CHE 201 Chemical Engineering Principles 1 **Date**:5-5-2006

Prepared by: Ahmed E. Abasaeed **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Recitation Cr: 1

Pre Req(s): Chem 101 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 3 Engineering Cr: 0 General Education Cr: 0

Catalog Data:

Familiarize the students with basic concepts and procedures to perform material balances on single, multiple units for both non-reactive and reactive processes

Textbook:

Felder R. M. and Rousseau, R. W. "Elementary Principles of Chemical Processes" John Wiley & Sons, 3rd ed.

Topics covered

1. Origin of Chemical Engineering and role of Chemical Engineer (**3 classes**).
2. Introduction to Engineering Calculations (Units, dimensions and basic definitions. Conversion of units. Dimensional homogeneity and dimensionless quantities. Mathematical tools and problem solving techniques). (**8 classes**)
3. Processes and process variables (Mass, volume, temperature, pressure, flow rate, chemical composition) (**8 classes**)
4. Material balances (Application of principles of mathematics, physics and chemistry in material balances in single unit, multiple inputs/outputs, multiple units, recycle, bypass, purging in non-reactive and reactive processes, combustion reactions). (**26 classes**)

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Able to understand the role of Chemical Engineers and the difference between Chemical Engineers and chemists.						1		1	1		
2. Able to convert quantities from one set of units to another quickly and accurately. [1](1)	3				1						
3. Able to define and determine properties of process streams including fluid density, flow rate, chemical composition (mass and mole fractions, concentrations), fluid pressure, and temperature. [1,2](1)	3				1						
4. Able to represent and interpret process data [1,4](1)		1									
5. Able to draw and label process flowcharts from verbal process descriptions. [1,4](1,2,5)	3		1								
6. Able to perform material balances on single and multiple units with recycle and by-pass for nonreactive processes.[1,2,4](1,2,3,4,6)	3		1		2						
7. Able to perform material balances on single and multiple units with recycle and by-pass for reactive processes. [1,2,4](1,2,3,4,6)	3		1		2						
8. Able to perform combustion reaction's calculations, [1,2,4](1,2,3,4,6)	3		1		2						

CHE 202 Chemical Engineering Principles 2 **Date**: 1/1/2006

Prepared by: Mohamed Abashar **Total credits**: 2 Lecture Cr: 2 Lab Cr: 0 Recitation Cr: 1

Pre Req(s): CHE 201 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: Engineering Cr: 2 General Education Cr: 0

Catalog Data:

The law of conservation of energy and energy balance concepts. Systematic approaches for the solution of energy balances on flow sheets of chemical processes.

Textbook:

R. M. Felder and R. W. Rousseau, R. W., "Elementary Principles of Chemical Processes", 3rd edition, Wiley, 2000. ISBN: 0-471-53478-1

Topics covered

1. Energy and energy balance (8 class)
2. (Forms of energy, the first law of thermodynamics, energy balances on closed systems, energy balance on opens systems, table of thermodynamic data, energy balance procedures, mechanical energy balances).
3. Balances on nonreactive processes (13 class)
4. (Elements of energy balance calculations, changes in pressure at constant temperature, changes in temperature, phase change operations, mixing and solution, psychrometric chart).
5. Balances on reactive processes (9 class)
6. (Heats of reaction, Hess's law, formation reactions and heats of formation, heats of combustion, energy balances on reactive processes, fuels and combustion).

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1.Able to identify, use and convert various forms of energy.[1](1)	3				2						
2.Able to use tabulated energy-related data. [1](1)	3				2						
3.Able to perform energy balances on non-reactive systems. [1,2](1,2,6)	3		1		2						
4.Able to use psychrometric chart [1](1)	3				2						
5.Able to perform energy balances on reactive systems. [1,2](1,2,6)	2		1		2						
6.Able to understand and perform energy balance calculations on combustion reactions. [1,2](1,2,6)	3		1		2						

CHE 302 Computer-Aided Mass and Energy Balances **Date**: 28/2/2006

Prepared by: Kamil M. Wagialla **Total credits**: 2 Lecture Cr: 2 Lab Cr: 0 Recitation Cr: 0

Pre Req(s): CHE 202, GE 209 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 1 Engineering Cr: 2 General Education Cr: 0

Catalog Data:

Application of computer software in solution of material and energy problems. Usage of equation solving software (such as EZ Solve), spreadsheets (such as Microsoft EXCEL), and simulation packages (such as SuperPro Designer or ChemCad). Determination of degree of freedom for multi-unit flowsheets.

Textbook:

G.V. Reklaitis, "Introduction to Material and Energy Problems", Wiley, 1983.

Topics covered

1. Classification of computer software (2 classes).
2. Material and energy balances involving chemical reactions (3 classes).
3. Material and energy balances involving phase change (3 classes).
4 .Degree of freedom analysis (3 classes).
5. Determination of number of independent unknown variables in a process flowsheet (2 classes).
6. Selection of independent unknown variables in a process flowsheet (2 classes).
7. Usage of equation solving software in material and energy balance problems (4 classes).
8. Usage of spreadsheets (e.g. EXCEL) in material and energy balance problems (4 classes).
9. Usage of simulation software package in material and energy balance problems (4 classes).

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1.Understand the types of computer software available for solving material and energy problems [1](1,4)			3						1	2	
2.Determination of susceptibility of an engineering problem for solution using degree of freedom analysis	1		3		3		1				3
3.Correct setting up of an engineering problem for solution [1](1,2)	3		3		3						
4.Training in efficient application of computer software in engineering problem solution. [1](1,4)			3						1		3

CHE 304 Thermodynamics for Petroleum Students **Date**:5-5- 2006

Prepared by: Inas Muen AlNashef **Total credits**: 2 Lecture Cr: 2 Lab Cr: 0 Recitation Cr: 1

Pre Req(s): CHEM 230 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 0.5 Engineering Cr: 1.5 General Education Cr: 0

Catalog Data:

Global picture of energy, sources and utilization, energy conversion. Economical and Environmental aspects. Thermo-Physical properties of pure substances and gases. Conservation of energy: non-flow and steady flow energy systems. Engineering applications. Introduction to phase equilibria of binary and multi-component systems

Textbook:

Cengel, Y. A. and Boles, M. A., Thermodynamics: An Engineering Approach. 4th ed., McGraw-Hill, N. Y., 2002.

Topics covered

1. The concept of energy and related issues, such as energy forms and sources. (2 classes)
2. Basic concepts of classical thermodynamics. (2 classes)
3. Thermo-Physical properties of pure substances. (6 classes)
4. Introduction to work and heat transfer. (4 classes)
5. Conservation of energy: non-flow and steady flow energy systems. (7 classes)
6. Introduction to phase equilibria of binary and multi-component systems. (4 classes)
7. Applications to Petroleum Engineering. (1 class)

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
(1) To provide the students with the concept of energy and its related issues, such as energy forms and its classifications, and with the basic concepts of classical thermodynamics.	3			1	2				2	2	
(2) To enable students to identify, formulate, and solve engineering problems.	2				3						
(3) To learn how to better use, interpret, predict, and produce thermodynamic data such as P-V-T data, heat capacities, and enthalpy data.	3	1			2				1		
(4) To apply mass and energy balances.	2		1		2						
(5) To develop skills to characterize and predict phase behavior for pure substances and mixtures with emphasis on applications to petroleum engineering.	2	1	1	1	2						
(6)To contribute to enhancing students communication skills.							1				

CHE 307 Chemical Engineering Thermodynamics 1 **Date**:5-5- 2006

Prepared by: Inas Muen AlNashef **Total credits**: 2 Lecture Cr: 2 Lab Cr: Recitation Cr: 1

Pre Req(s): CHE 201, Chem 230 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 0.5 Engineering Cr: 1.5 General Education Cr: 0

Catalog Data: :

Global picture of energy, sources and utilization, energy conversion. Economical and Environmental aspects. Basic definitions related to thermodynamics, development of the first law of thermodynamics, pressure/volume/temperature behavior of fluids and certain heat effects, application of the first law to realistic problems, the second law and some of its applications. `

Textbook:

Smith, J.M.; Van Ness, H.C.; and Abbott, M.M. "Introduction to Chemical Engineering Thermodynamics", 6th ed. McGraw Hill, 2001.

Topics covered

1. Global picture of energy. (**3 classes**)
2. Introduction to thermodynamics. (**2 classes**)
3. The first law and other basic concepts. (**6 classes**)
4. Volumetric properties of pure fluids. (**6 classes**)
5. Heat effects. (**4 classes**)
6. Second law of thermodynamics. (**5 classes**)

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. To provide the students with the concept of energy and its related issues, such as energy forms and its classifications, and with the basic concepts of classical thermodynamics. [1,2](1,6)	3			1	2				2	2	
2. To get familiar with the principle of energy conservation [1](1)	2	1						1			
3. To apply mass and energy balances to closed systems.[1](1,2,6)	2		1			2					
4. To learn how to better use, interpret, predict, and produce thermodynamic data such as P-V-T data, heat capacities, and enthalpy data. [1](1)	3	1			2				1		
5. To introduce the concept of entropy and the limitations on energy conversion. [1](1)	2	1		1	2						
6. To enable students to identify, formulate, and solve engineering problems. [3](3)	2				3		1				

CHE 308 Chemical Engineering Thermodynamics 2 **Date**: 5-5-2006

Prepared by: Inas Muen AlNashef **Total credits**: 2 Lecture Cr: 2 Lab Cr: Recitation Cr: 1

Pre Req(s): CHE 307 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 0.5 Engineering Cr: 1.5 General Education Cr: 0

Catalog Data:

Treatment of the thermodynamic properties of pure fluids, expanded treatment of flow processes, introduction to power production and refrigeration processes, and fluid phase equilibrium of ideal and non-ideal mixtures.

Textbook:

Smith, J.M.; Van Ness, H.C.; and Abbott, M.M. "Introduction to Chemical Engineering Thermodynamics", 6th ed. McGraw Hill, 2001.

Topics covered

1. Thermodynamic Properties of Fluids. (**7 classes**)
2. Applications of Thermodynamics to Flow Processes. (**7 classes**)
3. Production of Power from Heat: The Steam Power Plant. (**3 classes**)
4. Introduction to Refrigeration. (**3 classes**)
5. Introduction to Vapor Liquid Equilibrium. (**6 classes**)

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. To learn how to calculate enthalpy, internal energy and entropy using P-V-T and heat capacities data.[1](1)	2	1			1						1
2. To apply mass, energy, and entropy balances to flow processes. [1](1)	3		1	1	2						1
3. To develop student's skills of identifying limitations on the transformation of energy from one form to another, including the interrelationship of heat and work**. [1](1)**	1		1		2			1	1		
4. To get familiar with cyclic processes: Production of power from heat and refrigeration [1](1,2)	2		1	1	2					1	
5. To develop skills to characterize and predict phase behavior for mixtures, [1](1)	2	2	1		2						1

CHE 309 Unit Operations **Date**: 2/1/2006

Prepared by Maher Alodan **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Recitation Cr: 1

Pre Req(s): CHE 202 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 2 Engineering Cr: 1 General Education Cr: 0

Catalog Data:

Introduce students to processes involving particulate solids and their design equations.

Textbook:

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

Topics covered

1. Properties, Handling, and Mixing of Particulate Solids (**12 classes**): Characterization of solid particles, properties of particulate masses, storage of solids, mixing of solids, types of mixers.
2. Mechanical Size Reduction (**6 classes**): Principles of comminution, computer simulation of milling operations, size reduction equipment, and equipment operation.
3. Flow Past Immersed Bodies (**6 classes**): Friction in flow through beds of solids, motion of particles through fluids, fluidization.
4. Mechanical-Physical Separation I (**12 classes**): Screening, screening equipment, filtration, cake filters, centrifugal filters, principles of cake filtration, clarifying filters, liquid clarification, gas clarification, principles of clarification)
5. Mechanical-Physical Separation II (**6 classes**): Separation based on the motion of particles through fluids: gravity settling processes, centrifugal settling processes., fluidization.

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. To understand and analyze particulate of solids properties and measurements. [1](1)	3				1						
2. To understand and select best process to separate particles according to their size. [1]	3		1		1						
3. Design and calculate efficiency and performance of particles separation from fluids.	3		2		1						
4. Applications of fluid mechanics relationships to understand motion of particles through fluids to apply in filtration processes. [1](1)	3				3						
5. Apply course knowledge in selected problems from industries involving particulate solids operations [1,4].	3		2	1	3		2	2		1	
6. Compile all work as a team work to complete one full process.[3](2,3,5)	1		1	2	1		2				2

CHE 312 Momentum Transport Operations **Date**: 4/Dec/2005

Prepared by: Mourad Boumaza **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Tutorials Cr:1

Pre Req(s): CHE 202 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr:2 Engineering Cr: 1 General Education Cr:

Catalog Data: Course deals with the of concept of momentum and mechanical energy balances and explain flow through various media.

Textbook: Geankoplis, G.J: Transport Processes and Unit Operations, Allyn and Bacon, fourth edition

Topics covered

1. Introduction, Fluid static: Force, pressure, Head of fluid, Devices to measures pressures. (8classes).
2. Fluid Dynamics: Viscosity of Newtonian fluids, continuity equation, Shell momentum balance, energy and mechanical energy balance, Friction factor, Bernoulli's equation., .Piping design (17 classes)
3. Flow around submerged bodies, flow through porous media: Laminar flow in packed beds, Turbulent flow in packed beds, Shape factors, Darcy's law. Flow in fluidized beds: Minimum velocity and porosity of fluidization, expansion of fluidized beds. (7 classes).
4. Flow metering devices: Pitot tube, Venturi meter, Orifice meter, Flow in open channels and weirs. (2 classes).
5. Pumps and Fluid moving machinery: Pumps, Fans, Blowers, Compressors. (2 classes).
6. Non Newtonian fluids: Types of Non Newtonian fluids, Friction losses in contraction, Turbulent flow and generalized friction factors. (2 classes).
7. Dimensional analysis (2 classes).

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Fluid statics: Apply Newton's law of forces and determine the pressure at the bottom of fluid, calculate the pressure difference across a manometer and define head of fluid. [1](1)	3				2						
2. Fluid Dynamics: Explain Newton's law of viscosity and define shear stress and types of flow.	3	2			1						
3. Mechanical Energy Balance: Apply principles of the mechanical energy balance that are appropriate to a particular situation and determine the required pump power and pump size for a particular problem.[1](1)	3	2	3		3			2			
4. Shell Momentum balance: Determine velocity profiles in flow inside a pipe and for falling film.[1](1)	3		2					1	1		
5. Piping sizing: Determine friction factors for laminar and turbulent flow problems in both smooth and rough pipes and determine friction losses in valves and fittings.[1]	3	2	2		3			2		2	2
6. Porous media, flow through packed and fluidized beds: Determine Drag force and coefficient, calculate pressure drop across a packed bed using the Ergun Equation [1]	3	3			2		2		3	1	2
7. Flow meter devices and fluid moving machinery: Explain principles of pumps, flow meter devices [1]	3			2	2	2		1		1	

CHE 313 Heat Transfer Operations **Date**: 27/April/20

Prepared by: Malik Al-Ahmad **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Tutorials Cr:1

Pre Req(s): CHE 202, CHE 312 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr:2 Engineering Cr: 1 General Education Cr:

Catalog Data:

Consideration of thermal energy transfer problems which occur in the process industry. Conduction, convection and radiation, heat transfer with change in phase , heat exchange equipment and their design. .

Textbook:

Geankoplis, G.J: Transport Processes and Unit Operations, Allyn and Bacon, fourth edition; F.kreith and M.S Bohn,"Principle of Heat Transfer " , PWS Pub. company, 5th ed., Boston ,1997.

Topics covered

1. Introduction and mechanisms of heat transfer (2 classes).
2. Steady state heat transfer by conduction. (8 classes)
3. Individual coefficients of heat transfer, overall coefficients, scale resistance, mean temperature difference for parallel, counter-current and mixed flow arrangements. (6 classes83).
4. Heat Transfer correlation in convection (development by dimensional analysis) and its different forms for different actual situation such as heating and cooling inside tubes in turbulent, transition and laminar flow, heating and cooling outside tubes and tube bundles, heat transfer in agitate vessels. (6 classes).
5. Natural convection. (3 classes).
6. Radiation through non- absorbing and absorbing media. (6 classes).
7. Heat transfer with change equipment design. (4 classes).
8. Application to heat exchange equipment design. (5 classes).
9. Selected topics (extended surface, temperature measurement equipment, heat pipe, compact heat exchangers, packed and fluidized systems). (5 classes).
10. Tests: (3 classes)

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1.Mechanisms of heat transfer: Heat transfer by conduction, convection and radiation.	2				2						
2.Heat transfer by conduction: Fourier's Law of heat conduction, thermal conductivity, conduction through flat slab or wall, hollow cylinders and hollow spheres. Conduction through solids in series and parallel. Critical thickness of insulation, conduction with internal heat generation.[1](1)	2				2						
3.Heat transfer coefficients: Convective heat transfer coefficient, combined convection and conduction and overall coefficients.[1](1)	2		2								
4.Heat Transfer correlation in forced convection: Dimensionless numbers, Forced convection inside pipes; laminar, turbulent and transition regions, liquid metal heat transfer coefficients. Forced convection outside various geometries: flat plates, cylinders, single spheres, bank of tubes, heat transfer for flow in packed beds.[1]	2		2	2							2
5.Natural convection: Natural convection from various geometries.[1]	2		2	2							2
6.Radiation heat transfer: Thermal radiation, Stefan-Boltzman law, concept of gray body, view factors for different geometries.[1]	2			2							2
7.Heat exchangers: Types of heat exchangers, log mean temperature difference correction factor, Heat exchanger effectiveness, Fouling factor and typical overall U values.[1,2](1,2,6)			2								2
8.Selected topics (extended surface, temperature measurement equipment, heat pipe, compact heat exchangers, packed and fluidized systems). [1,2](1,2,6)			2	2					1	2	2

CHE 314 Mass transfer operations **Date**:5-5- 2006

Prepared by: Anis H. Fakeeha **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Recitation Cr: 1

Pre Req(s): CHE 312 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 1 Engineering Cr: 2 General Education Cr: 0

Catalog Data:

Familiarize the students with basic concepts of mass transfer by diffusion ,convection and interface mass transfer . Mass transfer operations involve separation processes such as absorption, adsorption , ion exchange will be discussed and design of packed bed absorption column will be covered.

Textbook:

1- Geankoplis ,G.J.: Transport processes and Unit Operation , Alyn and Bacon ,latest ed.

2- Treyball ,R.E. " Mass transfer operations " . McGraw hill ,NY 1980

Topics covered

1. Concept of mass transfer operations and its role in separation processes (**5 classes**).
2. Molecular diffusion ; General law for diffusion and convection, equimolar counter diffusion, transfer across stagnant layer, effect of changing area (**7 classes**)
3. Diffusion coefficient estimation in gases and liquid , diffusion in solid (permeate membrane , packed bed, catalyst & capillary) (**7 classes**)
4. Numerical methods for steady state molecular diffusion in two dimension. (**2 classes**)
5. Convective mass transfer , general equation ,mass transfer coefficient concept , dimensionless analysis ,mass transfer correlations ,analogy between heat, mass and momentum transfer (**9 classes**)
6. Interface mass transfer ; Two resistance theory, Relationship between overall and individual mass transfer coefficients (**5 classes**)
7. Mass transfer equipment ; Spraying column ,Bubbling column and packed bed column (properties, loading ,flooding, channeling) (**3 classes**)
8. Design of Packed bed absorber (e.g. for continuous mass transfer operation ion – exchange , adsorber) (**5 classes**)

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Introduce student to separation processes and its role in chemical industries.			3			2				3	3
2. Explain the diffusion concept and use Fick's law to predict flux [1]	3				3						3
3. Calculation of diffusion coefficient for real and ideal gas as well mixture of gases, in liquid and the effect of solid presence on flux and diffusion coefficient for the above cases. [1](1)	3	1			3						
4. Apply numerical methods to calculate flux. [1](1,2,4)	3				3						
5. Explain convection concept and its law using dimensional analyses to obtain mass transfer correlations, analogy between heat , mass and momentum transfer. [1]	3	1			3						3
6. Defining overall mass transfer coefficient and apply the two resistance theory for two phases. [1]	3	2			3						
7. Explain the different mass transfer equipment and their advantages and disadvantages [1,2](1,6)	3	2			3				2	3	3
8. Calculating height and diameter of the column, basic design equation, operating line, (HTU) Height of transfer unit, (NTU) Number of transfer unit. [1,2](1,2,6)	3		3		3						3

CHE 316 Separation Processes -1 **Date**:5-5- 2006

Prepared by: Mohammad Asif **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Recitation Cr: 0

Pre Req(s): CHE 314 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 0 Engineering Cr: 3 General Education Cr: 0

Catalog Data:

Theories and equipment design involving evaporation, drying and membrane based separation processes with main focus on reverse osmosis, gas permeation and dialysis

Textbook:

1. J.D. Seader and E. J. Henley, Separation Process Principles, John Wiley, 1998.
2. C.J. Geankoplis, Transport Processes and Unit Operations, 4th Edition, Prentice Hall, 2003.

Topics covered

- General introduction to separation processes
- Introduction to evaporation , types of evaporators and operation methods and calculation methods for single-effect and multiple-effect evaporators
- Introduction to drying, phases of drying and rate of drying curves, calculation methods for drying, material and heat balances for continuous dryers, equations for various types of dryers and drying equipment
- Membrane material, membrane modules, module flow patterns, module cascades, transport in membranes, concentration polarization, reverse osmosis, gas permeation and dialysis

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1.Appreciate the importance of separation processes in the modern chemical engineering.										3	
2.Understand core issues involved in the design of different types of evaporators and appreciate the overriding importance of the steam economy.[1](1,2,6)	2		2		3						
3.Familiarize students with basic definitions and terms of drying, interpretation of drying curves and carryout drying calculations therewith including heat and mass balance of continuous dryers. Appreciate issues involving different types of dryer and derive their governing design equations.[1]	3		2		2						
4.Updates students with reasons for the growing application of membrane-based separation process in engineering.						1		2		3	
5.Understand basics of membrane-based separation and different types of membranes and engineering issues involved with membrane applications. [1,2](1,6)	2		3								
6. Details discussion and problem solution for reverse osmosis, gas permeation and dialysis. [1]	3		3		3						
7. Trouble-shooting with different equipment used for separation. [1]		2							1		3

CHE 321: Computer Aided Process Design **Date**: 5-5-2006

Prepared by: Abdelhamid Ajbar **Total credits**: 3 Lecture Cr: 0 Lab Cr: Recitation Cr: 0

Pre Req(s): CHE302 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 3 Engineering Cr: 3 General Education Cr: 3

Catalog Data:

Study of scientific strategies for the design of chemical processes. Process Design involves the use of the principles of chemistry, physics, biology and computer software to create industrial chemical processes that satisfy social needs while returning a profit.

Textbook:

Process Design Principles, D.Seider, J.D.Seader and D.R.Lewin, John Wiley and Sons, Inc., New York, 1999.

Topics covered

1. Training in the efficient use of process simulators e.g. HYSYS, ASPEN PLUS, CHEM CAD, SuperPro Designer- 5 classes.
2. Principles of process creation – 5 classes.
3. Heuristics for process synthesis – 5 classes.
4. Algorithmic methods for synthesis of separation trains – 5 classes.
5. Heat and power integration in heat exchanger networks and distillation trains – 10 classes.
6. Equipment sizing, cost estimation and profitability analysis – 5 classes
7. Optimization of process flowsheets – 5 classes.
8. Analysis of process safety and environmental cleaness – 5 classes

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Learn the efficient use of process simulators e.g. HYSYS, ASPEN PLUS, CHEM CAD, SuperPro.[3](4)				1			1		1		3
2. Learn principles of process creation.[1](1)	3				2						
3. Learn the heuristics for process synthesis. [1]	3				2						
4. Learn algorithmic methods for synthesis of separation trains. [1](1,2)	3		1		2						
5. Learn heat and power integration in heat exchanger networks and distillation trains. [1](1,2,6)	3				2					2	1
6. Learn equipment sizing, cost estimation and profitability analysis. [1,2](1,2,6)			3	1				2			

CHE 323 Process Control **Date**:5-5- 2006

Prepared by: Khalid Alhumaizi **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Recitation Cr: 1

Pre Req(s): **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 0 Engineering Cr: 3 General Education Cr: 0

Catalog Data:

Familiarize the students with basic principles of chemical process control with clear ties to applications.

Textbook:

Thomas E. Marlin, Process Control – Designing Processes and Control Systems for Dynamic Performance, 2nd Edition, McGraw Hill, 2000.

Topics covered

1. Introduction to process control, Control objectives and benefits (**2 classes**).
2. Process dynamics: mathematical modeling (procedure, linearization, examples), simulation and analysis (Laplace transform, Block diagrams, Frequency response, numerical methods and computer software), dynamic behavior of process systems (first order systems, second order systems, series structure, parallel structure, Recycle structure, staged process). (**21 classes**)
3. Feedback Control: Feedback Loop (Introduction, Instrument elements, controlled and manipulated variables, control performance measure), Classical proportional-Integral-derivative (PID) control algorithm, PID tuning, Stability analysis (1**8 classes**)
4. Advanced Topics (Implementation, Cascade control, Feedforward control, Inferential control, single-variable model predictive control) **(3 classes)**

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Able to apply the skills build in previous courses to develop dynamic models for simple chemical systems.[1](1)	3				1						2
2. Able to examine the dynamics of simple chemical systems by solving the dynamic model analytically and numerically. [1](1)	3				1						2
3. Understand the elements of the process control structure and to be able to choose the suitable elements of this structure. [1,2](1,2)			3		2						1
4. Able to design classical controller for single-input single-output systems. [1](1,2)			3		2						1
5. Able to analyze the performance and stability of the controlled systems. [1](1,2)			3		2						1
6. Aware of the role of computer software to design control systems.[1](1,2,4)			2		1				1	2	3
7. Teamwork: Work effectively in problem-solving teams both in and out of class.[1,3](1,3,5)				3			2				

CHE 331 Principles of Materials Engineering **Date**:5-5- 2006

Prepared by: **Mansour Alhazzaa** **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Recitation Cr: 1

Pre Req(s): Chem 101 **Co Req(s):** **Course Designation: Required**

Contribution to professional component: Math and Basic science Cr: **0** Engineering Cr: **3** General Education Cr: 0

Catalog Data:

Introduce the student to materials science& engineering and to highlight the relationships between structure , properties , and application of materials

Textbook:

William D. Callister. "Materials Science and Engineering an introduction" John Wiley & Sons, sixth ed.2003

Topics covered

1.Introduction to materials science and engineering & the Role of material engineering (**3 classes**).

2.Atomic structure and bonding of materials& classification of materials. (**5 classes**)

3.Crystalline structure of materials& imperfection in crystalline materials (**9 classes**)

4.general properties of ,metals , ceramics ,and polymers. (**10 classes**)

5.Phase diagrams of solid materials.(**8 classes)**

6.Materials deterioration and failure.(**8 classes)**

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1.Able to differentiate between different types of materials and structures quickly and accurately.	3				1					1	1
2.Able to relate materials properties and performance to the structure.[1](1)	3				1		2				
3. Understanding phase diagrams for solid materials and performing materials balance calculations for different materials systems. [1](1)	3		3								1
4.Apply physics and chemistry principles to relate materials structure to their properties. [1]	3				2						1
5.Apply thermodynamic principles to study the equilibrium between different solid phases. [1]	3										
6.Teamwork: Work effectively in problem-solving teams both in and out of class. [1,3](1,3,5)				3			1				

CHE 401 Computational Methods **Date**:5-5- 2006

Prepared by: AbdelHamid Ajbar **Total credits**: 2 Lecture Cr: 2 Lab Cr: 0 Recitation Cr: 0

Pre Req(s): CHE 302 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 1 Engineering Cr: 1 General Education Cr: 0

Catalog Data:

Application of computational techniques for solving numerical problems that arise in chemical engineering problems. Using high-level programming languages such as Fortran or MATLAB. Topics include solving systems of linear and nonlinear algebraic equations, ordinary differential equations (initial and boundary value problem) and curve fitting.

Textbook:

J. B. Riggs, *An Introduction to Numerical Methods for Chemical Engineers*, 2nd Edition, Texas Tech University Press, 1994.

Topics covered

1. Classification of process models and the corresponding types of resulting equations. (2 classes)
2. Computational errors, conditioning and stability of algorithms. (2 classes)
3. System of linear algebraic equations (LU; Jacobi and Gauss- Siedel methods) (5 classes)
4. Nonlinear algebraic equations: Bisection; Newton-Raphson; System of nonlinear equations; Roots of polynomials. (5 classes)
5. Ordinary differential equations, Initial value problem: Taylor's series methods; Euler and Runge-Kutta methods; System of ordinary differential equations; Stability; Stiffness (6 classes)
6. Ordinary differential equations, Boundary value problem: Finite-difference method; shooting methods. (4 classes)
7. Curve fitting: Linear regression; Polynomial regression; Linear transformation (4 classes)

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Understand why computational methods are important in modern Chemical Engineering								3	2	3	2
2. Be able to identify the appropriate problem class (nonlinear equations, ordinary differential equations, etc.) of a given a physical problem that is already in a mathematical form.					3			1	1		
3. Be able to identify, within a problem class, the appropriate solution methods.					3						
4. Be able to write algorithms and software and/or use commercial or public-domain packages for solving mathematical problems in Chemical Engineering. [1](1,2)	3										3
5. Be able to check the correctness of an algorithm, a code, and of numerical results of a calculation	3										
6. Be able to solve systems of linear algebraic equations. [1](1,2,4)	3										3

7. Be able to solve single and system of non linear algebraic equations. [1](1,2,4)	3										3
8. Be able solve initial value problem for a single or system of ordinary differential equations. [1](1,2,4)	3										3
9. Be able to solve a boundary value problem for an ordinary differential equation [1](1,2,4)	3										3
10. Be able to perform curve fitting. [1](1,2,4)	3										3
11. Be able to work effectively in problem-solving teams both in and out of class.[1,3](1,2,3,4)				2							

CHE 402 Chemical Engineering Laboratory 1 **Date**:5-5- 2006

Prepared by: Anis H. Fakeeha **Total credits** 2 Lecture Cr: Lab Cr: 4 Recitation Cr:

Pre Req(s): CHE 309,CHE312, CHE313 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: Engineering Cr: 2 General Education Cr: 0

Catalog Data:

The course will focus in developing practical experience by implementing theories taken in Unit operation course (CHE309) , Momentum transfer course (CHE 312) and Heat transfer course (CHE 313) experimentally .The student will learn how to write technical report and make an oral presentation and discussion. The importance of safety in performing experiments will be addressed and stressed on the student to implemented during experiments sessions .

Textbook and References:

1- R.H.Perry and C.H.Chilton , " Chemical Engineers Handbook, 6th edition ,McGraw Hill "

2-Christie J. Geankoplis , "Transport Processes and Unit Operation " Prentice Hall , Latest edition

3-Anis Hamza Fakeeha, Malik Alahmed." Laboratory Experiments for Chemical Engineering" King Saud Press (2000).

Topics covered

A) Report Writing , Safety in performing experiments, Presentation of experimental data

B) Six to Seven experiments selected from the following list to cover some topics taken in (CHE 309), (CHE312) and (CHE313) .

Experiment 1: Filtration (plate and frame filtration at constant pressure, cake resistance and filter medium resistance).
Experiment 2: Solid Handling (sieve analysis, characteristic diameters, crushing and grinding, solid flow).
Experiment 3: Centrifugal Pump Performance (pump characteristics and performance).
Experiment 4: Flow Through Pipe and Fittings (study pressure drop and friction factor through different pipes and fittings).
Experiment 5: Permeability and Fluidization (fluidization characteristic curve, minimum fluidization velocity, permeability coefficient).
Experiment 6: Double Pipe Heat Exchanger (temperature profiles for counter and co-current flow, overall heat transfer coefficient, efficiency of heat transfer)
Experiment 7: Thermal Conductivity (thermal conductivity of several samples, overall and individual resistances).

Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Introduction , How to divide students into group and what is expected to done in the course				3		2	2		2		
2. Report writing [3](2,3,5)	3	3		3	3	3	3		2		2
3. Safety in lab.[2](6)						3	3				
4. Performing selected experiments. [2](2,3)	3	3	3	3	3	3	3		3		3
5. Final oral and written exam. [1,3](1,5)	3						3		3		3

CHE 403 Chemical Engineering Laboratory 2 **Date**:5-5- 2006

Prepared by: Anis Fakeeha **Total credits** 2 Lecture Cr: Lab Cr: 4 Recitation Cr:

Pre Req(s): CHE 316,CHE 404, CHE 411 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: Engineering Cr: 2 General Education Cr: 0

Catalog Data:

The course will focus in developing practical experience by implementing theories taken in Separation Processes (1) course (CHE 316), Chemical Reactor Engineering course (CHE 404) and Separation Processes (2) course (CHE 411) experimentally .The student will learn how to write technical report and make an oral presentation and discussion. The importance of safety in performing experiments will be addressed and stressed on the student to implemented during experiments sessions.

Textbook and References:

1- R.H.Perry and C.H.Chilton , " Chemical Engineers Handbook, 6th edition ,McGraw Hill "

2-Christie J. Geankoplis , "Transport Processes and Unit Operation " Prentice Hall , Latest edition

3-Anis Hamza Fakeeha,Dr.Malik Alahmed." Laboratory Experiments for Chemical Engineering" King Saud Press (2000).

Topics covered

A) Report writing , Safety in performing experiments , Presentation of experimental data.

B) Certain experiments from the following list will be selected and cover some topics taken in Separation Processes (1) (CHE 316), Chemical Reactor Engineering (CHE 404) and Separation Processes (2) (CHE 411).

Experiment 1: Cooling Tower (mass and energy balance, driving force, number of transfer units, mass transfer coefficients).
Experiment 2: Drying (drying rate curves and mechanism, study influence of particle size, velocity and air temperature on drying).
Experiment 3: Absorption (rate of absorption of carbon dioxide into water, height of packing, observe hydraulics including loading and flooding points).
Experiment 4: Distillation (column efficiency, batch distillation under total reflux and certain reflux ratio, binary distillation under continuous conditions).
Experiment 5: Reactors (order of reaction and reaction rate constant, continuous stirred tank reactor, and plug flow reactor).
Experiment 6: Liquid-liquid extraction (mass and energy balance, mass transfer coefficient, solvent recovery).
Experiment 7: Diffusion (diffusion coefficient of a solute in water, diffusion coefficient of a gas by evaporation from a liquid).

Objectives	a	b	c	d	e	f	g	h	i	j	k
6. Introduction , How to divide students into group and what is expected to done in the course				3		2	2		2		
7. Report writing [3](2,3,5)	3	3		3	3	3	3		2		2
8. Safety in lab.[2](6)						3	3				
9. Performing selected experiments. [2](2,3)	3	3	3	3	3	3	3		3		3
10. Final oral and written exam. [1,3](1,5)	3						3		3		3

CHE 404 Chemical Reactor Engineering **Date**: 3 December 2005

Prepared by: Waheed A. Al-Masry **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Tutorial Cr: 1

Pre Req(s): CHE 302 **Co Req(s):** CHE 308 **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 0 Engineering Cr: 3 General Education Cr: 0

Catalog Data:

Application of the chemical kinetics of homogenous reactions to the design of chemical reactors

Textbook:

H Scott Fogler, Elements of Chemical Reaction Engineering, 4th ed

Topics covered

1. Mole Balances, conversion and reactor sizing (9 classes)
3. Rate laws and stoichiometry (6 classes)
4. Isothermal reactor design (9 classes)
5. Collection and analysis of rate data (6 classes)
6. Multiple reactions (6 classes)
7. Steady-state nonisothermal reactor design (9 classes)

Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Ability to design isothermal reactors for homogenous systems. [1](1,2)	3	1	2		3						1
2. Ability to determine a rate law and reaction mechanism from laboratory data. [1](1)	3		2								1
3. Ability to analyze multiple and nonisothermal homogenous reaction systems. [1](1)	3		3		2						1
4. Ability to work as a team to achieve laboratory and research project goals. [3](3,5)				2			2				
5. A basis for incorporating safety into any reactor design. [2](6)						2		1	1		

CHE 405 Chemical Engineering Laboratory 3 **Date**: 3 December 2005

Prepared by: Emadadeen M. Ali **Total credits**: 2 Lecture Cr: 0 Lab Cr: 4 Tutorial Cr: 0

Pre Req(s): **Co Req(s):** CHE 323 **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 1 Engineering Cr: 2 General Education Cr: 0

Catalog Data:

Conducting 6-8 lab experiments focusing on the fundamental concepts taught in the process control course that emphasize the concept of steady and dynamic operations, investigating the dynamic characteristics of chemical processes, and designing a PID controller

Textbook: Lab Manual

Topics covered

Exp1A: Open-loop dynamic of two interacting storage tanks
Exp1B: Open-loop dynamics of temperature sensors
Exp2: Open-loop dynamic of three stirred tanks in series
Exp3: Open-loop response of tank pressure to step disturbances
Exp4: Determination of PID Settings for Level Control System
Exp5: Level automatic control with outflow
Exp6: Temperature Control System (Test I)

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Ability to design experiments. [1](1,2)		2	2								
2. Ability to run experiment and collect data. [1,3](1,3)		2	2								1
3. Ability to analyze and discuss the resulted data. [1](1,4)	2				2						2
4. Ability to write a technical report [3](3,5)	2				2						
5. Ability to present the experiment objectives, results and conclusions orally. [3](3,5)						1	2				1
6. Ability to characterize the open-loop dynamics of storage tanks, temperature sensors, and three tanks in series. [1](1)	2	2	2		2						1
7.Ability to characterize the open-loop dynamics of gas-pressurized tank. [1](1)	2	2	2		2						1
8.Ability to utilize lab data to determine the best PID tuning parameters. [1](1)	2	2	2		2						1
9.Ability to design the temperature control system of a heat exchanger. [1](1)	2	2	2		2						1
10. To understand and analyze the feedback control of a tank level[1](1)	2	2	2		2						1

CHE 411 Separation Processes 2 **Date**: 3 December 2005

Prepared by: Hamid M. Mustafa **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Tutorial Cr: 1

Pre Req(s): CHE 314 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 0 Engineering Cr: 3 General Education Cr: 0

Catalog Data:

Application of chemical engineering principles to multistage and differential processes involving separation of chemical components . Equilibrium stage concept. Design applications in distillation, gas absorption, liquid-liquid and solid-liquid extraction.

Textbook(s):

1. Geankoplis, C.J., "Transport Processes and Unit operations" 3rd ed., Prentice-Hall, Inc, Edgewood Cliffs, N.J.,1993.
2- Coulson, J.M. , Richardson, J.F., Backhurst, J.R and Harker, J.H. "Chemical Engineering vol.2" , 4th Edition, Pergamon Press, Oxford, U.K, 1991.

Topics covered

1. Phase Equilibrium relations and phase diagrams (**3 classes**).
2. Fundamentals of stage operations. The equilibrium stage. Graphical and analytical stage determination. Differential versus staged contactors (**6 classes**).
3. Application of equilibrium stage analysis to Distillation: Types of distillation: Differential, Equilibrium Flash Vaporization, azeotropic and steam distillation. Analysis of binary distillation processes, McCabe-Thiele, Ponchon-Savarit graphical methods and stage-to-stage calculations. Introduction to multicomponent distillation. plate-to-plate calculations and short-cut methods of stage determination. Efficiency of vapor-liquid contactors. Design and operating characteristics of plate columns. Determination of column height and diameter. Distillation tray design and dynamics (**15 classes)**.
4. Application of equilibrium stage analysis to solvent extraction and leaching:- Liquid-liquid Extraction: Fields of application, choice of solvent, modeling and analysis of single, multiple cross-current and multistage countercurrent extraction cascades. Equipment in common use. Leaching: Solid liquid equilibrium, design of countercurrent leaching equipment. (**9 classes)**
5. Absorption as an example of a differential contact process. Gas absorption relationships. Basic design equation of packed columns. Pickings, characteristics of tower packing, flow of fluid through tower packing and phenomena associated with it such as flooding and loading etc.... Introduction to absorption when accompanied by chemical reactions, and multicomponent absorption (**12 classes)**.

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1.Ability to perform vapor-liquid equilibrium calculations and to solve phase equilibrium problems. [1]	3		2		1						
2.Understanding the stage-wise approach and its use in multistage calculations. Awareness of the difference between differential and stage-wise approach. [1](1)	3		2		2						
3.Ability to formulate and solve problems involving, differential distillation, flash vaporization. [1]	3		3		2						
4.Ability to formulate and solve design problems involving binary and multi-component distillation with emphasis on plate columns. [1](1,2)	3		3		2						1
5.Application of equilibrium stage analysis to solvent extraction and leaching.[1,2](1,6)	3		3		2						1
6.Understanding the principles of plate column design, efficiency determination, plate dynamics and stability.[1](1,2)	3		3		2						1
7.Formulation and solution of design problems of differential contactors- packed columns- as applied to gas absorption and stripping.[1](1,2)	3		3		2						1
8.Ability to work effectively in problem solving teams in and out of the class room.[3](3)											2

CHE 413: Desalination and Water Treatment Date:5-5- 2006

Prepared by: Ibrahim almutaz **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Recitation Cr: 1

Pre Req(s): CHE313 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 0 Engineering Cr: 3 General Education Cr: 0

Catalog Data:

Study of the scientific, technical as well as economical aspects of desalination of seawater and brackish water with special reference to local conditions. Recovery of minerals as by-products. Solar energy utilization.

Textbook:

E.D.Howe, *Fundamentals of Water Desalination*, Marcel Dekker Inc., New York, 1974.

Topics covered

1. Introduction (water problem in Saudi Arabia, water characteristics, seawater chemistry: (composition, salinity, alkalinity, gases dissolved), brackish water, desalination terminology). [5 classes]
2. General Description of Water Treatment Processes. [2 classes]
3. Scale Formation and Prevention. [9 classes]
4. Water Hardness and Chemical Processes for Hardness Removal. [6 classes]
5. Desalination Processes and Methods of Classifications. [2 classes]
6. Thermal Desalination Processes. [12 classes]
7. Membrane Processes. [6 classes]
8. General Engineering Considerations. [3 classes]

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Ability to identify drinking water problems. [1,2,4](1,6)					3	1				2	
2. Understand available methods for salt & hardness removal and scale prevention. [1](1,6)					3					1	
3. Ability to design and operate thermal desalination processes. [1](1,2)	2	1	3		2			1		1	3
4. Ability to design and operate membrane desalination processes. [1](1,2)	2		3		2			1		1	3
5.Ability to distinguish the feasibility, advantage, and drawback of different water desalination methods. [1](6)				1				1		2	
6.Ability to evaluate and analyze the economics of water desalination plants.[1,2](1,2,6)	1									1	

CHE 421 Chemical Processes Economics **Date**: 28/2/2006

Prepared by: K.M.Wagialla **Total credits: 3** **Lecture Cr: 3** **Lab Cr: 0** **Recitation Cr: 0**

Pre Req(s): CHE 321 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 1 Engineering Cr: 2 General Education Cr:1

Catalog Data:

The use of chemical engineering and economic principles in the design of a complete chemical plant. General design considerations regarding environmental, health, safety and selection of plant location. Process design development. Sizing, selection and costing of equipment. Capital and operating cost estimation. Profitability indicators: ROI, PBP, NPV, and discounted cash flow return (IRR). Alternative investments and replacements. Introduction to computer-aided design. Optimization solution methodology. Linear programming (Graphical and computer application).

Textbook:

M.S. Peters, K.D. Timmerhaus and R.E. West, "Plant Design and Economics for Chemical Engineers", 5th Edition, McGraw – Hill, 2003.

Topics covered

1 .Introduction (2 classes).

2. General design considerations (2 classes).

3. Process design development. (3 classes).

4. Software use in process design. (2 classes).

5. Capital cost and operating cost estimation. (6 classes).

6. Profitability analysis. (4 classes).

7. Alternative investments and replacements. (3 classes).

8. Optimum design and design strategy. (6 classes).

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Understand basic economic principles regarding plant economics.[1,2](1,6)			1	1		2					
2. Steps in process design development.[1,3](1,2,6)			3		3			2			2
3. Methodologies in cost estimation of capital and operating costs.[1](1)			2		2						
4. Evaluation of chemical project profitability. [1,4](1,6)			3	1				1	1		2
5. Construction and solution of optimization problems with special emphasis on linear programming.[1](1,4)	1		3		3					2	

CHE 422: Selected Topics in Chemical Engineering- 1 **Date**:5-5- 2006

Prepared by: Ahmed E. Abasaeed **Total credits**: 3 Lecture Cr: 3 Lab Cr: Recitation Cr: 0

Pre Req(s): **Co Req(s):** **Course designation:** Required

Contribution to professional component: Math and Basic science Cr: Engineering Cr: 3 General Education Cr:

Catalog Data:

This course involves a variety of selected topics in Chemical Engineering. The contents of course depends on the Prepared by specialization and/or students' needs and/or contemporary issues

Textbook:

Depends on the topics offered.

Topics covered

To acquaint the students with various Chemical Engineering topics which affect the profession or society.

Objectives	a	b	c	d	e	f	g	h	i	j	k
The objectives vary according to topics offered, however, most of a-k outcomes are expected to be met with various degrees of depth (for the purposes of evaluation an average of 2 is used for all).	2	2	2	2	2	2	2	2	2	2	2

CHE 423: Selected Topics in Chemical Engineering- 2 **Date**:5-5- 2006

Prepared by: Ahmed E. Abasaeed **Total credits**: 2 Lecture Cr: Lab Cr: Recitation Cr: 0

Pre Req(s): **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: Engineering Cr: 2 General Education Cr:

Catalog Data:

Similar to CHE 422, this course involves a variety of selected topics in Chemical Engineering. The contents of course depends on the Prepared by specialization and/or students‘ needs and/or contemporary issues. Topics covered in this course are different than those covered in ChE 422.

Textbook:

Depends on the topics offered.

Topics covered

To acquaint the students with various Chemical Engineering topics which affect the profession or society.

Objectives	a	b	c	d	e	f	g	h	i	j	k
The objectives vary according to topics offered, however, most of a-k outcomes are expected to be met with various degrees of depth (for the purposes of evaluation an average of 2 is used for all).	2	2	2	2	2	2	2	2	2	2	2

CHE 426 Heterogeneous Reactor Engineering **Date**: 3 December 2005

Prepared by: Yousef S. Al-Zeghayer **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Tutorial Cr: 1

Pre Req(s): CHE 404 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 0 Engineering Cr: 3 General Education Cr: 0

Catalog Data:

Application of the chemical kinetics of heterogeneous reactions to the design of chemical reactors

Textbook:

H Scott Fogler, Elements of Chemical Reaction Engineering, 4th ed

Topics covered

1. Catalysis and catalytic reactors (5 classes)
3. Heterogeneous data analysis for reactor design (6 classes)
4. Catalyst deactivation (11 classes)
5. External diffusion effects on heterogeneous reactions (8 classes)
6. Diffusion and reaction in porous catalyst (6 classes)
7. Estimation of diffusion and reaction limited regimes (9 classes)

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Ability to design isothermal reactors for heterogeneous systems. [1](1,2)	3	1	2		3						1
2. Ability to determine a rate law and reaction mechanism from laboratory data. [1]	3		2								1
3. Ability to analyze a catalytic mechanism and establish rate limiting step(s) [1](1)	3		3		2						1
4. Ability to work as a team to achieve laboratory and research project goals. [1,3](1,2,3)				2			2				
5. A basis for incorporating safety into any reactor design. [1,2](1,2,6)						2		1	1		

CHE 432 Materials Engineering and Corrosion **Date**: 20-2-2006

Prepared by: Farag A. AbdelAleem **Total credits**: 4 Lecture Cr: 3 Lab Cr: 0 Recitation Cr: 1

Pre Req(s): CHE 331 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 1 Engineering Cr: 2 General Education Cr: 0

Catalog Data:

This course combines the principles of Extractive Metallurgy, electrochemical engineering and corrosion as described by the covered topics.

Textbook:

M.E. El-Dahshan, "Fundamentals of Extractive Metallurgy" king Saud university Press, 1993

Brett, M.A. and Brett A.O., "Electrochemistry, Principles, Methods and Applications", Oxford Press, 1993

Denny A. Jones, "Principles and Prevention of Corrosion", Prentice Hall, 1996.

Topics covered

1. Extractive Metallurgy (5 weeks): Basic concepts with emphasis on thermodynamics, extractive processes such as Pyrometallurgy, Hydrometallurgy and Electrometallurgy. Extraction of Iron, Aluminum and Copper.
2. Electrochemical engineering (4 weeks): electrochemical cells and its reaction. Thermodynamics of electrochemical systems. Kinetics of electrochemical reactions. Electrolytic hydrogen production, Fuel cells and Aluminum production.
3. Corrosion and its control (5 weeks): Basic concepts and principles. Thermodynamic of corrosion. Kinetics of Corrosion. Corrosion measurements. Corrosion protection and control.

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1.Able to apply chemical engineering principles; material & energy balances in extractive metallurgy. [1]	3		2								1
2.Understanding how to apply thermodynamics in material engineering. [1](1)	3				2						2
3.Able to select the suitable process flow sheet for metal extraction.[1](1,2)	3				3						1
4.Understanding the environmental aspects of extraction processes and how to control it.[2](6)					1	2		3			2
5.Ability to understand and analyze electrochemical reactions of the cells.[1](1)	3				1						1
6.Understanding the electrochemical kinetics and its application in corrosion.[1](1)	3	2			1						1
7.Recognition of the potential practical importance of corrosion and how to tackle it.[1,4](1,6)	1			1							2
8.Understanding the electrochemical nature of corrosion and how to utilize it. [1](1)	3			1	1						2
9.Ability to monitor and to measure the rates of corrosion and its utilization in the equipment design.[1,4](1,2)	3	2	3								2
10. Ability to identify the corrosive environments of chemical processes and how to deal with it.[1,2](1,6)			3		3	1					2

CHE 441 Petroleum Refining Engineering **Date**: 15 February 2006

Instructor: Hamid M. Mustafa **Total credits**: 3 Lecture Cr: 3 Lab Cr: 0 Tutorial Cr: 1

Pre Req(s): CHE 411 **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 2 Engineering Cr: 3 General Education Cr: 1

Catalog Data: Characterization and evaluation of crude petroleum. Application of chemical engineering to the oil industry. Refining techniques, physical separation, chemical conversion and treating processes. Design and costing of refinery equipment. Product testing and specifications. Environmental issues

Textbook(s):

1. Gary, J.H. and Handwerk, G.E., "Petroleum Refining Technology and Economics" , 4th edition, Marcel Dekker Inc, New York, 2001.
2. Nelson, W.L."Petroleum Refining Engineering", 4th Edition, McGraw Hill , New York, 1980

Topics covered

1. Introduction to history and development of refining. The operations and size of the petroleum and petroleum refining industry and its economic importance.**(6 classes)**
2. Refinery feed stocks, crude oil evaluation, and characterization , chemical composition of petroleum.**(9 classes)**
3. Types of refineries and basic refinery modules. Overall refinery flow. Factors affecting choice of a refinery type. **(6 classes)**
4. Principle operations in the refinery. Physical separation processes. Conversion processes. Treating and finishing processes**.(15 class)**
5. Products: Types and specifications. Product blending. **(6 classes)**
6. Introduction to environmental regulations and legislations and their effects on refining operations.(**3 classes)**

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Understanding the importance of crude oil as a source fuel and petrochemicals and the size of the refining industry. [1,2,4](1,6)	2	0	0	0	0		0	3	0		0
2. Knowledge of the physical and chemical nature of crude oil and crude oil characterization techniques.[1]	2	3	0	0	0		0	0	0		2
3. Understanding operations in modern fully integrated refineries and ability to choose a refining route for a crude type and product demand. [1]	3	0	2	0	2		0	0	0		1
4. Application of chemical engineering principles (heat, mass, fluid, reactor design…etc) to analysis of major refinery units, columns (furnaces, reformers, crackers. .etc)[1](1,2)	3	0	3	0	2		0	0	0		1
5.Awareness of the environmental regulations and product specifications and their effects on the refining industry as a whole and on individual refinery configuration. [1,2,4](1,6)	3	0	1	2	2		1	3	1		1
6. Ability to work effectively in problem solving teams in and out of the class room. [3](5,6)	3	0	3	0	2		0	0	0		2

CHE 498: Project - 1 **Date**: 5-5-2006

Prepared by: Ahmed E. Abasaeed **Total credits**: 2 Lecture Cr: 0 Lab Cr: Recitation Cr: 0

Pre Req(s): **Co Req(s):** **Course Designation:** Required

Contribution to professional component: Math and Basic science Cr: 2 Engineering Cr: 2 General Education Cr: 2

Catalog Data:

A two part project (CHE 498 and CHE 499). The student uses the previous knowledge gained through out of his course study of the various chemical engineering courses to design or model or perform experiments to meet graduation requirement.

Textbook:

Any books, journal's articles, software packages and/or laboratory equipment needed to accomplish the mission.

Topic covered

Problems of various natures (design, modeling, experimental) are posed by the faculty. Based on their interests, the students choose a problem and work on under the guidance of a faculty member for two semesters (CHE 498 and CHE 499). Independent grades are awarded each semester. Depending on the nature of problem, the objectives may vary.

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Design Projects [1-4](1-6) The student will be handed a problem statement, typically production of a particular material. It is the responsibility of the student to devise a proper flow sheet for the plant, collect needed data, perform material and energy balances, detailed design of some units, perform economic evaluation for the plant, write report at the end of each semester and present his findings. More than student may share the first part of the project, however, the design and economic parts are done independently.	3		3	1	3	1	3	2	2	2	3
2. Modeling Projects [1-4](1-6) This type is somewhat similar to the design type, however, the main focus will be on a particular unit. After defining the problem, the student required to collect data, develop material and energy balance equations, solve the equations, perform simulation studies, prepare his report and present his findings.	3		3	1	3		3	2	2	2	3
3. Experimental Projects [1-4](1-6) The main focus here will be in performing experiments. The student is required to design his experiments, perform them, use various analytical instruments pertaining to his experiments, present and discuss his results, prepare progress and final reports and present his findings. More than one student may share the project.	1	3	1	1	3	2	3	2	2	2	3

CHE 499: Project - 2 **Date**: 5-5-2006

Prepared by: Ahmed E. Abasaeed **Total credits**: 3 Lecture Cr: 0 Lab Cr: Recitation Cr: 0

Pre Req(s): **Co Req(s):** **Course designation:** Required

Contribution to professional component: Math and Basic science Cr: 3 Engineering Cr: 3 General Education Cr: 3

Catalog Data:

Continuation of CHE 498.

Textbook:

Any books, journal's articles, software packages and/or laboratory equipment needed to accomplish the mission.

Topics covered

Problems of various natures (design, modeling, experimental) are posed by the faculty. Based on their interests, the students choose a problem and work on under the guidance of a faculty member for two semesters (CHE 498 and CHE 499). Independent grades are awarded each semester. Depending on the nature of problem, the objectives may vary.

Course Objectives	a	b	c	d	e	f	g	h	i	j	k
1. Design Projects [1-4](1-6) The student will be handed a problem statement, typically production of a particular material. It is the responsibility of the student to devise a proper flow sheet for the plant, collect needed data, perform material and energy balances, detailed design of some units, perform economic evaluation for the plant, write report at the end of each semester and present his findings. More than student may share the first part of the project, however, the design and economic parts are done independently.	3		3	1	3	1	3	2	2	2	3
2. Modeling Projects [1-4](1-6) This type is somewhat similar to the design type, however, the main focus will be on a particular unit. After defining the problem, the student required to collect data, develop material and energy balance equations, solve the equations, perform simulation studies, prepare his report and present his findings.	3		3	1	3		3	2	2	2	3
3. Experimental Projects [1-4](1-6) The main focus here will be in performing experiments. The student is required to design his experiments, perform them, use various analytical instruments pertaining to his experiments, present and discuss his results, prepare progress and final reports and present his findings. More than one student may share the project.	1	3	1	1	3	2	3	2	2	2	3