



Faculty of Engineering – King Khalid University

# Chemical Engineering Program

## Study Plan

**2022/2023**

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***Distribution of Courses***

***over***

***Different Levels***

**Chemical Engineering Department  
First Year – Common Engineering Year**

<b>Level 1</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequest</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-ENG011-6	Intensive English Program - 1	-	6	6	12	
-CHEM107-6	General Chemistry	5	1	6	7	
-GE111-4	Engineering Drawing		4	4	8	
Total Credit Hours		5	11	16	27	

<b>Level 2</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequest</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-ENG012-6	Intensive English Program 2	-	6	6	12	-ENG011-6
-MATH119-5	Differentiation and Integration -1	5		5	5	-
-ICI111-2	Islamic Culture - 1	2	-	2	2	
Total Credit Hours		7	6	13	19	

<b>Level 3</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequest</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-PHYS129-6	Physics	5	1	6	7	
-MATH129-5	Algebra and Geometry	5		5	5	
-101CMS-2	Computer Science	1	1	2	3	
Total Credit Hours		11	2	13	15	

<b>Level 4</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequisite</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-ARAB201-2	Skills of Arabic Language	2		2	2	
-MATH219-5	Differentiation and Integration -2	5		5	5	
-ME121-4	Production Technology and Workshops	1	3	4	7	
-CHEM211-5	Organic Chemistry - 1	4	1	5	6	
<b>Total Credit Hours</b>		12	4	16	20	

<b>Level 5</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequisite</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-CHEM231-5	Physical Chemistry	4	1	5	6	
-ME218-4	Static & Dynamic	4	1	4	5	
- ARAB202-2	Arabic Writing	2		2	2	
-MATH229-5	Differentiation and Integration -3	5		5	5	-MATH219-5
<b>Total Credit Hours</b>		15	2	16	18	

<b>Level 6</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequisite</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-CHEM221-5	Organic Chemistry - 2	4	1	5	6	-CHEM211-5
-CHME222-5	Fundamentals of Chemical Engineering 1	4	1	5	6	-CHEM211-5
-CHME223-4	Materials Engineering	3	1	4	5	-CHEM231-5
-CHME224-4	Advanced Engineering Drawing	2	2	4	6	
<b>Total Credit Hours</b>		13	5	18	23	

<b>Level 7</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequest</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-MATH319-5	Differential Equations	5		5	5	-MATH129-5
-ME225-5	Strength of Materials and Testing	4	1	5	6	
-CHME311-5	Chemical Engineering Thermodynamics - 1	4	1	5	6	
-IC112-2	Islamic Culture - 2	2		2	2	
<b>Total Credit Hours</b>		15	2	17	19	

<b>Level 8</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequest</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-CHME312-5	Fundamentals of Chemical Engineering 2	4	1	5	6	-CHME222-5
-CHME313-5	Mass Transfer	4	1	5	6	
-CHME321-5	Momentum Transfer	4	1	5	6	
<b>Total Credit Hours</b>		12	3	15	18	

<b>Level 9</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequest</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-STAT329-3	Fundamentals of Statistics and Probability	3		3	3	
-EE218-4	Electric Engineering	3	1	4	5	
-CHME322-5	Chemical Reactions Engineering	4	1	5	6	-CHME312-5 -CHME231-5
-CHME323-4	Thermodynamics in Chemical Engineering - 2	3	1	4	5	-CHME311-5
<b>Total Credit Hours</b>		13	3	16	19	
CHME 400	Summer Training					Successfully pass 150 credit hours

<b>Level 10</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequisite</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-IC113-2	Islamic Culture - 3	2		2	2	
-ENG301-3	Technical Report Writing	3		3	3	-ENG012-6
-ME418-5	Principles of Engineering Design	3	2	5	7	-ME225-5 -CHME224-4
-MATH 419-5	Numerical Methods	5		5	5	-MATH319-5
<b>Total Credit Hours</b>		13	2	15	17	

<b>Level 11</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequisite</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-CHME412-4	Chemical Industries Engineering	3	1	4	5	-CHME322-5
-INE424-3	Engineering Economic	3		3	3	
-CHME422-4	Advanced Engineering Design	3	1	4	5	-ME418-5
-CHME423-4	Catalysis & Catalytic Processes	3	1	4	5	
<b>Total Credit Hours</b>		12	3	15	18	

<b>Level 12</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequisite</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-IC114-2	Islamic Culture 4	2		2	2	
-CHME421-3	Plants and Chemical Process Design	3		3	3	-INE424-3
-CHME424-4	Separation Processes	3	1	4	5	-CHME313-5
-CHME425-5	Heat Transfer	4	1	5	6	-CHME323-4
<b>Total Credit Hours</b>		13	2	14	16	

<b>Level 13</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequisite</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-CHME511-3	Extractive Metallurgy	3		3	3	-CHME223-4
-CHME512-3	Industrial Safety and Occupational Health	3		3	3	
-CHME513-5	Modelling & Simulation	4	1	5	6	-MATH 419-5
-CHME519-4	Graduation Project	4		4	4	At most 169 credits left for graduation
<b>Total Credit Hours</b>		14	1	15	16	

<b>Level 14</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequisite</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-CHME514-5	Computer Applications in Chemical Engineering	3	2	5	7	-CHME412-4
-CHME515-5	Polymers Engineering	4	1	5	6	
-CHME521-5	Petroleum Refining & Petrochemicals	4	1	5	6	
<b>Total Credit Hours</b>		11	4	15	19	

<b>Level 15</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hour</b>				<b>prerequisite</b>
		<b>Lectures</b>	<b>Lab/ Tutorial</b>	<b>Total</b>	<b>Contact</b>	
-CHME522-5	Chemical Reactor Design	4	1	5	6	-CHME423-4
-CHME523-5	Corrosion & Electrochemical Engineering	4	1	5	6	
-CHME524-4	Control of Processes	3	1	4	5	-CHME513-5
-CHME525-5	Water and Solid Waste Treatment	5		5	5	
<b>Total Credit Hours</b>		16	3	18	22	



**Course Syllabi and Description**  
**for**  
**Common First Year**  
**( Common Engineering Program )**

**Course Syllabi and Description**  
**for**  
**Second year**

## Department: Chemical Engineering

<b>Course Title</b>	<b>Fundamentals of Chemical Engineering 1</b>
<b>Course Code</b>	<b>-CHME222-5</b>
<b>No. of units (<i>Theoretical + Tutorials</i>)</b>	<b>5 (4+1)</b>
<b>Level-Year</b>	<b>6-2</b>
<b>Prerequisite (if any)</b>	<b>-CHEM211-5</b>

### 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	-CHME223-4
No. of units ( <i>Theoretical + Tutorial/Lab</i> )	4 (3+1)
Level-Year	6-2
Prerequisite (if any)	-CHEM231-5

### 1) Brief Course Description

This course covers and concentrates on principles of material science such as atomic structure and interatomic bonding, 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 bonding.
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 bonding, 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", 6<sup>th</sup>. Ed., New York, 2006

## 7) References:

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

## Department: Chemical Engineering

<b>Course Title</b>	<b>Advanced Engineering Drawing</b>
<b>Course Code</b>	<b>-CHME224-4</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>4 (2+2)</b>
<b>Level-Year</b>	<b>6-2</b>
<b>Prerequisite (if any)</b>	<b>-GE111-4</b>

### 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	CHME311-5
No. of units ( <i>Theoretical + Tutorial/Lab</i> )	5 (4+1)
Level-Year	7-3
Prerequisite (if any)	-PHYS129-6

### 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:** Thermodynamic diagrams

Steam tables and Heat effects: First law and second law; Entropy;

Calculation of thermodynamic properties:**Analysis of power cycles:** Refrigeration;

**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

<b>Course Title</b>	<b>Fundamentals of Chemical Engineering 2</b>
<b>Course Code</b>	<b>-CHME312-5</b>
<b>No. of units (<i>Theoretical + Tutorials</i>)</b>	<b>5 (4+1)</b>
<b>Level-Year</b>	<b>8-3</b>
<b>Prerequisite (if any)</b>	<b>-CHME222-5</b>

### 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

<b>Course Title</b>	<b>Mass Transfer</b>
<b>Course Code</b>	<b>-CHME313-5</b>
<b>No. of units (Theoretical + Lab)</b>	<b>5 (4 + 1)</b>
<b>Level – Year</b>	<b>8-3</b>
<b>Pre-requisites (if any)</b>	<b>No prerequisites</b>

### 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

<b>Course Title</b>	<b>Momentum Transfer</b>
<b>Course Code</b>	<b>-CHME321-5</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>5 (4+1)</b>
<b>Level-Year</b>	<b>8-3</b>
<b>Prerequisite (if any)</b>	<b>No prerequisites</b>

### 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**

<b>Course Title</b>	<b>Chemical Reactions Engineering</b>
<b>Course Code</b>	<b>-CHME322-5</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>5 (4+1)</b>
<b>Level-Year</b>	<b>9-3</b>
<b>Prerequisite (if any)</b>	<b>-CHME312-5</b>

### **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 2
Course Code	-CHME323-4
No. of units ( <i>Theoretical + Tutorial/Lab</i> )	4 (3+1)
Level-Year	9-3
Prerequisite (if any)	-CHME311-5

### 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 equilibrium:** 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

<b>Course Title</b>	<b>Chemical Industries Engineering</b>
<b>Course Code</b>	<b>-CHME412-4</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>4 (3+1)</b>
<b>Level-Year</b>	<b>11-4</b>
<b>Prerequisite (if any)</b>	<b>-CHME322-5</b>

### 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

<b>Course Title</b>	<b>Plants &amp; Chemical Processes Design</b>
<b>Course Code</b>	<b>-CHME421-3</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>3 (3+0)</b>
<b>Level-Year</b>	<b>12-4</b>
<b>Prerequisite (if any)</b>	<b>-INE424-3</b>

### 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	-CHME422-4
No. of units ( <i>Theoretical + Tutorial/Lab</i> )	4 (3+1)
Level-Year	11-4
Prerequisite (if any)	-ME418-5

### 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

<b>Course Title</b>	<b>Catalysis &amp; Catalytic Processes</b>
<b>Course Code</b>	<b>-CHME423-4</b>
<b>No. of units (<i>Theoretical + tutorial/Lab</i>)</b>	<b>4 (3 + 1)</b>
<b>Level – Year</b>	<b>11-4</b>
<b>Pre-requisites (if any)</b>	<b>-CHME322-5</b>

### 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; 3<sup>rd</sup> Ed. Publisher: John Wiley & Sons**
- **Catalysis: Principles and Applications; Author: Wiswanathan B., & Ramaswamy A. V., Publisher: Narosa; 3<sup>rd</sup> Ed.**

## **Department Chemical Engineering**

<b>Course Title</b>	<b>Separation Processes</b>
<b>Course Code</b>	<b>-CHME424-4</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>4 (3+1)</b>
<b>Level-Year</b>	<b>12-4</b>
<b>Prerequisite (if any)</b>	<b>-CHME313-5</b>

### **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, psychrometry, 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

<b>Course Title</b>	<b>Heat Transfer</b>
<b>Course Code</b>	<b>-CHME425-5</b>
<b>No. of units (Theoretical + Lab)</b>	<b>5 (4 + 1)</b>
<b>Level – Year</b>	<b>12-4</b>
<b>Pre-requisites (if any)</b>	<b>-CHME412-4</b>

### 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 unsteady-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<sup>th</sup> Ed., by Warren L. McCabe, Julian C. Smith and Peter Harriott
- Fundamentals of Heat and Mass Transfer by Incropera, DeWitt, 5<sup>th</sup> Ed.
- Heat Transfer: Principles and Applications by Binay K. Dutta, Eastern Economy Edition.

**Course Syllabi and Description**  
**for**  
**Fifth year**

## **Department: Chemical Engineering**

<b>Course Title</b>	<b>Extractive Metallurgy</b>
<b>Course Code</b>	<b>-CHME511-3</b>
<b>No. of units (Theoretical + Lab)</b>	<b>3 (3 +0)</b>
<b>Level – Year</b>	<b>13-5</b>
<b>Pre-requisites (if any)</b>	<b>-CHME223-4</b>

### **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, TiO<sub>2</sub>.
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 TiO<sub>2</sub>. 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**

<b>Course Title</b>	<b>Industrial Safety and Occupational Health</b>
<b>Course Code</b>	<b>-CHME512-3</b>
<b>No. of units (<i>Theoretical + Tutorials</i>)</b>	<b>3 (2+0)</b>
<b>Level-Year</b>	<b>13-5</b>
<b>Prerequisite (if any)</b>	<b>No Prerequisite</b>

### **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**’ 3<sup>rd</sup> 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**

<b>Course Title</b>	<b>Modeling and Simulation</b>
<b>Course Code</b>	<b>-CHME513-5</b>
<b>Number of units (Theoretical + Tutorial/Lab)</b>	<b>5 (4 + 1)</b>
<b>Level-Year</b>	<b>13-5</b>
<b>Pre-requisite</b>	<b>-MATH 419-5</b>

### **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**

<b>Course Title</b>	<b>Computer Applications in Chemical Engineering</b>
<b>Course Code</b>	<b>-CHME514-5</b>
<b>Number of units (Theoretical + Tutorial/Lab)</b>	<b>5 (4 + 1)</b>
<b>Level-Year</b>	<b>14-5</b>
<b>Pre-requisite</b>	<b>-CHME412-4</b>

### **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" 7<sup>th</sup> 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

<b>Course Title</b>	<b>Polymers Engineering</b>
<b>Course Code</b>	<b>-CHME515-5</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>5 (4+1)</b>
<b>Level-Year</b>	<b>14-5</b>
<b>Prerequisite (if any)</b>	<b>No pre-requisite</b>

### 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**", **2nd 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**

<b>Course Title</b>	<b>Graduation Project</b>
<b>Course Code</b>	<b>-CHME519-4</b>
<b>No. of units (<i>Theoretical + Tutorials</i>)</b>	<b>4 (0+4)</b>
<b>Level-Year</b>	<b>13-5</b>
<b>Prerequisite (if any)</b>	<b>At most 169 credits left for graduation</b>

### **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<sup>th</sup> 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**

<b>Course Title</b>	<b>Petroleum Refining and Petrochemicals Engineering</b>
<b>Course Code</b>	<b>-CHME521-5</b>
<b>Number of units (Theoretical + Tutorial/Lab)</b>	<b>5 (4 + 1)</b>
<b>Level-Year</b>	<b>14-5</b>
<b>Pre-requisite</b>	<b>No</b>

### **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

<b>Course Title</b>	<b>Chemical Reactors Design</b>
<b>Course Code</b>	<b>CHME522-5</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>5 (4+1)</b>
<b>Level-Year</b>	<b>15-5</b>
<b>Prerequisite (if any)</b>	<b>CHME423-4</b>

### 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, 1<sup>st</sup> order and 2<sup>nd</sup> 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**

<b>Course Title</b>	<b>Corrosion and Electrochemical Engineering</b>
<b>Course Code</b>	<b>-CHME523-4</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>4 (3+1)</b>
<b>Level-Year</b>	<b>15-5</b>
<b>Prerequisite (if any)</b>	<b>N/A</b>

### **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, H<sub>2</sub> 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**

<b>Course Title</b>	<b>Control of Processes</b>
<b>Course Code</b>	<b>-CHME524-4</b>
<b>No. of units (<i>Theoretical + Tutorial/Lab</i>)</b>	<b>4 (3+1)</b>
<b>Level-Year</b>	<b>15-5</b>
<b>Prerequisite (if any)</b>	<b>-CHME513-5</b>

### **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).
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## 6) Text Books

- Seborg D.E. , T.F. Edgar, and D.A.Mellichamp, , " **Process Dynamic and Cotrol**, 2<sup>nd</sup> 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	-CHME525-5
No. of units (Theoretical + Lab)	5 (5 +0)
Level – Year	15-5
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<sub>x</sub>, NO<sub>x</sub> 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 4<sup>th</sup> ed. 2005, Prentice Hall, India**
- **P. Aarne Vesilind, Susan M. Morgan, Lauren G. Heine, Introduction to Environmental Engineering, 4<sup>th</sup> 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**