بسم الله الرحمن الرحيم

Faculty of Engineering – King Khalid University

Chemical Engineering Program

Study Plan

Contents

Distribution of Courses

over

Different Levels

Chemical Engineering Department

First Year – Common Engineering Year

First Level:-

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
011	ENG	Intensive English (1)	6	----	6	
107	CHEM.	General Chemistry	4	3	1	
119	MATH	Differentiation &Integration (1)	3	3	----	
111	GE	Engineering Drawing (1)	3	----	3	
Total			16	6	10	

Second Level:-

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
111	ICI	Islamic Culture (1)	2	2	----	
012	ENG	Intensive English (2)	6	----	6	011ENG
129	MATH	Algebra& Geometry	3	3	----	
129	PHYS	Physics (1)	4	3	1	
101	CMS	Computer Science	3	2	1	
Total			18	9	9	

Chemical Engineering Department

Third Level:-

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
201	ARAB	Skills of Arabic Language	2	2	----	
219	MATH	Differentiation & Integration (2)	3	3	----	119 MATH
121	ME	Production Technology and Workshop	3	1	2	111 GE
211	CHEM	Organic chemistry (1)	3	2	1	107 CHEM
231	CHEM	Physical Chemistry	3	2	1	107 CHEM
218	ME	Static& Dynamic	3	2	1	
Total			17	13	4	

Fourth Level:-

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
202	ARAB	Arabic Writing	2	2	----	
229	MATH	Differentiation & Integration (3)	3	3		219 MATH
221	CHEM	Organic Chemistry (2)	3	2	1	211 CHEM
222	CHME	Fundamentals of Chemical Engineering (1)	3	2	1	211 CHEM
223	CHME	Materials Engineering	3	2	1	231 CHEM
224	CHME	Advanced Engineering Drawing	3	1	2	111 GE
Total			17	12	5	

Chemical Engineering Department

Fifth Level:-

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
319	MATH	Differential Equations	3	3	----	219 MATH
225	ME	Strength of Materials &Testing	3	2	1	
311	**CHME**	Fundamentals of Thermodynamic in Chemical Engineering	3	2	1	129 PHYS
312	**CHME**	Fundamentals of Chemical Engineering (2)	3	2	1	222 **CHME**
313	**CHME**	Mass Transfer	3	2	1	
Total			15	11	4	

Sixth Level:-

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
112	IC I	Islamic Culture (2)	2	2	----	
329	STAT	Fundamentals of Statistics and Probabilities	2	2	----	
218	EE	Electric Engineering (1)	3	2	1	129 PHYS + 129 MATH
321	**CHME**	Momentum Transfer	3	2	1	313 **CHME**
322	**CHME**	Chemical Reactions Engineering	3	2	1	312 **CHME**
323	**CHME**	Thermodynamic in Chemical Engineering	3	2	1	311 **CHME**
Total			16	12	4	

After the student passed this level he has to attend compulsory summer training in an industrial institution for a period not less 6 weeks. After attending such training, he has to submit a report to the department

Chemical Engineering Department

Seventh Level:-

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
113	IC	Islamic Culture (3)	2	2	----	
301	ENG	Technical Report Writing	2	2	----	014 ENG
418	ME	Principles of Engineering Design	3	2	1	222 ME + 224 **CHME**
419	MATH	Numerical Methods	3	3	----	319 MATH + 101 CS
412	**CHME**	Chemical Industries Engineering	3	2	1	322 **CHME**
424	INE	Engineering Economic	2	2	----	
Total			15	13	2	

Eights Level:-

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
114	IC	Islamic Culture (4)	2	2	----	
421	**CHME**	Plants and Chemical Processes Design	2	2	----	424 INE
422	**CHME**	Advanced Engineering Design	3	2	1	418 ME
423	**CHME**	Catalysis & Catalytic Processes	3	2	1	412 **CHME**
424	**CHME**	Separation Processes	3	2	1	313 **CHME**
425	**CHME**	Heat Transfer	3	2	1	323 **CHME**
Total			16	12	4	

Chemical Engineering Department

Ninth Level:

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
511	**CHME**	Extractive Metallurgy	2	2	----	511 **CHME**
512	**CHME**	Industrial Safety	2	2	----	
513	**CHME**	Modeling & Simulation	3	2	1	419 MATH
514	**CHME**	Computer Applications in Chemical Engineering	3	2	1	412 **CHME**
515	**CHME**	Polymers Engineering	3	2	1	
591	**CHME**	Graduation Project	3	----	3	
Total			16	10	6	

+ Graduation project special conditions:

1. As a prerequisite for registration, the number of hours remaining for graduation should not exceed 36 hours (sum of the hours for levels 9 and 10 + 7 hours).
2. The work in the project extends over two semesters, and the student is granted a continued grade by the end of the first semester after registration. By the end of the second semester he is granted his final grade after presenting and defending his project.
3. In case the student failed in the project he is given a chance for one more semester and will be eligible to present and defend the project by the end of that semester.

Tenth Level:

Course No.	Course Code	Course Title	Credit Hours	Weekly Distribution of Teaching Hours		Prerequisites
				Lectures	Exercises / Tut.	
521	**CHME**	Petroleum Refining & Petrochemicals	3	2	1	223 **CHME**
522	**CHME**	Chemical Reactors Design	3	2	1	423 **CHME**
523	**CHME**	Corrosion & Electrochemical Engineering	3	2	1	
524	**CHME**	Control of Processes	3	2	1	513 **CHME**
525	**CHME**	Water and Solid Waste Treatment	3	3	--	--
Total			15	11	4	

Course Syllabi and Description

for

Common First Year

(Common Engineering Program)

Course Syllabi and Description
for
Second year

Department: Chemical Engineering

Course Title	***Fundamentals of Chemical Engineering (1)***
Course Code	***222* CHME**
No. of units *(Theoretical + Tutorials)*	***3 (2+1)***
Level-Year	***4-2***
Prerequisite (if any)	***CHEM 211***

1) Brief Course Description

This course provides an introduction to basic concepts in chemical engineering. It prepares students to formulate and solve material balances on chemical process systems and lays the foundation for subsequent courses in fluid mechanics, transport phenomena, thermodynamics, unit operations, kinetics, and process control. More fundamentally, it introduces the engineering approach to problem solving.

2) Course Objectives

At the end of this course the student should be able to:

1. Convert quantities from one set of units to another quickly and accurately.
2. Define, calculate, and estimate properties of process materials including fluid density, flow rate, chemical composition variables (mass and mole fractions, concentrations), fluid pressure, and temperature.
3. Draw and label process flowcharts from verbal process descriptions.
4. Carry out degree-of-freedom analyses.
5. Write and solve material equations for single-unit and multiple-unit processes, processes with recycle and bypass, and reactive processes.
6. Perform pressure-volume-temperature calculations for ideal and non-ideal gases. Incorporate the results of these calculations into process material and energy calculations.
7. Decide if he has chosen the right field of education.

3) Course Contents

- **What is chemical engineering? Historical background of chemical engineering.**
- **Introduction to chemical engineering calculations:** Units and dimensions; conversion of units, systems of units; Force and weight; Numerical calculations and estimation; Dimensional homogeneity and dimensionless quantities; Process data representation and analysis.
- **Processes and process Variables:** Mass and volume; Flow rate; Chemical composition; Pressure; Temperature.
- **Fundamental of material balances:** Process classification; Mole and mass balances; Material balance calculations; Balances on multiple-unit processes; Recycle and Bypass; Chemical reaction stoichiometry; Balance on reactive processes; Combustion reactions.

- **Single-phase systems:** Liquid and solids densities; Ideal gases; Equation of state for nonideal gases; Compressibility factor equation of state.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams) …… (30 %)
- Quizzes, homework's, and other duties ……..... (20 %)
- Final Exam…….…… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorials).

6) Textbook

- T. Michael Duncan and Jeffrey A. Reimer, "**Chemical Engineering Design and Analysis: An Introduction", Cambridge Series in Chemical Engineering,** Prentice Hall, 1998.

7) References:

- R.M. Felder and R.W. Rousseau, "**Elementary Principles of Chemical Processes**", Wiley, New York, 2005.
- D.M. Himmelblau and J.B. Riggs, **"Basic Principles and Calculations in Chemical Engineering"**, Prentice Hall, 2004.

Department: Chemical Engineering

Course Title	***Materials Engineering***
Course Code	***223*CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***3 (2+1)***
Level-Year	***2-4***
Prerequisite (if any)	***Chem231***

1) Brief Course Description

This course covers and concentrates on principles of material science such as atomic structure and interatomic bounding, crystal structure of materials, theory of diffusion, imperfections in crystals, mechanical testing and evolution of materials, phase diagram and cooling curves of metals and alloys, iron-carbide diagram for steel and cast iron. Heat-treatment of metals and alloys

2) Course Objectives

At the end of this course,the students should be able to:

1. Gain knowledge of introduction to material science
2. Gain knowledge of atomic structure and interatomic bounding.
3. Gain knowledge of crystal structure of materials.
4. Gain knowledge of theory of diffusion.
5. Gain knowledge of imperfections in crystals
6. Gain knowledge of mechanical testing and evolution of materials.
7. Gain knowledge of phase diagram and cooling curves of metals and alloys, iron-carbide diagram for steel and cast iron.
8. Understand the theory of heat-treatment of metals and alloys.

3) Course Contents

Introduction to material science, atomic structure and type of inter atomic bounding, diffusion laws and mechanisms, type of crystal structure and type of defects of crystals, mechanical testing and evolution of materials (tensile test, hardness (Vickers, Rockwell), impact) and types of phase diagrams and iron carbide diagram.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) …….. (30 %)
- Practical Work …….. (20 %)
- Final Exam. …….. (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Textbook

- Callister, W. D.,"Material Science and Engineering: An Introduction", 6th. Ed., New York, 2006

7) References:

- William D. Callister, "Material Science and Engineering" 2009.

Department: Chemical Engineering

Course Title	***Advanced Engineering Drawing***
Course Code	***'224CHME***
No. of units *(Theoretical + Tutorial/Lab)*	***3 (1+2)***
Level-Year	***4-2***
Prerequisite (if any)	***GE111***

1) Brief Course Description

The main objective of the study of the Engineering Drawing (2) course is to provide the future engineer with the means of reading and preparing the machine drawings and steel structural drawings using both manual and CAD techniques.

2) Course Objectives

Upon successful completion of this course, students should be able to:

1. Understand the different types of sections in machine drawings.
2. Draw assembly machine drawings.
3. Draw steel structural drawings.
4. Use AutoCad software in machine drawing.

3) Course Contents

General Concepts – sections in machine elements – assembly and working drawings. Basics of AutoCad – drawing commands – editing commands – hatching – layers – line types. Threaded joints. Fits and Tolerances. Welding Joints. Pipe Fittings. Steel Structure drawing – Pipe Joints – Pipe line drawings.

4) Course Assessment

- Mid-Term Exams (Manual + AutoCAD.) …… (35 %)
- Class & Home Work (Manual + AutoCAD) …….. (15 %)
- Final Exam. ……..…….. (50 %)

5) Teaching Methods

- Lectures.
- AutoCad Labs.
- Manual Drawing Labs.

6) Textbook

- Frederick E. Giesecke, "Technical Drawing", Hardcover, 2005.
- Lecture Notes.

7) References:

- Colin Simmons and Dennis Maguire, "Manual of Engineering Drawing Practice ", 2nd Ed. 2004.
- Alan J. Kalameja, "The Autocad 2004 Tutor For Engineering Graphics With Autocad 2005 Update, Project Manual (AutoCAD)", 2005.
- Frederick E. Giesecke, "Technical Drawing", Hardcover, 2005.

Course Syllabi and Description
for
Third year

Department: Chemical Engineering

Course Title	***Chemical Engineering Thermodynamics 1***
Course Code	***311*CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***3 (2+1)***
Level-Year	***5-3***
Prerequisite (if any)	***Phys 129***

1) Brief Course Description

This course is mainly concentrates on the principles and concepts of thermodynamics, properties of pure fluids, and laws of thermodynamics. The material that will be covered in this course will include the first and second laws of thermodynamics, equilibrium state for ideal and real gases, mass and energy equilibrium in open and closed systems, heat effect on chemical reactions, entropy, enthalpy, conservation of energy, refrigeration cycles, power cycles, and computer applications in thermodynamics

2) Course Objectives

At the end of this course the student should be able to understand

1. The principles and concepts of thermodynamics.
2. The properties of pure fluids.
3. The skills of computer applications in thermodynamics.

3) Course Contents

Definitions: Volumetric properties of real fluids, equation of state
Multi-parametric corresponding states co-relations: Thermodyanmic diagrams
Steam tables and Heat effects: First law and second law; Entropy;
Calculation of thermodynamic properties:**Analysis of power cycles:** Referigeration;
Clapeyron and Clausius Clapeyron equations.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) …….. (30 %)
- Practical Work ……..….. (20 %)
- Final Exam. …… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorials + Labs).

6) Text Books:

- Yunus A. Cengel and Michael A. Boles, Thermodynamics: An Engineering Approach 6th Edition, McGraw Hill.
- J.B. Jones, Engineering Thermodynamics, Prentice Hall
- Moran and Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley

7) References:

- J.M. Smith, Hendrick C. Van Ness, and Michael Abbott," **Introduction to Chemical Engineering Thermodynamics**" , McGraw Hill, 2004
- Stanley I. Sandler, "**Chemical, Biochemical, and Engineering Thermodynamics**", John Wiley, 2006
- Milo D.Koretsky , "**Engineering and chemical Thermodynamics",** John Wiley, 2003.

Department: Chemical Engineering

Course Title	*Fundamentals of Chemical Engineering (2)*
Course Code	*312* CHME
No. of units *(Theoretical + Tutorials)*	*3 (2+1)*
Level-Year	*5-3*
Prerequisite (if any)	*222* CHME

1) Brief Course Description

This course is a continuation to Fundamentals of Chemical Engineering (1) course. It provides an introduction to basic concepts in single and multiphase systems. It also prepares students to formulate and solve simultaneous material and energy balances on chemical process systems with or without chemical reactions.

2) Course Objectives

At the end of this course, the student should be able to:

1. Draw and label process flowcharts from verbal process descriptions.
2. Write and solve material and energy balance equations for single-unit and multiple-unit processes, processes with recycle and bypass, and reactive processes.
3. Carry out degree-of-freedom analyses.
4. Perform vapor-liquid equilibrium calculations for systems containing one condensable component and for ideal multi-component solutions.
5. Calculate internal energy and enthalpy changes for process fluids undergoing specified changes in temperature, pressure, phase, and chemical composition.
6. Incorporate the results of these calculations into process material and energy calculations.

3) Course Contents

- **Multiphase systems:** Single-component phase equilibrium; The Gibbs phase rule; Gas-Liquid systems of one condensable components; Multicomponent gas-liquid systems; Solutions of solids in liquids; Equilibrium between two liquid phases.
- **Energy and energy balances:** Forms of energy; First law of thermodynamics; Energy balances on closed systems; Energy balances on open systems at steady state; Tables of thermodynamic data; Mechanical Energy Balances.
- **Simultaneous material and energy balances on nonreactive processes:** Elements of energy balance calculations; changes in temperature and pressure; phase change operations; heat of mixing and solutions.
- **Simultaneous material and energy balances on reactive processes:** Heat of reaction; measurement and calculation of heat of reaction; Formation reaction

and heat of formation; Heat of combustion; Energy balances of reactive processes.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams) …… (30 %)
- Quizzes, homework's, and other duties ……... (20 %)
- Final Exam…… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorials).

6) Textbook

- T. Michael Duncan and Jeffrey A. Reimer, "**Chemical Engineering Design and Analysis: An Introduction", Cambridge Series in Chemical Engineering,** Prentice Hall, 1998.

7) References:

- R.M. Felder and R.W. Rousseau, "**Elementary Principles of Chemical Processes**", Wiley, New York, 2005.
- D.M. Himmelblau and J.B. Riggs, **"Basic Principles and Calculations in Chemical Engineering"**, Prentice Hall, 2004.

Department: Chemical Engineering

Course Title	***Mass Transfer***
Course Code	***313* CHME**
No. of units (Theoretical + Lab)	***3 (2 + 1)***
Level – Year	***5-3***
Pre-requisites (if any)	***No prerequisites***

1) Brief Course Description

This course will educate the students to understand the basic principles of mass transfer processes. The students would learn the skills of separating multicomponent mixtures by utilizing different techniques and would get jobs in the petroleum industry

2) Course Objectives

Upon completion of the course, the students will be able:

1. To understand the fundamentals of mass transfer processes
2. To understand the principles of steady and unsteady – state molecular diffusion, natural and forced convection mass transfer.
3. To understand the analysis of chemical engineering operations involving mass transfer. Simultaneous heat and mass transfer; mass transfer accompanied by chemical reaction.
4. To gain the skills of conducting experiments and mass transfer accompanied by chemical reaction.

3) Course Contents

Fundamentals of mass transfer processes. Fick's Law, The control volume approach to the mass transfer processes, differential equations of mass transfer. **Steady and unsteady –state molecular diffusion**. **Natural and forced convection mass transfer**. **Mass transfer theories**. Convective mass transfer correlations. Binary and multicomponent systems, Analysis of chemical engineering operations involving mass transfer. Simultaneous heat and mass transfer; mass transfer accompanied by chemical reaction.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……(30 points)
- Homework and other duties……..……..(20 points)
- Final Exam. ……...……(50 points)

5) Teaching Methods

- Lectures
- Training exercises (Tutorials + Labs)

6) Text Books

- Anthony L. Hines and Robert N. Maddox, "**Mass Transfer: Fundamentals and Applications", (Prentice Hall International Series in the Physical and Chemical Engineering Sciences)**, **Prentice-Hall,** Last Edition.
- Anthony F. Mills, **Mass Transfer**, 2001.

7) References:

- J.M Coulson & J.F Richarson, "Chemical Engineering", Vol-II, 6th Ed. Butterworth & Heinemann
- McCabe Warren L., Smith Julian C., Harriott Peter, "Unit Operations of Chemical Engineering", 5th Ed. McGraw Hill Inc.
- Treybal Robert R., "Mass Transfer Operations" 3rd Ed. (1980) McGraw Hill Book Company.

Department: Chemical Engineering

Course Title	***Momentum Transfer***
Course Code	***321*CHME**
No. of units ***(Theoretical + Tutorial/Lab)***	***3 (2+1)***
Level-Year	***6-3***
Prerequisite (if any)	***313* CHME**

1) Brief Course Description

This course is devoted primarily to the basic principles and practical applications of fluid mechanics. Control-volume and differential-equation analysis methods are derived and used to demonstrate applications to simple fluid flow engineering systems to determine variables of interest such as pressure, velocity, shear stresses, momentum, flow rates, forces, energy losses, and power requirements.

2) Course Objectives

At the end of this course, the student should be able to:

1. Understand the different types of fluids and their properties.
2. Understand Pascal's law, pressure variation with elevation and pressure forces on surfaces.
3. Derive and apply conservation principles of mass, energy, and momentum for fluid flow situations.
4. Understand and develop a mathematical type of understanding for principles of momentum equations as well as its application.
5. Develop and observe the concept behind the flow into conduits, and comparing the two different types of flow laminar and turbulent.
6. Use the energy equation to predict pressure drop in pipes, across fittings, and through pumps.
7. Learn how to deal with different kinds of instruments for flow, velocity, and pressure measurements.
8. Analyze physical flow situations and prescribe appropriate methods to obtain quantitative information for engineering use.

3) Course Contents

- **Introduction to fluid mechanics**: definition of fluid mechanics and of fluid, properties and types of fluid.
- **Fluid static**: pressure and Pascal's law, pressure measurements, pressure forces on surfaces, buoyancy.
- **Flow of fluid and conservation principle of mass.**
- **General Energy equation and Bernoulli equations**
- **Fluid friction in steady one-dimensional flow:** flow in conduits, laminar and turbulent flow in pipe, noncircular conduits with constant cross sectional area, entrance region and developed-undeveloped flow, energy loss due to fittings.
- **Conservation principle of momentum**.

- **Fluid flow measurements**: Stagnation tube, Pitot-static tube, Orifice meter, Venturi meter, Rotameters.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams) …… (30 %)
- Practical Work …….. (20 %)
- Final Exam…… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorials and Labs).

6) Textbook

- James Welty, Charles E. Wicks, Robert E. Wilson, and Gregory L. Rorrer, "**Fundamentals of Momentum, Heat, and Mass Transfer**", John Wiley & Sons, 2000.

7) References:

- Clayton T. Crowe, Donald F. Elger, John A. Roberson, "**Engineering Fluid Mechanics"**, John Wiley & Sons, 2004.
- Noel de Nevers, "**Fluid Mechanics for Chemical Engineers"**, McGraw-Hill, 2005.
- Mott R. L., **"Applied fluid mechanics"**, Prentice Hall, 2005.

Department: Chemical Engineering

Course Title	***Chemical Reactions Engineering***
Course Code	***322* CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***3 (2+1)***
Level-Year	***6-3***
Prerequisite (if any)	***312* CHME**

1) Brief Course Description

This course highlights the principles of chemical reactions and the types of reactors; it also addresses the various parameters affecting the chemical reaction.

2) Course Objectives

At the end of this course the student should be able to

1. Know the principles of chemical reactions.
2. Know the types of chemical reactors.
3. Know the effect of the various parameters affecting chemical reactions.
4. Gain skills to conduct experimental chemical reactions.

3) Course Contents

Chemical kinetics, mechanisms and kinetics of homogenous reactions, reaction rate analysis, homogenous and heterogeneous reactions: (gas-liquid, liquid-liquid, solid-gas), introduction about catalytic reactions.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……..…….. (30 %)
- Practical Work ……..... (20 %)
- Final Exam. ……..…… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises.

6) Text Books:

- Octave Levenspie "**Chemical Reaction Engineering",** 3rd Edition, **New York, Wiley,**1998

7) References:

- H. Scott Fogler , "**Elements of Chemical Reaction Engineering ",**4th Edition, (Prentice Hall International Series in the Physical and Chemical Engineering **Sciences)**, Prentice Hall PTR, 2005.

Department: Chemical Engineering

Course Title	***Chemical Engineering Thermodynamics* II**
Course Code	323 **CHME**
No. of units ***(Theoretical + Tutorial/Lab)***	***3 (2+1)***
Level-Year	***6-3***
Prerequisite (if any)	311 **CHME**

1) Brief Course Description

This course is mainly concentrates on the review of first law and second law of thermodynamics, energy, and mechanical work. Energy conservation, thermodynamic properties of fluids and gases, energy and mass equilibrium, and chemical reaction equilibrium. Enthalpy, temperature effects, entropy

2) Course Objectives

At the end of this course the student should be able to understand

1. The concepts of energy.
2. Temperature effects and energy conservation.
3. Thermodynamic properties of fluids and gases, and energy and mass equilibrium.

3) Course Contents

Partial Molar thermodynamic Quantities: Non-ideality in solids ,liquids and gases Application of corresponding states co-relations in the calculation of $\Delta H, \Delta S$ using residual thermodynamic properties; Fugacity and calculation of fugacity of pure substances; gas mixtures, solid and liquid solutions; **Phase equlibrium:** Multi-component system **Thermodynamic of chemical reactions:** Solid and liquid solutions, **Electrochemical equilibrium.**

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……..... (30 %)
- Practical Work ……... (20 %)
- Final Exam. …… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Text Books

- Yunus A. Cengel and Michael A. Boles, Thermodynamics: An Engineering Approach 6th Edition, McGraw Hill. (Text Book)
- J.B. Jones, Engineering Thermodynamics, Prentice Hall
- Moran and Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley

7) References:

- J.M. Smith, Hendrick C Van Ness, and Michael Abbott, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill, 2004.
- Stanley I. Sandler , "**Chemical, Biochemical, and Engineering Thermodynamics**", John Wiley, 2006.

Course Syllabi and Description
for
Fourth year

Department Chemical Engineering

Course Title	***Chemical Industries Engineering***
Course Code	***412* CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***3 (2+1)***
Level-Year	***7-4***
Prerequisite (if any)	***322* CHME**

1) Brief Course Description

This course covers the principles of chemical industries such as gas production, construction materials. Acids, fertilizers, paper industry and many other industries available in the Kingdom

2) Course Objectives

Upon completion of this course, the following objectives will be able:

1. To know the principles of chemical industries.
2. To know the major chemical industries in Saudi Arabia.
3. To gain the manufacturing skills of important petrochemicals, petroleum refining industries.

3) Course Contents

The material involves the fundamentals of chemical industries such as industrial gases, construction materials, mineral acids, chlorine – alkaline, phosphate, fertilizers, paints, water treatment, paper industry, detergents, petrochemicals, petroleum refining, and other different types of major chemical industries now operating in Saudi Arabia. Description of processes flow, production technologies of synthesis gas, olefins and aromatic, technology of polymers production, and important plastic materials.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) …….. (30 %)
- Practical Work ……..... (20 %)
- Final Exam. ……..…… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Text Books:

- James G. Speight, '**Chemical and Process Design Handbook**' McGraw Hill, London 2002.

7) References:

- Harry Silla, "**Chemical Process Engineering** (Chemical Industries)", Marcel Dekker, 2003
- Robert A. Smiley and Harold L. Jackson, "**Chemistry and the Chemical Industry: A Practical Guide for Non-Chemists**", CRC Press, 2002

Department Chemical Engineering

Course Title	***Plants & Chemical Processes Design***
Course Code	***421*CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***2***
Level-Year	***8-4***
Prerequisite (if any)	***IE 424***

1) Brief Course Description

This course addresses the overall design for the industrial and/or service organization, looking at the principles of site selection criteria, the relationship between the facility's departments and the liaison in decision taking as well as the function of the related departments to the students' discipline

2) Course Objectives

Upon completion of this course, the following objectives will be able:

1. To gain the necessary information and skills for data analysis.
2. To know the factors that effects the plant site selection.
3. To gain the application skills of computer design.
4. To understand the chemical effect on environment.
5. To understand the safety requirements in plants design.

3) Course Contents

This course covers site selection and design of industrial plant or services, and computer application in processes plan. Theories of plant site selection, factors that affect the site selection, Processes design, processes flow diagrams, selection of material handling and storage systems, chemical wastes, safety requirements for the design, Project development, study of alternatives, computer application, chemical or petrochemical plant design case study.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……..... (30 %)
- Practical Work ……... (20 %)
- Final Exam. …… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Text Books:

- R.K. Sinnott, 'Chemical Engineering Design' Coulson & Richardson Chemical Engineering Series, Vol. 6 Fourth Edition, Elsevier, London 2005.
- G. Salvendy, 'Handbook of Industrial Engineering: Technology and Operations Management' third edition, John Wiley & Sons, Inc, 2001

7) References:

- Francis R., Mc Ginnisl . &White J. ; "Facility Layout and Location : Analytical Approach" , Prentice Hall , Last Edition.
- White T. , Frazelle B . & Trevino J. ," Facilities Planning Problems" , John Wiley & Sons, 1996 .

Department: Chemical Engineering

Course Title	***Advanced Engineering Design***
Course Code	***422* CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***3 (2+1)***
Level-Year	***8-4***
Prerequisite (if any)	**ME 418**

1) Brief Course Description

This course covers and concentrates on the theory, design, performance, and principles of the Kinematics and Kinetics of rigid bodies which deal with motion; position; velocity and acceleration (Dynamics of machines), also dealing with cams, governors, balancing and other applications.

2) Course Objectives

1. Understand the basic concepts of design tanks, pressure vessels and pipes.
2. The basic concepts of the sealing materials and design.
3. Knowledge of the hydraulic and pneumatic systems.
4. Understand the hydraulic and pneumatic systems design.

3) Course Contents

Design codes, tanks design, pressure vessels design, piping and pipe design, sealing selection and materials, steel towers design, heat exchanger design, hydraulic cylinder design, hydraulic and pneumatic systems design.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) …….. (30 %)
- Practical Work …….. (20 %)
- Final Exam. …….. (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Textbook

- Machine design by RS Khurmi and JK Gupta; S.Chand and Company Ltd., New Delhi.
- design of hydraulic cylinder by q.s. khan tanveer publications hydro-electric machinery premises , ram-rahim uduog nagar, bus stop lane, l.b.s. marg, sonapur, bhandup (west), mumbai - 400 078 (india) e-mail: hydelect@vsnl

7) References

Department: Chemical Engineering

Course Title	***Catalysis & Catalytic Processes***
Course Code	***'423* CHME**
No. of units (*Theoretical + tutorial/Lab*)	***3 (2 + 1)***
Level – Year	***Level 8/ Year 4***
Pre-requisites (if any)	***412* CHME**

1) Brief Course Description

This course would examine the basic physical, chemical, and microbiological principles that provide the foundation for environmental engineering. Students would be educated to illustrate how these principles are applied to solve a wide range of environmental problems

2) Course Objectives

Upon completion of the course, the students will be able:

1. To understand the principles of catalysis and the mechanism of catalyst reactions.
2. To gain the skills of Mass and heat transfer in catalyst.
3. To understand the chemical and physical properties of solid catalysts.

3) Course Contents

Principles and applications of catalysis, process of catalysis reactions, fundamentals of mass and heat transfer in catalyst, and chemical and physical properties of solid catalysis. Nature and mechanism of catalyst reactions. Kinetic analysis of homogeneous and heterogeneous catalytic reactions. Application of catalytic processes in petroleum and petrochemical industries.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……(30 points)
- Homework and other duties…….(20 points)
- Final Exam. ……(50 points)

5) Teaching Methods

- Lectures

- Training exercises (Tutorials + Labs)

6) Text Books

- Mario Occelli, **"Fluid Cracking Catalysts (Chemical Industries)"**, Marcel Dekker, 1998
- Alvin B. Stiles, **"Catalyst Manufacture (Chemical Industries)"**, Marcel Dekker, Last Edition.

7) References:

- **Chemical Reaction Engineering; Author Octane Levenspiel; 3rd Ed. Publisher: John Wiley & Sons**
- **Catalysis: Principles and Applications; Author: Wiswanathan B., & Ramaswamy A. V., Publisher: Narosa; 3rd Ed.**

Department Chemical Engineering

Course Title	***Separation Processes***
Course Code	***424* CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***3 (2+1)***
Level-Year	***8-4***
Prerequisite (if any)	***313* CHME**

1) Brief Course Description

This course highlights the various methodologies applied in separation process using different technologies and materials. The course also covers the mass transfer and equipment associated with each process. It also provides and insight about the industrial applications of each system

2) Course Objectives

Upon completion of this course, the following objectives will be able to:

1. gain the skills of separation operations for different types of materials.
2. know mass transfer operations.
3. gain the necessary skills for using the separation processes equipment.

3) Course Contents

The material covered in this course involves separation processes, mass transfer operations and the equipment used in separation processes. Solvent extraction, liquid-liquid extraction, phsychrometry, humidification, drying, membrane separation, separation processes, diffusion: types of diffusion, phase equilibrium , mass transfer operations, equipments, condensation, absorption and osmosis, separation towers, crystallization, Ion exchange, Membrane based separation processes including Reverse osmosis, sublimation, electrochemical dialysis

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……... (30 %)
- Practical Work ……... (20 %)
- Final Exam. …… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorials + Labs).

6) Text Books

- J.F. Richardson and J.H. Harker '**Chemical Engineering Particle Technology and Separation Processes**' Coulson and Richardson Series, Butterworth & Heinemann, Oxford, 2002.

7) References:

- Phillip C. Wankat, **"Separation Process Engineering**"2nd Ed., 2006**.**
- F. B. Petlyuk, "**Distillation Theory and its Application to Optimal Design of Separation Units"** (Cambridge Series in Chemical Engineering), Cambridge University Press, 2004.

Department: Chemical Engineering

Course Title	***Heat Transfer***
Course Code	***425* CHME**
No. of units (Theoretical + Lab)	***3 (2 + 1)***
Level – Year	***8- 4***
Pre-requisites (if any)	***323* CHME**

1) Brief Course Description

This course would prepare the students to understand the basic modes of heat transfer such as conduction, convection and radiation and apply then these algorithms for the design of heat transfer equipments

2) Course Objectives

Upon completion of the course, the students will be able:

1. To understand the fundamentals of heat transfer processes (conduction, convection and radiation).
2. To gain the skills of heat transfer on different engineering processes related to heat exchange
3. To gain the skills of conducting heat transfer experiments

3) Course Contents

The material covered in this course involves **heat transfer principles** and its practical application in engineering fields related to heat exchanges. **Introduction of heat transfer by conduction, convection and radiation**, **steady and un-steady-state conduction**. **Free and forced convection in laminar and turbulent flows**. **Differential equations of energy transport**. **Numerical solution of heat conduction problems**. **Radiation**, properties, radiation processes and radiation heat transfer between surfaces, electrical circuits representation, hydraulic and heat analysis for forced and natural convection and its **application in the design of heat exchangers**.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……(30 points)
- Homework and other duties……...(20 points)
- Final Exam. ……..……(50 points)

5) Teaching Methods

- Lectures

- Training exercises (Tutorials + Labs)

6) Text Books

- Thomas, L.C "Heat Transfer" -Professional Version, 2nd Edition. Capston Pub. Comp., 1999.
- Incropera, F. De witt, D. , P. ," Introduction to Heat Transfer ", John Wiely & Sons Publisher, 2006.
- Kreith, F. and Bohn, M. S. , " Principles of Heat Transfer " ,5th Ed., West Publishing Comp., 2000.

7) References:

- Process Heat Transfer by D. Q. Kern published by the International Student Edition
- Unit Operations of Chemical Engineering, 7^{th} Ed., by Warren L. McCabe, Julian C. Smith and Peter Harriott
- Fundamentals of Heat and Mass Transfer by Incropera, DeWitt, 5^{th} Ed.
- Heat Transfer: Principles and Applications by Binay K. Dutta, Eastern Economy Edition.

Course Syllabi and Description
for
Fifth year

Department: Chemical Engineering

Course Title	***Extractive Metallurgy***
Course Code	***511*** **CHME**
No. of units (Theoretical + Lab)	***2 (2 +0)***
Level – Year	***9- 5***
Pre-requisites (if any)	***223*** **CHME**

1) Brief Course Description

This course highlights to basic process in the production of Iron ore and other precious and metallic manufacturing processes. It also investigated the mechanisms behind various related operations such as oxidization, and looks at the units used in these operations.

2) Course Objectives

Upon completion of this course, the student will be able to:

1. Major operations of iron and steel making.
2. Direct reduction processes.
3. Furnaces that used in the production of iron and steel.
4. Basic operations of extractive metallurgy of aluminum, TiO2.
5. Extractive operations of valuable metals like gold titanium.

3) Course Contents

This course mainly concentrates on major operations in iron and steel production. Direct reduction processes, blast furnaces. Steel making and refining by electric arc and converter. Electric refining and vacuum induction refining. Bauxite production. Electro-thermal reduction of cryolite to produce commercial aluminum. Production of TiO2. Basic principles and operations of Extractive metallurgy of titanium and Gold extraction. Continuous casting.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……..……(30 points)
- Homework and other duties……..……..(20 points)
- Final Exam. ……..……(50 points)

5) Teaching Methods

- Lectures
- Training exercises (Tutorials)

6) Text Books

- Terkel Rosenqvist , "**Principles Of Extractive Metallurgy**" McGraw Hill, 2004.

7) References

- Fathi Habashi, "**Handbook of Extractive Metallurgy**", New York, Gordon and Breach,1998.

Department: Chemical Engineering

Course Title	***Industrial Safety and Occupational Health***
Course Code	***512*** **CHME**
No. of units ***(Theoretical + Tutorials)***	***2 (2+0)***
Level-Year	***9-5***
Prerequisite (if any)	***No Prerequisite***

1) Brief Course Description

This course discusses the safety issues and the safety fields that related to personnel and environment in industry. Ideal measures for performing tasks in order to meet safety standards within industrial environments.

2) Course Objectives

At the end of this course the student should be able to:

- Understand the principles of safety in industrial environment.
- Understand the lawful basics to apply safety processes and industrial health.

3) Course Contents

- Job safety analysis; study the work environment in chemical plants. Major process hazards. Hazard identification, assessment and prevention. Safety of people, equipments, and building in industrial environment. Methods of fire prevention and fire fighting. Explosions and toxic release and methods of prevention. Safety procedures and first aid. First aid, planning for emergencies.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams) …… (30 %)
- Quizzes, homework's, and other duties ……..…... (20 %)
- Final Exam…….…… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorials).

6) Textbook

- Dennis P. Nolan, '**Application of HAZOP & What-If Safety Reviews to the Petroleum, Petrochemicals and Chemical Industries**' Noyes Publications, New Jersey, 1994.
- Roy E. Sanders, '**Chemical Processes Safety, Learning from Case Histories**' 3rd edition, Elsevier, Amsterdam, 2005.

7) References:

- Ray, C.," **Industrial Safety and Health Management** ", Prentice Hall, 1998.
- Wuntz, C.A.," **Safety, Healthy and Environmental Protection** ", Mc Graw Hill, 1998 .

Department: Chemical Engineering

Course Title	Modeling and Simulation
Course Code	513CHME
Number of units (Theoretical + Tutorial/Lab)	3 (2 + 1)
Level-Year	9-5
Pre-requisite	MATH-419

1) Brief Course Description:

The course concentrates on the principles of simulation, and dynamic analysis of different chemical systems. Introduction to modeling, simulation and analysis of dynamic systems. Models of systems - Lumped parameter systems - Distributed parameter systems. Examples related to chemical engineering field, Laplace transform application, planning for ideal processes in chemical plants, some applications using available simulation computer packages.

2) Course Objectives:

Upon completion of this course, the student will be able:

1. To understand the principles of simulation, and dynamic analysis of different chemical systems.
2. To gain understanding of modeling and simulation.
3. To be able to differentiate between lumped parameter and distributed parameter system.
4. To gain the analytical skills and understand the properties of linear systems
5. To gain the skills of building mathematical models and simulate it by using simulation software.

3) Course Content:

Modeling: Process and Process Modelling, Observations on Some General Aspects of Modelling Methodology, The Life-cycle of a Process and Modelling, Modelling and Research and Development Stage , Modelling and Conceptual Design Stage, Modelling and Pilot Stage, Modelling and Detailed Engineering Stage.

Classification of Models: Fields of Modelling and Simulation in Chemical Engineering, Steady-state Flowsheet Modelling and Simulation , Unsteady-state Process Modelling and Simulation, Molecular Modelling and Computational Chemistry.

Mathematical Modelling Based on Transport Phenomena: Algorithm for the Development of a Mathematical Model of a Process, The Limits of Modelling Based on Transport Phenomena. The Distribution Function and the Fundamental Flow Models.

Stochastic Mathematical Modelling : Introduction to Stochastic Modelling, Mechanical Stirring of a Liquid, Numerical Application, Stochastic Models by Probability Balance, Solid Motion in a Liquid Fluidized Bed.

Statistical Models in Chemical Engineering : Basic Statistical Modelling , Characteristics of the Statistical Selection, The Distribution of Frequently Used Random Variables.

Similitude, Dimensional Analysis and Modelling : Dimensional Analysis in Chemical Engineering, Vaschy–Buckingham Pi Theorem Determination of Pi Groups, Chemical Engineering Problems Particularized by Dimensional analysis.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) …….. (30 %)
- Practical Work/Tutorial …….. (20 %)
- Final Exam. ……(50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Text Books:

- C.T. Shaw, 'Using Computational Fluid Dynamics' Prentice Hall, 1992

7) Reference:

- Simulation and Control for Chemical Engineers", Mc Graw Hill, New York, NI, Last Edition.
- K. ogata, "System Dynamics" Prentice Hall , 1998.-1
- IRA. Cachin, and Hared J. Plass," Analysis and design of system dynamics", Herper Collins pub.,2001.

Department: Chemical Engineering

Course Title	Computer Applications in Chemical Engineering
Course Code	514 CHME
Number of units (Theoretical + Tutorial/Lab)	3 (2 + 1)
Level-Year	9-5
Pre-requisite	412 CHME

1) Brief Course Description:

Theory and principles of numerical methods in chemical engineering and problem solving. Computer programming languages. Chemical information systems. Models of dynamic and thermodynamics properties and data base. Linear and non-linear programming. Series processes flowchart. Processes integration. Improvement of logical maps. Simulation software uses in different applications in chemical engineering field.

2) Course Objectives:

Upon completion of the course, the students will be able:

1. To know the necessary principles for using the computer in chemical engineering applications.
2. To write simple algorithms for some of the chemical engineering applications.
3. To know the principles of numerical methods and solving the linear and non-linear equations for some of the chemical engineering applications.
4. Solving initial value problems ,Boundary value problems and become
5. Familiar with numerical optimization.

3) Course Content:

Theory and principles of numerical methods in chemical engineering: Linear algebra, Non-linear algebraic systems, Initial value problems, Numerical optimization, Boundary value problems. Equations of State – Mathematical formulation, Solving Equations of State Using Excel, Solving Equations of State Using MATLAB, Example of a Chemical Engineering Problem Solved Using MATLAB, Thermodynamic Parameters, Example Using MATLAB, Chemical Reaction Equilibrium ,Chemical Equilibrium Expression, Multiple Equations, Few Unknowns Using MATLAB, Using MATLAB to Solve Ordinary Differential Equations. Mass Balances with Recycle Streams:

Example of Process Simulation. Using Excel for Simple Mass Balances, Example of Process Simulation with Excel Including Chemical Reaction.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) …….. (30 %)
- Practical Work/Tutorial …….. (20 %)
- Final Exam. …….. (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Text Books:

- Bruce A. Finlayson, 'Introduction to Chemical Engineering Computation' Wiley & Sons, INC. New Jersey, 2006.

7) Reference:

- Steven C. Chapra, " Applied Numerical Methods with MATLAB for Engineers and Scientists", McGraw Hill, 2007.
- Richard L. Burden and J. Douglas,"Numerical Analysis" 7th Ed., Brooks/COLE, 2001.
- Young W., Kwon, and Hyochoong Bang, "The Finite Element Method Using MATLAB", CRC Press, 2000.
- John H. Mathews , and Kurtis D. Fink," Numerical Methods Using MATLAB ", 3rd Ed., Jones & Bartlett Pub. ,2006.

Department: Chemical Engineering

Course Title	*Polymers Engineering*
Course Code	*515* CHME
No. of units *(Theoretical + Tutorial/Lab)*	*3 (2+1)*
Level-Year	*9-5*
Prerequisite (if any)	No pre-requisite

1) Brief Course Description

This course is mainly concentrates on polymerization process, manufacturing and production of polymers, and physical and mechanical properties of polymers. Polymeric materials classification, calculations of molar mass and molar mass distribution, production methods, homogeneous and heterogeneous polymerization processes, polymerization reactions, mechanisms and kinetics of polymerization reactions, composites materials, polymer processing, computer application in polymers engineering. Degradation

2) Course Objectives

At the end of this course the student should be able to understand

1. Understand polymerization processes, manufacturing and production of polymers
2. Understand the physical and mechanical properties of polymers
3. Gain the computer skills that can be used in special applications of polymers engineering.

3) Course Contents

Polymerization process: *Physical and mechanical properties of polymer, manufacturing and production of polymer,* **Polymeric materials,** composite materials, classification of polymer, calculation of molar mass distribution, production methods
Mechanism and kinetic of chemical reactions, computer applications in polymer engineering

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……..….. (30 %)
- Practical Work ……..…… (20 %)
- Final Exam. …… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Text Books

- Arie, Ram, “Fundamentals of polymer engineering” Springer, 1997
- Allison Calhoun, Andrew J. Peacock, “Polymer Chemistry: Properties and Applications”.

7) References:

- Anil Kumar and Rakesh Gupta, "**Fundamentals of Polymer Engineering", 2 nd Ed., (Plastics Engineering)**, Marcel Dekker, 2003.
- N. G. McCrum, C. P. Buckley, and C. B. Bucknall ,"**Principles of Polymer Engineering**" , Oxford Science , 1997.

Department: Chemical Engineering

Course Title	***Graduation Project***
Course Code	***591* CHME**
No. of units *(Theoretical + Tutorials)*	***3 (0+3)***
Level-Year	***9-5***
Prerequisite (if any)	***At most 38 credits left for graduation***

1) Brief Course Description

It is a realistic practical project related to the chemical engineering that can be chosen by a student in the final year (9^{th} level) of their study. The project can be supervised by a faculty member. Individual student or group of students can work on the project. Student(s) start working on the project by collecting Theoretical and practical data, conducting experiments, or building a mathematical or simulation model. During the project study period, student(s) should prepare periodic reports that include an introduction about the project, project objectives, project accomplishment stages and the project results. At the end of the project, the student(s) prepare a report and defended it in front of a committee.

2) Course Objectives

At the end of this course, the student should be able to:

1. gain the necessary information and skills for data analysis.
2. work within a team or group of students on an engineering project.
3. understand the rules and steps of engineering projects planning and design.

8) Course Contents

- Research topic selection based on relevance and importance to communities.
- Information and data gathering and evaluating (theoretical and experimental).
- Developing experimental and numerical framework.
- Data acquisition and analysis.
- Report writing and presentation.
- Defining findings technically and scientifically in front of committees.

9) Course Assessment

- Accomplished duties and periodic reports during the study period: 50 Points
- Project final defense: 50 Points

10) Teaching Methods

- Supervision and leading during project studying stages

11) Textbook

- To be defined according to the selected project.

12) References:

- To be defined according to the selected project.

Department: Chemical Engineering

Course Title	Petroleum Refining and Petrochemicals Engineering
Course Code	521CHME
Number of units *(*Theoretical + Tutorial/Lab*)*	3 (2 + 1)
Level-Year	10-5
Pre-requisite	No

1) Brief Course Description:

The course is intended to develop the student's ability to understand the discovery of oil fields, methods used in oil recovery techniques, oil Refinery operations and crude oil refining processes. Theories of oil formation, discovery operations, drilling and production crude oil, crude oil evaluation and characterization, characterization and classification of crude oils, physical properties of oil. Refinery operations; atmospheric and vacuum distillation, treatment processes, catalytic cracking, reforming, alkylation, coking, asphalt production and lubricating oil production. Blending of refinery products. Recent developments in heavy oil processing. Properties of petroleum products and their future uses. Refinery operations and processes and the study of different refinery utilities used in these processes

2) Course Objectives:

Upon completion of this course, the student will be able to:

1. Know the theories of oil formation.
2. Understand the series processes to recover the crude oil.
3. Understand the different crude oil refining processes to get the various petroleum products.
4. Understanding the blending of different refinery products.
5. Understanding of different refinery utilities used in these processes

3) Course Content:

Methods used in oil recovery techniques, oil Refinery operations and crude oil refining processes. Theories of oil formation, discovery operations, drilling and production crude oil, crude oil evaluation and characterization, characterization and classification of crude oils, physical properties of oil. Refinery operations; atmospheric and vacuum distillation, treatment processes, catalytic cracking, reforming, alkylation, coking, asphalt production and lubricating oil production. Blending of refinery products. Recent developments in heavy oil processing. Properties of petroleum products and their future uses. Refinery operations and processes and the study of different refinery utilities used in these processes.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) …….. (30 %)
- Practical Work/Tutorial …….…… (20 %)
- Final Exam. ……..……(50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Text Books:

- W.L. Nelson, '**Petroleum Refinery Engineering'** Fourth Edition, McGraw Hill Chemical Engineering Series, New York.

7) Reference:

- H.K. Abdel-Aal, Mohamed Aggour, and M.A. Fahim, "**Petroleum and Gas Field Processing (Chemical Industries)**", Marcel Dekker, 2003.
- Jim Brooks, "**Advances in Petroleum Geochemistry", Vol.1, (Advances in Petroleum Geochemistry)**", Academic Press, Last Edition.

Department: Chemical Engineering

Course Title	***Chemical Reactors Design***
Course Code	***522* CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***3 (2+1)***
Level-Year	***10-5***
Prerequisite (if any)	***423* CHME**

1) Brief Course Description

The course is intended to develop the student's ability to understand kinetics of chemical reactions, introduction in chemical reactors, engineering principles of reactor design, design of batch and continuous tubular reactors, reactor sizing, rate laws and stoichiometry for single and multiple reactions and its applications to steady-state isothermal reactor design, temperature and pressure effect, basic heterogeneous reactions and nonideal reactors performance, and catalytic reactor design with computer applications in the reactors design.

2) Course Objectives

At the end of this course the student should be able to

1. understand kinetics of chemical reactions, develop the ability to analyze kinetic data and determine rate laws
2. gain the knowledge of different types and properties of reactions.
3. gain the design skills of different chemical reactors and obtain the ability to apply ideal reactor models
4. obtain the ability to analyze data for heterogeneous catalytic reactions and to employ the results of such analyses in designing simple reactors
5. gain the knowledge of different types and properties of reactions.

3) Course Contents

Introduction: The rate equation, the general mole balance equation, batch reactors, continuous flow reactor. Advantages and disadvantages of different reactors
Kinetics of homogenous reactions: Power rate law, 1st order and 2nd order reactions,
Design of isothermal reactors(batch; mixed flow reactor; and plug flow);
Design equation based on mole and conversion**,** Design of single and multiple ideal reactors: **Multiple reactor:** reactors in series

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) …….. (30 %)
- Practical Work …….. …….. (20 %)
- Final Exam. …….. (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).

6) Text Books

- H.Scott. Fogler "**Elements of Chemical Reaction Engineering**" 4th Edition.

7) References:

- Peter Harriott , "**Chemical Reactor Design (Chemical Industries)** ", Marcel Dekker, 2002.
- James B. Rawlings, and John G. Ekerdt, "**Chemical Reactor Analysis and Design Fundamentals**", Madison, Wis. : Nob Hill Pub., 2002.

Department Chemical Engineering

Course Title	***Corrosion and Electrochemical Engineering***
Course Code	***523*CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***3 (2+1)***
Level-Year	***10-5***
Prerequisite (if any)	***N/A***

1) Brief Course Description

The course is intended to develop the student's ability to understand the electrochemical cell and its engineering applications in industrial electrochemical processes. Chemical corrosion and corrosion control methods.

2) Course Objectives

Upon completion of this course, the following objectives will be able:

1. To understand the economic effect and design principles of electrochemical cell.
2. To understand the industrial applications of electrochemical cell.
3. To understand chemical corrosion.
4. To gain the skills of mechanisms used in chemical corrosion control technologies.
5. To understand the factors that affect corrosion processes.

3) Course Contents

The material covered in this course involves Electrochemical cell, cell polarization, Nernst equation, H2 scale, kinetics of electrochemical reactions, polarization and corrosion rates, industrial applications (aluminum cells, electrode position, modern battery technology, fuel cells), corrosion (corrosion mechanisms and techniques used in prevention and control, corrosion types, corrosion measurements), electrochemical mechanisms, corrosion principles, corrosion environment, corrosion reactions and its rates, types of cells responsible for corrosion, corrosion measurement rates, factors effecting corrosion process, Pourbaix diagrams, corrosion control technologies, electrochemical control mechanisms and its applications in corrosion, passivity, Material selection for different environments.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) …….. (30 %)
- Practical Work …….. (20 %)
- Final Exam. …… (50 %)

5) Teaching Methods

- *Lectures.*
- *Training exercises (Tutorial + Labs).*

6) Text Books:

- L.L. Shreir, R.A. Jarman and G.T Burstein, '**Corrosion**' Vol. 1, Butterworth and Heinemann, Oxford, 2000

7) References:

- Pierre R. Roberge, **"Handbook of Corrosion Engineering" ,** McGraw Hill Professional, 1999.

- Uhlig, H.H., Uhli, "**Electrochemical Society ",** John Wiley, 2000.

- Fontana, M.G., and Greene, N.D, **'Corrosion Engineering',** McGraw Hill, Last Edition.

Department Chemical Engineering

Course Title	***Control of Processes***
Course Code	***524* CHME**
No. of units *(Theoretical + Tutorial/Lab)*	***3 (2+1)***
Level-Year	***10-5***
Prerequisite (if any)	***513* CHME**

1) Brief Course Description

This course investigates control systems and analyzes the dynamics behaviors of chemical processes, besides addressing the designing and tuning of control systems and equipment. The program also equip the students with the basic understanding of various control actions and their applications.

2) Course Objectives

Upon completion of this course, the following objectives will be met:

1. To understand the principles and importance of control and feedback control in chemical engineering.
2. To gain the analysis skills of open loop and closed loop systems.
3. The skills of computer applications in chemical process control.

3) Course Contents

The course is intended to develop the student's ability to understand control mechanisms, the analysis of dynamic behavior of chemical processes, and design of control systems. Introduction of control systems, transfer functions and block diagram representation. Feedback control, Routh stability analysis, root locus method, frequency response analysis (Nyquist and Bode diagrams), controller design and tuning, multi – controller design using Hurwitz and Nichols method, laboratory and simulations applications

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……..…... (30 %)
- Practical Work ……..…….. (20 %)
- Final Exam. ……..…… (50 %)

5) Teaching Methods

- Lectures.
- Training exercises (Tutorial + Labs).
-

6) Text Books

- Seborg D.E. , T.F. Edgar, and D.A.Mellichamp, , " **Process Dynamic and Cotrol**, 2nd Ed., " ,John Wiley & sons Inc., New York, 2004.**:**
- Smith and Corripo, , **"Principles and Practice of Automatic Process Control"**, 3rd, Ed.," John Wiley & Sons, Inc, New York , NY, 2006.
- Benjemin C. Kuoend Luyben ,"**Modeling, Simulation and Control for Chemical Engineers**" , Mc Graw Hill, Pub.Co., New York, Last Edition.

7) References

- Connell, B., **Basic Math for Process Control**, ISA, NY 2003.
- Shinkskey, F.G., **Process Control Systems, Applications, Design and Adjustment,** Mc Graw Hill, London.

Department: Chemical Engineering

Course Title	***Water and Solid Waste Treatment***
Course Code	***'525 CHME***
No. of units (Theoretical + Lab)	***3 (3 +0)***
Level – Year	***10- 5***
Pre-requisites (if any)	***No prerequisites***

1) Brief Course Description

This course would examine the basic physical, chemical, and microbiological principles that provide the foundation for environmental engineering. Students would be educated to illustrate how these principles are applied to solve a wide range of environmental problems

2) Course Objectives

Upon completion of this course, the student will be able to:

1. Know the standard methods for specifying water quality.
2. Understand the methods of industrial wastewater characterization.
3. Understand the methods of waste treatment processes.
4. Understand the sources of pollution from chemical industries.
5. Understand the methods of treatment of industrial wastes.
6. Understand the sources and abatement of air pollution.
7. Understand the sources and abatement of solid wastes.
8. Understand the environmental standards and legislation.

3) Course Contents

Sources of pollution: air, water and solid wastes, **Impact of pollution:** on human health and the environment, **environmental standards and legislation**: to protect environment. **Modeling and design of biological waste treatment processes**: Sources of pollution from chemical industries, Analysis of chemical and physical processes for wastewater treatment in process industries, and purification, **Water treatment methods**: Treatment of industrial wastewater, urban wastes, study of water and liquid standards, design, maintenance, and economic analysis of the major process of water desalination like condensation, reverse osmosis, and

electro-membrane. **Air pollution:** particulates, SO_x, NO_x and organic vapors, air pollution control. **Handling of solid wastes**. Monitoring of pollutants. **Case studies**: Specific industries like petrochemicals, fertilizers, desalination and petroleum refining.

4) Course Assessment

- Mid-Term Tests (Not less than two Exams.) ……..…….(30 points)
- Homework and other duties…….…….(20 points)
- Final Exam. …….…….(50 points)

5) Teaching Methods

- Lectures
- Training exercises (Tutorials)

6) Text Books

- **"Industrial Waste Treatment Handbook", 2nd Ed**. , Woodard & Curran Inc., 2005.
- C., Kennes, and M. C., Veiga, "**Bioreactors for Waste Gas Treatment", (Environmental Pollution)**, Springer, 2006
- Louis Theodore, R. Ryan Dupont, and Kumar Ganesan, "**Pollution Prevention: The Waste Management Approach to the 21st Century**" ,CRC Press, 2000.

7) References:

- **Venugopala R. P. Text book of Environmental Engineering 4th ed. 2005, Prentice Hall, India**
- **P. Aarne Vesilind, Susan M. Morgan, Lauren G. Heine, Introduction to Environmental Engineering, 4th ed. 2009, Cengage learning**
- **Gilbert M. Masters, Wendell Ela, Introduction to Environmental Engineering and Science, 2008, Prentice Hall**
- **Henry Z. Kister , "Distillation Operation" , McGraw Hill Professional, Last Edition.**
- Water Treatment Plant Design, **American Water Works Association and American Society of Civil Engineers, McGraw Hill, 2004.**

Elective Courses Syllabus

Courses Taught Outside The department