3	0	1	
Total			21	17	4	3	
				24			

1.6.3.2 Semester 2

No.	Code	Course Title	Credits	Hours/Week			
				Theo.	Prac.	Tut.	Prerequisite
1	CHE 3212	Engineering Numerical Method	3	2	2	0	
2	CHE 3319	Heat Transfer II	3	2	2	1	None
3	CHE 3320	Technology of Natural Gas	2	2	0	0	None
4	CHE 3321	Water Treatment	2	2	0	0	None
5	CHE 3322	Composite Materials	2	2	0	0	None
6	CHE 3323	Unit Operation II	3	3	0	1	None
7	CHE 3324	Reactor Design II	3	3	0	1	None
Total			19	16	4	3	
				23			

1.6.4 Forth level

1.6.4.1 Semester 1

No.	Code	Course Title	Credits	Hours/Week			
				Theo.	Prac.	Tut.	Prerequisite
1	CHE 4107	English Language IV	3	2	2	0	None
2	CHE 4325	Petroleum Refining Engineering I	3	3	0	1	None
3	CHE 4326	Industrial Equipment Design	3	2	2	0	None
4	CHE 4327	Environmental Engineering	2	2	0	0	None
5	CHE 4328	Process Control	3	3	0	0	None
6	CHE 4329	Transport Phenomena	3	3	0	1	None
7	CHE 4330	Project Design I	3	1	4	0	None
Total			19	15	8	2	
				25			

1.6.4.2 Semester 2

No.	Code	Course Title	Credits	Hours/Week			
				Theo.	Prac.	Tut.	Prerequisite
1	CHE 4108	Management and leadership skills	2	2	0	0	None
2	CHE 4331	Petroleum Refining Engineering II	3	3	0	1	None
3	CHE 4332	Industrial Safety	2	2	0	0	None
4	CHE 4333	Corrosion Engineering	2	2	0	0	None
5	CHE 4334	Technology of Catalyst	2	2	0	0	None
6	CHE 4335	Modeling and Simulation	3	2	3	0	None
7	CHE 4336	Project Design II	3	1	4	0	None
Total			16	13	7	1	
				21			

2 Course Definition and Description:

2.1 Level 1st

2.1.1 1st semester

2.1.1.1 CHE1101 -Human Rights

CHE1101	**Human Rights**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course is designed to give the student the definition of freedom and the right language and idiomatically and legitimacy of the user, Origin of the right in the eyes of Islamic law, Elements of the right and types of, Personal freedom, Intellectual freedom, Rights and economic freedoms, Islam and Slavery, Human rights objectives, The use of freedom and the right general project, The right of a Muslim to his Muslim brother, Parental rights, Right neighbor, The right of women, Human rights in the heavenly religions, Religious tolerance in Islam.						
Recommended Textbook(s):						
By Topics						
Prerequisites:						
None						
Course Topics:						
• The definition of freedom and the right						
• Origin of the right in the eyes of Islamic law						
• Elements and Types of the Human right						
• Rights and economic freedoms						
• Islam and Slavery						
• Human rights objectives						
• The use of freedom and the right general project						
• The right of a Muslim						
Course Outcomes: ***Students can:***						
• Explain the concept of "human rights"						
• Able to recognize the human rights in Islam						
• Define and describe the relationship between human rights and democrac						

2.1.1.2 CHE 1102-English language I

CHE 1102	English language I					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course is designed to enable academic writing course which provides an opportunity for the students to learn and practice the skills needed for handling topics related to the field of study. The course emphasizes the development of academic writing skills as well as the ability to read and think critically. Students will learn to use the library and appropriate online resources to find and evaluate sources to inform, develop and support their ideas in term paper writing. They will also learn skills for reading analysis, such as comprehension and inference						
Recommended Textbook(s):						
• Ewer J.R. & Latore G. "A Course in Basic Scientific English", Longman Group United Kingdom (1984).						
Prerequisites:						
None						
Course Topics:						
• Am/ are/ is, my/ your • This is ....• How are you? • Good morning! • What's this in English? • Numbers 1-10• Plurals						
• Countries • He/ she/ they, his/ her • Where's he from? • Fantastic/ awful/ beautiful • Numbers 11-30 • Jobs • Am/are/is • Negatives and questions • Personal information • Social expressions-1						
• Our/ their • Possessive's • The family • Has/ have • The alphabet • Sports/ food/ drinks • Present simple- I/ you/we/they • a/ an • languages and nationalities • Numbers and prices						
The time • Present simple- he/ she • Always/ sometimes/ never • Words that go together • Days of the week						
• Question words • Me/ him/ us/ them • This/ that • adjectives • Can I ....? • Rooms and furniture • There is/ are • Prepositions • Directions						
• Saying years • As/ were born • Past simple- irregular verbs • Have/ do/ go • When's your birthday? • Past simple- regular and • Questions and negatives Irregular • Sport and leisure • Going sightseeing						
• Can/ can't . Adverbs • Adjective+ noun • Everyday problems • I'd like- some/ any • In a restaurant • Signs all around						
Course Outcomes: Students can:						
• Develop academic writing proficiency and critical thinking skills • Students are able to conduct effective searches of printed and electronic resources • Students can use external sources to support ideas in an academic writing in electrical engineering • Students can identify and explain the academic integrity (how to avoid plagiarism) • Students are familiar with the citation methods like the APA style • Students can participate in a classroom community that involves constructive exchange of ideas						

2.1.1.3 CHE 1201-Computer Science

CHE 1201	Computer Science					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course presents an overview of fundamental computer science topics and an introduction to computer programming. Overview topics include an introduction to computer science and its history, computer hardware, operating systems, digitization of data, computer networks, office and application.						
Recommended Textbook(s):						
By Topics						
Prerequisites:						
None						
Course Topics:						
General Definitions. System, Computer System, Program, Hardware, Software, …etc. - Hardware Components. CPU, Main Memory, I/O, System Bus. CPU Structure (ALU, Registers, Control Unit, CPU Interconnection). Basic Computer Functions (Data Processing,) - Memory System Input/ output. Input Devices. Output Devices (Display Screens, Printers, Speakers). Mass Storage or External Storage - Representation of Information on Computer. Numeric Data. Number System (Decimal, Binary, Octal, Hexadecimal). Computer safety and licenses. Operating systems. Microsoft word, Microsoft PowerPoint, introduction to excel sheet: creation and manipulation. Advanced Microsoft word. Basic applications of Internet.						
Course Outcomes: ***Students can:***						
• Analyze, design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.						
• Identify problems and formulate solutions for systems.						
• Communicate effectively with a range of audience.						
• Work effectively as part of a team to develop and deliver quality software artifacts.						
• Design solutions using approaches that integrate ethical, social, legal, and economic responsibilities.						

2.1.1.4 CHE 1202-Physics

CHE 1202	Physics					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course uses calculus-based mathematical models to introduce the fundamental concepts that describe the physical world. Topics include units and measurement, vector operations, linear kinematics and dynamics, energy, power, momentum, rotational mechanics, periodic motion, fluid mechanics, and heat. Upon completion, students should be able to demonstrate an understanding of the principles involved and display analytical problem-solving ability for the topics covered. Laboratory experiments, some of which are computer-based, and computerbased tutorials enhance and consolidate the basic principles discussed in the theoretical section of the course.						
Recommended Textbook(s):						
R.D. Knight, Physics for Scientists and Engineers, 2nd ed., Pearson 2008 Laboratory Manual, Compiled by Instructor						
Prerequisites:						
None						
Course Topics:						
Basic international units of physics; Vectors; Motion; Laws of motion; Circular motion. Work and energy; Linear momentum; Rotation of rigid bodies; Angular momentum; Static equilibrium; Oscillatory motion; Universal gravitation; Mechanics of solids and fluids; Temperature; thermal expansion, and ideal gases. Heat and the first law of thermodynamics; Kinetic theory of gases; Heat engines and entropy.						
Lab. Section:						
• Orientation. Introduction to Error Analysis/ Part (I). Introduction to Error Analysis/ Part (II) • Experiment 0: Measurements and Data Analysis • Experiment 1: Analyzing the kinematic components of 1Dmotion by using motion sensor • Experiment 2: Determination of the Acceleration of Gravity by studying Free fall • Experiment 3: Verification of Newton's Second Law • Experiment 4: Conservation of mechanical energy • Experiment 5: Verification of Work – energy theorem • Experiment 6: Static Equilibrium of a rigid object • Experiment 7: Determination of the Acceleration of Gravity using the Simple Pendulum • Experiment 8: Verification of Hook's Law • Experiment 9: Determination of the speed of Sound in Air using a resonance tube • Experiment 10: Determination of the Coefficient of Viscosity • Experiment 11: Determination of the Mechanical Equivalent of Heat • Experiment 12: Determination of Specific Heat Capacity of a solid						
Course Outcomes: Students can:						
• Describe the SI unit system and convert units.						
• Describe the translational motion of a single particle in terms of position and inertial frames, inertia, velocity, acceleration, linear momentum and force.						
• Describe the rotational motion of a rigid body using the concepts of rotation angle, angular velocity, angular acceleration, angular momentum, moment of inertia, and torque.						
• State the Newton's three laws of motion and apply them to solve problems on one and two-dimensional translational motion.						
• Represent graphically the problem of motion of a physical system using the free-body diagram technique.						
• Identify the forces acting on ordinary mechanical systems to be gravity and electromagnetism (Drag force, frictional force, normal force, etc.).						
• State the fundamental laws of kinematics and dynamics of rotational motion of a rigid body and use them to solve problems on simple rotational motion.						
• Analyze the translational and rotational motion using a scalar approach based on the concepts of work, conservative and non-conservative forces, potential energy and conservation of mechanical energy.						

2.1.1.5 CHE 1203-Calculus I

CHE 1203	Calculus I					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
Students are expected to use their mathematical knowledge and practices to solve problems. This course strengthens students' understanding of functions in preparation for the process of differentiation and integration. The course provides a comprehensive, thorough, and up to date treatment of engineering mathematics. It is intended to introduce students of engineering, physics, mathematics, computer science, and Related fields to those areas of the applied mathematics that are most relevant for solving practical problems.						
Recommended Textbook(s):						
• Stewart, J., Clegg, D. K., & Watson, S. (2020). Calculus: early transcendental. Cengage Learning. • Thomas, G. 8., Haas, J., Heil, C., & Weir, M. (2018). Thomas' Calculus. Pearson Education Limited. • Stroud, K. A., & Booth, D. J. (2020). Engineering mathematics. Bloomsbury Publishing.						
Prerequisites:						
None						
Course Topics:						
Tangent line and slope problems; drawing functions; continuity and limit of functions; Limits at infinity, horizontal asymptote. infinite limits, vertical asymptotes and drawing of functions; Derivative of functions and rates of change. Differentiation of polynomials; product of quotient rules; Derivatives of exponential, logarithmic, and trigonometric functions; Chain rule and implicit differentiations; Applications of differentiation maximum and minimum values; the mean value theorem; derivative of hyperbolic functions and indeterminate form and hospital's rule; Optimiztion problems and anti derivative of functions.						
Lab. Section:						
None						
Course Outcomes: Students can:						
• To develop mathematical skill so that students are able to sketch the graph of various functions and evaluate Limits by using different techniques including L'Hospital's rule.						
• Apply mathematical methods and principals in solving various derivative problems from Engineering fields, involving applications of derivatives.						
• Demonstrate algebraic facility with algebraic topics including exponential, logarithmic, and trigonometric functions,						
• Compute derivative and anti derivative of algebraic, trigonometric, in trigonometric, exponential, logarithmic, and apply them to solve problems in a range of engineering applications.						

2.1.1.6 CHE 1204-General Chemistry

CHE 1204	General Chemistry					

This is a required course for the Chemical and Petrochemical Engineering Program.

Course Description:

This course is a comprehensive survey of chemistry for the general student that emphasizes the principles underlying the formation and interaction of chemical substances: stoichiometry, states of matter, thermochemistry, atomic and molecular structure, intermolecular forces, solutions, thermodynamics, kinetics, chemical equilibrium, acids and bases, electrochemistry, and environmental chemistry.

Recommended Textbook(s):

By Topics

Prerequisites:

None

Course Topics:

Measurements Handling Numbers. Dimensional Analysis in Solving Problems Recognize chemical safety and hazardous materials icons. And apply laboratory safety rules; Atomic Number. Mass Number. and isotopes. The Periodic Table. Molecules and Ions. Describe laboratory instruments and some basic techniques used in the chemistry laboratory, including balances and standard volumetric equipment. Chemical Formulas. Naming Compounds. Atomic Mass. Avogadro's number and Molar Mass of an Element. Describe and use UV/VIS spectrophotometric methods of analysis; Molecular Mass. The Mass Spectrometer. Percent Composition of Compounds. Experimental Determination of Empirical Formulas. Chemical Reactions and Chemical Equations. Describe how to Prepare accurate laboratory reports of their experimental results; Amounts of Reactants and Products; Limiting Reagent Calculations; Reaction Yield; General Properties of Aqueous Solutions. Precipitation Reactions. Acid-Base Reactions; Oxidation-Reduction Reactions; Concentration of Solutions. Acid-Base Titrations, Cases Pressure. The ideal Gas Equation; Gas Stoichiometry; Partial Pressures; The Nature of Energy and types of energy; Energy Changes in Chemical Reactions; introduction to Thermodynamics. Enthalpy of Chemical Reactions; Calorimetry; Standard Enthalpy of Formation and Reaction; From Classical Physics to Quantum Theory; Bohr's Theory of the Hydrogen Atom; Quantum Numbers; Atomic Orbitals; Electron Configuration; Development of the Periodic Table; Periodic Classification of the Elements; Periodic variation in Physical Properties; Ionization Energy; Electron Affinity Lewis Dot Symbols; The ionic Bond; The Covalent Bond; Electro negativity; Writing Lewis structure; Formal Charge and Lewis Structures. The Concept of Resonance. Exceptions to the Octet Rule Bond Energy; Molecular Geometry; Dipole Moment; Spectrophotometric Analysis of tetracycline; Valence Bond Theory. Hybridization of Atomic Orbital's. Hybridization in Molecules Containing Double and Triple Bonds. Delocalized Molecular Orbital's.

Lab. Section:

1- Safety; Lab Check-in; Mass and Volume Measurements.
2- Qualitative Analysis of Anions: Part I
3- Qualitative Analysis of Anions: Part II
4- The Empirical Formula of a Metal Oxide
5- Volumetric Analysis: Standardization of Sodium Hydroxide and Determination of Molar Mass of an Acid
6- Applications of Volumetric Analysis: Determination of Active Ingredients of Commercial Bleach and Vinegar.
7- Evaluation of the Universal Gas Constant R
8- Heat of Formation of Magnesium Oxide
9- UV/VIS Spectroscopy and Spectrophotometry
10- Spectrophotometric Analysis of Aspirin
11- Synthesis of Alum and Crystal Growth

Course Outcomes:

Students can:

• Define the structure of atoms in terms of the nucleus with protons, neutrons, & electrons.

• Write and balance chemical equations, name inorganic compounds and ions and describe the properties of the main group elements.

• Carry out chemical calculations, including mass relations in chemical reactions, limiting reagent & reaction yield calculations, and calculations of reactions taking place in solution.
• Understand the concept of oxidation-reduction, calculate oxidation numbers, and balance redox reactions. • Apply the ideal gas law in solving problems involving the gas phase.
• Solve problems in chemical thermodynamics and calorimetry.
• Predict the electronic structure of atoms and ions from quantum theory, and9) relate the position of an element in the periodic table to its electronic structure and to the physical and chemical properties of the elements.
• Describe the principles of chemical bonding and write Lewis structures
• Predict the geometry of the electron pairs and the shape of molecules using VSEPR theory, predict bond polarity and molecular dipoles
• Describe the valence bond theory, predict the hybridization of atoms in molecules, and describe bonding in molecules with single, double and triple bonds in terms of and π bonds, and delocalized molecular orbitals

2.1.1.7 CHE 1301-Principles of chemical Engineering I

CHE 1301	**Principles of chemical Engineering I**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course will introduce you to a number of principles and concepts that are fundamental to chemical engineering. The fundamentals of engineering calculations (units and dimensions), behavior of fluids, mass balances, processes and process variables. The course gives real-life examples of process industries to provide you with the context engineering in practice. We equip students with creative engineering problem solving techniques and fundamental chemical engineering material balance skills. Lectures, experiments problem, and recitation sessions are designed to provide coordinated training and experience in data analysis, material property estimation for single- and multi-phase systems, basic process flowsheet, reactive and non-reactive mass balances, problem solving strategies and tools, and team dynamics.						
Recommended Textbook(s):						
Felder R. M. and Rousseau, R. W. "Elementary Principles of Chemical Processes" John Wiley & Sons.						
Prerequisites:						
None						
Course Topics:						
Introduction, dimensions, units, and their conversion. Moles, density and concentrations, Choosing A basis. Temperature and pressure basic relationships and their units and their conversion. Introduction to the material balance in chemical engineering instruments. A general strategy for solving material balance problems. Solving material problems for single unit without chemical reaction. The chemical reaction equation and stoichiometry.						
Course Outcomes: Students can:						
1. To introduce the student to the principles and calculations techniques used in chemical engineering. 2. To explain to the student what material balance is, and how formulate and solve them. 3. To assist the student in learning efficient and consistent methods of problem solving so that he/she can effectively solve problems that she/he faces after leaving school. 4. To offer practice in defining problems, collecting data, analyzing the data and breaking it down into basic patterns, and selecting pertinent information for application. 5. To review certain principles of applied physical chemistry.						

2.1.2 2nd semester

2.1.2.1 CHE 1103-Arabic language

CHE 1103	**Arabic language**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course aims at building students' familiarity with and competence in Arabic literature in its various genres to increase their ability to appreciate literature and to develop their awareness of its concepts through the study of poetry, novel and the short story.						
Recommended Textbook(s):						
None						
Prerequisites:						
By Topics						
Course Topics:						
Study the text of the Quran and analyze its language, spelling, and rules. the rules of writing the hamza, Written verbatim by Arab and Za -Rules of number and numerical adjective, punctuation, the method of detection for words in Arabic Dictionaries, In the applications of grammar and language- the actor and his deputy, Debutante and the news Acts missing, Equated with the letters already By products, The case and exception, Ancient literary studies, Definition of literature and its importance, Ages historical Arabic literature – Modern Literary Studies, Study the texts of poetic eras (pre-Islamic, Islamic, Umayyad, Abbasid, Andalusia), Study of ancient prose texts (speeches, messages), examine the texts of modern poetry and contemporary, examine the texts of modern prose (drama, novel, article)						
Course Outcomes: Students can:						
• Develop academic essay writing proficiency • Apply reading skills • Expand academic vocabulary through reading • Improve critical thinking skills						

2.1.2.2 CHE 1205-Calculus II

CHE 1205	**Calculus II**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course provides a comprehensive guide and up-to-date treatment of engineering mathematics with an in-depth overview of the many mathematical methods. It is intended to introduce students of engineering, physics, mathematics, computer science, and related fields areas of applied mathematics that are most relevant for solving practical problems.						
Recommended Textbook(s):						
• Stewart, J., Clegg, D. K., & Watson, S. (2020). Calculus: early transcendental. Cengage Learning. • Thomas, G. 8., Haas, J., Heil, C., & Weir, M. (2018). Thomas' Calculus. Pearson Education Limited. • Stroud, K. A., & Booth, D. J. (2020). Engineering mathematics. Bloomsbury Publishing.						
Prerequisites:						
Calculus I						
Course Topics:						
Principles of Integration; Integral Methods; Integration techniques- integration by parts; integration techniques; trigonometric integrals; partial fractions. Integral Application: infinite integral areas; Arc length; Surface Area. Volumes (Disk, Washer, Shell); Polar Coordinates: Tangent with polar coordinates, curves defined parametric equations; Sequence and series.						

Course Outcomes: Students can:
1- Evaluate of definite, indefinite and improper integrals by using different integration techniques 2- To determine arc length, surface area and volume by using the applications of integration techniques' 3- Define polar coordinate graphs and solve related problems including area, arc length and volume 4- Identify the properties of sequences and their limits with identifying standard convergent operations of power series'

2.1.2.3 CHE 1206-Eng. Drawing

CHE 1206	**Eng. Drawing**
This is a required course for the Chemical and Petrochemical Engineering Program.	
Course Description:	
The fundamentals of engineering drawing including orthographic projection, dimensioning, sectioning, exploded and auxiliary views, assembly drawings, and SolidWorks. Homework drawings are of parts fabricated by the student in the lab.	
Recommended Textbook(s):	
Interpreting Engineering Drawings, Jensen, C.H. and Helsel, G.D., 7th ed., Thomson Delmar Learning, 2007	
Prerequisites:	
None	
Course Topics:	
Introduction: graphic language, standards, instruments, letters…etc; Basics for interpreting drawings, line types, types of drawings and sketches; Orthographic views. Deducing front, top, and side views from a pictorial; Dimensioning Sectional views: full and half sections; Drawing a missed view from given two;Pictorial sketching: isometric and oblique	
Course Outcomes: Students can:	
1. Recognize the value of engineering graphics as a language of communication. 2. Infer the nature of engineering graphics, the relationships between 2D and 3D environments. 3. Comprehend and deduce orthographic projections of an object. 4. Visualize wide variety of objects and drawing the missing views. 5. Comprehend and deduce section views	

2.1.2.4 CHE 1207 -Engineering Mechanics (Static)

CHE 1207	**Engineering Mechanics (Static)**
This is a required course for the Chemical and Petrochemical Engineering Program.	
Course Description:	
The objective of this course is to introduce students to the basic concepts of engineering mechanics. We will start by reviewing the general method of mechanics and principles of analysis. Then, we will define the basic quantities (force and moment) and relations, which are necessary for describing and analyzing, in a systematic mathematical way, the equilibrium of particles and rigid bodies. Along the way, students will also learn how to treat distributed loads and how to find the centroid/center of gravity and moments of inertia of bodies and areas. Eventually, we will put a strong emphasis on applying the concepts to solving the equilibrium of simple structures (trusses, frames and machines) and analyzing internal forces in beams, when they are acted on by external loads.	
Recommended Textbook(s):	
R.C. Hibbeler, Engineering Mechanics: Statics, Prentice Hall, 12th ed.2010.	
Prerequisites:	
None	
Course Topics:	
1- Resultant and equivalence of 2D force system,	

2- Definition of moments and couples, Couples in 2D and 3D systems, Force systems with couples.
3- Resultant and equivalence of 3D force system, Systems with couples Analytical solutions.
4- Concept of free body diagram (FBD), Equilibrium of rigid bodies, Equations of equilibrium in 2D and 3D space.
5- Distributed forces and centre of gravity, Determination of Centroids
6- Coefficients of friction, friction law, solving systems with friction.
7- Definition and types of internal forces, getting internal force diagrams in beams and shafts.
8- Truss structures, various methods of structural analysis, method of sections and method of joints.

Course Outcomes:
Students can:

- Draw free-body diagrams
- Formulate and solve the equations of equilibrium
- Analyze internal forces for simple structures
- Construct shear force and bending moment diagrams for beams
- Determine the centroid, center of gravity, and moment of inertia
- Determine friction forces and their effects on rigid bodies

2.1.2.5 CHE 1208-Fundamentals of electric circuit

CHE 1208	**Fundamentals of electric circuit**					

This is a required course for the Chemical and Petrochemical Engineering Program.

Course Description:

Basic Concepts & Basic Laws: System of units, voltage and current, circuit elements, voltage and current sources, electrical resistance and conductance, power and energy, Ohm's and Kirchhoff's laws, Resistances in series and parallel, current and voltage division, delta-star and star-delta transformations. DC circuits' analysis: Nodal analysis, Nodal Analysis with Voltage Sources, Mesh analysis, Mesh Analysis with Current Sources. Circuit Theorems: Linearity Property, Superposition, source transformation, Thevenin's theorems, Norton's theorems and maximum power transfer theorems. Capacitors and Inductors: series and parallel connections of capacitors and inductors.

Recommended Textbook(s):

• Alexander and Sadiku "Fundamentals of Electric Circuits" Third Edition McGraw Hill.
• Boylestad, R. L., Introductory Circuit Analysis (10th Edition).

Prerequisites:

CHE 1203

Course Topics:

Systems of Units, Charge, Current, voltage, power and Energy. Voltage and current sources, electrical resistance and conductance. Ohm's law. Nodes, Branches, and Loops. Series/parallel connections of resistors. Voltage Division and Current Division. Kirchhoff's current law and Kirchhoff's voltage law. Wye-Delta Transformations, Delta to Wye Conversion, Wye to Delta Conversion. Series/parallel DC circuit analysis. Nodal analysis, Nodal Analysis with Voltage Sources. Mesh analysis. Mesh Analysis with Current Sources. Superposition theorem. Thevenin's Theorem and Norton's theorem. Source transformation. Maximum power transfer theorem. Capacitance and capacitors series/parallel connections. Inductance and inductors series/parallel connections.

Course Outcomes:
Students can:

• Define concepts of electric current, voltage, power, Kirchhoff's
• Apply Ohm's Law in series and parallel connections.
• Apply Thevenin's theorem and Maximum power transfer and superposition theorems for circuit analysis.
• Apply nodal and mesh analysis to solve DC circuits
• Apply superposition and source transformation methods to solve DC circuits.
• Apply Thevenin's Theorem and Norton's theorem to solve DC circuits.
• Apply Source transformation and maximum power transfer theorem
• Analyze electric circuit using simulation software

• Understand inductors and capacitors properties.

2.1.2.6 CHE 1302-Practical Physics

CHE 1302	Practical Physics
This is a required course for the Chemical and Petrochemical Engineering Program.	
Course Description:	
This course provides a basic understanding of the core area of physical chemistry, based around the theme of systems, states and processes. As students receive a solid background in chemistry and organic chemistry through the CHEM 1112 and CHEM ……., respectively, this course is an appropriate ensuing course for students because it will give them a good understanding of physical chemistry which is very important to students intending to complete a major or minor study in Chemical Engineering. This course covers the basic principles and methods of Physical Chemistry, mainly: ideal gas behavior and its laws, real gases, thermodynamics and chemical kinetics.	
Recommended Textbook(s):	
Prerequisites:	
CHE 1204 General Chemistry	
Course Topics:	
Introduction to Physical Chemistry; Review of gas behavior from both theory and empirical viewpoints :The perfect gas: states of gases, the gas laws; Real gases: the Van der Waals equation ;The First law of Thermodynamics: the basic concepts; Work , heat, energy: The Internal energy; Expansion work ; Heat transactions (Heat Capacities); Enthalpy; Adiabatic changes; Thermochemistry: Standard enthalpy changes; Standard enthalpies of formation; The temperature dependence of reaction enthalpies. The Second law of thermodynamics: The dispersal of Energy; Entropy; Entropy change accompanying specific processes (Expansion, Phase transition, Heating). The Third law of Thermodynamics: The Nernst theorem; The Third law Entropies. Gibbs Free Energy (and Helmholtz Free Energy): Criteria of spontaneity; Maximum work; Maximum non-expansion work; Standard molar Gibbs energies (Properties of the Gibbs Energy. What is Nanotechnology.	
Course Outcomes: Students can be:	
1.able to demonstrate an understanding of gas behavior using different equations of state and kinetic molecular model. 2.able to demonstrate an understanding of thermodynamics laws and their applications. 3.able to demonstrate knowledge about kinetics laws, define the rate of reaction and the rate constant. 4.skilled in problem solving and analytical reasoning as applied to scientific problems.	

2.1.2.7 CHE 1303-Principles of Chemical Engineering II

CHE 1303	Principles of Chemical Engineering II
This is a required course for the Chemical and Petrochemical Engineering Program.	
Course Description:	
Energy forms and energy balances and thermodynamic principles. Balances on non-reactive processes Balances on reactive processes including fuels and combustion. Solution of simultaneous material and energy balance equations for process flow sheets using suitable software's (computer laboratory).	
Recommended Textbook(s):	
Felder R. M. and Rousseau, R. W. "Elementary Principles of Chemical Processes" John Wiley & Sons.	
Prerequisites:	
CHE 1301- Principles of Chemical Engineering I	
Course Topics:	
Energy and energy balance; (Forms of energy, the first law of thermodynamics, energy balances on closed systems, energy balance on opens systems, table of thermodynamic data, energy balance procedures, mechanical energy balances). Balances on nonreactive processes (Elements of energy balance calculations, changes in pressure at constant temperature, changes in temperature, phase change operations, mixing and	

solution, psychrometric chart). Balances on reactive processes (Heats of reaction, Hess's law, formation reactions and heats of formation, heats of combustion, energy balances on reactive processes, fuels and combustion).
Course Outcomes: Students can:
1- Able to identify, use and convert various forms of energy. 2- To use tabulated energy-related data. 3- Able to perform energy balances on non-reactive systems. 4- Able to perform energy balances on reactive systems. 5- Able to understand and perform energy balance calculations on combustion reactions.

2.2 Level 2nd

2.2.1 1st Semester

2.2.1.1 CHE 2104 – Democracy

CHE2104	Democracy					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course is designed to give the student the definition of freedom democracy, the concept of democracy, history of democracy, the properties of democracy, traditional Greek democracy, its principles, modern democracy, and pressure groups .						
Recommended Textbook(s):						
- By Topics						
Prerequisites:						
CHE 1101						
Course Topics:						
• The concept of democracy • History of democracy • The properties and principle of democracy • Traditional Greek democracy and modern democracy • The relationship between human rights and democracy • Pressure groups						
Course Outcomes: ***Students can:***						
• Learn what democracy ?						
• Democratic approach in Islam and its applications						
• Accepts differing views						
• Evaluation of pressure groups						

2.2.1.2 CHE 2209 - Calculus III

CHE 2209	Calculus III					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course uses to understand these concepts of applications and how to evaluate volumes, surface area, and to understand analytic geometry. Provide practice at developing critical thinking skills, solving open ended problems and to work in teams Develop a deep understanding of issues related to the basic principles of polar Coordinates, vector analysis, determinants, and how to solve problems in chemical engineering.						
Recommended Textbook(s):						
- Thomas Calculus, by George B. Thomas, Jr, Elevnth Edition Media Upgrade 2008"						
Prerequisites:						
CHE1203, CHE1205						
Course Topics:						
Multiple integrals: double integral, area, double integral in polar form, triple integral in rectangular coordinate volumes and averages value trible integral in spherical and cylindrical coordinate. Matrix theory: definition						

properties, system of linear equation gas elimination linear independence and rank, determinants and inverses, gauss Jordan elimination, matrix eigen values problem , special matrices, Ordinary differential equation: definition type, order , degree , first order , ordinary differential equation, separable variable equation , homogenous equation linear differential equation exact equation substitution method integrating factor method, second order differential equation, homogeneous second order, non- homogenous second order (undeterminants coefficient variation of parameters ,engineering application third and fourth order, solution of differential equation by series). Vector calculus: scalar and vector: components of vectors, vector addition, and multiplication of vector, scalar product, vector product and line integral using parametric equation of the path, line integral in vector field work. Laplace transform: definition and properties of Laplace transform, Laplace transform of different function inverse Laplace transform, using different method, solution of ordinary differential equation using Laplace transformation.
Course Outcomes: ***Students can:***
Recognize the analogy between Cartesian and polar coordinates systems.
Understand the vectors and their applications in modern mathematics.
Be familiar with 3-dimension mathematics.
Understand the differentiation concepts.
Understand double and triple integrals and be able to extend them to higher integrals.

2.2.1.3 CHE 2304 - Organic chemistry

CHE 2304	Organic chemistry				
This is a required course for the Chemical and Petrochemical Engineering Program.					
Course Description:					
Introduce and develop an understanding the basic concepts of organic chemistry, understanding the concepts of organic reactions for analysis of unit processes Students will learn the polymeric chemistry					
Recommended Textbook(s):					
- Morrison, R. Thornton; Boyd, R. Neilson "Organic Chemistry" 6th edition, 2001 - Skoog, D.A., West D.M., Holler F.J., and Crouch S.R. “Fundamentals of analytical chemistry”, 8ed edition, brooks/Cole Cengage Learning. 2004					
Prerequisites:					
CHE 1204					
Course Topics:					
Introduction & Classification Organic Chemistry, names of organic compounds, Aliphatic compounds, alkyl halides properties, preparation and reactions, Bonding and isomerism. Alkanes and cycloalkanes. Alkenes and alkynes. Aromatic compounds. Alcohols, phenols and thiols. Ethers and epoxies. Aldehydes and ketones. Carboxylic acids and their derivatives. Amines.					
Lab. Section:					
• Experiment 1: Separation and purification processes. • Experiment 2: Determination of physical constants. • Experiment 3: Identification of different functional groups (alcohols, phenols, aldehydes, ketones, carboxylic acids and amines). • Experiment 4: Carbohydrates (simple sugars and polysaccharides). • Experiment 5: Separation of mixtures of organic compounds. • Experiment 6: Preparation of simple organic compounds (aspirin and methyl benzoate).					
Course Outcomes: ***Students can:***					
Able to differentiate between different types of organic materials and structures.					
Able to relate materials properties and performance to the structure.					

Understanding different property of organic and aromatic material.
Apply physics and chemistry to relate materials structure to their properties.

2.2.1.4 CHE 2305 - Fluid Mechanics (I)

CHE 2305	Fluid Mechanics (I)					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
foundations of fluid mechanics, fluid statics, kinematics, laminar and turbulent flow; macroscopic balances; dimensional analysis and flow corrections.						
Recommended Textbook(s):						
- Fluid Mechanics by whith - Fluid mechanics and Mechinery by dranlics by R.V Giles - Fundamentals of Fluid Mechanics by Mustafa B.Hadithe						
Prerequisites:						
None						
Course Topics:						
Introduction : physical properties of fluid ,definition of type of fluid (Newtonian -non-Newtonian), incompressible ,compressible fluid , static and dynamic fluid , dimensional analysis Raleigh's method and Buckingham's theorem ,fluid static and application ,fluid dynamic :fluid pattern and Reynolds number ,Bernoulli equation ,correction to Bernoulli equations Newton's law of viscosity and momentum boundary layer flow of incompressible Newtonian in pipes and channels effect of friction calculation of friction in straight pipe and fitting ,calculation of pressure drop in straight pipe and fittings ,calculation of pressure drop in straight pipe, friction from changes in velocity in all direction velocity distribution for laminar and turbulent flow in pipe, flow measurement :venture meter ,orifice meter Pitot tube area meter Rota meter notch and weirs.						
Course Outcomes: ***Students can:***						
Students will demonstrate a knowledge of the fundamentals of fluid mechanics.						
Students will demonstrate the ability to use various techniques for analyzing problems with frictional flow.						
Students will demonstrate an understanding of the basics of boundary layer theory for use in transport of heat and mass.						
Students will demonstrate the ability to apply fluid mechanics principles and their relevance to engineering and the ability of these to solve societal problems.						

2.2.1.5 CHE 2306 - Physical Chemistry

CHE2306	Physical Chemistry				
This is a required course for the Chemical and Petrochemical Engineering Program.					
Course Description:					
This course give an introduction to the uses of physical chemistry in chemical engineering, It provide many opportunities for the intermediate applications of ideas and equations in solving problems, Studying thermodynamics laws zero, first , second and third law , Learning about Thermo chemistry, Show how rates of chemical reactions can be understood, Learn about different energy like entropy ,Gibbs and Helmoltz energies,					

Drive Maxwell relation used in thermodynamics relations & Understnnd phase equilibrium and chemical equilibrium
Recommended Textbook(s):
- Physical chemistry seventh edion by alberty - Physical chemistry by S.CHAND
Prerequisites:
Course Topics:
1st of thermodynamic, 2nd and 3rd law of thermodynamic, Gibbs free energy, chemical equilibrium, chemical reaction, rate of reaction equation, phase equilibria in ideal solution, phase equilibria in non-ideal solution, electrochemical equilibrium surface thermodynamics, experimental gas kinetics and liquid kinetics, viscosity of liquid, electrical conductance, electrolyte.
Lab. Section:
Course Outcomes: ***Students can:***
Calculation of ideal gas law and real gas laws
Calculations of enthalpy at different conditions
connect between theory and the experimental work in the physical chemistry laborotary.
calculations of different energies
learning about reactions rates

2.2.1.6 CHE 2307 - Technology of Chemical Industry

CHE 2307	Technology of Chemical Industry				
This is a required course for the Chemical and Petrochemical Engineering Program.					
Course Description:					
Chemical or chemical industries, also called manufacturing industries, include manufacturing processes that take place during the production of petrochemicals, medicine, polymers, paint, oils, cement, glass, soap and detergents, fertilizers and other industries. The sciences of chemistry and chemical reactions are used to produce new chemicals, or separate substances from each other using many properties such as the extent of solubility, charge or distillation, in addition to transformations that take place using heat and other methods. The chemical industry involves operating or changing raw materials obtained from mines, soils, and agriculture into other useful materials that can be used in our daily lives or as raw materials for other industries. The food industries are not considered among the chemical industries.					
Recommended Textbook(s):					
- Shreve's Chemical Process Industries ,5th edition,1988 - د.جابر شنشول جمالي،الصناعات البتروكيمياوية، الجامعة التكنولوجية ٢٠٠٤					
Prerequisites:					
None					
Course Topics:					
Treatment of industrial water. Prevention and removal of scales, Industrial carbon, Gases (carbon dioxide, ammonia, nitrogen, helium, oxygen), Sulphur and its compounds, sulfur and sulfuric acid production. Fertilizers, urea, nitric acid, Soap and detergents, Magnesium compounds, Ceramic industries, Cement, Glass industry, Paper and cellulose, Sugar industry, Fermentation industries, Fats and vegetable oils, Pharmaceutical industry. Introduction to Food industry such as dietary industries.					

Course Outcomes: ***Students can:***
Knowing the advantages of chemical industries and how they are developed and increasing interest in theoretical knowledge.
Knowing the forms and types of equipment needed for each industry and how to choose and deal with them.
Knowing the variables of each industry and the optimal conditions for it and how to give the best production capacity in the least time and at the lowest cost.
Calculation of production capacity, as well as operational costs and total costs for each industry.
Determining the type of reactions specific to each industry and knowing the appropriate conditions for them, as well as determining their quality if they are homogeneous or heterogeneous.

2.2.1.7 CHE 2308 - Mass Transfer I

CHE 2308	Mass Transfer I				
This is a required course for the Chemical and Petrochemical Engineering Program.					
Course Description:					
The course aims to provide deeper knowledge, a wide scope and improved understanding of the mechanics in mass transfer as well as a better insight into analytical and empirical methods applied in analysis and synthesis of mass transfer. The student should gain knowledge to apply the theories to relevant engineering.					
Recommended Textbook(s):					
- Coulson, J.M. , Richardson, J.F., Backhurst, J.R and Harker, J.H. "Chemical Engineering vol.2" , 4th Edition, Pergamon Press, Oxford, U.K, 1991. - Geankoplis, C.J., "Transport Processes and Unit operations" 3rd ed., Prentice-Hall, Inc, Edgewood Cliffs, N.J., 1993.					
Prerequisites:					
Course Topics:					
Definition of mass transfer, molecular and convective diffusion, Ficks first law for molecular diffusion definitions of concentration, velocities and fluxes, molecular diffusion in gases and liquids, diffusion through varying cross-sectional area. Maxwell theory: for gases in binary and multi component mixtures diffusion coefficient in gas and liquids, molecular diffusion in solid, molecular diffusion in biological solutions, continuity equations and introduction to unsteady state of diffusion. Mass transfer coefficients: mass transfer coefficients from dimensionless group, mass transfer for flow inside a wetted well column, mass transfer in flow parallel to flat plates and past single spheres, theories of mass transfer. Absorption: vapor liquid equilibrium gases and absorption, capacity of packed absorption for diluted and concentrated mixtures, relation between individual and overall height of transfer unit, absorption in plate tower, non-isothermal absorption, steam stripping.					
Course Outcomes: ***Students can:***					
Explain the diffusion concept and use Fick's law to predict flux					
Calculation of diffusion coefficient for real and ideal gas as well mixture of gases, in liquid and the effect of solid presence on flux and diffusion coefficient for the above cases.					
Apply numerical methods to calculate flux.					
Defining overall mass transfer coefficient and apply the two resistance theory for two phases.					

2.2.2 2nd semester

2.2.2.1 *CHE 1105 - English Language II*

CHME1105	English Language II				
This is a required course for the Chemical and Petrochemical Engineering Program.					
Course Description:					
This course is designed to enable students to achieve academic oral and written communication to the standard required for English language at university level. The course integrates all the language skills with emphasis on writing. It stimulates students' imagination, and promotes personal expression. Course activities include writing various types of academic essays, acquiring advanced academic vocabulary and getting involved in group discussions and debates. In addition, the course also includes other skills to consolidate the main skills, such as further readings in civil engineering.					
Recommended Textbook(s):					
- John & Liz Soars, ,,New Headway plus- pre_lntemediate Student,s Book,,, lOth 2012					
Prerequisites:					
CHE1102					
Course Topics:					
- Question forms – Tenses - Vocabulary (Jobs) - Present simple - Present continuous -Have/have to - Writing (informal letter) - Writing (Linking words +Describing a person) - Past simple - Past continuous - Have + noun - Writing (a story 1) -Count and uncount nouns – Articles - Expression of quantity - Vocabulary (clothes) - Writing (filling in forms) - Verb patterns - Will and going to - Writing (postcard) - Would like and like - Vocabulary (adjective formation) - Comparative and superlatives - Writing (relative closes) - What... like? - Present perfect-Vocabulary (men and women)- Tense revision - have to & got to -biography) - Vocabulary (job description) - have to & should & must - Present simple or will -Writing (formal letter) - Time clauses - Conditional clauses -Verb patterns- Used to – Infinitives - The passive form - Active and passive -Vocabulary (words with more than one meaning) - Second conditional - Writing (email) Might - Vocabulary (phrasal verbs) Writing (a story 2)					
Course Outcomes: ***Students can:***					
By the end of successful completion of this course, the student will be able to: l. Develop academic writing					
2. Apply reading skills					
3. Expand academic vocabulary through reading					
4. Ability to speak through group discussions and debates					

2.2.2.2 *CHE 1210 - Calculus IV*

CHE 1210	Calculus IV				
This is a required course for the Chemical and Petrochemical Engineering Program.					
Course Description:					
This course uses to Understand methods of solving First order and Higher order ordinary differential equations along with some physical Application. Demonstrate the relevance of the mathematical methods learnt to chemical engineering. Understand the concept of Fourier-series representation of periodic functions and their application.					
Recommended Textbook(s):					
- Thomas Calculus, by George B. Thomas, Jr, Elevnth Edition Media Upgrade 2008"					
Prerequisites:					
CHE1203, CHE1205, CHE2209					
Course Topics:					
Some of the areas covered in a single-variable calculus course include: Polynomials, Derivatives, Logarithmic functions, Limits, Integration, Qualities of the real number system. Multivariable Calculus: Differentiation involving several variables, Vector-valued functions, Multiple integration, Line integrals, Vector analysis and					

surface integrals. Differential Equations: Linear systems of differential equations, Fourier series applications, Stability, Bifurcations, Numerical methods, Nonlinear systems. Linear algebra and the closely related analytic geometry are used extensively in natural sciences like chemistry. Students enrolled in a linear algebra course learn about solutions to linear equations, linear independence, determinants, eigenvalues, subspaces and matrices as well as vectors.
Course Outcomes: ***Students can:***
Identify various types of equations and their particular solution.
Understand finite differences and their applications in interpolation and extrapolation.
Identify formulate and solve chemical engineering problems.
Use the techniques, skills and modern mathematical tools necessary for engineering practice in chemical engineering applications.
Be familiar with the differential equations and able to use the relevant equations in solving the problems.

2.2.2.3 CHE 1309 - Engineering Materials

CHE 1309	Engineering Materials				
This is a required course for the Chemical and Petrochemical Engineering Program.					
Course Description:					
Introduce the student to materials science& engineering and to highlight the relationships between structure , properties , and application of materials					
Recommended Textbook(s):					
- William D. Callister. “Materials Science and Engineering an introduction” John Wiley & Sons, sixth ed.2003					
Prerequisites:					
CHE 1207					
Course Topics:					
Strength of materials definitions, Simple stress, Shear stress, Stress in cylinders, Simple strain, Thermal stress, deformation in beams, Equations of stress and momentum in beams. Curves of stress and momentum in beams. Crystalline structure, Phase diagram, Alloys of copper, aluminum and iron, Plastics (polymers), Properties and uses of polyethylene, Ceramics, crystalline deformations, Practical: tests of the resistance of materials to friction, crystalline structure of metals.					
1- Support Reactions for Simply Supported Beam 2- Tension Test 3- Compression Test 4- Verification of the Theory of Pure Bending 5- Torsion Test 6- Deflection of Beam 7- Impact Test 8- Fatigue 9- Hardness Test					
Course Outcomes: ***Students can:***					

Able to differentiate between different types of materials and structures quickly and accurately.
Able to relate materials properties and performance to the structure.
Understanding phase diagrams for solid materials and performing materials balance calculations for different materials systems.
.Apply physics and chemistry principles to relate materials structure to their properties.
Apply thermodynamic principles to study the equilibrium between different solid phases.

2.2.2.4 CHE 1310 - Petrochemical Industry

CHE1310	Petrochemical Industry					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
Getting to know the industries that produce petroleum, how are the production processes in the factories? How to control the production process. The study of how interactions between substances and compounds take place. The effect of pressure and temperature on the petrochemical industries						
Recommended Textbook(s):						
- Shreve's Chemical Process Industries ,5th edition,1988 - التكنولوجية ٢٠٠٤ د.جابر شنشول جمالي،الصناعات البتروكيمياوية، الجامعة						
Prerequisites:						
None						
Course Topics:						
Characteristics of petrochemical industries, classification of petrochemical compound according to their source (methane, ethylene, propylene, and aromatics hydrocarbons) methane and their derivatives, (acetylene and methanol) ethylene and derivatives (ethylene oxide, and poly-ethylene), propylene and derivatives (isopropyl alcohol, Phenol and poly propylene) aromatics cyclic hydrocarbons. Introduction of benzene derivatives (ethylbenzene, styrene, cumene, nitro benzene, cyclohexane, toluene derivatives (benzoic acid, xylene derivatives, teretholic acid), polymers (LDPE, HDPE, PP, PVC, PS) synthetic fibers, industrial rubber.						
Course Outcomes: ***Students can:***						
Clarify the petrochemical industries and their products and consider them as raw materials for the various chemical industries.						
Knowing the forms and types of equipment needed for each industry and how to choose and deal with them.						
The ability to know the advantages and disadvantages of each industry and how to deal with them and choose the best.						
The ability to determine the necessary and required equipment for each industry and know what is best to give better and more productivity.						

2.2.2.5 CHE 1311 - Fluid Mechanics II

CHE 1311	Fluid mechanics II					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
Student's knowledge of dynamic fluid specifications in general and how to simulate the practical side theoretically, Introduce the student to how to calculate the coefficients of friction and the energy lost during the movement of fluids, introduce students to the design laws of centrifugal pumps, How to use engineering applications in the laws of mass, time, continuity and momentum for fluid motion and deduce forces of which.						

Recommended Textbook(s):
- Fluid Mechanics by whith - Fluid mechanics and Mechinery by dranlics by R.V Giles - Fundamentals of Fluid Mechanics by Mustafa B.Hadithe
Prerequisites:
CHE 2305
Course Topics:
Pumping of liquids, calculation of total head NPSH, performance, characteristics curves, calculation of horsepower, types of pump, compressible fluid: general equation, isothermal and adiabatic condition work and compressors fans and blowers. Mixing: equipment and operation, degree of mixing , power curve , scale up of liquid mixing, non Newtonian fluid :type of fluid calculation of friction , pressure drop for general time, independent in laminar and turbulent flow, flow through granular bed, and packed column, fixed bed and fluidized bed.
Lab. Section:
1. Calibration of pressure measurement device. 2. Determination of pressure center of a surface embedded completely or partially in a liquid. 3. Determination of Reynolds number. 4. Measurement of flow rate through piped using Venturi-Meter. 5. Comparison of flowrate measurement using different devices. 6. Determination of Hydraulic gradient line and total energy line. 7. Determination of losses friction through pipes and fittings.
Course Outcomes: ***Students can:***
Students will demonstrate a knowledge of the fundamentals of head, pump and type of fluid mechanics.
Students will demonstrate the ability to use various techniques for analyzing problems with mixing.
Students will demonstrate an understanding of the basics of non Newtonian fluid.
Students will demonstrate the ability to design packed column fluidized bed.

2.2.2.6 CHE 1312 - Mass Transfer II

CHE 1312	Mass Transfer II				
This is a required course for the Chemical and Petrochemical Engineering Program.					
Course Description:					
Application of chemical engineering principles to multistage and differential processes involving separation of chemical components, equilibrium stage concept. Design applications in distillation, gas absorption, and liquid-liquid and solid-liquid extraction					
Recommended Textbook(s):					
- Coulson, J.M. , Richardson, J.F., Backhurst, J.R and Harker, J.H. “Chemical Engineering vol.2” , 4th Edition, Pergamon Press, Oxford, U.K, 1991. - Geankoplis, C.J., “Transport Processes and Unit operations” 3rd ed., Prentice-Hall, Inc, Edgewood Cliffs, N.J., 1993.					
Prerequisites:					
CHE 2308					
Course Topics:					
Phase Equilibrium relations and phase diagrams. Fundamentals of stage operations, the equilibrium stage, graphical and analytical stage determination, Application of equilibrium stage analysis to Distillation: Types of distillation:					

Differential, Equilibrium Flash Vaporization, and steam distillation. Analysis of binary distillation processes, McCabe-Thiele, graphical methods and stage-to-stage calculations, Introduction to multicomponent distillation. Plate-to-plate calculations and short-cut methods of stage determination. Efficiency of vapor-liquid contactors. Design and operating characteristics of plate columns. Determination of column height and diameter. Distillation tray design and dynamics, Application of equilibrium stage analysis to solvent extraction and leaching: - Liquid liquid Extraction: Fields of application, modelling and analysis of single, multiple cross-current and multistage counter current extraction cascades. Equipment in common use. Leaching: Solid liquid equilibrium, design of counter current leaching equipment. Absorption as an example of a differential contact process. Gas absorption relationships. Basic design equation of packed columns. Characteristics of tower packing, flow of fluid through tower packing and phenomena associated with it such as flooding and loading etc…, Introduction to absorption when accompanied by chemical reactions, and multicomponent absorption.
Course Outcomes: ***Students can:***
Ability to perform vapor -liquid equilibrium calculations and to solve phase equilibrium problems.
Ability to formulate and solve problems involving, differential distillation, flash vaporization.
Ability to formulate and solve design problems involving binary and multi -component distillation with emphasis on plate columns.
Application of equilibrium stage analysis to solvent extraction and leaching.
Understanding the principles of plate column design, efficiency determination, plate dynamics and stability.

2.2.2.7 CHE 1313 - Thermodynamics I

CHE 1313	Thermodynamics I				
This is a required course for the Chemical and Petrochemical Engineering Program.					
Course Description:					
Learn to analyze energy transfer and transformation in systems using fundamental concepts of properties of materials, work, heat, internal energy, entropy, equilibrium, and relations derived from the First and Second Laws of Thermodynamics. Learn the methods to measure thermodynamic properties and estimate values for properties using property tables and relations.					
Recommended Textbook(s):					
- Smith, J.M.; Van Ness, H.C.; and Abbott, M.M. "Introduction to Chemical Engineering Thermodynamics", 6th ed. McGraw Hill, 2001. - Thermodynamics, An Engineering Approach, Yunus A. Cengel and Michael A. Boles, McGraw-Hill, 8th Edition, 2015.					
Prerequisites:					
CHE 2306					
Course Topics:					
Introduction first law of thermodynamic ,Joules experiment, internal energy equilibrium ,phase rule, reversible processes and heat capacity volumetric properties of pure fluids ,virial equation and application ,ideal gas ,equation of state , generalized correlation for liquids and gases ,heat effect ,standard heat of reaction ,formation and combustion heat effects of industrial reaction ,standard law of thermodynamic ,heat engine ,entropy and 3rd of thermodynamic ,thermodynamics properties of fluid ,residual properties and thermodynamic properties of gases, thermodynamic of flow processes (flow in pipes expansions and compression pressures.					
Lab. Section:					
• Experiment 1: steam boiler (relation between saturated temperature and pressure). • Experiment 2: temperature measuring devices. • Experiment 3: The relationship of temperature, pressure, and volume at isothermal process. • Experiment 4: The relationship of temperature, pressure, and volume at isochoric process.					

Course Outcomes: ***Students can:***
To provide the students with the concept of energy and its related issues, such as energy forms and its classifications, and with the basic concepts of classical thermodynamics.
To get familiar with the principle of energy conservation
To apply mass and energy balances to closed systems.
To learn how to better use, interpret, predict, and produce thermodynamic data such as P-V-T data, heat capacities, and enthalpy data.
To introduce the concept of entropy and the limitations on energy conversion.
To enable students to identify, formulate, and solve engineering problems.

2.3 Level 3rd

2.3.1 1st semester

2.3.1.1 CHE 3106-English Language III

CHE 3106	**English Language III**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course emphasizes the fundamental language skills of reading, writing, speaking, listening, thinking, viewing and presenting. An emphasis on vocabulary and composition skills will be an on-going part of the program. Its main aim is to continue in student´s actual language skills, improve them and extend basic vocabulary so that he or she would be able to understand a simple text and to communicate and study in an English.						
Recommended Textbook(s):						
• Liz and John Soars, "The new headway intermediate book", Oxford.						
Prerequisites:						
CHE 1105						
Course Topics:						
Auxiliary verbs; Grammar revision; Vocabulary; Pronunciation; Prepositions; Writing (Correcting mistakes 1); Reading (Wonders of the modem world); Listening and speaking (My wonders). Present simple; Pronunciation revision; Present states and actions; Vocabulary; Phrasal verbs; Reading and speaking (I'm a clown doctor!); Writing (Letters and emails). Past simple and past continuous; Grammar revision; Past perfect; Past passive Vocabulary; Prepositions revision; Listening and writing (Books and films); Writing Narrative 1); Everyday English (Giving opinions). Have to /don't have to; Can and be allowed to; Should; Must and have to; Vocabulary; Pronunciation; Listening and speaking (Come round to my place!); Writing (For and against). Future form 1; Future form 2; Grammar revision; Vocabulary; Pronunciation; Prepositions revision; Reading and speaking (Hotels with a difference); Writing (Making a reservation). Like; Grammar review; Verb patterns; Vocabulary; Pronunciation; Phrasal verbs; Listening and speaking (New York and London) Everyday English (Signs and sounds); Writing a description. Present perfect; Tense review; Present perfect passive; Vocabulary; Pronunciation; Prepositions; Reading and speaking (Dream jobs); Listening and speaking (The busy life of a retired man); Writing (A letter of application). Conditionals 1 and time clauses; Conditionals 2; Vocabulary; Pronunciation; Phrasal verbs; Reading and speaking (Who wants to be a millionaire); Everyday English (Making suggestions) Writing (Narrative 2). Modal verbs of probability in the present; Modal verbs of probability in the past Vocabulary; Pronunciation; Prepositions; Listening and speaking (Brothers and sisters); Writing A description 2.						

Course Outcomes: By the end of the course, at the intermediate level, students will be able to:
• Make informed guesses of target vocabulary of intermediate level reading passages. • Expand targeted vocabulary assigned from intermediate level textbooks. • Improve vocabulary quiz- and test-taking ability. • Identify topic sentences and main ideas; discern major from minor details in intermediate textbooks. • Be able to identify the setting, main events, climax and resolution of readers at the intermediate level and summarize the novel in writing. • Respond thoughtfully, verbally and in speaking and writing, to intermediate level texts by drawing connections between personal experiences and/or world knowledge to the assigned text

2.3.1.2 CHE 3211-Engineering Statistic

CHE 3211	**Engineering Statistic**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
Statistical Engineering models are based on mathematics and probability theory. This course provides students with a working knowledge of fundamental statistics principles and probability in addition to a preface to the regression and correlation analysis. By the end of the semester, students should be able to determine when each of the various topics we have covered is appropriate to use, and to apply them to practical engineerin8 situations or problems. This course will cover techniques on data collection (presentation, descriptive statistics, basic elements of probability theory, sampling techniques theory, statistical estimation, hypothesis testing and regression analysis.						
Recommended Textbook(s):						
• Elementary Statistics A Step-by-Step Approach, Eighth Edition, By Allan G. Bulman • Probability and Statistics for Engineers and Scientists, Fourth Edition, By Sheldon Ross						
Prerequisites:						
Course Topics:						

Fundamentals (Introduction to Statistics): Introduction; Descriptive and inferential statistics; Variables and Types of Data; Data Collection and Sampling Techniques; Observational and Experimental Studies.
Presentation of a Statistical Data: introduction; Organizing Data; Grouped Frequency Distributions or Frequency Distributions Table; Graphs: Histograms, Frequency Polygons, and Ogive; Other Types of Graphs
Data Description: Measures of Central Tendency (Mean, Median and Mode); Measures of Variation: Population Variance and Standard Deviation; Sample variance and Standard Deviation; Variance and Standard Deviation for Tabulated Data; range. Coefficient of Variation
Discrete Probability Distributions: Probability Distributions; Mean, Variance, Standard an Deviation; The Binomial Distribution; The Poisson Distribution;
Continuous Probability Distributions the Normal Distribution: Normal Distributions; Applications of the Normal Distribution; Normal Distributions Formula; The Standard Normal Distribution; Finding Areas Under the Standard Normal Distribution curve (Table Method); A Normal Distribution Curve as a Probability Distribution Curve; Applications of the Normal Distribution; Determining Normality; The Normal Distribution Approximation to the Binomial Distribution.
Confidence intervals and Sample Size: Preface; Confidence intervals for the Mean When o is Known: A point estimates; An interval estimates Confidence intervals. Sample Size; t-Distribution; Confidence intervals for the Mean when σ is Unknown; The chi-square Distribution. Confidence intervals for Variances and Standard Deviations Confidence interval for a Variance; Confidence interval for a Standard Deviation.
Hypothesis Testing: Preface; Steps in Hypothesis Testing-Traditional Method: The null hypothesis (H_o); The alternative hypothesis (H_r); The level of significance. z Test for a Mean; P-Value Method for Hypothesis Testing; t Test for a Mean; z Test for a Proportion χ^2 Test for a Variance or Standard Deviation
Testing the Difference Between Two Means, Two Proportions, and Two Variances: Preface. Testing the Difference Between Two Means: Using the z Test; Testing the Difference Between Two Means of independent Samples: Using the t T; Testing the Difference Between Two Means: Dependent Samples; Testing the Difference Between Two Variances
Correlation and Regression: Preface Scatter Plots and Correlation; Regression; Coefficient of Determination and Standard Error of the Estimate.

Course Outcomes:
On completion of this course, the student should be able to:

- Use a number of methods and techniques for collecting and presentation the sets of data.
- Calculation and demonstration the center tendency and variation of data;
- Compute the probabilities in a simple case and using the rules of probability in computing.
- Give an account of the concept random variable and be able to use some common probability distributions;
- Understand the meaning of the central limit theorem;
- Use point and interval estimates for some typical statistical problems;
- Apply elementary regression for fitting measured data.

2.3.1.3 CHE 3314-Heat transfer I

CHE 3314	Heat transfer I					

This is a required course for the Chemical and Petrochemical Engineering Program.

Course Description:

This course deals mainly with an introduction of thermal energy transfer problems which occur in the process industry (Chemical, Petrochemical, food, Pharmaceuticals, etc.) It also gives an Introduction to the 3 modes of heat transfer: Conduction, convection c and radiation, heat transfer. Finally, the course reviews heat transfer with phase change and describe heat exchangers and their design.

Recommended Textbook(s):

C.J.Geankoplis ," Transport Processes and Unit Operations, Allyn And Bacon , 2nd ed. , Newton ,1983

Prerequisites:

Course Topics:

Introduction and mechanisms of heat transfer;

Conduction: Steady state heat transfer by conduction; conduction through single plane; conduction through composite plane; conduction though cylindrical annulus; conduction through composite pipe; conduction though single spherical wall; conduction though composite spherical walls.

Convection: Introduction to convection; dimensionless analysis; natural convection; forced convection; correlations for convections and its different forms for different actual situation such as heating and cooling inside tubes outside tubes in turbulent; transition and laminar flow.
Radiation: Principles, grey bodies, black bodies, emissivity, Kirchhoff's law, Planck's law, absorbing, non absorbing bodies.

Overall heat transfer coefficient, fouling factors, Logarithmic mean temperature difference for parallel, counter-current and mixed flow arrangements.

Heat transfer with phase change: Boilers- condensers
Introduction to multi tubular heat exchangers: Types, classification, constructions, applications, sizing. Effectiveness

Steps for design of Multi tubular heat exchangers without phase change: general considerations, introduction to TEMA codes.
Thermal and mechanical design for shell and tube multi tubular selection: Fluid allocations, heat transfer calculations (tube side- shell side), Determination of initial and final thermal areas, pressure drop calculations), optimization.

Course Outcomes:

By the end of the course, at the intermediate level, students will be able to:

- To familiarize the students with basic modes of heat transfer, appreciate the physical principles and basic concepts underlying the transfer of heat by conduction, convection and radiation.
- To present the methodology required to solve problems to be encountered in actual practice (determine heat transfer coefficient, LMTD).
- To introduce the student to the design of heat exchangers
- To familiarize the students with the concept of heat transfer parameters measurement (conductivity, heat flux, temperatures…)
- To enable students to prepare written technical reports and oral presentation.
- To expose students to open ended problems solving.

2.3.1.4 CHE 3315-Unit operation I

CHE 3315	Unit operation I					

This is a required course for the Chemical and Petrochemical Engineering Program.

Course Description:

This course deals mainly with the study and concept of the operations involving particulate solids: properties, modification, separation, settling and flow through porous media.

Recommended Textbook(s):

- W. L. McCabe, J. C. Smith and P. Harriot, Unit Operations of Chemical Engineering, 6th ed., McGraw-Hill, Inc., New York, 2001.

Prerequisites:
CHE 1312-Mass Transfer II
Lab. Section:
• Solid handling: size reduction and screen analysis. • Filtration (discontinuous- cake filtration using filter press).
Course Topics:
1.Properties, Handling, and Mixing of Particulate Solids: Characterization of solid particles, properties of particulate masses, storage of solids, mixing of solids, types of mixers. 2.Mechanical Size Reduction: Principles of comminution, size reduction equipment, equipment operation. 3.Flow Past Immersed Bodies: Friction in flow through beds of solids, motion of particles through fluids, fluidization. 4.Mechanical-Physical Separation I: Screening, filtration, centrifugal filters, principles of cake filtration, clarifying filters, liquid clarification, gas clarification, principles of clarification. 5.Mechanical-Physical Separation II: Separation based on the motion of particles through fluids: gravity settling processes, centrifugal settling processes.
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:
• Study the different physical separation processes based on mechanical unit operations, with emphasis on a physical understanding of these processes. • Provide the necessary tools to obtain quantitative solutions to engineering problems involving basic separation operations. • Study the properties of particulate solids. • Understand Solid handling: size reduction and screen analysis. • Understand principles of size reduction. • Understand principles of Flow through Packed Beds, and fluidization. • Understand principles of mechanical physical separations processes such as filtration, screening, gravity settling, centrifugal settling. • Expose students to open-ended problem solving

2.3.1.5 CHE 3316-Characteristics of Petroleum and Natural Gas

CHE 3316	Char. Petroleum and Natural Gas					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course is designed to familiarize the students with the fundamental aspects of petroleum engineering: introduction to engineering, petroleum exploration, major concepts of drilling, production and reservoir engineering, historical background of petroleum industry, worldwide sources of petroleum, companies and societies in petroleum industry as well as relevant environmental, health, safety and ethical issues.						
Recommended Textbook(s):						
By topics						

Prerequisites:
None
Course Topics:
Introduction: Composition Of Crude Oil; Physical Properties Of Crude Oil;Origin Of Hydrocarbons ;Exploration Techniques ; Origin Of Hydrocarbons; Exploration Techniques; Resource Estimation; Oil Field Development; Well Logging; Transportation And Metering Of Crude Oil; Coal Bed Methane
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:
• Be able to understand the characteristics of crud oil properties • Understand the mechanism of oil exploration techniques • Familiar with steps of oil field development • Familiar with transportation and metering with crude oil • Familiar with crude oil products and test methods

2.3.1.6 CHE 3317- Thermodynamic II

This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course deals mainly with the applications of chemical Engineering thermodynamics to phenomena of interest in chemical engineering, such as flow system, expansion and compression processes, with emphasis on phase equilibrium in pure fluid and chemical-reaction equilibrium and thermodynamic analysis of process. A good understanding of the material in this course is essential for the study and understanding of chemical engineering.						
Recommended Textbook(s):						
-J.M Smith and H.C Van Ness, M.M.Abott: Introduction to Chemical Engineering Thermodynamics, 7th edition, McGraw-Hill, N.Y, 2005.						
Prerequisites:						
Course Topics:						
Introduction: Review of the scope of thermodynamics (fundamentals and laws) **Thermodynamic Properties of Fluids:** Property relations for Homogeneous phases, Residual properties, Residual Properties by equation of states, Thermodynamic diagrams, generalized Property correlations for Gases **Applications of Thermodynamics to Flow Processes:** Throttling process, turbine and expanders, compressors and pumps. **Production of power from heat and refrigeration:** Steam power plant, Rankin cycle and efficiency calculation, Carnot refrigerator, the vapor-compression cycle, coefficient of performance. **Introduction to vapor-liquid equilibrium calculation**: VLE qualitative description, Raoult's law, Henry's law, modified Raoult's law, VLE from K-value calculation, azeotropic detection, flash calculation **Theory of solution thermodynamics:** Chemical potential and phase equilibria, partial properties, the ideal gas mixture model, fugacity and fugacity coefficient.						

Chemical reaction equilibria: the reaction coordinate, the standard Gibbs energy change and the equilibrium constant, effect of temperature on the equilibrium constant, evaluation of equilibrium constant and its relation to composition.
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:
• To give students concepts and understanding the basics of chemical engineering thermodynamics. • To develop the fundamental mathematical structure of thermodynamics by applying the first and second laws principles for real fluids at any temperature and pressure. • To apply thermodynamics principles for flow processes, heat engines and refrigerators • To acquire a basic understanding of phase equilibrium and different methods of computing Vapor-Liquid Equilibrium properties. • To understand the thermodynamics of liquid solutions and reacting systems. • To assess team problem-solving processes to improve these processes

CHE 3318	Reactor Design I	
This is a required course for the Chemical and Petrochemical Engineering Program.		
Course Description:		
This course provides a detailed and in-depth analysis to the principles of chemical kinetics, and reactor analysis and design. The topics in chemical kinetics include: rate constants, reaction order, rate equations for elementary and complex reactions, kinetic data analysis, and product distribution. In reactor analysis and design, discussion is focused on ideal reactor systems and arrangements, including batch reactors, plug flow reactors, continuous stirred tank reactors, and recycle reactors. The last part of the course considers homogeneous and heterogeneous catalytic reactions. The design component consists of how to make an appropriate choice of reactor type and operating conditions to optimize a desired product; sizing such reactors and determining conversion levels under various conditions of temperature and pressure; determination of reaction kinetics from experimental data.		
Recommended Textbook(s):		

- Walas, S. M. (2013). Reaction Kinetics for Chemical Engineers: Butterworths Series in Chemical Engineering. Butterworth-Heinemann.
-

Prerequisites:

CHE 2306- Physical Chemistry

Course Topics:

1. Mole Balances, conversion and reactor sizing
3. Rate laws and stoichiometry
4. Isothermal reactor design
5. Collection and analysis of rate data
6. Multiple reactions
7. Steady-state nonisothermal reactor design

Course Outcomes:

The objective of this course is to develop general methodologies for analysis and design of a variety of systems (chemical, biochemical/biological, polymer, electrochemical) for which engineering of reactions is needed. In the first part of the course, basic concepts of chemical kinetics and chemical reactor design as related to simple reaction systems will be introduced. Topics covered will include the general mole balance, reactor types, conversion and reactor sizing, rate laws and stoichiometry and isothermal reactor design. In the second part of the course, we will build upon the concepts developed in the first half of the course to describe real systems that deal with complex reactions and non-ideal reactors. Topics to be covered will include non-isothermal reaction design (energy balances), multiple reactions and reaction pathways, non-ideal reactors/residence time distribution (time permitting), and heterogeneous reactions (time permitting).

2.3.1.7 CHE 3318- Reactor Design I

CHE 3212	**Engineering Numerical Method**	

This is a required course for the Chemical and Petrochemical Engineering Program.

Course Description:

ln numerical analysis one explores how mathematical problems can be analyzed and solved with a computer. As such, numerical analysis has solved with a computer. As such, numerical analysis has very broad applications in mathematics, physics, engineering, finance, and the life sciences. This course gives an introduction to this subject

for mathematics majors, Theory and practical examples using MATLAB will be combined to study a range of topics ranging from simple root-finding procedures to differential equations and the finite element method.

Recommended Textbook(s):

- Atkinson, K. E., & Han, W. (1985). Elementary numerical analysis. New York: Wiley.
- STEVEN, C. C. (2007). Applied Numerical Methods with Matlab: For Engineers and Scientists. Tata McGraw Hill Education Private Limited.

Prerequisites:

Calculus-l, Calculus-ll, Calculus-lll, Ordinary Differential Equations.

Course Topics:

Error Analysis: Measuring Errors; Sources of Error; Consistency, order, Smoothness and convergence.
Roots of equations (Nonlinear Equations): Bisection Method; Newton-Raphson Method; Secant Method (optional); False-Position Method (Optional).
Simultaneous Linear algebraic Equations:

- **Direct Methods** – Review of Determinants and Matrices; Cramer's Rule; Gauss-Elimination method (simple and partial pivoting methods); Gauss-Jordan Method; Matrix inversion method
- **Indirect (iterative) Method-** Jacobi Method; Guess- Seidel Method; Successive Over Relaxation Method

Numerical Differentiation and Integration: Numerical differentiation using difference method; Numerical integration, Trapezoid and Simpson's Rules; Extrapolation of Errors
Interpolation and Curve Fitting: Direct Fit Polynomial; Least Squares Method; Logarithmic regression (Optional) ; Exponential regression (optional); Linear interpolation; Quadratic interpolation; Lagrange interpolation (Optional); Newton Divided Difference interpolation (optional).

- **Numerical Solutions of Ordinary Differential Equations:** Initial Value Problem; Euler's Method; Runge-Kutta 2nd ; Runge-Kutta 4th ;Higher Order Equations
- **Boundary Value Problem:** Equilibrium (Finite Difference) Method

Numerical Solutions of Partial Differential Equations: Elliptic Equations; Parabolic Equations; Hi-parabolicEquations; Advanced Application (Case Studies based on each department interests).

Course Outcomes:

After successful completion of the course, the students will be able to:

- Find roots of functions by using a range of methods,
- Solve systems of linear and non-linear algebraic equations by using a range of methods
- Apply numerical interpolation, approximation, integration and differentiation in solving engineering problems,
- Use techniques for solving ordinary differential equations
- Use MATIAB or other numerical tools for solving problems by numerical methods

2.3.2 2nd semester

2.3.2.1 CHE 3212-Engineering Numerical Method

CHE 3319	**Heat Transfer II**	
This is a required course for the Chemical and Petrochemical Engineering Program.		

Course Description:
This undergraduate course provides an introductory treatment of steady and transient conduction, natural and forced convection and radiation heat transfer with applications to basic heat exchanger design and other multimode problems. Students will work through textbook problem and lecture material to establish the relationship between these principals and practical applications.
Recommended Textbook(s):
- Incropera, F.P. and DeWitt, D.P., Fundamentals of Heat and Mass Transfer, 5th edition, John Wiley and Sons, New York, 2002.
Prerequisites:
CHE 3314-Heat transfer I
Course Topics:
Course Outcomes:

2.3.2.2 CHE 3319-Heat Transfer II

2.3.2.3 CHE 3320-Technology of Natural Gas

CHE 3320	**Technology of Natural Gas**
This is a required course for the Chemical and Petrochemical Engineering Program.	
Course Description:	
This course deals mainly with the study of concept of gas processing, the principal types of natural gas, its applications both as feedstock in petrochemicals industries and as an energy source. The course also discusses the main low temperatures process such as liquefaction cycles, and separations process related to natural gas. It also introduces recent advanced technology related to LNG, storage and transport equipment	
Recommended Textbook(s):	
• 1A.J. Kidnap, Parish, D.Mc Carty: Fundamental of Natural Gas, 2nd edition.	
Prerequisites:	
CHE 3316	
Course Topics:	
1. Natural Gas background (History- Development- Properties-) 2. Types of natural gas (Resources, Rich gas, lean gas) 3. Principal uses of natural gas (Natural gas industry-Petrochemicals- Energy- calorific values) 4. Transport –storage and distribution of natural gas 5. Principles of low temperature processes: relative volatility, boiling points, component mixtures. 6. Purification of natural gas - Low temperatures distillation (single column-double column): McCaBe Thiele method, PanchonSavarit method 7. Principles of liquefaction natural gas cycles (classical cycles and recent advanced cycles),Partial and total condensation principles.: 8. Swing adsorption used in natural gas processing: Definition, principles and applications 9. Membrane separation applied to natural gas purification: Description, theories and applications.	

10. Natural gas upgrading: Description and design.
Course Outcomes:
• identify the geological origins of petroleum reservoirs and reservoir fluids; • describe the history of the oil and gas industry; • explain the structure of the modern oil and gas industry; • list the various disciplines that make up the petroleum engineering profession; • illustrate the differences between conventional and unconventional reservoirs; • analyze rudimentary engineering methods; • interpret semi-log and log-log plots; • apply linear interpolation and regression; • analyze statistical descriptions of reservoir data; • identify and solve problems requiring simple iteration; and • discuss the role of environmental stewardship in the petroleum engineering profession.

2.3.2.4 CHE 3321-Water Treatment

CHE 3321	**Water Treatment**	
This is a required course for the Chemical and Petrochemical Engineering Program.		
Course Description:		
This course is an overview of engineering approaches to protecting water quality with an emphasis on fundamental principles. Theory and conceptual design of systems for treating municipal wastewater and drinking water are discussed, as well as reactor theory, process kinetics, and models. Physical, chemical, and biological processes are presented, including sedimentation, filtration, biological treatment, disinfection, and sludge processing. Finally, there is discussion of engineered and natural processes for wastewater treatment.		
Recommended Textbook(s):		
• MWH Staff. Water Treatment: Principles and Design. 2nd ed. New York, NY: Wiley, 2005. ISBN: 0471110183.		
Prerequisites:		
Course Topics:		
Introduction to Water Supply and Wastewater. Why Treat Water and Wastewater? Water Quality Parameters. Reactor Tanks - Mixed Tanks, First-order Kinetics, Plug Flow. Reactor Tanks - Dispersed Flow, Tanks-In-Series, Residence Time Distribution; Sedimentation-Flocculation; Filtration; Chemical Treatment – Softening; Chemical Treatment - Adsorption and Ion Exchange		
Course Outcomes:		
An ability to apply knowledge of mathematics, science, and engineering An ability to design a system component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. An ability to identify, formulate and solve engineering problems. The broad education necessary to understand the impact of engineering solutions in a global economic and environmental and societal context. Recognition of the need for, and an ability to engage in life-long learning. Knowledge of contemporary issues. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.		

2.3.2.5 CHE 3322-Composite Materials

CHE 3322	Composite Materials	
This is a required course for the Chemical and Petrochemical Engineering Program.		
Course Description:		
Composite materials are materials comprising two or more material phases with different physical properties. Because they usually exhibit remarkable physical properties, in general superior to the properties of their individual components, they appear pervasively in engineering applications (e.g., reinforced concrete in construction, fiber-reinforced materials for aircraft structures, reinforced rubber in car tires, …). Despite being comprised multiple material phases with different physical properties, these materials may be considered for practical purposes as homogeneous materials with physical material-like effective properties.		
Recommended Textbook(s):		
- Callister, W. D., & Rethwisch, D. G. (2018). Materials science and engineering: an introduction (Vol. 9). New York: Wiley.		
Prerequisites:		
None		
Course Topics:		
Introduction to composite materials; filler materials; classification of the composite materials; Reinforcement; Types of Fiber Reinforced; Composites; Fiber Materials; Mechanical behaviour of fibre reinforced composites; Effect of fiber length; Elastic behavior Longitudinal loading (continuous and aligned fiber composite); Elastic behavior - Transverse loading (continuous and aligned fiber composite); Longitudinal Tensile Strength; Discontinuous and aligned -fiber composites; Discontinuous and randomly oriented-fiber composite. Manufacturing Techniques; Manufacturing Process Selection Criteria; Product Fabrication Needs; Basic Steps in a Composites Manufacturing Process; Manufacturing Processes for Thermoset Composites; Hand lay-up process; Methods of Applying Heat and Pressure. Filament Winding Process; Making of the Part; Pultrusion Process; Basic Raw Materials characterization of composite materials; Practical application of composite in industry.		
Course Outcomes: By the end of successful completion of this course, the student will be able to:		
1. obtain important information of the mechanical properties of materials. 2. classified the materials. 3. select the optimal material for each application. 4. Analyze any type of failure and find the reasons of failure. 5. To know the developments of new materials.		

2.3.2.6 CHE 3323-Unit Operation II

CHE 3323	Unit Operation II	
This is a required course for the Chemical and Petrochemical Engineering Program.		

Course Description:
This course is a complementary to the third–year course Unit Operation I at which the student gained an introductory to unit operations through studying diffusion, absorption, and distillation in the first place. The covered topics in this course are meant to deal with: Boundary layer theory and its applications in chemical processes, the analogies between momentum, heat, and mass transfer such as Reynolds analogy, the Evaporation which is a type of the separation process, drying (mainly used in food industry), humidification and dehumidification to design cooling towers, extraction, leaching, crystallization, and adsorption.
Recommended Textbook(s):
• C.J. Geankoplis, Transport Processes and Unit Operations, 3rd edition, Prentice Hall Inc., 1993. • J.F. Richardson, J.H. Harker, J.R. Backhurst, Coulson and Richardson's Chemical Engineering: Volume 2, 5th edition, Butterworth-Heinemann, 2002.
Prerequisites:
CHE 1312-Mass Transfer II
Course Topics:
Boundary layer in laminar and turbulent flow; Boundary layer in laminar sub layer; Distribution on surface and pipes; Momentum heat and mass transfer; Analogies; Evaporation, introduction, and definitions; Types of evaporation, and evaporator types; Heat transfer in evaporation single and multi effects; Design of evaporators single and multi effects types; with and without BPR Drying; general principles; Drying rate and mechanisms; Theories of drying material movements; Material and energy balance for continuous dryer; Humidification, dehumidification , and cooling towers, general principles; Air- water system , enthalpy – humidity charts; Mechanism for humidification, and dehumidification; Cooling towers and its design; Extraction process, and general definitions; Ternary diagram and three liquid system; Single and multistage extraction processes and types of arrangements with soluble or partially soluble solvents, examples; Crystallization process: general principles, rate of crystallization batch and continuous process.
Course Outcomes:
• Apply the principle of filtration and its application to food and allied industries; • Apply the principle of centrifugation and its application to food and allied industries • Apply the principles of size reduction including milling, screening and emulsification and their application to food and allied industries; • Understand fully the importance of mixing in food processing systems.

2.3.2.7 CHE 3324-Reactor Design II

CHE 3324	**Reactor Design II**	
This is a required course for the Chemical and Petrochemical Engineering Program.		
Course Description:		
Recommended Textbook(s):		
Prerequisites:		
CHE 3318	Reactor Design I	

Course Topics:
Non isotherm reaction fundamental; Energy balance and 1st law of thermodynamic; constant balance and its relation with Gibbs free energy; Study the irreversible reaction; Enthalpy study and estimation heat of reaction; Study the adiabatic reaction; design a plug flow reactor under adiabatic condition; study the mix flow reactor; adiabatic and non-adiabatic operation for plug, mixed flow and plug with recycle; Multiple reaction, parallel reaction and how to maximize the yield of reaction. Multiple reaction in PFR and mixed flow reactor.
Course Outcomes:
On successful completion of the course students will be able to: 1. Demonstrate an understanding of the fundamental principles underlying kinetics and reaction engineering 2. Show an awareness of issues related to the practical application of reaction engineering 3. Exhibit expertise relevant to the practice of kinetics and reaction engineering

2.4 Level 4

2.4.1 1st semester

2.4.1.1 CHE 4107-English Language IV

CHE 4107	**English Language IV**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						

This course is designed to enable the students to achieve academic oral and written communication to the standard required at university level. The course integrates all the language skills with emphasis on writing, and it stimulates students' imagination, and promotes personal expression. Students, in this course, are trained to apply critical thinking skills to a wide range of challenging subjects from diverse scientific topics. Course activities include writing various types of academic essays, acquiring advanced academic vocabulary, and getting involved in group discussions and debates. In addition, the course also includes other skills to consolidate the main skills, such as further readings in chemical engineering

Recommended Textbook(s):

John & Liz Soars, "New Headway Plus- Beginner Student's Book", 10th ed 2014

Prerequisites:

Course Topics:

1. • Grammar (The tense system and spoken English) • Vocabulary (Compound of words lifestyle, home town, house-proud) • Reading (A home from home-two people describe their experiences of living abroad) • Listening ('things I miss from home') • Speaking (Exchanging information about people who live abroad) • Everyday English (Social expressions) • Writing (Applying for a job) • Vocabulary • Pronunciation • Phrasal verbs • Revision • Reading and speaking (A death) • Listening and speaking (My way) • Writing (Correcting mistakes 2) • Grammar (Present perfect, simple and continuous, and spoken English) • Vocabulary (Hot verbs, make, do make way, do damage) • Reading ('Paradise Lost'- how tourism is destroying the object of its affection) • Listening (An interview Tashi Wheeler about her travels as child with parents) • Speaking (Information Gap) • Everyday English (Exclamations) • Writing (Informal letters and correcting mistakes) 3. • Grammar (Narrative tenses, past simple, Conts, and Perfect) • Vocabulary (books and films) • Reading (Jane Austen-one of the world's most downloaded authors) • Listening (The money jigsaw-a news item from BBC's radio) • Speaking (Retelling a news story, responding to a news) • Everyday English (Showing interest and surprise) • Writing (Narrative writing 1) 4. • Grammar (questions and negatives and spoken English) • Vocabulary (Prefixes and Antonyms in context) • Reading ('Diana and Elvis shot JFK!) • Listening ('My most memorable lie'-people confess to untruths) • Speaking (Discussion-good and bad lies) • Everyday English (Being polite) • Writing (Linking ideas) 5. • Grammar (Future forms and spoken English) • Vocabulary (Hot verbs-take, put) • Reading ('Today's teenagers are just fine') • Listening arranging to meet-three friends decide a time and a place to get together) • Speaking (Future possibilities in your life) • Everyday English (Telephone conversations) • Writing (writing Emails) 6. • Grammar (Expression of quantity) • Vocabulary (Words with variable stress) • Reading (A profile of two famous brands) • Listening (Radio advertisements-what's the product? What are the selling points?) • Speaking (A lifestyle survey) • Everyday English (Business expression, Numbers, Fractions, decimals, date, time…) • Writing (A consumer survey) 7. • Grammar (Modals and related verbs 1, spoken English, Declarative questions, and Question expressing surprise) • Vocabulary (Hot verb-get) • Reading ('Meet the kippers'-an article about grown-up children who won't leave home) • Listening (Getting married-an Indian lady talks about her marriage) • Speaking (The pros and cons of arranged marriage) • Everyday English (Exaggeration and understatement) • Writing (Arguing your case) 8. • Grammar (Relative clauses) • Vocabulary (Adverb collocations and adverb adjectives) • Reading ('Chukotka, the coldest place on earth'-an article about a remote territory of Russia) • Listening (Extreme experiences-people describe their experiences in extreme weather conditions)

Course Outcomes:

By the end of the course, at the intermediate level, students will be able to:

• Develop academic essay writing proficiency
• Promote reading skills
• Expand academic vocabulary through reading
• Promote speaking ability through group discussions and debates
• Promote critical thinking skills

2.4.1.2 CHE 4325-Petroleum Refining Engineering I& II

This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
Characterization and evaluation of crude petroleum. Application of chemical engineering to the oil industry. Refining techniques, physical separation, chemical conversion and treating processes. Design and costing of refinery equipment. Product testing and specifications. Environmental issues						
Recommended Textbook(s):						
1. Gary, J.H. and Handwerk, G.E., "Petroleum Refining Technology and Economics" , 4th edition, Marcel Dekker Inc, New York, 2001. 2. Nelson, W.L."Petroleum Refining Engineering", 4th Edition, McGraw Hill , New York, 1980						
Prerequisites:						
Course Topics:						
1. Introduction to history and development of refining. The operations and size of the petroleum and petroleum refining industry and its economic importance. (2. Refinery feed stocks, crude oil evaluation, and characterization, chemical composition of petroleum. 3. Types of refineries and basic refinery modules. Overall refinery flow. Factors affecting choice of a refinery type. (6 classes) 4. Principal operations in the refinery. Physical separation processes. Conversion processes. Treating and finishing processes. 5. Products: Types and specifications. Product blending. (6 classes) 6. Introduction to environmental regulations and legislations and their effects on refining operations.(3						
Lab. Section:						
Experiment 1: distillation if crude oil Experiment 2: pour and cloud point Experiment 3: specific gravity and viscosity of oil Experiment 4: flash and fire point						
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:						
• Understanding the importance of crude oil as a source fuel and petrochemicals and the size of the refining industry. • Knowledge of the physical and chemical nature of crude oil and crude oil characterization techniques. • Understanding operations in modern fully integrated refineries and ability to choose a refining route for a crude type and product demand • Application of chemical engineering principles (heat, mass, fluid, reactor design…etc) to analysis of major refinery units, columns (furnaces, reformers, crackers. .etc). • Awareness of the environmental regulations and product specifications and their effects on the refining industry as a whole and on individual refinery configuration. • Ability to work effectively in problem solving teams in and out of the class room						

2.4.1.3 CHE 4326- Industrial Equipment Design

CHE 4326	**Industrial Equipment Design**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
In this course, the student will look deeply into the main parts of the chemical equipment, and how these parts will work together for desired product. The course covers the steps to design a heat exchanger; a distillation column, and a vessel (time permit). The course will cover the optimization for each equipment.						
Recommended Textbook(s):						

Prerequisites:
Course Topics:
Introduction to equipment design; Process layout, Categories of Processes lay out; fluid transport equipment; pumps; mechanical design of piping system; heat transfer equipment; types of heat exchangers; design of heat of heat exchangers; separation process design, design of distillation, design of vessel.
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:
• The primary types of fluid flow equipment—pipes, pumps, compressors, valves • The key relationships for designing and analyzing a heat exchanger • Analysis of shell-and-tube heat exchangers. Common correlations for heat transfer coefficients for single-phase and change-of phase conditions • The combination of these coefficients with appropriate resistances due to fouling and conduction to determine a single overall heat transfer coefficient. Equations for extended heat transfer surfaces (fins) for common fin configurations. Methods to design new heat exchangers. Predicting the performance of existing exchangers • The separation basis and separating agent for the most common chemical engineering separations • How to determine the size of tray columns and packed columns • The key design parameters affecting tray columns and packed columns • The internals of tray and packed columns • The impact of the reboiler and condenser on the design and performance of distillation columns • The economic trade-offs for tray and packed columns • The performance of existing tray and packed columns • The types of equipment used in extraction, their advantages and their disadvantages • The type of equipment used for gas-permeation membrane separation

2.4.1.4 CHE 4327-Environmental Engineering

CHE 4327	**Environmental Engineering**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
Recommended Textbook(s):						
• Environmental Engineering, Peavy etal. • Fundamental of environmental engineering, James. • Warren Viessman Jr., Mark J. Hammer, Elizabeth M. Perez, Paul A. Chadik, Water Supply & Pollution Control, Prentice Hall, 8th ed., 2009.						
Prerequisites:						
General Chemistry, fluid mechanics; Unit operations.						
Course Topics:						
Introduction-Environment, environmental Engineering, environmental Engineering Rule, Pollution, pollution types, Wastewater, wastewater characteristics, wastewater sources, Effluent wastewater quality, wastewater treatment plant, Air pollution, Air pollutant types, Air pollution effects, Air quality Standards, dispersion equations, Air pollution treatment Solid Waste Management: Types, characteristics, sources and quantities of solid waste; Collection disposal and recycling. Environmental Legislation and Regulations Sustainable environmental engineering Sustainability, Sustainable Engineering, and Sustainable Engineering Design						
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:						
1- To know the basics, importance, and methods of Wastewater treatment.						

2- To learn the objectives and methods of Air treatment and to study the features and function of different Air treatment units. 3- To study the features and function of different Solid waste management. 4- To learn the principles of Sustainable environmental engineering.

2.4.1.5 CHE 4328-Process Control

CHE 4328	**Process Control**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
Process control is the ability to monitor and adjust a process to give a desired output. It is used in industry to maintain quality and improve performance. An example of a simple process that is controlled is keeping the temperature of a room at a certain temperature using a heater and a thermostat. Other examples, material and energy balances are used to model unsteady state (dynamic) process systems where control algorithms are required to bring the process back to equilibrium. Therefore, this course applies the key concepts of automatic control and instrumentation to process plants.						
Recommended Textbook(s):						
Modern Control Engineering, Fifth Edition 2010, Katsuhiko Ogata						
Prerequisites:						
Calculus IV, Physics, Fluid Mechanic, Heat transfer, Electrical systems						
Course Topics:						
Introduction to automatic control; Representation of control components; Representation of mechanical systems: Mass, spring damper system; Representation of electrical systems: DC motor. Steady-state operation; Laplace transformer; Transient and steady-state responses; Steady-state errors in control systems; Stability of control systems; The rout locus method; Frequency response systems						
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:						

2.4.1.6 CHE 4329-Transport Phenomena

CHE 4329	**Transport Phenomena**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
The course advances the fundamentals of material, momentum and energy transfer. Emphasis is placed on the theory and analysis of diffusion, convection and interphase transport of material in laminar and turbulent streams and their similarities. Applications in engineering and environmental transport processes are presented, and the modelling of complex processes is considered.						
Recommended Textbook(s):						
• Bird, R.B., W.E. Stewart and E.N. Lightfoot, Transport Phenomena, REVISED SECOND EDITION, Wiley, New York (2007).						
Prerequisites:						
Mass Transfer, Fluid Mechanics, Heat Transfer						
Course Topics:						
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:						
• Understand the basic unifying concept behind transport phenomena • Understand the general form and solution strategy for transport phenomena problems						

- Through examples develop an understanding of how the general form is converted to a specific solution
- Review and recall how the basic vector and matrix operators are used in defining Transport Phenomena problems
- Become familiar with the general expression for diffusive flux of a conserved quantity
- Understand the concept of diffusive transport of conserved quantities: Fick's Law, Fourier's Law, Newton's Law

2.4.1.7 CHE 4330-Project Design I &II

CHE 4330	**Project Design I& II**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
A two-part project (CHE 496 and CHE 497). The student uses the previous knowledge gained through out of his course study of the various chemical engineering courses to design or model or perform experiments to meet graduation requirement						
Recommended Textbook(s):						
Any books, journal's articles, software packages and/or laboratory equipment needed to accomplish the mission.						
Prerequisites:						
Course Topics:						
Problems of various natures (design, modeling, experimental) are posed by the faculty. Based on their interests, the students choose a problem and work on under the guidance of a faculty member for two semesters (CHE 4330 and CHE 4336). Independent grades are awarded each semester. Depending on the nature of problem, the objectives may vary.						
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:						
• **Design Projects**: The student will be handed a problem statement, typically production of a particular material. It is the responsibility of the student to devise a proper flow sheet for the plant, collect needed data, perform material and energy balances, detailed design of some units, perform economic evaluation for the plant, write report at the end of each semester and present his findings. More than student may share the first part of the project; however, the design and economic parts are done independently. • **Modeling Projects**: This type is somewhat similar to the design type; however, the main focus will be on a particular unit. After defining the problem, the student required to collect data, develop material and energy balance equations, solve the equations, perform simulation studies, prepare his report and present his findings. • **Experimental Projects**: The main focus here will be in performing experiments. The student is required to design his experiments, perform them, use various analytical instruments pertaining to his experiments, present and discuss his results, prepare progress and final reports and present his findings. More than one student may share the project.						

2.4.2 2nd semester

2.4.2.1 CHE 4108-Mangement and Leadership Skills

CHE 4108	Management and leadership skills					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
This course is designed for engineering students who are interested in advancing into management and leadership roles. You will gain a perspective on what it is like to be an engineering leader. You will develop awareness of your own strengths and weaknesses as a leader when you are placed in charge of a project. You will learn how to leverage your strengths and control your weaknesses. You will also learn how to manage relationships with your team members and how to set up a creative environment for your team to motivate each team member to reach his or her potential. You will also learn how to deal with different ethical issues that are related to engineering field.						

Recommended Textbook(s):
1- Benator, Barry and Thumann, Albert "Project Management and Leadership Skills for Engineering and Construction Projects." 2003, The Fairmont Press, Inc., USA 2- Fleddermann, C. B. (2012). Engineering Ethics. Upper Saddle River, NJ: Prentice Hall. 3- Code of Ethics- Iraqi Engineers Association
Prerequisites:
None
Course Topics:
Introduction to leadership: Leadership definition Can one person make a difference? Why is leadership important for engineers? Are leaders born or made? Personality assessment. **Leadership and management styles** Command leadership vs. servant leadership Characteristics of servant leader Management styles Leader or manger? The outstanding leader competencies **Effective team leadership:** What is team Why work in teams? Different types of teams Team roles. Role of team leader **Practical Implementation:** Time management (first things first) Project related activities Conducting Effective Meetings Giving effective feedback Recognition and reward **Communication:** Communication types Thoughts emotion and communication (head, heart and hands) What influences our communication Damaging communication habits Connecting with others 6. Leadership and management styles Management styles Attributes of the engineering leader Modern leadership Characteristics of servant leader Command leadership vs. servant leadership 7. Professional Ethics Definition Origins Principles 8. Introduction to Engineering Ethics Professional Codes of Ethics 9. Ethical Issues in Engineering Practice 1 -Safety Considerations 2- The Role of Good Design A- Sustainable design and design for all B- Safety and risk in Design 3- Environmental Ethics 10. Steps in Confronting Moral Dilemmas 11. Case Studies
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:
• Explain the basic concepts of leadership. • Build power and influence. • Add value to their sphere of influence • Give and receive feedback, actively listen, provide supportive communication, and coach and counsel their team members.

2.4.2.2 CHE 4331- Petroleum Refining Engineering I& II

CHE 4331	**Petroleum Refining Engineering I& II**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
Characterization and evaluation of crude petroleum. Application of chemical engineering to the oil industry. Refining techniques, physical separation, chemical conversion and treating processes. Design and costing of refinery equipment. Product testing and specifications. Environmental issues						
Recommended Textbook(s):						
1. Gary, J.H. and Handwerk, G.E., "Petroleum Refining Technology and Economics" , 4th edition, Marcel Dekker Inc, New York, 2001. 2. Nelson, W.L."Petroleum Refining Engineering", 4th Edition, McGraw Hill , New York, 1980						
Prerequisites:						
Course Topics:						
1. Introduction to history and development of refining. The operations and size of the petroleum and petroleum refining industry and its economic importance. (2. Refinery feed stocks, crude oil evaluation, and characterization, chemical composition of petroleum. 3. Types of refineries and basic refinery modules. Overall refinery flow. Factors affecting choice of a refinery type. (6 classes) 4. Principal operations in the refinery. Physical separation processes. Conversion processes. Treating and finishing processes.						

5. Products: Types and specifications. Product blending. (6 classes) 6. Introduction to environmental regulations and legislations and their effects on refining operations.(3
Lab. Section:
Experiment 1: distillation if crude oil Experiment 2: pour and cloud point Experiment 3: specific gravity and viscosity of oil Experiment 4: flash and fire point
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:
• Understanding the importance of crude oil as a source fuel and petrochemicals and the size of the refining industry. • Knowledge of the physical and chemical nature of crude oil and crude oil characterization techniques. • Understanding operations in modern fully integrated refineries and ability to choose a refining route for a crude type and product demand • Application of chemical engineering principles (heat, mass, fluid, reactor design…etc) to analysis of major refinery units, columns (furnaces, reformers, crackers. .etc). • Awareness of the environmental regulations and product specifications and their effects on the refining industry as a whole and on individual refinery configuration. • Ability to work effectively in problem solving teams in and out of the class room

2.4.2.3 CHE 4332-Industrial Safety

CHE 4332	**Industrial Safety**
This is a required course for the Chemical and Petrochemical Engineering Program.	
Course Description:	
This course will provide students with a strong overall understanding of the many safety practices and requirements as they relate to industrial settings, specifically power generation, transmission, and distribution. The course will cover material from the Occupational Safety and Health Administration Standard and other current industrial safety practices.	
Recommended Textbook(s):	
Prerequisites:	
Course Topics:	
Introduction to industrial safety, Environmental and Occupational Diseases; Repetitive Stress Injury; Regulations, Laws, and Agencies, Overview of Pollution Issues, Injury and Illness Statistics Hazards in the chemical process industries, General Terminology; Polymer Production; Rubber Products Manufacturing Industry; Sulfuric Acid Manufacturing; Phosphoric Acid Manufacturing; Insecticide Manufacture; Concepts of Industrial Hygiene Sources of Information; Inhalation hazard in refineries Inhalation and Fire Hazards; Pressure Relieving Systems; Inhalation Hazards from Tanker Operations; Oil-Water Effluent Systems; Air Emissions from Valves; Cooling Tower Operations; Miscellaneous Air Emissions. Personal Protective Equipment Eye, Face and Head Protection; Foot and Hand Protection; Chemical Protective Clothing; Levels of Protection; Working with Asbestos and Other Synthetic Mineral Fibers; Radiofrequency/Microwave Radiation; Web Sites for Additional Information. Safety in the Laboratory Compressed and Liquefied Gases; Flammables and Combustibles; Corrosives; Ethers and Other Peroxide-Forming Chemicals; Oxidizers; Carcinogens, Highly Toxic Chemicals, and Controlled Substances; NFPA Hazard Ratings	

Course Outcomes: By the end of the course, at the intermediate level, students will be able to:
• The student will consider and analyze the various operating characteristics of different types of generation, transmission, and distribution equipment and systems.

2.4.2.4 CHE 4333-Corrosion Engineering

CHE 4333	**Corrosion Engineering**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
Corrosion Engineering provides you with a thorough training in corrosion and its control. Initially, you will study the fundamental chemistry, physics, and metallurgy underpinning corrosion processes. Subsequently, you will learn about approaches to corrosion control, ranging from material selection, through cathodic protection, to corrosion inhibition and protective coatings						
Recommended Textbook(s):						
Prerequisites:						
Course Topics:						
Corrosion of metals and alloys Local cell model and mixed potential; Potential-pH diagram; General corrosion; Localized corrosion **Passivation and passive film** Polarization curve; Measurement of passive film – impedance, ellipsometry and other methods **Atmospheric corrosion** Atmospheric corrosion through thin water layer Weathering steels **Corrosion protection** Protection on the basis of electrochemistry; Cathodic protection; Anodic protection Inhibitor **New trends for study on corrosion** Optical technique; Electrochemistry						
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:						
• This course aims the students to be able: • Provide an introduction to the corrosion phenomenon and its repercussions is carried out • Provide an understanding of various corrosion processes, protection methods and materials selection with practical examples • Estimate the disastrous effects of corrosion on the economy, safety, energy consumption and environment. • Determine the probable corrosion type, estimate the corrosion rate and propose the most reasonable protection method as regards safety, price and environmental considerations.						

2.4.2.5 CHE 4334-Technology of Catalyst

CHE 4334	**Technology of Catalyst**					
This is a required course for the Chemical and Petrochemical Engineering Program.						
Course Description:						
The course "Catalysis and Catalysts technology" covers the general mechanism of the catalytic action, types of adsorption, macro kinetics features of heterogeneous catalytic reactions, and mass transfer laws.						
Recommended Textbook(s):						

Prerequisites:
Course Topics:
Catalyst Preparation Techniques and Equipment 1: Introduction; Forming of Catalysts; Impregnation and Drying; Rotary Calcination; From the Laboratory to a Commercial Plant **Extrusion Technology** Background; Rheology; Extrusion. **The Aspect Ratio of an Extruded Catalyst: An In-depth Study** General; Introduction to Catalyst Strength and Catalyst Breakage; Mechanical Strength of Catalysts; Experimental Measurement of Mechanical Strength; Breakage by Collision; Breakage by Stress in a Fixed Bed; Breakage in Contiguous Equipment; Statistical Methods Applied to Manufacturing Materials **Steady-state Diffusion and First-order Reaction in Catalyst Networks** Introduction; Classic Continuum Approach; The Network Approach 1
Course Outcomes: By the end of the course, at the intermediate level, students will be able to:
• be aware of the patterns and mechanisms of catalytic action; • be able to select and describe the technology of preparation and equipment design of basic catalyst production; • calculate and predict the catalytic process; • able to classify and summarize the basics of modern catalyst technologies; • have experience in calculation and selection of optimal catalysts and catalytic systems

2.4.2.6 CHE 4335-Modeling and Simulation

This is a required course for the Chemical and Petrochemical Engineering Program.
Course Description:
Study of scientific strategies for the design of chemical processes. Process Design involves the use of the principles of chemistry, physics, biology and computer software to create industrial chemical processes that satisfy social needs while returning a profit.
Recommended Textbook(s):
• Process Design Principles, D.Seider, J.D.Seader and D.R.Lewin, John Wiley and Sons, Inc., New York, 1999
Prerequisites:
CHE 3212 Numerical Method
Course Topics:
Chemical engineering problems; Modeling – Steps involved; Variables – Stream, Unit, and Process variables; Constraints – Conservation relations, Sources and sinks, Material, Energy, Momentum balances; Equilibrium relations, Constitutive models; Common assumptions in modeling; Types of models – Lumped, Distributed, and Staged parameter models; Design variables – Characteristic length, time, velocity, temperature, mass, force; Change of variables; Dimensionless groups in modelling. Filling and draining tanks: Steady and unsteady states, Varying inlets and outlets, Level and flow control; Mixing tanks: Two and multiple streams, Composition control; Heated tank: Jacketed kettle with steam condensation, Electrical heating, Phase change; Isothermal CSTR: 1st and 2nd order reactions, Enzyme kinetics; Nonisothermal CSTR; Centrifugal separation. Shell balances: Flow through a pipe, Continuity equation; Compressible fluid flow, Shock waves; Double-pipe heat exchanger: Steam condensing in shell/tube, Parallel vs counter flow; Pipeline flashing; Isothermal PFR: Component continuity equation, 1st and 2nd order reactions; Non-isothermal PFR: 1st and 2nd order reaction.

Triple effect evaporator; Binary distillation: continuous and batch columns; Multicomponent distillation: Underwood-Gilliland model; Gas absorption into a laminar liquid jet; Tray tower absorption: Kremser-Brown-Sauders equation, rigorous models; Reactive absorption in a wetted wall column; Multistagecountercurrent liquid-liquid extraction.

Selected Systems from the following: Multiple steady states and Stability: Isothermal and Non-isothermal CSTR; Temperature control in a non-isothermal PFR; Packed bed reactor; Polymerization: Bulk and Suspension polymerization; Membrane separation – Cross flow and reverse osmosis; Activated sludge process – secondary bioreactor; Pyrolysis of plastic; Chemical vapor deposition; Continuous, multicomponent distillation column; Dry flue gas desulfurization; Ball mill; Rotary kiln.

Course Outcomes:

By the end of the course, at the intermediate level, students will be able to:

-