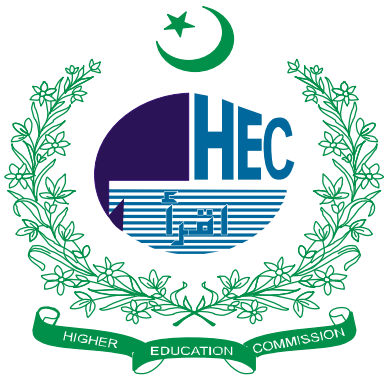
CURRICULUM

OF

CHEMICAL ENGINEERING

B.E/B.S

2008



HIGHER EDUCATION COMMISSION
ISLAMABAD.

CURRICULUM DIVISION, HEC

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PREFACE

Curriculum development is a highly organized and systematic process and involves a number of procedures. Many of these procedures include incorporating the results from international research studies and reforms made in other countries. These studies and reforms are then related to the particular subject and the position in Pakistan so that the proposed curriculum may have its roots in the socio-economics setup in which it is to be introduced. Hence, unlike a machine, it is not possible to accept any curriculum in its entirety. It has to be studied thoroughly and all aspects are to be critically examined before any component is recommended for adoption.

In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification No. D773/76-JEA (cur.), dated December 4th 1976, appointed the University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at the bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the Higher Education Commission (HEC) is continually performing curriculum revision in collaboration with universities. According to the decision of the special meeting of Vice-Chancellor's Committee, the curriculum of a subject must be reviewed after every 3 years.

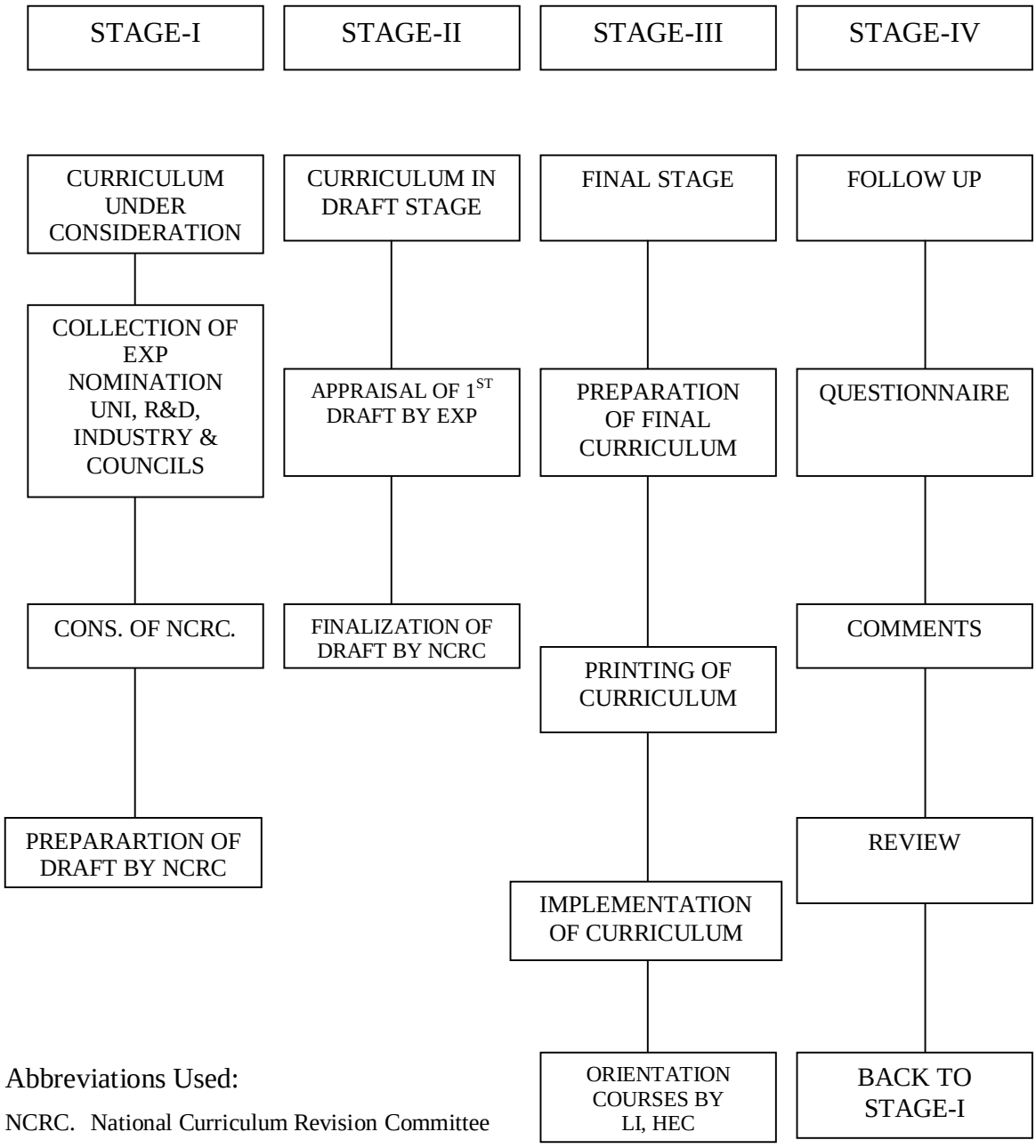
A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Basic, Applied Social Sciences and Engineering disciplines met in April 2007 and developed a unified template to standardize degree programs in the country to bring the national curriculum at par with international standards, and to fulfill the needs of the local industries. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education. The new BS degree shall be of 4 years duration, and will require the completion of 130-136 credit hours. The engineering degree will devote 65-70% of the curriculum towards engineering courses, and 35--30% to non Engineering courses.

For the purpose of curriculum revision various committees are constituted at the national level, comprising of senior teachers nominated by universities, degree awarding institutions, R&D organizations and respective accreditation councils. The National Curriculum Revision Committee for Chemical Engineering in a meeting held on March 17-19, 2008 at HEC Regional Centre, Lahore in continuation of its earlier meetings held on July 31 – August 2, 2007 revised the curriculum in light of the unified template. The final draft prepared by the National Curriculum Revision Special Committee, duly approved by the competent authority, is being circulated for implementation in the concerned institutions.

DR.RIAZ-UL-HAQ TARIQ
Member Academics

April 2008

CURRICULUM DEVELOPMENT



Abbreviations Used:

NCRC. National Curriculum Revision Committee

VCC. Vice-Chancellor's Committee

EXP. Experts

COL. Colleges

UNI. Universities

PREP. Preparation

REC. Recommendations

LI Learning Innovation

R&D Research & Development Organization

HEC Higher Education Commission

Introduction

The National Curriculum Revision Committee final meeting in Chemical Engineering was Held at HEC, Regional Centre, Lahore on March 17-19, 2008, to finalize draft curriculum for Chemical Engineering. The following participants attended the meeting:

1.	Prof. Dr. Moinuddin Ghauri, Chairman, Department of Chemical Engineering, COMSAT Institute of Information Technology M.A Jinnah Building, Defense Road, Off Riwind Road, Lahore.	Convener
2.	Prof. Dr. Suhail A. Soomro Department of Chemical Engineering, Mehran University, Jamshoro	Member
3.	Prof. Dr. Arshad Chughtai, Institute of Chemical Engineering & Technology, University of the Punjab, Lahore.	Member
4.	Prof. Dr. Nadeem Feroze, Department of Chemical Engineering, University of Engineering & Technology, Lahore	Member
5.	Prof. Dr. Syed Abid Hussain, Dean, Faculty of Engineering, Balochistan University of Information Technology Engineering & Management Science (BUITEMS), Jinnah Town Quetta.	Member
6.	Dr. Wasi-uz-Zaman Khan, Foreign Professor Department of Chemical Engineering and Technology, University of Karachi, Karachi.	Member
7.	Prof. Dr. Javaid Rabbani Khan Director NFC Institute of Engineering & Fertilizer Research, Faisalabad	Member
8.	Engr. Abdul Waheed Bhatto, Assistant Professor, Department of Chemical Engineering, Dawood. College of Engg. & Tech., Karachi.	Member
9.	Prof. Dr. Fasihullah Khan, Department of Chemical Engineering & Technology University of Karachi, Karachi.	Member

10.	Dr. Khair-uddin Sanaullah, Associate Professor, Department of Chemical Engineering, National University of Science & Tech. H. # 26, St. # 60, Sector F – 11/4, Islamabad.	Member
11.	Dr. M. Tayyeb Javed, Associate Professor, Department of Chemical Engineering, Pakistan Institute of Engineering & Applied Sciences (PIEAS), P.O. Nilore, Islamabad.	Member
12.	Prof. Dr. Inayatullah Memon, Co-Chairman Department of Chemical Engineering, NED University of Engineering & Technology, University Road, Karachi.	Member
13.	Prof. Dr. Nazimuddin Qureshi, Dean (MME) NED University of Engineering & Technology, University Road, Karachi.	Member
14.	Mr. Atir Rashid, JGC-Descon Engineering Pvt. Ltd. 18-KN Ferooz Pur Road, Lahore	Member
15.	Dr. Murid Hussain, Associate Professor, Department of Chemical Engineering, COMSAT Institute of Information Technology, Lahore	Member
16.	Mr. Ghulam Murshid, Lecturer Department of Chemical Engineering COMSAT Institute of Information Technology, Lahore	Member
17.	Engr. Khuram Maqsood, Lecturer, Department of Chemical Engineering NFC, Institute of Engineering & Fertilizer Research, Faisalabad.	Member

Meeting started with recitation from the Holy Quran by Mr. Ghulam Murshad. Chaudhary Bashir Director Incharge HEC, Regional Centre, Lahore welcomed the members of NCRC on behalf of the Chairman, HEC. Mr. Muhammad Tahir Ali Shah, Assistant Director (Curriculum), HEC, Islamabad was also present in the meeting all the three days. He explained objective to revise and update the existing curriculum is to bring it in the line with national requirements, introduce innovations to ensure quality of education, uniformity of curricula in the universities and affiliated colleges of Pakistan, adjusts to the requirements of industry and bring to international standards. He also explained in detail all the related and mandatory requisites for designing curricula according to generic framework/template designed by Conveners of NCRC in Engineering discipline in April 2007.

Professor Dr. Amjad Hussain Dilawar, UET Lahore, Dr. Tayab Javed PIEAS, Associate Professor, Islamabad could not attend the meeting due to their pre-engagements.

The members unanimously agreed to recommend the following objectives, scheme of studies and the course outline for Chemical Engineering: Dr. Moinuddin Ghauri, Convener of Committee thanks the participants of the meeting for their valuable contributions and support in finalizing the curriculum.

RATIONAL

The chemical engineering curriculum is designed so that its graduates are familiar with the techniques used in analyzing and solving engineering problems associated with the chemical and related industries (petroleum, pharmaceutical, metallurgical, plastics, pollution control, etc.).

The chemical engineering is the application of mathematical & Natural Sciences by processing the raw material to finished product, economically with out polluting environment for the benefit of man kind. The chemical engineering also applies the principles & application of other field to improve & solve the problems of chemical engineering processes encountered in industries

The chemical engineering curricula is so designed that it not only courses the core chemical engineering courses but also basic sciences (mathematics, chemistry, physics and communication skills & Islamiat & Pakistan studies, so that the graduate will not have professional skills but have a knowledge & understanding of basic principles, & ethical consideration & leadership qualities.

Courses in chemical engineering fundamentals (material and energy balances) are introduced, followed by intensive work in engineering science and analysis (heat, mass, and momentum transfer; chemical thermodynamics; chemical reaction engineering; continuous and stage-wise separation processes; process dynamic and control). Computer solutions and simulation topics are stressed. An understanding of the ethical, social, economic, and safety considerations in engineering practice is stressed throughout the curriculum. The appreciation of these professional concepts is incorporated as a part of all engineering course work.

GOAL & OBJECTIVES

The goal of this curriculum is to educate boys and girls who, as graduates of the program, are able to analyze industrial chemical engineering problems and synthesize solutions to those problems, compare favorably in their knowledge of chemical engineering with students completing similar program nationally, and use their training as a springboard to further professional and career development. In addition to preparing students for rewarding jobs in the chemical process industries, the program provides an excellent background for graduate study in engineering, science, business administration.

ELIGIBILITY CRITERIA

1. The committee determined the eligibility of the candidates seeking admission to degree of Chemical Engineering and recommended that F.Sc. (Pre Engineering) with chemistry, physics and mathematics as main subjects (12 years of education) or its equivalent should be the minimum requirement.

Frame Work/Template
for BE/BS/B.Sc in Chemical Engineering

Non-Engineering Domain									
Knowledge Area	**Subject Area**	**Name of Course**	**Lec CH**	**Lab CH**	**CR**	**Total Courses**	**Total Credits**	**% Area**	**% overall**
Humanities	English	English-I (Functional English)	3	0	3	3	9	22.0	6.7
		English-II (communication Skills)	3	0	3				
		English-III (Technical Report writing & Presentation skills)	3	0	3				
	Culture	Pakistan Studies	1	0	1	2	2	4.9	1.5
		Islamic Studies/Ethics	1	0	1				
	Social Sciences	Social Sciences-I (Logic and critical thinking)	3	0	3	2	6	14.6	4.5
		Social Sciences-II (Engineering Economics)	3	0	3				
Management sciences		Management Sciences-I (Production & Operations Management)	3	0	3	2	5	12.2	3.7
		Management Sciences-II (Project Management)	2	0	2				
Natural Sciences	Physics	Physics	3	0	3	1	3	7.3	2.2
	Mathematics	Maths-I	3	0	3	3	9	22.9	6.7
		Maths-II	3	0	3				
		Maths-III	3	0	3				
		Applied Chemistry-I (Inorganic & Analytical Chemistry)	3	1	4	2	7	17.1	5.2
	Chemistry	Applied Chemistry-II (Organic & Biochemistry)	3	0	3				
TOTAL						**15**	**41**	**100**	**30.6**

Engineering Domain									
Knowledge Area	**Subject Area**	**Name of Course**	**Lec CH**	**Lab CH**	**CR**	**Total Courses**	**Total Credits**	**% Area**	**% overall**
Computing	Fundamentals	Computer and Computation	1	1	2	4	11	11.8	8.2
	Programming	Computer programming and Software Applications	2	1	3				
		Numerical Analysis & Computer Application	2	1	3				
	Computer application in Chemical Engineering design	Chemical Process Design and Simulation	2	1	3				
Engineering Foundation	Engineering Foundation	Chemical Engineering Thermodynamics-I (includes Ph-Chem-I)	3	1	4	8	29	31.2	21.6
		Particulate technology	3	1	4				
		Mass Transfer	3	1	4				
		Chemical Process Technology-I	3	0	3				
		Fluid mechanics	3	1	4				
		Heat Transfer	3	1	4				
		Chemical Process Principles-I	3	0	3				
		Chemical Process Principles-II	3	0	3				
	Major Based Core (Breadth)	Instrumentation and process control	3	1	4	8	29	31.2	21.6
		Simultaneous heat and mass transfer	3	1	4				
		Chemical Reaction Engineering	3	1	4				
		Chemical Process technology-II	3	1	4				
		Transport Phenomena	3	0	3				
		Chemical Engineering Plant Design	3	0	3				
		Fuels & Combustion	3	1	4				
		Thermodynamics-II	3	0	3				

Major Based Core (Breadth)	Major Based Core (Depth)	Elective-I	3	0	3	3	10	10.8	7.5
		Elective-II	3	1	4				
		Elective-III	3	0	3				
Inter-disciplinary Engineering Breadth (Electives)	Inter Disciplinary Engg.Breadth	Workshop practices	0	1	1	6	10	10.8	7.5
		Electrical Technology & Electronics	2	0	2				
		Engineering Materials	3	0	3				
		Engineering Drawing	0	1	1				
		Computer Aided Engineering Drawing	0	1	1				
		Maintenance Engineering & Safety	2	0	2				
Senior Design Project		Chemical engineering Plant Design project I	0	1	1	2	4	4.3	3.0
		Chemical engineering Plant Design project II	0	3	3				
TOTAL						**31**	**93**	**100**	**69.4**
Industrial Training									
Grand Total						**46**	**134**		

Electives *		
Chemical Engineering	**Design Engineering**	**Oil & Gas Engineering**
Computational Fluid Dynamics (CFD)	Computational Fluid Dynamics (CFD)	Petroleum refining engineering
Novel Separation Processes	Process Design	Gas Processing
Process Analysis & Optimization	Piping Design	Petrochemical Engineering
Biochemical Engineering	**Environmental Engineering**	**Nuclear Engineering**
Food Technology	Safety, Health & Environmental Engineering	Nuclear Engineering
Biochemical Engineering	Environmental Engineering	Novel Separation Processes
Bio-reaction Engineering	Waste Management	Mineral Processing Technology
Process Engineering	**Energetic Materials**	**Energy & Power**
Polymer Engineering	Science of Energetic Materials	Energy Management
Wet Processing of Textile	Combustion & Propulsion	Renewable Energy Resources
Process Analysis & Optimization	Manufacturing, Formulation and Filling	Coal Technology

* Other subjects can also be included according to the specialization/availability of the faculty and facilities

Scheme of Studies
BE/BS/B.Sc Chemical Engineering

Chemical Engineering Curricula Under Uniform Framework (BE)

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
First Year (Sem 1)				**Sem 2**			
Functional English	3	0	3	Applied Chemistry-I	3	1	4
Islamic Studies/ Ethics	1	0	1	Pakistan Studies	1	0	1
Chemical Process Principles-I	3	0	3	Maths-II	3	0	3
Engineering Drawing	0	1	1	Computer & Computation	1	1	2
Physics	3	1	4	Technical Report Writing & Presentation Skills	3	0	3
Maths-I	3	0	3	Chemical Engineering Thermodynamics-I	3	1	4
Total	**13**	**2**	**15**	**Total**	**14**	**3**	**17**
First Year Credit Hours	**32**						

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Second Year (Sem 3)				**Sem 4**			
Workshop Practices	0	1	1	Computer Aided Engineering Drawing	0	1	1
Electrical Technology & Electronics	2	0	2	Computer Programming & Software Application	2	0	3
Applied Chemistry-II	3	1	4	Heat Transfer	3	1	4
Chemical Process Principles-II	3	0	3	Particulate Technology	3	1	4
Maths-III	3	0	3	Logic & Critical Thinking	2	0	2
Fluid Mechanics	3	1	4	Chemical Process Technology-I	3	0	3
Total	**14**	**3**	**17**	**Total**	**13**	**3**	**17**
Second Year Credit Hours	**34**						

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Third Year (Sem 5)				**Sem 6**			
Mass Transfer	3	1	4	Engineering Materials	3	0	3
Fuels & Combustion	3	1	4	Chemical Reaction Engineering	3	1	4
Transport Phenomena	3	0	3	Simultaneous Heat & Mass Transfer Operations	3	1	4
Chemical Engineering Thermodynamics-II	3	0	3	Engineering Economics	2	0	2
Numerical Analysis and Computer Application	2	1	3	Instrumentation & Process Control	3	1	4
				Industrial Training (4-6 Weeks)			
Total	**14**	**3**	**17**	**Total**	**14**	**3**	**17**
Third Year Credit Hours	**34**						

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Final Year (Sem 7)				**Sem 8**			
Chemical Process Technology-II	3	1	4	Project Management	2	0	2
				Elective-II	3	1	4
Chemical Process design & Simulation	2	1	3	Elective-III	3	0	3
Elective-I	3	0	3	Chemical Engineering Plant Design Project (B)	0	3	3
Chemical Engineering Plant Design Project (A)	0	1	1	Production & Operations Management	3	0	3
Communication Skills	3	0	3	Maintenance Engineering & Safety	2	0	2
Chemical Plant Design	3	0	3				
Total	**14**	**3**	**17**	**Total**	**13**	**4**	**17**
Final Year Credit Hours	**34**						
Total Credit Hours	**134**						

DETAILS OF COURSES FOR BE/BS IN CHEMICAL ENGINEERING

1	**English- I (Functional English)**	**Annexure – "A"**
2	**English-II (Communication Skills)**	**"**
3	**English-III (Technical Report Writing & Presentation Skills)**	**"**
4	**Pakistan Studies**	**Annexure – "B"**
5	**Islamic Studies (To be included)**	**Annexure – "C"**
6.	**Course for Social Science**	**Annexure – "D"**

CHEMICAL ENGINEERING THERMODYNAMICS-I

Credit hours 4(3, 3, 0)
Prerequisites:

Specific objectives of the course:

To familiarize students with the concept of thermodynamic, heat and its application in chemical engineering

Course Outline:

Kinetic Theory of Gases, electrochemistry
Chemical thermodynamics: Scope and definitions; Isolated, closed and open systems; Intensive and extensive properties; State and functions of state; First law; Internal energy U; Enthalpy H; Reversibility; Calorimetry; Enthalpies of formation and reaction; Bond dissociation energy and mean bond energy; Dependence of U and H on temperature; Kirchhoff's equation; First law as applied to ideal gases; Isothermal; Isometric; isobaric; polytropic and adiabatic processes involving an ideal gas; P-V-T relationships for non ideal gases.
Phase equilibria: Phase rule; One component systems; Clapeyron and Clausius-Clapeyron equations. Two component systems. Liquid-vapor equilibria. Ideal and Non-ideal solutions; Composition of vapor in equilibrium with liquid; Fractional distillation. Azeotropes. Mixing. Liquid-solid equilibria. Eutectic. Compound formation. Solid solutions.

Lab Outline:

To study the miniature steam power plant, Refrigeration unit, Mechanical equivalent of heat, Thermal conductivity of different material and Coefficient of linear expansion.

Recommended Books:

1. Smith J.M., Van Ness H.C., Abbott M.M. "Chemical Engineering Thermodynamics" 6th Ed. 2001. McGraw Hill International Edition.
2. Daubert Thomas E. "Chemical Engineering Thermodynamics", 1st Ed. 1985, McGraw Hill Book Company.
3. Sandler Stanley I. "Chemical and Engineering Thermodynamics" 3rd Ed. John Wiley and sons, Inc.
4. Eastop, Mc Conkey "Applied Thermodynamics" National Book Foundation

CHEMICAL PROCESS PRINCIPLES – I

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To develop understanding of basic calculations involved in chemical engineering

Course Outline:

Units, dimensions and conversions, Pressure scales, Composition of mixtures, Ideal gas laws, Equation of State and its Deviations; Dalton's law, Henry's Law and Raoult's. Antoine equation. Relative volatility. Heat capacity, latent heat and enthalpy.

Principles of stochiometric combination.

Nature of balances: Concept of a balance. Input-output relationships. Steady state considerations. Block box approach. Sub-systems and interconnections. Familiarization with flow sheets. Mass and energy balance diagrams and tables.

Lab Outline: N/A

Books Recommended:

1. Himmelblau David M. "Basic Principles and Calculations in Chemical Engineering". 7th Ed. 2003. Prentice Hall PTR
2. Felder Richard M., Rousseau Ronald W. "Elementary Principles of Chemical Processes" 3nd Ed. 2001. John Willey & Sons.
3. Reklaitis G.V., Schneider Daniel R. "Introduction to Material and Energy Balances" 1983. John Wiley & Sons.
4. Hougen Olaf A., Watson Kenneth M. "Chemical Processes Principles" . 2004, John Wiley and Sons & CBS Publishers.
5. Chopy & Hicks, "Handbook of Chemical Engineering Calculations" , 2nd Ed. 1994 McGraw-Hill Professional Publishing.
6. B.I. Bhatt, " Stoichiometry" , 2004, McGraw Hill

COMPUTERS AND COMPUTATATION

Credit hours: 2(1,3,0)
Prerequisites:

Specific objectives of the course:

To give working knowledge &skills of coding (C++ syntax.), how to avoid common coding pitfalls, to use and create own functions and classes. The course will enable students recognize the advantages of using pointers and references & to understand the fundamental ideas of object oriented (OO) design.

Course Outline:

Introduction to Computers: CPU, Memory Structures and their addressing, I/O devices and data storage devices. Computer network basics: logging-in, proper usage, access and security. General features of Microsoft Windows operating

systems: use of on-line help and tutorials, files, directories, disk partitions, good practices of file / data handling.
Word Processing: Document creation and editing, document formatting, use of styles and templates, use of various tools like tables, equation editing, spelling & grammar checking, page numbering and auto table-of-contents.
Spreadsheets: Data types, entry and editing. Formatting, inserting, deleting and formatting cells, rows and columns, formula entry and copying, use of relative and absolute addresses, paste and paste-special features. Use of data analyses tools and built-in functions. Use of charting tools.
Presentation Software: Basic presentation guidelines, layout, Using slide templates, editing inserting and moving slides in various views. Editing Master slide. Inserting links to various objects like figures, animations etc.

Lab Outline: N/A

Books Recommended:

1. Habraken, Joseph W., "Microsoft Office 2003 All-in-One", Que Publishing, 2003.
2. User Manuals for respective software. Norton, Peter, "Introduction To Computers, 5th Ed.", Career Publishing, 2002.

ELECTRICAL TECHNOLOGY AND ELECTRONICS

Credit hours: 2(2,0,0)
Prerequisites:

Specific objectives of the course:

The objective of the course is to impart the basic knowledge of electrical and electronics that is generally part of process industry.

Course Outline:

Introduction to electrical technology; A.C/D.C. motors, their types and control; Generators; Transformers; Single and three phase A.C. circuits; Power factor; Introduction to industrial electronics. Introduction to machines and power transmission systems; Prime movers; Pullies; Gears and governors etc.

Lab Outline: N/A

Books Recommended:

1. A. Kelly & M.J. Harris, Management of Industrial Maintenance, Butter Worth, London, Boston.
2. Salih O. Tuffuaa, A. Rauf & John Dixon Compbell "Planning & Control of Maintenance Systems: Modeling & Analysis" John Willey and Sons.
3. Mobley, R. "Maintenance fundamentals", 1999. ISBN.0-7506-7151-3.
4. Chappman "Workshop Technology"
5. R. Keith Mobley "Maintenance Fundamentals" Newnes (Butterworth-Heinmann).

CHEMICAL PROCESS PRINCIPLES – II

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

In depth study of calculation in chemical engineering involving both mass balance and energy balance for design and operation applications

Course Outline:

Mass balances for items of plant, Choice of basis/datum for balances. Overall and component balances, Limiting and excess reactants. Balances for systems with recycle, purge and by-pass streams Mass balances for unit operations Tie components. Balances for batch and continuous plant.
Simultaneous mass and energy balances. Temperature and pressure dependence. Balances for condensing systems. Dynamic balances.

Balances with reaction: Mass and energy balances for reacting systems. Balances for combustion processes. Environmental balances, Sub-systems and interconnections. Concept of integrated pollution control. Case studies on balances for a selection of important industrial processes. Efficiency and conversion.. Standard states. Temperature dependence. Heat Effects. Application of Computers in stoichiometric calculations.

Lab Outline: N/A

Books Recommended

1. Himmelblau David M. “Basic Principles and Calculations in Chemical Engineering”. 7th Ed. 2003. Prentice Hall PTR
2. Felder Richard M., Rousseau Ronald W. “Elementary Principles of Chemical Processes” 3rd Ed. 2001. John Willey & Sons.
3. Reklaitis G.V., Schneider Daniel R. “Introduction to Material and Energy Balances” 1983. John Wiley & Sons.
4. Hougen Olaf A., Watson Kenneth M. “Chemical Processes Principles” . 2004, John Wiley and Sons & CBS Publishers.
5. Chopy & Hicks, “Handbook of Chemical Engineering Calculations” , 2nd Ed. 1994 McGraw-Hill Professional Publishing.
6. B.I. Bhatt, “ Stoichiometry” , 2004, McGraw Hill

FLUID MECHANICS:

Credit hours: 4(3,3,0)
Prerequisites:

Specific objectives of the course:

To familiarize students with the concept of fluid and particle mechanics

Course Outline:

Concept & Use of Units, Dimensional Analysis: Bukingham –Pi Theorem, Reynold’s law of Similarity. (2 Lectures)

Fluid Statics: pressure forces on surfaces, Pressure distribution, Head Calculations, pressure measuring devices, Buoyancy,. Pressure in accelerated rigid body motions.
(3 Lectures)

Nature of Flow: Laminar & Turbulent Flow, Compressible & Non-Compressible.
Bernoulli's equation and its applications; Continuity Equation, Energy Relationships & the Bernoulli equation, pressure terminology, diffusers and sudden expansion.
Momentum of a Flowing Fluid; Newton's 2nd law of motion & Momentum Balance, Calculations for Laminar& Turbulent pipe flow, nozzle flow & other examples.
Stress in Fluids; Viscosity, Newton's Law of Viscosity, Shear Stress Components, Newtonian and non-Newtonian flow. (5 Lectures)

Turbulence & Boundary Layers; Concept of Eddies as a source to sustain Turbulence, Velocity Fluctuations & Reynolds Stresses, Transport Properties and Prantl's Power Law Velocity Profile, Laminar & Turbulent Boundary Layers over a flat plate (4 Lectures)

Flow of Incompressible Newtonian Fluids in Pipes & Channels
Shear stress in a pipe, Friction factor & pressure drop, Losses in fittings and bend pipes, enlargements and contractions, friction in non-circular channels, Velocity distribution for turbulent flow in a pipe. (5 Lectures)

Flow of Compressible Newtonian Fluids
The Mach Number, Equation of State, Adiabatic and Isentropic Steady Flow, Isentropic Flow with Area Changes, One dimensional high velocity gas flows, Choking flow, Shock waves, nozzles and diffusers . (6 Lectures)

Gas-Liquid Two-phase Flow
Flow patterns and flow regime maps, Momentum equation for two-phase flow, two-phase flow parameters, Bubbly flow, Slug flow in vertical tubes, The homogenous model for two-phase flow, Separated flow models, Drift-flux Calculations. (6 Lectures)

Fluid Motion in the Presence of Solid Particles
Relative motion between a fluid and a single particle, Effect of presence of other particles and wall on the particle velocity, Flow through packed beds, Fluidization, Slurry transport and Filtration. (5 Lectures).

Flow of Non-Newtonian Fluids
Elementary viscometry, Rabinowtisch-Mooney Equation, Calculation of flow rate-pressure drop relationship for laminar flow, Generalized Reynolds number for flow in pipes, Turbulent flow of inelastic non-Newtonian fluids in pipes, Power Law Fluids, Pressure drop for Bingham plastics in laminar flow, Viscoelasticity (6 Lectures).

Lab Outline: N/A

Bernouuli's theorem demonstration, Pipe friction, Energy loses across bends and fittings, characteristic curve of pumps

Books Recommended:

1. McCabe Warren L., Smith Julian C., Harriott peter “Unit Operations of chemical Engineering” 6th Ed. 2001. McGraw Hill Inc.
2. Coulson J.M., Richardson J.F. “Chemical Engineering” Vol-I, 1985. The English Book Society and Pergamon Press.
3. Holland, F.A. & Bragg, R. “Fluid flow for Chemical Engineers”, 2nd Edition, Butterworth & Heinemann. 1995.
4. White, F.M. “Fluid Mechanics”, 4th Edition, McGraw-Hill. 1999.
5. Noel-de-Nevers “Fluid Mechanics for Chemical Engineers” McGraw Hill

COMPUTER PROGRAMMING & SOFTWARE APPLICATIONS

Credit hours: 3(2,3,0)
Prerequisites:

Specific objectives of the course:

To enable the students to understand facility design and exposure to relevant computer software.

Course Outline:

Introduction: History and development of languages. Elements of a language: instructions, data and addresses. Syntax and instruction sets. Mnemonics and arguments.

Variable types: Names and character sets. Constants and variable. Real and integer data types. Double precision, character, complex and logical variable. Pointers, arrays and other data structure concepts. Effective choice of variable types. Declaration statements, e.g. common, data and dimension. Format: read, write and print.

Arithmetic operations: Operator symbols. Arithmetic expressions. Assignment statements. Library functions. Algorithms.

Program structure: Declarations, main program and termination. Input and output requirements. Use of subroutines and functions. Program flow: use of DO loops, IF statements, GOTO and labels. Nesting of loops and IF blocks. Structured programming. Data Input/Output using files.

File handling: Editing. Compiling, linking, loading and executing. Opening and closing of files. Program development: Sequential modular layout. Choice of step length and run time. Initial and boundary conditions. Flow diagrams. Importance of comments. Debugging. Interpretation of error messages. Functional testing and validation. Good practice. C++ and other advanced Computer Languages.

Matlab Primer: Introduction to Matlab, Linear algebra applications: matrix calculations, solution of linear equations, Eigen value calculation. Ploting of various types of graphs using ezplot and plot functions. Symbolic mathematics: symbolic differentiation and solution of differential equations. Numerical solution / calculation of integrals, derivatives and differential equations. Transfer function manipulation and study of transient response of various first and second order

systems, plotting Bode and Root Locus diagrams. Introduction to Simulink, simulation of a typical feedback control loop in Simulink.

Lab Outline: N/A

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Books Recommended:

1. Sanford, Larry R. and Nyhoff, L., "Introduction to FORTRAN 90 for Engineers and Scientists", Prentice Hall, 1996.
2. Lafore " Programming for PC using Turbo C++" SAMS
3. Bob McFarlane, Robert McFarlane, "Beginning AutoCAD 2007", Newnes, 2007
4. Wilson, John E., "3D Modeling in AutoCAD", CMP Books, 2001.
5. Bruce A. Finlayson. "Introduction to Chemical Engineering Computing". John Wiley and Sons, Ltd.2006

HEAT TRANSFER

Credit hours: 4(3,3,0)
Prerequisites: After third semester

Specific objectives of the course

To develop the concept of heat transfer in chemical engineering

Course Outline:

Conduction in Steady state and unsteady state cases for one dimension. Heat transfer by convection (Natural & Forced Convection), Application of dimensional analysis to convection, Heat transfer by Radiation, Radiation from black and real surfaces, radiation between black surfaces, radiation between grey surfaces, radiation from gases, Concept of film and overall heat transfer coefficients, Heat transfer equipment's, their types and selection criteria, Heat Exchanger design. Heat transfer with phase change; Condensation and boiling heat transfer and designing of single component condensers.
Evaporation: Heat transfer in evaporators, Single effect evaporators, Multiple-effect evaporators, The calculation of multiple-effect systems, comparison of forward and backward feeds, vapour compression evaporators, The heat pump cycle, Evaporator operation, Equipments for evaporation.

Lab Outline:

Heat transfer through insulated pipes, co-current and counter-current heat exchanger, efficiency of evaporators, comparison of thermal efficiency and operation of heat exchangers, estimation of thermal conductivity, heat transfer through series of insulating blocks, heat transfer during mixing

Books Recommended:

1. Kern Donald Q. "Process Heat Transfer" , 1997, McGraw Hill Book Company.
2. Cengel Yunus A. "Heat Transfer-A Practical approach" , 1988, McGraw Hill Book Company.

3. Incropera Frank P., De Witt David P. “Fundamentals of Heat and Mass Transfer” 5rd Ed. 2002. John Wiley and Sons.
4. Coulson J.M., Richardson J.F. “Chemical Engineering” Vol-I, 1999. The English Book Society and Pergamon Press
5. Coulson J.M., Richardson J.F. “Chemical Engineering” Vol-II, 5th Ed. 2002. The English Book Society and Pergamon Press
6. Hewitt & Bott. “Process Heat transfer”
7. J.P. Holman, “ Heat Transfer”, 2002, McGraw Hill Book Company.

PARTICULATE TECHNOLOGY

Credit hours: 4(3,3,0)
Prerequisites:

Specific objectives of the course:

To familiarize the students with the concept of Particulate Technology

Course Outline:

Particle size distribution, classification, screening and sieving, mechanism of size reduction, machinery for crushing and grinding, Pneumatic and hydraulic conveying; Screw, vibrating, belt conveyors and elevators; Fluidization, mixing and agitation, Flow pattern and baffles, rate of mixing and power consumption; Agglomeration phenomena and its application e.g granulation, pelletization, tabling and storage; dust explosion.
Filtration: Mechanism of filtration. Filter media. Flow through filter cake and/or cloth. Cake resistance and relation between thickness of cake and volume of filtrate. Studies of different types of filter

Lab Outline: N/A

Energy calculations for ball mill, Jaw crusher, Hammer mill, Pebble mill, Sieve analysis

Books Recommended:

1. McCabe Warren L, Smith Julian C, Harriott Peter., “Unit Operations, 6th edition, 2001, McGrawHill Inc.
2. Coulson J.M, Richardson J.F., “Chemical Engineering”, 1999, Pergamon Press.
3. Perry Robert H., Green Don W., “ Perry’s Chemical Engineering Handbook, 7th Edition, 1997, McGrawHill Inc.
4. Foz R. W and McDonald A.T., “ Introduction to Fluid Mechanics, 1998, John Willey & Sons.
5. Noel de Nevers, “Fluid Mechanics for Chemical Engineers”, 2005, McGrawHill Inc.
6. Chopy and Hicks., Handbook of Chemical Engineering calculations,

MASS TRANSFER

Credit hours: 4(3, 3, 0)
Prerequisites: After fourth semester

Specific objectives of the course

To familiarize the students with mass transfer operations in chemical engineering

Course Outline:

Mass transfer theories: Diffusion through gases and liquids. Fick's law. Mechanism of absorption and desorption. Mass transfer at gas/liquid interfaces. The two-film theory, The penetration theory, The film-penetration theory, concentration profiles. Calculation of rate of absorption. Concept of resistance to mass transfer. Mass transfer coefficients(overall and film). Film dominance and solubility. Schmidt, Sherwood, Stanton and Marshall numbers. Countercurrent mass transfer and concept of transfer units.

Distillation: Vapor-liquid equilibria: Partial vaporization and condensation. T-X-Y and X-Y diagrams. Composition calculations, Differential and flash distillation, rectification.

Absorption: Extension of design techniques to absorption as appropriate. Wetted wall columns and determination of transfer coefficients. Absorption associated with chemical reaction. Equipments for gas absorption: Packed and plate columns, vessels with agitators, centrifugal absorber and Spray towers.

Liquid-Liquid extraction: Introduction, Extraction Processes, Equilibrium data, Calculation of the number of theoretical stages for various cases of countercurrent and cocurrent operations, Classification of extraction equipment, Stage-wise equipment for extraction, Differential contact equipment for extraction, Use of specialized fluids.

Leaching: General principles, Factors influencing the rate of extraction, Mass transfer in leaching operations, Equipments for leaching, Calculation of the number of stages by graphical methods.

Adsorption: Introduction, The nature of adsorbents, Adsorption equilibria, Adsorption from liquids, structure of adsorbents, Adsorption equipments and regeneration of spent adsorbents.

Crystallization: Growth and properties of crystals, saturation and nucleation, crystallization rate, impurities, effect of temperature on solubility. Solubility and phase diagram, fractional crystallization, caking, crystallizers, principles of construction and operations.

Ion exchange: principles, applications and equipment.

Lab Outline:

Leaching, liquid-liquid extraction, gas-liquid absorption, diffusion, crystallization, distillation and ion exchange

Books Recommended:

1. MeCabe Warren L., Smith Julian C., Harriott peter "Unit Operations of chemical Engineering" 7th Ed. 2005. McGraw Hill Inc.
2. Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-II, 5th Ed. 2002. The English Book Society and Pergamon Press.
3. Incropera Frank P., De Witt David P. "Fundamentals of Heat and Mass Transfer" 3rd Ed. 1990. John Wiley and Sons.
4. Treybal Robert E. "Mass Transfer Operations" , 1981, McGraw Hill Book Company.
5. Schweitzer, "Handbook of Separation Techniques for Chemical Engineers", 1979, McGraw Hill Book Co.
6. Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-I, 1999. The English Book Society and Pergamon Press
7. Alan S.Foust, Leonard A.Wenzel "Principles of Unit Operations" 2nd Ed.1980. John Wiley & Sons.
8. Diran Basmadjian. "Mass Transfer and Separation Process (Principles and Applications) CRC Press Taylor and Francis Group.2007

CHEMICAL PROCESS TECHNOLOGY-I

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To provide an understanding of processes of different chemical and process industries

Course Outline:

History & Development of Chemical Process Industry in Pakistan;
Basic Industries: Silicate and allied products, Glass, Ceramics and Cement; Phosphorus,; Heavy Chemicals: Sulfuric Acid, Nitric Acid, Sodium carbonate and sodium hydroxide; Water conditioning and purification for industrial purposes; Refractories; Types, properties, manufacture and major uses.

Industrial gases; Carbon dioxide, Hydrogen, Nitrogen;

Lab Outline: N/A

Books Recommended:

1. Austin George T. "Shreve's Chemical Processes Industries" 6th Ed. 1997, McGraw Hill International Edition.
2. Haidari Iqbal "Chemical Industry in Pakistan" .1992. Industrial Research Service Karachi, Pakistan.
3. Pandey G.N. "A Textbook of Chemical Technology" 2nd Ed. Vol-I & II. 2000. Vikas Publishing House (Pvt) Limited
4. Riegels Handbook of Industrial Chemistry, James A. Kent 2000, Springer/ Van Norstrand/ Rein Hold.
5. Kirk Othmer "Encyclopedia of Chemical Technology" 1999, Inter Science Publishers.

6. Government of Pakistan. “Prospects of Chemical Industry in Pakistan” 2003, Export Advisory cell, Ministry of Industries and Production, Islamabad.
7. Government of Pakistan. “Digest of Industrial Sectors in Pakistan” 2003, Export Advisory cell, Ministry of Industries and Production, Government of Pakistan, Islamabad. 2003.

TRANSPORT PHENOMENA

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To familiarize the students with the concept of Transport Phenomena and its application in the process industry.

Course Outline:

Transfer processes: A review of the mechanisms of momentum, energy and mass transport. Momentum transport: Derivation of equations of continuity and motion (Navier-Stokes). Application to laminar flow problems. Energy transport: Derivation of energy equation. Application to heat transfer problems involving conduction, forced and free convection.

Mass transport: Derivation of species conservation equations for binary and multi-component mixtures. Application to mass transfer problems with and without chemical reaction. Transport in turbulent flow: Fluctuations and time-averaged quantities. Time averaged form of the governing equations of momentum, energy and mass transport. Expressions for the Reynolds stresses, turbulent energy and mass flux. Temperature and concentration distribution in turbulent pipe flows.

Lab Outline: N/A

Books Recommended:

1. Bennett C.O., Myers J.E. “Momentum, Heat & Mass Transfer” 3rd Ed. 1983. McGraw Hill Book Company.
2. Bird R. Byron, Stweart Warren E., Lightfoot Edwin N. “Transport Phenomena” , 1976, John Wiley & Sons Inc.
3. Brodkey Robert S., Hershey Harry C. “Transport Phenomena –A unified Approach”, 1988, McGraw Hill International Editions.
4. Wilty, “Heat Mass and Momentum Transfer”

CHEMICAL ENGINEERING THERMODYNAMICS-II

Credit hours: (3, 0, 3)
Prerequisites:

Specific objectives of the course:

To enable students to apply the knowledge in chemical engineering application

Course Outline:

Second and Third Laws: Second law; Entropy; Equilibrium and observable change; Changes in entropy with changes in P, V, and T; Measurement of entropy. Helmholtz function A. Gibbs function (free energy) G. Fundamental equations for closed systems. Maxwell'' relationships. properties of mixtures of ideal gases. G for ideal and non-ideal gases. Fugacity. Partial molar quantities. Chemical potential. Excess Thermodynamic Functions. Compressibility factors; Heat engines, various cycles and turbine. Third law of Equilibrium (reversible) and spontaneous (irreversible) change.

Chemical equilibria: equilibrium constants for gas phase reactions. Temperature dependence of dG° and K°. factors affecting degree of conversion. Equilibria involving condensed phases. Equilibria in solution. Thermodynamics of cells.
Liquification; Refrigeration and airconditioning. Heat pump. Thermodynamic of separation processes, Electrochemical reactions.
Chemical Exergy, Reduction of lost work, Energy Conversion.

Lab Outline: N/A

Books Recommended:

1. Smith J.M., Van Ness H.C., Abbott M.M. "Chemical Engineering Thermodynamics" 6th Ed. 2001. McGraw Hill International Edition.
2. Daubert Thomas E. "Chemical Engineering Thermodynamics", 1st Ed. 1985, McGraw Hill Book Company.
3. Sandler Stanley I. "Chemical and Engineering Thermodynamics" 3rd Ed. John Wiley and sons, Inc.
4. Eastop, Mc Conkey "Applied Thermodynamics" National Book Foundation

FUELS & COMBUSTION

Credit hours: 4(3,3,0)
Prerequisites:

Specific objectives of the course:

To give and overview of different fossil fuels. Students should be able to understand the significance of combustion in process industry. After this course, student should be able to design industrial furnaces and boilers. He should also be able to develop techniques and technologies to comply with emission legislation in this regard.

Course Outline:

Survey of available fuels; Industrial fuels. Principles of combustion, combustion of oil, coal and gas. Fluidized Bed Combustion Boilers. Criteria for the selection of fuels for industrial purposes; Combustion calculations; Enthalpy of Combustion and Heating Values . Furnaces and Waste Heat Recovery: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.

Mass and Energy conservation in premixed flames, structure of the ideal, adiabatic, one-dimensional, premixed flame, Properties of the premixed flame.

Properties of diffusion flames, Flame Diagnostics – Laser-induced fluorescence , Planar Imaging Techniques.

Turbulent Premixed Flame Speed & Structure, Three Flame Regimes, Wrinkled Flame Regime, Flamelets in Eddies Regime & Flame Stabilization.
Jet Flames, Simplified Analysis and Flame liftoff and blowout.
Some Applications; Industrial Gas Burners/Furnaces, Gas-Turbine Engines, Spark-Ignition Engines

Burning of a liquid droplet; Diffusion of oxygen outside the flame front, Droplet-Gas-Phase Interface Energy Balance, An expression for the Flame Temperature, Droplet Lifetimes. Applications; Droplet combustion in heavy fuel oil burners, Diesel Engines, Liquid-Rocket Engines

Energy conversion with combustion. Geo thermal power and Nuclear power. Calculations in fuel and energy, energy economics. Energy conservation methodologies of selected systems, Renewable energy technologies. Design of boiler, furnaces, Combustion efficiency and
Emission.

Lab Outline:

Fuel analysis, Flash point, Fire point, Calorific value, Combustion characterization, Combustion emissions and Combustion efficiency

Books Recommended:

1. Turns, S R.. “An Introduction to Combustion” 2nd Edition McGraw Hill. 2000.
2. Griffiths, J.F. & Barnard, J.A. “Flame and Combustion”, 3rd Edition, Blackie Academic & Professional. 1995.
3. Harker J.H., Backhurst J.R. “Fuel and Energy” , 1981, Academic Press”
4. Probstein, “Synthetic Fuels”, McGraw Hill.
5. Marion Smith, “Fuels and Combustion”, McGraw Hill.

ENGINEERING MATERIALS

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To familiarize the students with material properties and their applications.

Course Outline:

Introduction to the concept of stress and strain as applied to engineering design. Physical, Mechanical and thermal properties & characterization. Classification and application of the following materials of construction. Iron and steel, stainless steel, Nickle, Hastaloy, Copper alloys, Aluminum and its alloys, Lead Titanium and tantalum, PVC, Teflon, polyolefins, polytetra flouro ethylene (PTFE) glass, stone ware, acid resistant bricks and tiles. Biomaterials, Composites.

Corrosion: Electrochemical series and corrosion potential. Nature, types and rate of corrosion. Passivity. Crevice and pitting corrosion. Stress corrosion: cracking and fatigue. Cathodic and anodic protection. Coatings. Corrosion resistance of

steels & alloys. Selection criteria for material of construction, International standards for materials.

Lab Outline: N/A

Books Recommended:

1. Srivastava C.M., Srinivasan C. "Science of Engineering Materials" 2nd Ed.2000, New Age International (PRACTICALS) Limited, Publishers.
2. Varnon John. "Introduction of Engineering Materials" MacMillan.
3. William F. Smith. "Principles of Materials Science and Engineering" McGraw Hill.
4. R.A. Flinn and P.K. Trjan "Engineering Materials and Their Applications"Jaico.
5. Ijaz Hussain Khan. "Corrosion Technology", Vol-I and 2, Institute of Chemical Engineering, University of the Punjab, Lahore Pakistan.
6. Government of Pakistan "Pakistan coal power production potential". Private power and infrastructure board. Islamabad. 2004.
7. Government of Pakistan. "Pakistan Energy Yearbook". Hydrocarbon development institution of Pakistan, Islamabad. 2006.

CHEMICAL REACTION ENGINEERING

Credit hours: 4(3,3,0)
Prerequisites:

Specific objectives of the course:

To apply the knowledge of chemistry, thermodynamics and chemical engineering for designing of reactors.

Course Outline:

Kinetics of homogeneous reactions: Rate of reaction, variables affecting the rate of reaction, order of reaction, rate constant; searching for a mechanism of reaction, activation energy and temperature dependency, Interpretation of batch reactor data for single and multiple reactions. Integral method and differential method of analysis for constant volume and variable volume batch reactors, Search for a rate equation. Design of homogeneous reactors, Batch, Mixed flow, Plug flow reactors, Comparison of single reactor, multiple reactor systems in parallel/series. Temperature and pressure effects. Adiabatic and non-adiabatic operations. Surface phenomenon and catalysis, Heterogeneous reaction systems, Rate equations for heterogeneous reactions, Fluid particle reactions, Determination of rate controlling steps.
Catalysis desorption Isotherms, Kinetics of solid catalyzed reactions. Catalyst deactivation and regeneration. Design of fluid-solid catalytic reactors.

Lab Outline:

Practicals to be based on performance of CSTR (single stage and multi stage), Irregularities of flow reactors, Fluidized bed reactors, Gas–Solid non catalytic reactor, Gas-liquid reactor, Reaction Kinetics

Books Recommended:

1. Levenspiel Octave. "Chemical Reaction Engineering" 2nd Ed. 1999, John Willey & Sons Inc.
2. Smith J.M. "Chemical Engineering Kinetic" 2001, McGraw Hill Book Co.

3. Fogler H. Scott. “Elements of Chemical Reaction Engineering” 2nd Ed. 2001. Prentice Hall
4. E Bruce Naumen “Chemical Reactor Design, Optimization and Scale up” McGraw Hill 2002.

SIMULTANEOUS HEAT & MASS TRANSFER

Credit hours: 4(3,3,0)
Prerequisites: After fifth semester

Specific objectives of the course:

To develop understanding of simultaneous heat and mass transfer operations

Course Outline:

Humidification and Cooling Towers: Humidification terms, wet-bulb and adiabatic saturation temperature, Humidity data for the air-water system, temperature-humidity chart, enthalpy-humidity chart, determination of humidity, humidification and dehumidification.
Cooling Towers: Basic principles, types, features and operation of various cooling towers.
Cooling tower design. Alternative sinks for waste heat. Design of equipment based on worst case studies. Water and air based systems. Environmental effects

Drying: General principles, Rate of drying, The mechanism of moisture movement during drying, Diffusion and Capillary theory of drying, Classification and selection of dryers(Tray, tunnel, rotary, drum, spray, pneumatic, fluidized beds, turbo-shelf, disc and centrifuge dryers), solvent drying, superheated steam drying, freeze drying, flash drying, partial-recycle dryers, The drying of gases.

Distillation: The fractionating column. Concept of constant molal overflow. Calculation of number of plates required for binary separations. Lewis-Sorel, McCabe-Thiele methods. Concept of operating lines. Intersection of operating lines and location of feed plate. Importance of the reflux ratio. Calculation of minimum reflux ratio. Number of plates at total reflux. Underwood and Fenske methods. Selection of economic reflux ratio. Effect of multiple feeds and sidestreams. Plate efficiency and Murphree’s formula. Concept of a theoretical plate and HETP. Method of transfer units and HTU. Multi-component distillation: Degrees of freedom in separation specifications. Key components in multi-component mixtures and recovery fraction. Continuous flash distillation with heat balancing. Equilibrium and enthalpy expressions. Multi-stage distillation Numerical examples of multi-component separation problems. Side streams and partial condensers. Column Design: Tray design; hydraulics and performance.

Batch distillation: operation at constant product composition or constant reflux ratio. Calculation of column, diameter and height.

Azeotropic and Extractive distillation: Heterogeneous azeotropes. Illustrative examples of azeotropic distillations. Reactive distillation.

Lab Outline:

No. of theoretical plates, distillation under constant reflux and constant product composition, equilibrium curve, steam distillation, extractive distillation, performance of cooling tower (mass transfer coefficient, overall heat transfer coefficient), humidification with or without recirculation of air, drying with forces circulation

Books Recommended:

1. McCabe Warren L., Smith Julian C., Harriott peter "Unit Operations of chemical Engineering" 7th Ed. 2005. McGraw Hill Inc.
2. Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-II, 5th Ed. 2002. The English Book Society and Pergamon Press.
3. Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-I, 1999. The English Book Society and Pergamon Press
4. Foust Alan S., Wenzel Leonard A., Clump Curtis W., Maus Louis and Anderen L. Bryce "Principles of Unit Operations" 2nd Ed. , 1963, John Wiley and sons.
5. Incropera Frank P., De Witt David P. "Fundamentals of Heat and Mass Transfer" 3rd Ed. 1990. John Wiley and Sons.
6. Treybal Robert E. "Mass Transfer Operations" , 1981, McGraw Hill Book Company.

INSTRUMENTATION AND PROCESS CONTROL

Credit hours: 4(3,3,0)
Prerequisites: Nil

Specific objectives of the course:

To familiarize the students with process parameter measurements and their instruments, various control strategies and response analysis

Course Outline:

Instrumentation: Principles of measurement of temperature. Pressure level, flow, weight Power, speed, position; etc. Study of common sensors, transmitters, controllers, actuators, recorders, switches, etc. Methodology for calibration. Fail-safe modes of operation, alarm, trip and interlock system. Emergency shut-down systems. Fire and gad detection. Pressure relief & venting systems.

Control Practice: Terminology signal types and standard ranges interpretation of P & I diagrams; Servo and regulator operation. Bias and offset auto/manual optimum settings. Ziegler and Nichols formulae. Control strategy: Formulation P & I diagrams. Control loop elements, Block diagrams. Control objectives. Industrial Applications. Use of feedback, cascade, ratio, fee forward. Use of analyzer and chromatographs, Modeling: Lumped parameter models to plant, e.g. jacked vessel.

Control theory: Use of Laplace transforms. Mathematical modeling of simple lumped parameter systems and their Laplace transforms. Response of First & Second order systems. Study of a typical feedback control loop, open and closed loop response to simple inputs. Stability of a system, frequency response methods, various stability criteria. Tuning of PID controllers, criteria, methodologies.
Introduction to advance control system, cascade & selective control system.

Lab Outline:

Study the K & J type thermocouples, Study of control loops, Process plant training.

Books Recommended:

1. Smith, C. A, Corripio, A. B, Principles and Practice of Automatic Process Control, John Wiley, 1985.
2. Marlin, T.E., Process Control, 2nd Ed., McGraw Hill Book Co., 2000.

3. Ogunnaike, B. A., et al., Process Dynamics, Modeling, and Control, Oxford University Press, 1997.
4. Coughanown, D.R. and Koppel, C.B., Process system Analysis & Control, McGraw Hill 1991.
5. Process Control Instrumentation Technology, Curtis D. Johnson, Person Education 2003.
6. Chemical Process Control, G. Stephanupolos, Prentice Hall 2002
7. Essentials of Process Control, W.L. Luyben McGraw Hill 1997.

CHEMICAL PROCESS TECHNOLOGY-II

Credit hours: 4(3,3,0)
Prerequisites: Nil

Specific objectives of the course:

To provide an understanding of processes of different chemical and process industries

Course Outline:

Soap and Detergents; Sugar and Agro based industry. Biomass processing, Fermentation Industries: Industrial alcohol and industrial solvents. Food processing industry; Types of food processing, Food by products, Leather processing and tanning.
Gas and oil processing: oil refining ,Fertilizers; Urea, Potassium Nitrate, Super phosphate. Di-ammonium Phosphate; Insecticides, Explosives; Types, Manufacture.
Plastic industry; Plastics, Types and their properties, Polymerization, Manufacture of plastics, Uses; synthetic fibers; Paints and Varnishes
Pulp and paper; Pulp manufacture, Comparison, description of different methods available; Paper making. Basic Pharmaceutical industries. Waste processing.

Lab outline:

Preparation of soap, Leather analysis, Milk analysis, Fermentation, Preparation of nitrobenzene, Aspirin, Acetic acid and Oxalic acid.

Books Recommended:

1. Austin George T. “Shreve’s Chemical Processes Industries” 6th Ed. 1997, McGraw Hill International Edition.
2. Groggins P.H. “Unit Processes in Organic Synthesis” 4th Ed. 2005, Tata McGraw Hill Book Company, Inc.
3. Haidari Iqbal “Chemical Industry in Pakistan” .1992. Industrial Research Service Karachi, Pakistan.
4. Pandey G.N. “A Textbook of Chemical Technology” 2nd Ed. Vol-I & II. 2000. Vikas Publishing House (Pvt) Limited
5. Riegels Handbook of Industrial Chemistry, James A. Kent 2000, Springer/ Van Norstrand/ Rein Hold.
6. Kirk Othmer “ Encyclopedia of Chemical Technology” 1999, Inter Science Publishers.
7. Jacob A. Moulijn; Michiel Makkee; Annelies Van Diepen. Chemical Process Technology. John Wiley and Sons, Ltd.

8. Harold A. Wittcoff; Bryan G. Reuben; Jeffrey S. Plotkin. “Industrial Organic Chemicals (2nd Edition).”. John Wiley and Sons Ltd.2004
9. Government of Pakistan. “Prospects of Chemical Industry in Pakistan” 2003, Export Advisory cell, Ministry of Industries and Production, Islamabad.
10. Government of Pakistan. “Digest of Industrial Sectors in Pakistan” 2003, Export Advisory cell, Ministry of Industries and Production, Government of Pakistan, Islamabad. 2003.

CHEMICAL PROCESS DESIGN & SIMULATION

Credit hours: 3(2,3,0)
Prerequisites: Nil

Specific objectives of the course:

To develop understanding of various simulations and programming tools for process design.

Course Outline:

Optimization method. Heat and power integration. Reactor network design. Separation system selection and design. Design & Simulation Software: Introduction to various design and simulation software e.g. HYSYS, ChemCAD etc. (A particular software may be selected to cover the rest of the course contents) A review of capabilities and limitations of the design / simulation software. Flowsheets and sub-flowsheets. Defining process streams and use of Fluid Packages. Adding common unit operations in the flowsheet. Drawing simple Process Flow Diagrams (PFD) in HYSYS, steady state material and energy balances using graphical user interface and worksheet. Adding instrumentation and control components. Simple transient calculations.

Lab Outline:

Material and energy balance, Flow sheeting on HYSIS, Chem Cad and Matlab

Books Recommended:

1. HYSYS (or ChemCAD) User and Tutorial Guides.
2. Chau, Pao C. “Process Control : A First Course with MATLAB”, Cambridge University Press, 2002.
3. Davis, Timothy A. and Sigmon, Kermit, “MATLAB Primer, 7th Ed.” Chapman & Hall/CRC, 2004.

CHEMICAL PLANT DESIGN

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

This course will make capable the students to understand basic needs and requirement of a plant design practices and techniques by using design codes and standards.

Course Outline:

Process design and development. General design consideration. Health and safety.; Fire and explosion hazards; HAZOP; Optimum design; Design codes & standards.
Vessel design: Low, medium and high pressure storage and transportation vessels. Cryogenic vessels.
Design of mass transfer equipment, material transport, material handling and heat transfer including furnaces and refrigeration units. Piping and pipeline design.

Lab Outline: N/A

Books Recommended:

1. Peters Max S., Timmerhaus Klaus D. "Plant Design and Economics for chemical Engineers" 4th Ed. 1991. McGraw Hill Inc.
2. Ludwig Ernest E. "Applied Process Design for Chemical and Petrochemical Plants" Voll 1,2 & 3, 3rd Ed.2002, Gulf Publishing Company.
3. Walas Stanley M. "Chemical Process Equipment – Selection and Design "Butterworth Heinemann" 1999.
4. Coulson J.M, and Richardson, "Chemical Engineering" , Vol VI , "Butterworth Heinemann" 1999.
5. Wells G. L. Rose L.M. "The art of Chemical Process Design" 1986. Elsevier.
6. Smith Robin "Chemical Process Design" 1995. McGraw Hill Inc.
7. Backhurst & Harker, "Chemical Process Design, John Willey
8. Evans, "Handbook of Chemical Equipment Design"
9. E.L. Cussler and G.D. Moggridge, "Chemical Product Design", 2001, Cambridge University Press.
10. Special Issue of Chemical Engineering Research and Design, Part A 80 (A1), 2002 on "Process and Product Development"
11. James Wel, Molecular Structure and Property: Product Engineering, Ind. Engg. Chem. Res. 41(8) 1917-1919 (2002)

COMPUTATIONAL FLUID DYNAMICS **(Optional Course)**

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To develop understanding of applying governing equations of mass, momentum and energy to simulate chemical engineering processes by the use commercial CFD and numerical codes

Course Outline:

Scope and limitations of experimental, analytical and numerical methods in transport processes. The Continuity Equation and governing equations for Momentum, Heat and Mass transport in a continuum. The General Transport Equation.
Discretization, basic concepts and methods. Discretized forms and solution methodologies for steady and unsteady one-dimensional heat conduction. Extension of discretization concepts to two- and three- dimensional domains. Modeling of Convection and Diffusion terms using various discretization schemes. Calculation of flow field using SIMPLE algorithm.

Case studies: Simulation of various one- and two-dimensional laminar flow situations covered in the course of Transport Phenomena using a CFD software and comparison of results with analytical solutions.

Lab Outline: N/A

Books Recommended:

1. Patankar. S. V., Numerical heat transfer and fluid flow, Hemisphere, 1980.
2. Versteeg, H. and Malalasekra, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2nd Ed., Prentice Hall, 2007.

MINERAL PROCESSING (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To teach students about art and science of beneficiating ores and minerals with the name to yield marketable value added products

Course Outline:

Introduction to Mineralogy, Objectives of mineral processing. Mine-mill interface. Properties of minerals and ores. Sampling and evaluation. Comminution: fracture, liberation, size criteria, energy-size relationships. Crushing and grinding. Screening and classifying. Concentration processes: density and other physical processes. Interfacial phenomena. Flotation. Liquid-solid separation: flocculation, thickening, filtration. Washability curves. Partition curves. Material balances. Performance prediction.

Lab Outline: N/A

Books Recommended:

1. Jones, Meurig P., Applied Mineralogy: A Quantitative Approach, John Wiley & Sons, 1987
2. Kelly, Errol G. and Spottiswood, David J., Introduction to Mineral Processing, John Wiley & Sons, 1989
3. Wills, B.A., Mineral Processing Technology, Pergamon Press. 1985

NUCLEAR ENGINEERING (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

The graduate will have knowledge of basic nuclear reaction mechanism, nuclear cycles and nuclear reactors that will be used peaceful purposes.

Course Outline:

Role and importance of nuclear energy; Nuclear cross-sections; Reaction Rates; Nuclear fission and chain reaction; Criticality conditions; Conversion and breading;

Reactor components and their characteristics; Classification and design features of research, production and power reactors; Introduction to fast and fusion reactor systems.
Different types of fuel cycles; Core and feed – material preparations; Uranium enrichment; Fabrication of fuel; Reprocessing of Irradiated fuel; Fuel cycle performance of commercially available reactors; In-core fuel management and fuel management strategies.

Lab Outline: N/A

Books Recommended:

1. Lamarsh, J. R, Introduction to Nuclear Engineering, 3rd Edition, Prentice Hall, 2001.

Journals / Periodicals:
1. Annals of Nuclear Enenrgy
2. Nuclear Engineering & Design
3. Nuclear Technology

NOVEL SEPARATION PROCESSES (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To impart the knowledge about Novel separation processes i.e membrane processes, adsorption and desorption that had been used in process industries in last few decades in increasing order.

Course Outline:

General theory of multistage separations based upon equilibrium and rate processes. Theory, design and analyses of ion exchange processes along with their industrial applications. Mass transfer processes through membranes: separation of chemical species using osmosis, reverse osmosis, electrodialysis and molecular sieves. Adsorption, desorption and other surface phenomena, design and operation of adsorption columns. Chromatographic separation technology and its application to chemical and biochemical separations.

Lab Outline: N/A

Books Recommended:
1. Seader, J. D., and Ernest J. Henley. Separation Process Principles. New York, NY: Wiley, 1998.
2. King, C. J. Separation Processes. 2nd ed. New York, NY: McGraw-Hill, 1980
3. Manson Benedict, Nuclear Chemical Engineering, 2nd Ed., McGraw-Hill, 1981
4. Treybal, R. E. Mass Transfer Operations. 3rd ed. New York, NY: McGraw-Hill, 1980.

ENERGETIC MATERIALS (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To develop an understanding with chemistry, thermal and kinetics of nitro compounds. Salient feature of primary and hi-explosives as well as propellants are also presented.

Course Outline:

Science of Energetic Materials

History of Explosives & Types of Explosions.
The Chemistry of Explosives: Oxidation Reactions (concept of fuel & oxidant, oxygen balance), structural organization & classification of Pure Explosive compounds, Energetics of Explosives: Simple prediction of Energy, Temperature, Heat, Work Enthalpy, Pressure of explosion, Thermal Decomposition & Burning, Free Energy & Gas Equilibria.
Distinction amongst ordinary Burning, Deflagration, Explosion & Detonation Phenomena.
Classification of Explosives: Gas Expansion Effects, Detonation Shock Effects, Initiation of Explosives.
Principles of Propellant Chemistry: Solid and liquid propellants for guns & rockets, Non-Military Applications of Explosives.
Principles & applications of pyrotechnics: Production of noise, smoke, light, colour etc.
New developments in Explosives

Combustion & Propulsion

Introduction to Combustion, Classification of fuels.
Explosions in Closed Vessels.
The Chemistry of Combustion, Combustion of Hydrocarbons
Flames and Combustion Waves, Detonation Waves in Gases.
Special aspects of Gaseous combustion.
Combustion in Mixed & Condensed Phases.
Rocket propulsion.
Selection of propellants: Solid, Liquid or hybrid & Rocket Motor Design

Explosives Manufacture, Formulation & Filling

Manufacture of Energetic Materials: Trinitrotoluene (TNT), Cyclotrimethylene Trinitramine (RDX), Cyclotetramethylene Tetranitramine (HMX), 2,4,6 Trinitrophenylmethylnitramine (Tetryl), Pentaerythrite Tetranitrate (PETN), Nitroglycerine (NG), Nitrocellulose (NC), Lead Azide, Lead Styphnate & others.
Formulation & Filling
Process Selection, Casting & Projectile Preparation.
Effect of Casting Procedure on Charge Characteristics; Porosity & Cavitation, Crystal size, Uniformity of Composition.
Standard Casting Procedure.
Some Special Casting Techniques; Pellet Casting, Vacuum Melting & Casting, Vibration & Centrifugal Casting, Controlled Cooling & Extrusion.
Pressing; Standard Procedures & Measurement of Explosive Charges, Direct

Pressing in Casing, Stop vs Pressure Loading, Palletizing, Vacuum Pressing, Hot Pressing, Hydrostatic & Isostatic Pressing.
Machining of Explosives
Factors Affecting Quality of Explosive Charges; Density, Cracks & Cavities, Composition Variation

Lab Outline: N/A

Books Recommended:

1. A Bailey, G.S Murray "Explosives, Propellants & Pyrotechnics".
2. Paul W Cooper "Explosives Engineering"
3. Stephen R. Turns "Combustion, applications & its concepts".
4. Luigi De Luca Politecniceo de Malino & Edward W. Price "Nonsteady Burning and Combustion Stability of Solid Propellants" (1992).
5. Urbanski "Chemistry & Technology of Explosives" 1982.

POLYMER ENGINEERING (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To enhance the knowledge in the field of polymers, their raw material, uses and method of polymerization.

Course Outline:

Detailed account of raw materials used; advanced treatment of methods of polymerization and co-polymerization; principles of polymers formation; thermal cleavage of covalent bonds; radical production by photochemical; high energy radiation and oxidation – reduction processes; flow properties of polymers, classification of melt flow behavior, rheological properties, structure and properties of polymer; analysis and testing of polymers; production and properties of commercially important polymers; detailed account of polymer processing; design of equipment and machinery used; recent advances in polymer technology.

Lab Outline: N/A

Books Recommended:

1. Fried Joel R. "Polymer Science and Technology", 2000, Prentice Hall.
2. Stanley Middlean, Fundmentals of Polymer Engineering, 3rd Ed. 996
3. Tim A. Ossworld, Georg Menges, Hanser Material Science of Polymer for Engineering 2003.
4. I.M. Ward & D.W. Hadley, Wiley, An Introduction to the Mechanical Properties of Solid Polymer, 3rd Ed. 1998

CHEMICAL WET PROCESSING OF TEXTILES (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

The objective of the course is to import knowledge about chemistry, processes inmachines used for designing, bleaching and printing in textile industry.

Course Outline:

Chemistry, processes and machines for desizing, scouring, bleaching and mercerization. Pretreatments. Application of reactive vat and another classes of dyestuff on various machines. Dying of cotton, viscous rayon and blend fibres. Printing, exposing print paste, pigment and reactive types. thickening.

Rotary printing machine on curing process. Objective and service performance of chemical finishing of soft and hard finishing agents. Printing flexibility using CAD / CAM system, Treatment of effluent from Textile Industry, Recovery of chemicals.

Lab Outline: N/A

Books Recommended:

1. Tyron. L. Vigo,Textile Processing and properties, 1994 Elsevier.
2. S. Kawabek, Objective Parameters of fabric, 1999, Textile Machinery Society Kyoto.
3. E.R. Trotman, Hodder & Stoughton, Dyeing & Chemical Technology of Textile Fibres, 1993 Charles Griffin & Co.
4. A.J. Hall, The Standard Handbook of Textiles, 2004, Woodhead Publishing Co.

PROCESS ANALYSIS & OPTIMIZATION (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

The knowledge about the various models used for process analysis and optimization in the process industry.

Course Outline:

Use of models in process engineering: Model as a working description of a system. Levels of detail. Types and function of model: mechanistic, empirical, stochastic, procedural and qualitative. Reasoning for using models. Strategy for model building: Relationship between engineering and mathematical approximations. Example of dynamic delay of air heater. Conceptual models. Formulation of functional – mechanistic models based on conservation equations. Coordinate free methods based on vector/matrix notation. Models for complex and irregular geometry. Case study examples for heat exchanger and tubular reactor definition of system parameters consistent with the model. Averaging and modelreduction techniques. Numerical procedures based on weighted residuals.

Adaptive models: Empirical models based on non-linear regressive adaptive refinement of models. State variables models and matrix differential equations. Filtering and continuous up-dating of models. State estimation and adaptive control. Population balance models: Description of process in terms of distribution functions based on principal attributes. Age distribution. Process vessel characteristics in terms or residence time distribution functions. Standard models based on plug flow, CSTR and dead space. Mixing and age distribution. Application to reaction systems and liquid-liquid extraction. Quantitative models: Diagnostics procedures. Signal flow graphs. Reasoning with qualitative models.

Models for process simulation: Analysis of systems behavior for process optimization, flexibility and safety. Stability and multiple states. Optimization methods; Analytical/numerical techniques for single variable and multi variable (constraint and unconstrained) functions; linear programming; PERT and CPM project and its organization.

Lab Outline: N/A

Books Recommended:

1. Taha Hamdy A. “Operation Research-An Introduction” Prentice Hall
2. (Pvt) Limited.
3. Edgar T.F., Himmelblau D.M. “Optimization of Chemical Processes” 1989
4. McGraw-Hill Inc.
5. B.V. Babu “Process Plant Simulation”, 2004 Oxford University Press.
6. E. Bruce Nauman, “Chemical Reactor Design, Optimization and Scaleup”, 2002 McGraw Hill.

PETROLEUM REFINERY ENGINEERING (OPTIONAL COURSE)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To familiarize students with the applications of distillation operations as applied in petroleum refinery. Application of catalysis for increasing and improving quality.

Course Outline:

Introduction; origin; formation and composition of petroleum. Indigenous and world resources. Refinery products; properties; significant tests and standard test methods; characterization and evaluation of crude oil stocks; generation of crude processing data; Crude pre heating and preliminary treatment; pipestill heaters; desalting; atmospheric and vacuum distillation; steam stripping; arrangement of towers. Calculation of number of trays, types of reflux employed; Packie’s approach; processing plans, schemes and product patterns of refineries. Modern separation, conversion and treatment processes. Thermal & catalytic cracking and reforming, hydrocracking. Auxiliary processes and operations; refinery corrosion and metals; blending plants, product design and marketing. Use of linear programming techniques to solve refinery blending and production problems; overview of petroleum act.

Lab Outline: N/A

Books Recommended:

1. W.L. Nelson, Petroleum Refinery Engineering, 1991, MacGraw Hill.
2. G.D. Hobson:, Modern Petroleum technology, 1991, Applied Sc. Publisher.
3. J.H. Cary and G.E Handwork ,Petroleum Refinery Technology & Economics, 2001, Dekker.
4. S. Parkash, Refining Processes Handbook, 2003, Elsevier / GPP.

GAS ENGINEERING (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To familiarize students with gas separation & techniques for production of natural gas or LPG.

Course Outline:

Introduction to natural gas industry; gas production. testing of well fluid ;Test separator, Multiphase flow meters, establishing GOR; Gas-liquid separation - Design and configurations. Acid gas sweetening ,Chemical and Physical solvent processes. Membrane/molecular sieve processes, Cryogenic separation , solvent regeneration. Dehydration of Natural Gas, LPG recovery and condensate stabilization . Gas processing facilities, process flow schemes and product specifications .
Disposal of gas field emissions, effluent, produced water (EOR, Re-injection, flaring) Design, metallurgy and corrosion protection of gas pipelines and equipments .Slug handling . Gas compression ; compressors types, selection between centrifugal and reciprocating compressor, design considerations. Heat conservation in gas processing facilities. Flare system design ; PSVs, blow down, flare/vent stack sizing. Project design using computer softwares.

Lab Outline: N/A

Books Recommended:

1. Ken Arnold, Maurice Stewart , Design of Gas Handling Systems and Facilities, Volume 2 , 1989, Gulf Publishing Company
2. Stephen A. Newman, Acid and Sour Gas Treating Processes,1985, Gulf Publishing Company
3. Donald L. Katz , Handbook of Natural Gas Engineering,1990, McGraw Hill
4. M.Saeed , Handbook of Natural Gas Transmission and Processing, 2006, Gulf Publishing Company
5. EJ Hoffman, Membrane Separation Technology, 2003, Gulf Publishing Company

PETROCHEMICALS (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To develop skills of chemical engineering operations for production of valuable products.

Course Outline:

Recent trends in research and development in Petrochemical industries. Hydrocarbon Sources and Raw materials; their characterization, availability and

pricing. Processes for the production of ethylene, acetylene, and other monomers. Polymerization of monomers into useful palstics.

Synthesis gas production, separation and purification, ammonia synthesis.

BTX production, separation and purification.

Lab Outline: N/A

Books Recommended:

1. Austin George T. "Shreve's Chemical Processes Industries" 6th Ed. 1997, McGraw Hill International Edition.
2. Robert A. Meyers, Handbook of Petrochemical Production Processes, 2005, McGraw Hill.
3. A.C. Waddems, Chemicals from Petroleum 978, John Murrey.
4. S. Strelzoff, Technology and Manufacture of Ammonia, 1982, Inter Science Publishers.
5. Kirk Othmer , Encyclopedia of Chemical Technology, 1999, Intoosc Publishers.

RISK MANAGEMENT & SAFETY (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

The course prepares the students to deal with the risks involved by identifying various hazards in chemical industry and ways and means to deal with them.

Course Outline:

Major hazard accidents, Basic concepts of risk, Hazard identification procedures and techniques, What-if, HAZOP, FMEA. Consequence analysis concerning release of chemical hazards including discharge models, dispersion and effect models

Fire and explosion models, effect models, Estimation of incident frequencies (estimation of incident frequencies from historical data, frequency modeling techniques, FTA and ETA).

Human factors in risk analysis , Risk of chemical reactions e. g. chemical reactivity and run away, Inherent safety in the design of equipment and systems

Emergency planning and responses, Storage and transportation of hazardous materials

Lab Outline: N/A

Books Recommended:

1. Fullwood R. R., "Pobabilitistic Safety assessment in Chemical and Nuclear Industries". 1999.

WASTE MANAGEMENT (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

The objective of the course is to impart the knowledge of waste generated, its treatment and disposal in light of international/national standards, policies and regulations.

Course Outline:

Environmental Management ISO 14001, EMAS, Environmental auditing, Responsible Care, Environmental Policies & regulations. Different types of ecolabelling

Material Recycling

a. Recycling of metals
b. Recycling of polymeric materials

Treatment of liquid waste streams: mechanical, biological and chemical methods. Production of bio-gas. Anaerobic digestion and other stabilization methods. Dewatering. Drying.

Treatment of solid waste: separation, incineration, composting.

a. Separation
b. Incineration
c. Other methods for disposal of solid waste (e.g. composting and landfilling)
d. Treatment and use of ash-products.
   Treatment of radioactive waste.

Lab Outline: N/A

Books Recommended:

1. Cheremisinoff, “Handbooks of water and waste water treatment technologies”, 2002.

ENVIRONMENTAL ENGINEERING (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

The graduate will have knowledge in the area of environmental engineering that includes types of pollution, sampling, monitoring, pollution control considering the international and national standards.

Course Outline:

Environmental Monitoring (Air, Water & Soil) : Objectives of sampling and monitoring programme. Design and types of samples; pre-sampling requirements/information, sampling and design purposes,

Pollution Concept, Types of Pollution, air pollution control technologies, water pollution control technologies, water treatment technologies, soil pollution control technologies, noise pollution control technologies, Biotechnology for environment, industrial pollution control, Occupational safety devices.

Principles and purposes of IEE and EIA and its significance for the society. Cost and benefits of EIA. Main stages in EIA process. Public consultation and participation in EIA process. EIA methods and
techniques for impact prediction and evaluation.

Lab Outline: N/A

Books Recommended:

1. Cheremisinoff, “Handbooks of air pollution prevention and control”, 2002.

RENEWABLE ENERGY RESOURCES (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

The objective of the course is to have in-depth knowledge of renewable energy resources that maybe exploited to meet the energy needs of the country.

Course Outline:

Biomass Sources, Pretreatment of biomass for thermo-chemical conversion, methods of production of fuels from biomass, Gasification and liquefaction of forest products, Biomass volatilization, Pyrolytic reactions and products of biomass, Kinetics of wood gasification, Characterization of peat and biomass liquids, Fermentation to Ethanol and Biogas, Ethanol and Methanol production, Social, economical, and environmental implications, Applied Solar energy, Current status of wind and Tidal energy, Economics of Tidal power, Wind turbines

Lab Outline: N/A

Books Recommended:

1. Overand R. P, Milne T. A, and Mudge L.K, “ Fundamentals of Thermo-chemical Biomass Conversion”, 1985, Elsevier Applied Science publishers, NY, USA, ISBN 0 85334 306 3.
2. Palz W, Chartier P, and Hall D.O,”Energy from Biomass”, 1981, Proceedings of First EC Conference, Applied sciences publishers Ltd. London, UK, ISBN 0 85334 970 3.
3. Hobson P. N, Bousfield S, and Summers R, “ methane production from Agricultural and Domestic waste”, 1981, Applied sciences publishers Ltd. London, UK, ISBN 0 85334 924-X.
4. Report of National Research Council, Committee on Technology Innovation, Board on Science and Technology for International Development, USA, “ Alcohol Fuels-Options for Developing Countries”, 1983, National Academy Press, Washington DC, ISBN 0309 03386 1.

5. Meinel B Aden, and Meinel P. Marjorie, “Applied Solar Energy – an Introduction”, 1976, Addison Wesley publishing Co. London, UK, ISBN 0 201 04719 5.
6. Roger Henri Charlier,” Tidal Energy” 1982, Van Nostrand Reinhold Co. NY, USA, ISBN 0 442 24425 8.
7. Bhadra S.N, Kastha D, and Banerjee S, “Wind Electrical Systems”, 2005, Osford University Press, ISBN 0 195 67093 0.

INDUSTRIAL ENERGY SYSTEMS (Optional Course)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

The course will impart the knowledge of energy system in the process industry that includes heat balances, energy conversion, their performance in an efficient manner, keeping in view the green house gases emissions.

Course Outline:

Introduction to industrial process energy systems: concepts, heat balances, heat distribution systems; local heating vs central heating systems; illustrating example from the pulping industry.

Energy conversion technologies in industrial energy systems: overview of technologies and engineering thermodynamics for process utility boilers, heat pumps, steam turbine combined heat and power (CHP) and gas turbine CHP. Energy conversion performance of such systems for given energy conversion process parameters and given process head load.

Process integration: Basics of process integration methodologies with emphasis on pinch analysis (Pinch temperature, minimum process heating and cooling requirements, composite curves and grand composite curves, targeting for minimum number of heat exchanger units). Design of heat exchanger networks for maximum heat recovery. Process integration principles for high-efficiency energy conversion technologies (heat pumps and combined heat and power units) and energy-intensive chemical separation operations (distillation, evaporation). Energy efficiency and economic performance evaluation of process integration measures. Process integration methodologies for retrofit applications in existing industrial energy systems. Impact of reduced steam demand on electricity production for an industrial process equipped with a steam turbine CHP unit

Economics of energy conversion in industrial energy systems: characteristics of heat pumps and combined heat and power (CHP) units (performance, investment costs). Influence of operating conditions on performance. Optimization of size and various design parameters based on process integration principles. Methodology for identifying the cost-optimal mix of technologies for satisfying a process heat demand, accounting for heat load variation over the course of the year.

Greenhouse gas emissions consequences of energy efficiency measures in industry. Greenhouse gas emissions from industrial energy systems. Optimisation of industrial energy systems considering future costs associated with greenhouse gas emissions. Potential for greenhouse gas emissions reduction in industry. Overview of energy policy instruments and their impact on industrial energy system decision-making.

Lab Outline: N/A

BIOCHEMICAL ENGINEERING (Optional)

Credit hours: 4(3,3,0)
Prerequisites:

Specific objectives of the course:

To develop know how to utilize microbes carryout chemical conversions and to design for above purpose

Course Outline:

Basic of Microbiology; Enzyme Classification; Enzyme reaction kinetics (Single-substrate Reactions) and energy patterns in biological system; Enzyme Inhibition; Non-ideal Enzyme Kinetics, Isolation of enzymes and immobilized enzyme technology; Applications of Enzyme Catalysis (Biocatalysis); Transport phenomenon in microbial system; Design and analysis of biochemical reactors (fermentators); Anaerobic and aerobic metabolism photosynthesis and bio synthesis; biochemical and microbiological application to commercial and engineering;

Books Recommended:

1. Shuler, Michael L., and Fikret Kargi. Bioprocess Engineering: Basic Concepts. 2nd ed. Upper Saddle River, NJ: Prentice Hall PTR, 2001.
2. Blanch, Harvey W., and D. S. Clark, eds. Biochemical Engineering. New York, NY: Marcel Dekker Incorporated, 1997.
3. Bailey, James E., and David F. Ollis. Biochemical Engineering Fundamentals. 2nd edition, McGraw-Hill, Inc., New York, 1986.
4. Lovitt, R., and Jones, M. Biochemical reaction engineering, Coulson and Richardson's Chemical Engineering, Richardson, J.F., and Peacock, D.G (Eds.), 3rd edition, Vol-3, Pergamon Press, London. 1994.
5. Levenspiel, O. Chemical Reaction Engineering, Wiley Eastern Pvt. Ltd., 1999
6. Electronic Journal of Biotechnology < http://www.ejbiotechnology.info/ >
7. Chemical and Biochemical Engineering Quarterly < http://www.pbf.hr/cabeq/ >

BIOCHEMICAL SEPARATIONS (Optional)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To study the techniques involved in the for purification or recovery o product obtained through reactions involved.

Course Outline:

Introduction to the fundamental principles of separation operations for the recovery of products from biological processes; mass transfer coefficients, supercritical fluids flocculation and coagulation; membrane filtration,

chromatography, centrifugation, crystallization, drying, cell disruption, Protein Refolding, extraction, and processes design for recovery of products from biological processes. Application of biotechnology to energy conversion, solid waster and water treatment etc.

Lab Outline: N/A

Books Recommended:

1. Bailey, James E., and David F. Ollis. Biochemical Engineering Fundamentals. 2nd edition, McGraw-Hill, Inc., New York, 1986.
2. Lovitt, R., and Jones, M. Biochemical reaction engineering, Coulson and Richardson's Chemical Engineering, Richardson, J.F., and Peacock, D.G (Eds.), 3rd edition, Vol-3, Pergamon Press, London. 1994.
3. Tutunjian, R. S. "Ultrafiltration Processes in Biotechnology." In Comprehensive Biotechnology. Vol. 2, The Principles of Biotechnology: Engineering Considerations. Edited by C. L. Cooney, and A. E. Humphrey. Elmsford, NY: Pergamon Press Ltd., 1985.
4. Electronic Journal of Biotechnology < http://www.ejbiotechnology.info/ >

BIOCHEMICAL PROCESS AND PRODUCTS (optional)

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

To apply the knowledge in biochemical engineering to develop the processes.

Course Outline:

Application biotechnology in Chemical Industry. Biodegradation. Bio mass productivity & activity, Aerobic & anaerobic processes. Bio-chemical processes involved in the production of food products, beverages, organic acids, industrial solvents, various pharmaceutical products and antibiotic and commercial enzymes.
Fermentation Industries: Industrial alcohol, Biodiesel and industrial solvents. Biodegradable Plastics and other related products. Treatment waste from Food and pharmaceutical Industry, Bioremediation. Food preservation, Health hazards, Hygiene and sanitation. Important food industries in Pakistan. Food legislation: Concept and significance. Food legislation in Pakistan in relation to international laws. Bio-safety regulations

Lab Outline: N/A

Books Recommended:

1. Bailey, James E., and David F. Ollis. Biochemical Engineering Fundamentals. 2nd edition, McGraw-Hill, Inc., New York, 1986.
2. Austin George T. Shreve's Chemical Processes Industries. 6th Ed., McGraw Hill International Edition. 1997
3. Kirk Othmer Encyclopedia of Chemical Technology. Inter Science Publishers. 1999.
4. Government of Pakistan. "Prospects of Chemical Industry in Pakistan" 2003, Export Advisory cell, Ministry of Industries and Production, Islamabad.

5. Electronic Journal of Biotechnology < http://www.ejbiotechnology.info/ >
6. Chemical and Biochemical Engineering Quarterly < http://www.pbf.hr/cabeq/ >

COMPUTER AIDED ENGINEERING DRAWING

Credit hours: 1(0,3,0)
Prerequisites: Nil

Specific objectives of the course:

The course would enable students generate projection mainly orthographic projection, understand tolerance theory & label dimensions, to make subassembly & assembly drawings, missing views ,sectional views. Exposure to threads, bearings Joints etc, uses cad tools for 3D Models & 2d drawings. In addition freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.

Course outline:

Introduction to AutoCAD: User interface, Entity selection, Setting drawing limits, Using the grid and snap, Creating drawing geometry, Modifying drawing geometry, Typed input, Using Ortho, polar and object tracking, Object snapping, Screen manipulation, Transformation commands, Layers, Hatching, Properties, Text creation and editing, Dimension creation and editing, Layouts/paperspace, Plotting

Lab Outline: N/A

Books Recommended:
1. Engineering Drawing and Graphic Technology 14th Edition by T.E. French, C.J. Vierk and R.J. Foster
2. Elementary Engineering Drawing by N.D. Bhatt
3. AutoCAD 2002 User's Guide by Autodesk, Mastering AutoCAD 2002 by George Omura

MAINTENANCE ENGINEERING AND SAFETY

Credit hours: 2(2,0,0)
Prerequisites: Nil

Specific objectives of the course

Plant life depends on its proper maintenance and up keep safety is very essential for any productive unit and it is said that safety and productivity go in hand and hand. The subject prepare the students for above mentioned aims.

Course outline:

Types of maintenance, Preventive, predictive, break down and total productive maintenance. Individual versus group replacement; Internal versus external maintenance. Scheduling of maintenance. Computerized Maintenance. Organization of maintenance force. Design considerations; Layout and construction maintenance of rotary and stationery equipment, inspection

techniques. Non-destructive testing techniques, basic of rigging and lifting. Lubrication and lubricants.
Importance of safety with increased productivity. Overall safety of plant and personnel; Accident and loss statistics. Accident analysis and prevention. Types of accidents in chemical industry. Govt. regulations for industrial safety. Difference between accident and incident. Accident rate calculations and economics of accident prevention. Safety management. Hazard and risk assessment. Accident investigation and case history. Fires and explosions. Fire triangles. Flammability characteristics. Safety equipment, fire fighting equipments and their uses. Occupational diseases related to chemical industry

Lab Outline: N/A

Books Recommended:

1. Maintenance Manager's Standard Manual by Thom as A. Wester-Kamp, Prentice-Hall
2. A Guide to Effective Industrial Safety by Jack W. Boley, Gulf Publishing Company

PRODUCTION & OPERATIONS MANAGEMENT

Credit hours: 3(3,0,0)
Prerequisites: Nil

Specific objectives of the course

To familiarize the students with techniques of management in order to run the project in an efficient and most productive manner

Course outline:

Introduction to Production/Operations Management; The Productivity Challenge: measurement and variables; Achieving Competitive Advantage Through Operations: Competing on differentiation, Cost, and Response. Ten Decisions of OM; System concept; Functions of management; Managerial decision making; Models as decision aids.

Selection of region; Selection of community; Site selection; Location factor dependence; Sources of assistance; Plant location trends; Quantitative analysis; Plant layout; Product & process layout analysis and comparison; Material handling considerations in layout.

Formalized production planning; Production planning methods; Master scheduling; MRP; MRP inputs, MRP outputs; Product structures; Types of MRP; Capacity planning and control; Production control systems; Job shop scheduling; Production control charts; Scheduling techniques; Purchasing and procurement.

Inventory control; types of inventory; Inventory costs; Independent versus dependent demand; EOQ/EPQ models; Types of control systems; Selective inventory control; Inventory system development.

Definition: objectives; procedure; process chart symbols; outline process hcart; flow process charts; multiple activity chart; two handed chart, the principles of

motion economy, two handed process chart, simo chart. critical examination; case studies & application.

Definition; objectives; techniques of work measurement; stop watch time study; timing methods; performance rating; standard timing; allowance factors. Work sampling; confidence level; determination of sample size; making random observation; scope of work sampling. Predetermined time standards; definition; advantages and criticisms; motion classification; TMU; use of PTS system.

Lab Outline:N/A

Books Recommended:

1. Production and Operations Management: Strategies and Tactics by Jay Heizer and Barry Render.
2. Production / Operations Management: Concepts, Structure and Analysis by Richard J. Tersine.

Journals / Periodicals:

World Wide Web:

PROJECT MANAGEMENT

Credit hours: 2(2,0,0)
Prerequisites: Production and Operation

Specific objectives of the course:

Management of the projects is the role of good managers for which he will be running the project with good performance in terms of time and cost

Course outline:

Overview and understanding of Project Management; Project Manager-Line Manager Interface; Defining the role of Project Manager, Functional Manager, Functional Employee's, and Executive's.

Project Management Growth: Concepts and Definitions; Benefits of Project Management, Difference between Systems, Programs, and Projects. Product versus Project Management. Project-Driven & Non-Project Driven Organizations. Maturity and Excellence. Project Life Cycles. Classification of Projects. Project Management Methodologies.
Traditional Organization, Line-Staff Organization, Pure Product Organization, Matrix Organization, Modified Matrix Organization, The Project Organization. Implementation of Project Management. Project-Driven & Non-Project Driven Organizations, Organizational Charts.

Project Planning: Role of Project Manager, Statement of Work, Project Specifications, Work Breakdown Structure, WBS Decomposition Problems; Project Scheduling: Milestone Schedules, Detailed Schedules and Charts, Master Production Scheduling, Bar/Gantt Charts, Project Controlling: Monitoring and Control actions. CPM/PERT: Activities, Events, and Networks; Activity Time Estimates, Critical Path Analysis, Probability of Project Completion. Cost-Time Trade-Offs and Project Crashing. MS Project

Lab Outline: N/A

Books Recommended:

1. Harold Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", Ninth Edition, John Wiley & Sons, 2006.
2. Jay Heizer and Barry Render, "Principles of Operations Management", Third Edition, Prentice Hall, 1999.
3. Jay Heizer and Barry Render, "Operations Management", Fifth Edition, Prentice Hall, 2000.
4. Engineering Economy Analysis Donald G. Newman
5. Industrial Management Methods Ronald Hurst
6. Engineering Economy (8th Edition) DeGarmo, Sullivan, Bontadelli
7. Industrial Organization & Management BETHEL
8. Principles of Management Design Robert E. Parr

Journals / Periodicals:

Word Wide Web: PMI.ORG

ENGINEERING ECONOMICS

Credit hours: 2(2,0,0)
Prerequisites: Nil

Specific objectives of the course

To equip the graduate engineers to identify the economically feasible process in the engineering field

Course Outline:

Engineering economy defined; Measures of financial effectiveness; Non-monetary factors and multiple objectives; principles of engineering economy.

Consumer and producer goods; Measures of economic worth; Price, Supply, & Demand relationship; Production; Factors of production; Laws of return.

Sunk & opportunity costs; Fixed, variable, and incremental costs; Recurring & nonrecurring costs; Direct, indirect, and overhead costs; Standard costs; Breakeven analysis; Unit cost of production; Cost-benefit analysis; Feasibility studies; Value analysis in designing & purchasing.

Simple interest, Compound Interest, Cash flow diagrams, Interest formulas, Nominal versus effective interest rates, continuous compounding.

Purpose of depreciation, types of depreciation, economic life, what can be depreciated?

Present economy, Selection among machines, materials, processes, and designs, Payback period method, Present worth method, Uniform annual cost method, Rate of return method, Alternatives having identical live, Alternatives having different lives.

Manufacturing lead time; Production rate; Capacity; Utilization; Availability; Work in process; WIP and TIP ratios.

Mathematical statement of linear programming problems; Graphic solution; Simplex method; Duality problems.

Types of ownership; types of stock; Partnership & joint stock companies; Banking & specialized credit institutions.

Labour problems; Labour organizations; Prevention & settlement of disputes.

Lab Outline: N/A

Books Recommended:

1- Leland Blank, and Anthony Tarquin, " Engineering Economy", 6th Edition, McGraw Hill, 2005.
2- G. J. Thuesen, and W. J. Fabrycky, "Engineering Economy", 9th Edition, Prentice Hall of India, 2005.
3- Ted G. Eschenbach, "Engineering Economy", 2nd Edition, Oxford University Press, 2003.
4- James L. Riggs, David D. Bedworth, and Sabah U. Randhawa, "Engineering Economics", 4th Edition, Tata McGraw-Hill, 1996.
5- James L. Riggs, and Thomas M. West, "Essentials of Engineering Economics", 2nd Edition, McGraw-Hill, 1986

Journals / Periodicals:
World Wide Web:

APPLIED CHEMISTRY-II (ORGANIC & BIOCHEMISTRY)

Credit hours:
Prerequisites:

Specific objectives of the course:

To apply knowledge of organic chemistry for unit processes in organic synthesis.
To introduce students to Biochemistry.

Course Outline:

Functional groups, Inter conversion of functional groups, Reactions mechanism. Unit Process; Thermodynamics, kinetics, and mechanism, of sulfonation; nitration; hydrogenation; amination; halogenation, oxidation, polymerization

Introduction to Bio-Chemistry, carbohydrates, proteins, lipids, Enzymes and their types, Mode of action of Enzyme, Factors influencing enzymes activity.

Lab Outline:

Practicals to be based on:
Determination of optimum conditions for any unit process.
Preparation of ethers on Semi-batch process.
Preparation of organic compounds.

Books Recommended:

1. Unit Process in Organic synthesis P.H. Groggens McGraw Hill 5th Ed. 1984.
2. Encyclopedia of Chemical Technology Kirk Othner Inter - Science Publisher (1999)

3. Shreve's Chemical Process Industries, G.T. Austen, McGraw Hill 1995.
4. Riegels Handbook of Industrial Chemistry, James A. Kent 10th Ed. Springer/Van Nostrard Reinhold, 2003.

APPLIED CHEMISTRY-I (INORGANIC AND ANALYTICAL)

Credit hours
Prerequisites

Specific objectives of the course

To enhance the knowledge of Inorganic and Analytical chemistry and their reaction with process industry.

Course Outline:

Overview of periodic table: molecular orbital theory: Chemistry of solutions: Chemistry of transition metals, coordination compound and radioactive elements. Crystalline state of metals and lattice structure. Industrial inorganic Chemistry. Qualitative and group theory of inorganic Chemistry. Electrochemistry, including fuel cells

Introduction to instrumental techniques involving potentiometery, pH-Metery: liquid solid chromatography: high performance liquid chromatography, ion exchange, gas chromatography, plane chromatography. Spectroscopy, Basics of spectroscopy UV and visible spectroscopy, atomic absorption spectroscopy

Books Recommended:

1. Inorganic Chemistry, Gary L. Miessler, Donald A. Tarr, Prentice-Hall, 2003
2. Analytical Chemistry, G.L. Hargis, Prentice Hall Inc. 2000.
3. Analytical Chemistry, G.D. Christian, J. Wiley 6th Ed. 2003
4. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, FJ. Holler 7th Ed. Harcourt Asia 2001.
5. Richard M Pashley; Marilyn E Karaman. “Applied Colloid and Surface Chemistry”. John Wiley and Sons, Ltd.2004

Lab Outline:

Practical are based on, Inorganic Preparations Qualitative analysis,
Preparation of standard solution by ion exchange chromatography,
Trace amount determination by spectrophotometer, Conductrometric titrations, Potentiometer titrations

MATHEMATICAL METHODS

Credit hours: 3(3,0,0)
Prerequisites

Specific objectives of the course:

To provide in-depth knowledge of mathematical methods

Course Outline:

Rectangular Coordinate Systems in three dimension, direction cosines, plane (straight line) and sphere. Taylor's Theorem for functions of two variables without proof. Maxima and minima of functions of two variables. Lagrange's method of multipliers. Double integration, change of order, conversion to polar form. Applications in finding areas, volumes, centroids, centre of pressure. Movement of inertia and principal axes. Theorems of Pappus and Guldinus. Surface area and volumes of revolution. Differentiation of vectors, gradient, divergence and curl. Laplacian and spherical harmonies. Vector integration. Theorems of Gauss, Green and Stokes. Simple applications. Linearity, dependent and independent vectors, bases and dimension, vector spaces, fields, linear transformations, matrix of a linear transformation. Basic definitions and matrix operations, adjoin and inverse of a 3 x 3 matrix. Rank of a matrix. Cayley-Hamiltion Theorem, Eigen values. Applications in solving linear homogeneous and non-homogeneous equations in three unknowns. Cases of existence of solution, no solution, infinite and unique solutions.
Cartesian Tensors, understanding

Lab Outline: N/A

Recommended Books:

1. Peter B. Kahn, "Mathematical Methods" Courier Dover Publications, 2004, ISBN 0486435164
2. Howard Anton, "Elementary Linear Algebra" 7th ed., John Willey, 1993
3. Sadri Hassani, "Mathematical Methods", Springer, 2000, ISBN 0387989587
4. Carl M. Bender, Steven A. Orszag "Advanced Mathematical Methods for Engineers", Springer, 1999 ISBN 0387989315

STATISTICAL METHODS & ESTIMATION

Credit hours: 3(3,0,0)
Prerequisites:

Specific objectives of the course:

Course Outline:

Statistical treatment of data, frequency distribution and graphs, measures of central tendency, measures of variation. Probability, samples, spaces and events, counting probability, the axioms of probability, some elementary theorems, conditional probability, Bay's theorem, mathematical expectation and decision making. Probability distribution, random variables, the binomial distribution, Poisson approximation to the binomial distribution, Poisson processes, probability densities, normal distribution, statements "T" distribution. Sampling distribution, populations and samples. Curve fitting regression analysis by least square method, correlation, linear, polynomial, power, regression analysis by least square method, incorporation of linear polynomial, exponential or power function. Correlation coefficient of determination. Application and exponential model of reliability and life testing.

Lab Outline: N/A

Books Recommended:

1. Jyotiprasad Medhi “Statical Methods”, New Age Publishers, 2005, ISBN 8122404197
2. Kenneth. Lange, “Statical Methods”, Springer, 2002, ISBN 0387953892
3. Montgomery, D.C., and Runger, G.C., “Applied Statistics and Probability for Engineers”, John Wiley & Sons, 2001
4. N. A. Weiss, “Introductory Statistics”, Addison Wesley, 1995

Journals/Periodicals
World Wide Web

MATHS I (CALCULUS & STATISTICS)

Credits: 3(3,0,0)3
Prerequisite: None

Objectives of the Course:

To develop understanding with the concepts of calculus and analytic geometry and the applications of these concepts to the solution of engineering problems. Statistics applicable to Engineering problems is also taught.

Course Outline:

Introduction to functions, introduction to limit, derivatives and their applications, integral calculus with applications, vecor algebra, vector calculs, introduction to analytical geometry, straight line in R3, planes, cylindrical and spherical coordinates, surfaces, cylinders and cones, spherical trigonometry.
Stratistical treatment of data. Probability analysis and distribution including random variables, binomial distribution, poisson approximation to binomial distribution, Probability density function. Sampling distribution. Regression analysis by least sq. method.

Lab Outline: N/A

Books Recommended:

1. George B. Thomas and Ross L. Finney, “Calculus and Analytic Geometry, Addison-Wesley, ISBN: 0201531747.
2. George F. Simmons, “ Calculus with Analytic Geometry”, McGraw-Hill, ISBN: 0070576424.
3. Gerald B. Folland, “Advanced Calculs”, Prentice Hall, ISBN: 0130652652.
4. Monty J. Strauss, Gerald L. Bradley and Karl J. Smith, “Calculus”, Prentice Hall, ISBN: 0130918717.

MATHS II (DIFFERENTIAL EQUATIONS)

Credits: 3(0)3
Prerequisite: Maths I

Objectives of the Course:

Introduce differential equations and teach methods to solve first and second order differential equations.

Course Outline:

Differential equations of first order: Differential equations and their classification, formation of differential equations, solution of differential equations initial and boundary conditions.

Methods of solution of differential equation of first order and first-degree: Separable equations, homogenous equations, equations reducible to homogenous, exact differential equations, integrating factor, linear equations, Bernoulli equations, orthogonal trajectories in Cartesian and polar coordinates, application of first order differential equations. Non linear first order differential equations.

Higher order linear differential equations: Homogeneous linear equations of order n with constant coefficients, auxiliary/characterisitics equations. Solution of higher order differential equation according to the roots of auxiliary equation. Non-homogenous linear equations. Working rules for finding particular integral. Cauchy Euler Equation.

Matrices: Addition & multiplication of matrices, determinant of matrices. Hyperbolic and inverse Hyperbolic functions.

Lab Outline: N/A

Books Recommended:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, ISBN: 0471728977.
2. John Polking, Al Boggess, & David Arnold “Differential Equations”, Prentice Hill, ISBN: 0131437380
3. Stephen Goode, “Differential Equations and Linear Algebra”, Prentice Hill, ISBN: 013263757X.

MATHS III (DIFFERENTIAL EQUATIONS & APPLIED TECHNIQUES)

Credit hours: 3(3,0,0)
Prerequisites: Maths II

Specific objectives of the course:

To focus use and application of differential equations in the areas relevant to process.

Course Outline:

Solution of first-order ODE's by analytical, graphical and numerical methods; Linear ODE's, especially second order with constant coefficients; Undetermined Coefficients and Variation of Parameters; Sinusoidal and Exponential Signals: Oscillations, Damping, Resonance; Complex Numbers and Exponentials; Periodic Solutions; Delta Functions, Convolution, and Laplace Transform Methods; Matrix and First-order Linear Systems. Eigenvalues and Eigenvectors; and Non-linear Autonomous Systems: Critical Point Analysis and Phase Plane Diagrams, heuristic derivation of examples of partial differential equations taken from heat conduction, vibration problems, electromagnetism, etc. separation of variables, application to boundary value problems.

Lab Outline: N/A

Books Recommended:

1. Edwards, C., and D. Penney. *Elementary Differential Equations with Boundary Value Problems*. 6th ed. Upper Saddle River, NJ: Prentice Hall, 2003.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley, 2006

NUMERICAL ANALYSIS AND SOFTWARE APPLICATION:

Credit hours: 3(2,3,0)
Prerequisites: Maths I, Maths II & III

Specific objectives of the course:

To enable students using structured programming techniques in suitable programming languages and implement numerical solutions using MATLAB.

Course Outline:

Finite difference and theory of interpolation, iterative methods, Taylor, Newton Series etc, Approximation zeros (roots) numerical integration and differentiation. Iterative methods for solution of linear systems, design value problems, numerical solutions of ordinary differential equations.
Matlab Primer: Introduction to Matlab, Linear algebra applications: matrix calculations, solution of linear equations, Eigen value calculation. Ploting of various types of graphs using ezplot and plot functions. Symbolic mathematics: symbolic differentiation and solution of differential equations. Numerical solution / calculation of integrals, derivatives and differential equations. Transfer function manipulation and study of transient response of various first and second order systems, plotting Bode and Root Locus diagrams. Introduction to Simulink, simulation of a typical feedback control loop in Simulink.

Lab Outline: N/A

Books Recommended:

1. Zhilin Li, Lubin & Vulkov, Jerzy Wasniewski, “Numerical analysis and its applications”, Springer, 2005, ISBN 3540249370.
2. Michelle Schatzman, “Numerical Analysis” Oxford University Press, 2002, ISBN 0198508522.
3. Steven T. Karris, “Numerical Analysis” Orchard Publications, 2004, ISBN 0974423912.

RECOMMENDATIONS

1. Four Academic years should be the duration of the Curriculum for BE/BS/B.Sc in Chemical Engineering

2. The minimum number of teaching weeks per semester year should be 18.

3. The minimum number of contact hours for the theory, practical and tutorial should be so determined as to make a total of 130 credit hours.

4. or this purpose one theory hour should be one credit hours; two to three practical hours should be one credit hour and tutorial is zero credit hours.

5. The Practical/Lab work should comprise at least one third of the total credit hours.

6. All the Universities/Institutions should make arrangements for practical training of their students in industrial organizations during summer vacations specially in the Third Year.

7. The students should be evaluated during the session through tests, quizzes and assignments followed by a comprehensive examination at the end of the year.

8. A minimum of 75% attendance should be made compulsory for all years.

Annex "A"

COMPULSORY COURSES IN ENGLISH FOR BE/BSc IN ENGINEERING DISCIPLINE

Semester I

Functional English

Objectives: Enhance language skills and develop critical thinking.

Course Contents

Basics of Grammar
Parts of speech and use of articles
Sentence structure, active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

Comprehension
Answers to questions on a given text

Discussion
General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening
To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills
Urdu to English

Paragraph writing
Topics to be chosen at the discretion of the teacher

Presentation skills
Introduction

Note: Extensive reading is required for vocabulary building

Recommended books:

1. Functional English

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

Semester II

Communication Skills

Objectives: Enable the students to meet their real life communication needs.

Course Contents

Paragraph writing
Practice in writing a good, unified and coherent paragraph

Essay writing
Introduction

CV and job application

Translation skills
Urdu to English

Study skills
Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills
Letter/memo writing, minutes of meetings, use of library and internet

Presentation skills
Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended books:
Communication Skills

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by Riachard Yorky.

Semester III

Technical Writing and Presentation Skills

Objectives: Enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

Academic writing
How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended books:
Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).

2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.

3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills

c) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editiors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Annex "B"

Pakistan Studies (Compulsory)

(A Compulsory Subject for Degree Students)

Introduction / Objectives

Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. **Historical Perspective**
   a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
   b. Factors leading to Muslim separatism
   c. People and Land
      i. Indus Civilization
      ii. Muslim advent
      iii. Location and geo-physical features.

2. **Government and Politics in Pakistan**

   Political and constitutional phases:
   a. 1947-58
   b. 1958-71
   c. 1971-77
   d. 1977-88
   e. 1988-99
   f. 1999 onward

3. **Contemporary Pakistan**
   a. Economic institutions and issues
   b. Society and social structure
   c. Ethnicity
   d. Foreign policy of Pakistan and challenges
   e. Futuristic outlook of Pakistan

Books Recommended

1. Burki, Shahid Javed. *State & Society in Pakistan,* The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy.* Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development.* Lahore, 1994.
5. Wilcox, Wayne.*The Emergence of Banglades.,* Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota,* Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development.* Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh.* Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

Annex "C"

ISLAMIC STUDIES

(Compulsory)

Objectives:

This course is aimed at:

1 To provide Basic information about Islamic Studies
2 To enhance understanding of the students regarding Islamic Civilization
3 To improve Students skill to perform prayers and other worships
4 To enhance the skill of the students for understanding of issues related to faith and religious life**.**

DETAIL OF COURSES

INTRODUCTION TO QURANIC STUDIES

1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul -Quran

STUDY OF SELLECTED TEXT OF HOLLY QURAN

1) Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

STUDY OF SELLECTED TEXT OF HOLLY QURAN

1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

SEERAT OF HOLY PROPHET (S.A.W) I

1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

SEERAT OF HOLY PROPHET (S.A.W) II

1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

INTRODUCTION TO SUNNAH

1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

SELLECTED STUDY FROM TEXT OF HADITH

INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE

1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

ISLAMIC CULTURE & CIVILIZATION

1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

ISLAM & SCIENCE

1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quranic & Science

ISLAMIC ECONOMIC SYSTEM

1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

POLITICAL SYSTEM OF ISLAM

1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

ISLAMIC HISTORY

1) PERIOD OF KHLAFT-E-RASHIDA
2) PERIOD OF UMMAYYADS
3) PERIOD OF ABBASIDS

SOCIAL SYSTEM OF ISLAM

1) BASIC CONCEPTS OF SOCIAL SYSTEM OF ISLAM
2) ELEMENTS OF FAMILY
3) ETHICAL VALUES OF ISLAM

REFERENCE BOOKS:

1) Hameed ullah Muhammad, "**Emergence of Islam**" , IRI, Islamabad
2) Hameed ullah Muhammad, "**Muslim Conduct of State**"

3) Hameed ullah Muhammad, '**Introduction to Islam**
4) Mulana Muhammad Yousaf Islahi,"
5) Hussain Hamid Hassan, **"An Introduction to the Study of Islamic Law"** leaf Publication Islamabad, Pakistan.
6) Ahmad Hasan, **"Principles of Islamic Jurisprudence"** Islamic Research Institute, International Islamic University, Islamabad (1993)
7) Mir Waliullah, **"Muslim Jrisprudence and the Quranic Law of Crimes"** Islamic Book Service (1982)
8) H.S. Bhatia, **"Studies in Islamic Law, Religion and Society"** Deep & Deep Publications New Delhi (1989)
9) Dr. Muhammad Zia-ul-Haq, **"Introduction to Al Sharia Al Islamia"** Allama Iqbal Open University, Islamabad (2001)

COURSES FOR SOCIAL SCIENCE

Sociology and Development

Objectives: The main objective of this course is to apprise potential engineers about social factors that contribute towards enhancing their professional performance for the good of society and the country. This course is culture specific and has to be taught within the context of local and national socio-economic environment. The engineers are expected to supervise several people in different capacities and their understanding about human behaviour is critical for their optimum performance. Modification of human behaviour or getting work done from sub-ordinates and seniors remain a major challenge for all the professional engineers. This course will enhance understanding about the determinants of human behaviour, which ultimately will result in improved individual efficiency.

Course Contents

1. Introduction to Sociology
- 1.1 What is sociology?
- 1.2 Nature, scope, and importance of sociology
- 1.3 Social interactions
- 1.4 Social groups
- 1.5 Social institutions

2. Culture and Related Concepts
- 2.1 Definition of culture
- 2.2 Types of culture
- 2.3 Elements of culture
- 2.4 Role of culture in organization
- 2.5 Socialization and personality

3. Interpersonal Relations
- 3.1 Interpersonal behaviour
- 3.2 Formation of personal attitudes
- 3.3 Language and communication
- 3.4 Motivations and emotions
- 3.5 Public opinion

4. Social Stratification
- 4.1 Factors of social stratification
- 4.2 Caste and class
- 4.3 Power, prestige, and authority
- 4.4 Social mobility
- 4.5 Migration

5. Human Ecology
- 5.1 Ecological processes
- 5.2 Ecosystem and energy
- 5.3 Ecosystem and physical environment
- 5.4 Solid waste disposal
- 5.5 Pollution

6. Population Dynamics
- 6.1 World population growth and distribution

6.2 Population dynamics in Pakistan
6.3 Causes and consequences of urbanization
6.4 Population policy in Pakistan
6.5 Population and development

7. Community Development

7.1 Meaning, scope, and subject matter of community development
7.2 Processes of community development
7.3 Community development programs in Pakistan
7.4 Community organization and related services
7.5 Cooperation and conflict in community development

8. Deviance and Crime

8.1 Crime as a social and cultural phenomenon
8.2 Crime and social organization
8.3 Organized crime
8.4 Culture based crime
8.5 Economics of crime

9. Sociology of Change and Development

9.1 What is social change and development?
9.2 Dynamics of social change
9.3 Role of NGOs in development
9.4 World system and development
9.5 Gender and development

Recommended Readings

1. *Allport, G. W. (1985). The Historical Background of Modern Social Psychology. New York, Random House.*
2. *Bernard, A. and T. Burgess (2004). Sociology, Cambridge University Press.*
3. *DuBrin, A. J. (2007). Human Relations: Interpersonal Job Oriented Skills. New York, Prentice Hall.*
4. *Gardezi, H. N., Ed. (1991). Understanding Pakistan: The Colonial Factor in Societal Development. Lahore, Maktaba Fikr-o-Danish.*
5. *Hafeez, S. (1991). Changing Pakistan Society. Karachi, Royal Book Company. Gardezi, H. N., Ed. (1991).*
6. *Jones, G. W. (2005). "Why are Population and Development Issues not Given Priority?" Asia-Pasific Population Journal 20(1).*
7. *Macionis, J. J. (1999). Sociology 7th Edition, National Book Foundation, Islamabad*
8. *Maser, C. (1997). Sustainable Community Development: Principles and Concepts. Plorida St. Lucie Press.*
9. *Nelson, N. and S. Wright (1995). Power and Participatory Development: Theory and Practice. London, Intermediate Technology Publications.*
10. *Syed, S. H. (2003). The State of Migration and Multiculturalism in Pakistan: The Need for Policy and Strategy. Islamabad, UNESCO: 1-30.*
11. *Utton, A. E. (1976). Human Ecology, West View Press.*
12. *Webster, A. (1990). Introduction to Sociology of Development. London, Nacmillan Education Ltd.*
13. *Weiss, A. M. (2001). Power and civil society in Pakistan, Oxford University press.*

Social Anthropology

Objectives: The students are expected to learn anthropological skills for application by professional engineers and other related practitioners. Societal growth needs are to be understood within our own cultural environment. Such a body of applied knowledge will result in improving the professional performance of would-be engineers. As culture and society play an important role towards all human activities, this course will help students relate technical skills to the societal needs and requirements.

Course Contents

I Introduction

1. Anthropology and social anthropology
2. Fields of anthropology
3. Anthropological research methods
4. Social anthropology and other social sciences
5. Significance of social anthropology

II Culture

1. Definition, properties and taxomony
2. Evolution of growth and culture
3. Evolution of man: Religious and modern perspectives
4. Evolution of culture
5. Culture and personality

III Evolution and Growth of Culture

1. Evolution of man
2. Schools of thought in cultural anthropology
3. Acculturation
4. Enculturation
5. Ethnocentrism and xenocentrism

IV Language and Culture

1. Communication
2. Structural linguistics
3. Historical linguistics
4. Relationship between language and culture
5. Ethnography

V Economic System

1. Global economic system
2. The allocation of resources
3. The conversion of resources
4. The distribution of goods and services
5. Poverty and inequality

VII Marriage and Family

1. Marriage and mate selection
2. The family: Types and functions
3. Kinship system
4. Structure and function of family
5. Gender Relations

VIII Political Organization

1. Political sociology
2. Origin of political organization and organizational system
3. Types of political organizations
4. Power politics and factionalism in Pakistan
5. Resolution of conflict

IX Religion and Magic

1. The universality of religion
2. Comparative religions
3. Religion and society
4. Religious beliefs and practices
5. Witchcraft and sorcery

XI Culture Change

1. Forms of art
2. Expressive culture
3. Process of cultural change
4. Cultural change in the modern world
5. Cultural change in Pakistani society

Recommended Books

1. *Ahmad, Akbar S. 1990. Pakistani Society, Karachi, Royal Books Co.*
2. *Bernard, H. Russel. 1994. Research Methods in Anthropology, Qualitative and Quantitative Approaches. London: Sage Publications*
3. *Bodley, John H. 1994. Cultural Anthropology, California: Mayfield Publishing Co.*
4. *Brogger, Jan. 1993. Social Anthropology and the Lonely Crowd. New Delhi: Reliance Publishing*
5. *Ember, Carol R. & Ember Melvin. 2005. Anthropology, 11th ed. Englewood Cliffs: Prentice Hall, Ince. Harper and Row*
6. *Harris Marvin. 1987. Cultural Anthropology. New York: Harper and Row*
7. *Harris Marvin. 1985. Culture, People, nature; An Introduction to General Anthropology London: Harper and Row*
8. *Haviland, W. A. (2005). Anthropology: The Human Challenge. New York, Thomson Learning Inc.*
9. *Hertzler J. O. 1981. The Social Structure of Islam. Cambridge: Cambridge University Press.*
10. *Keesing, Roger m. 1998. Cultural Anthropology: A contemporary perspective. 3rd ed. New York: Harcourt Brace College Publishers.*
11. *Kottak, Conard Phillip. 2002. Anthropology: The Exploration of Human Diversity. 9th ed. Boston: McGraw Hill Higher Education.*
12. *Kennedy, Charles H. 1992. Pakistan London: Westview Press,.*
13. *Marron, Stanley. 1057. Pakistani Society and Culture. New Heaven*
14. *Wilson, Richard A. 1996. Human Rights, Culture and Context: Anthropological Perspective. London: Pluto Press.*

Understanding Psychology and Human Behaviour

Course Contents

- What is psychology?
- Nature, scope and application with special reference to Pakistan
- Different schools of psychology
- Methods of psychology
- Learning
- Intelligence and artificial intelligence
- Personality and its assessment
- Understanding maladjustive behaviour
- Positive emotional states and processes
- Stress management and anger management

Books Recommended

1. Atkinson R.C., & Smith E.E. (2000), Introduction to Psychology (13th ed.), Harcourt Brace College Publishers.
2. Fernald, L.D., & Fernald, P.S. (2005), Introduction to Psychology, USA: WMC Brown Publishers.
3. Hergenhahn, B.R. (2001). An Introduction to the History of Psychology, New York: Wadsworth.
4. Goodwin, C.J, (2000) Research in Psychology: Methods and Design, (3rd ed.), New York: John Wiley & Sons.
5. Synder, C.R., & Lopez, S.J. (2007) Positive Psychology, USA, Sage Publications.
6. Allen, B.P. (1997), Personality Theories: Development, Growth and Diversity, (2nd Ed.), Boston: Allyn & Bacon.
7. Cohen, R.J., & Swerdlik, M.E. (2005) Psychological Testing & Assessment (6th ed.), New York: McGraw-Hill.
8. Corcini, R., (2000). Current Psychotherapies. London: Thompson & Co Publishers.
9. Comer, R.J. (2004). Abnormal Psychology, USA: Freeman & Company.
10. Schwartz, B., Wassernman, E., & Robbins, S. (2002), Psychology of Learning and Behaviour, 5th Ed. Norton and Company.

Professional Psychology

Course Contents

- Introduction to professional psychology
- Psychological testing
- Educational psychology
- Industrial/organizational psychology
- Social psychology
- Health psychology
- Clinical psychology
- Positive psychology
- Legal, ethical, and professional issues.

Books Recommended

1. Crow, L., & Crow, A. (2000) Educational Psychology, New Delhi: Eurosia Publishing House Ltd.
2. Spiegel, P.K., & Koocher, G.P. (1998), Ethics in Psychology, New York: Oxford University Press
3. Snyder, C.R., & Lopes, S.J. (2000), Handbook of Positive Psychology, New York: Oxford University Press.
4. Compton, W.C. (2005), Introduction to Positive Psychology, USA, Thomson Wadsworth.
5. Debra, L.N. & James Compbell Quick, (2000) Organizational Behaviour (3rd ed), Cincinnat: South Western.
6. Fred Luthans, Alexander, D.S. & Edwin, A. Locke (2000) (Eds), Handbook of Principles of Organizational Behaviour, London: Blackwell.
7. Brannon, L.& Reist, J. (2000), Health Psychology: An Introduction to Behaviour and Health (4th ed.), USA Wadsworth.
8. Donohue, W. & Ferguson, K. (Eds), (2003), Handbook of Professional Ethics for Psychologists; Issues, Questions and Controversies, London: Sage Publications.
9. Meyers, D. (2005), Social Psychology, 8th Ed. McGraw Hill Inc.
10. Cooper, J. & Hogg, M. (2003) Handbook of Social Psychology, Sage Publications
11. Halgin, R.P., Whitbourne, S.K., & Halgin, R. (2004), Abnormal Psychology: Clinical Perspectives on Psychological Disorders, New York: McGraw Hill.
12. Thorndike R.L., & Hage, E.P. (1995), Measurement and Evaluation in Psychology and Education (4th Ed), New York, MacMillan.

Organizational Behaviour

Course Contents

- Introduction to organizational behaviour
  - Organizational disciplines and topics
  - Psychological perspective
  - Social-psychological perspectives

- Structure and control in organization
  - Introduction
  - Bureaucracy
  - Managerial work
  - Contingency theory
  - Organizational design

- Individual and work learning
  - Learning theories
  - Learning and work

- Stress
  - Types of stress and work
  - Occupational stress management

- Individual differences
  - Personality and its factors

- Personality dimensions and social learning
- Intelligence

- Motivation and job satisfaction
  - Needs at work
  - Theories of motivation and job satisfaction
  - Correlates of job satisfaction
  - Correlates of job satisfaction

- Group and work
  - Social interaction
  - Dramaturgy and impression management
  - Social skill

- Group and inter-group behaviour
  - Group structure and norms
  - Group processes
  - How throne studies

- Leadership
  - Leadership as an attribute
  - Leadership style

- Patterns of work
  - Work-the classical approach
  - Marx, Weber, and the critique of labor
  - Foucault and disciplinary power

- Conflict and consent in work
  - The labor process debate
  - Work place control and resistance
  - Industrial conflict and industrial relations

- Organizational culture
  - Organizational culture and strategic management
  - Exploring organizational culture
  - Evaluating concept of culture

Books Recommended:

1. Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3rd Oxford.
2. Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. (2006), Human Resource Management, 5th ed., McGraw Hill.
3. Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGraw Hill.
4. Luthan Fred, (2005), Organizational Behaviour, McGraw Hill Inc.
5. Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.

INTRODUCTION TO SOCIOLOGY

Course Contents

- The Nature of sociology
  - The study of social life
  - Exploring the global village
  - Sociology as a science
  - The sociological imagination
  - The development of sociology
  - Pioneers of sociology
  - Nature, scope and subject matter of sociology
  - Brief historical development of sociology
  - Society and community
  - Relationship with other social sciences
  - Social interaction processes

- Social groups
  - Definition and functions
  - Types of social groups

- Social institutions
  - Definition
  - Structure and function of social institutions
  - Inter-relationships among various social institutions

- Culture and related concepts
  - Definition and aspects of culture
  - Elements of culture
  - Organization of culture
  - Other concepts, cultural relativism, sub cultures, ethnocentrism, culture lag

- Socialization and personality
  - Role and status
  - Socialization
  - Culture and personality

- Deviance and social control
  - Definition and types of deviance
  - Juvenile delinquency
  - Formal and information methods of social control

- Social stratification
  - Approach to study social stratification
  - Caste class and race as basics of social stratification

- Major perspectives in sociology
  - Functionalist perspective
  - Conflict perspective
  - Interactionstic perspective

- Social control and deviance
  - Agencies of social control

- Social stratification
  - Determinants of social stratification
  - Social mobility, types and definition
  - Dynamics of social mobility

- Concept of social movement
  - Theories of social movement
  - Social and cultural change

- Social and cultural change
  - Definition of social change
  - Dynamics of social change
  - Impact of globalization on society and culture
  - Resistance to change

- Collective behaviour
  - Definition
  - Characteristics
  - Causes
  - Types
  - Social movements
  - Mob and crowd behaviour

Books Recommended

1. Neulreck, Kenneth, J. 2005, Sociology: Diversity, Conflict and Change, Boston
2. Barnard, Andy. 2004. Sociology, Cambridge University Press
3. Giddens, Anthony, 2004, Sociology 4th edition, Cambridge Polity Press
4. Albrow, Martin, 2003, Sociology, London Routledge.
5. Richard, T. Schaefer, 2003, Sociology5th edition, McGraw Hill College
6. Kendall, Diana, 2004. Sociology in our Times, 4th ed, Wadsworth
7. Tyler Melissa, Wallace Claire & Abbott Pamela, 2005, An Introduction to Sociology, 3rd ed. Routledge.

Critical Thinking

Course Contents

- The Power of critical thinking
  - Claims and reasons
  - Reasons and arguments
  - Arguments in the rough

- The Environment of critical thinking
  - Perils of haunted mind
  - Self and the power of the group
  - Subjective and social relativism
  - Skepticism

- Making sense of arguments
  - Arguments basics
  - Patterns
  - Diagramming arguments

- Assessing long arguments

- Reasons for belief and doubt
  - Conflict experts and evidence
  - Personal experience
  - Fooling ourselves
  - Claims in the news

- Faulty reasoning
  - Irrelevant premises
  - Genetic fallacy, composition, division
  - Appeal to the person, equivocation, appeal to popularity
  - Appeal to tradition, appeal to ignorance, appeal to emotion
  - Red herring, straw man

- Unacceptable premises
  - Begging the question, false dilemma
  - Slippery slope, hasty generalization
  - Faulty analogy

- Deductive reasoning: Propositional logic
  - Connectives and truth values
  - Conjunction, disjunction, negation
  - Conditional, checking for validity
  - Simple arguments, tricky arguments
  - Streamlined evaluation

- Deductive reasoning: Categorical logic
  - Statements and classes
  - Translations and standard form
  - Terms, quantifiers
  - Diagramming categorical statements
  - Sizing up categorical syllogisms

- Inductive reasons
  - Enumerative induction
  - Sample size, representativeness, opinion polls
  - Analogical induction
  - Casual arguments, testing for causes
  - Casual confusions

- Inference to the best explanation
  - Explanations and inference
  - Theories and consistency
  - Theories and criteria
  - Testability, fruitfulness, scope, simplicity
  - Conservatism

- Judging scientific theories
  - Science and not science
  - The scientific method, testing scientific theories
  - Judging scientific theories
  - Copernicus versus Ptolemy, evolution versus creationism
  - Science and weird theories

- Making weird mistakes
- Leaping to the weirdest theory, mixing what seems with what is
- Misunderstanding the possibilities
- Judging weird theories
- Crop circles, talking with the dead

BOOKS RECOMMENDED

1. Vaughn Lewis, 2005, The Power of Critical Thinking, Oxford University Press.

2. Paulsen David W., Cederblom Jerry:2000, Critical Reasoning, Wadsworth
3. Restall Greg. 2005, Logic: An Introduction, Routledge

Introduction To Philosopy

Course Contents

- Definition and nature of philosophy
- Theory of knowledge
  - Opinion and knowledge
  - Plato, the republic selection
  - Knowledge through reason
  - Descartes meditation on first philosophy
  - Knowledge through experience
  - Hume an Inquiry concerning human understanding (Selection)
  - Experience structured by the mind
  - Kant critique of pure reason (Selection)
  - Knowing and doing
  - James pragmatism (Selection)
  - Knowledge and emotion
  - Jaggar love and knowledge (Selection)

- Philosophy of religion
  - Proving the existence of God
  - Anselm, Aquinas, Paley, Dawkins (Selection)
  - Justifying religious beliefs
  - Pascal Pensees (Selection)
  - James The will to believe selection
  - Freud The future of an illusion (Selection)
  - Confronting the problems of evil
  - Mackie Evil and omnipotence (Complete)
  - Hick Philosophy of religion (Selection)

- Metaphysics
  - Idealism and materialism
  - Berkeley Three dialogues between Hylas and Pholonous (Selection)
  - Armstrong Naturalism, materialism and first philosophy (Selection)
  - The mid-body problem
  - Descartes Meditations on first philosophy (Selection)
  - O'Hear Introduction to the philosophy of science (Selection)
  - Dennett The origins of selves (Complete)

- Pali Canon (Selection)
- Penelhum Religion and rationality (Selection)

- Freedom to Choose
  - Libertarianism
  - James The dilemma of determinism (Selection)
  - Taylor Metaphysics (Selection)
  - Determinism
  - Hospers Meaning and free will (Selection)
  - Skinner Walden Two (Selection)
  - Compatibilism
  - Stace Religion and the modern mind (Selection)
  - Radhakrishnan Indian philosophy (Selection)

- Ethics
  - Fulfilling Human Nature
  - Aristotle Nicomachean Ethics (selection)
  - Loving God
  - Augustine The Morals of the Catholic Church and the City of God (Selection)
  - Following Natural Law
  - Aquinas Summa Theologiae (Selection)
  - Doing One's Duty
  - Kant Fundamental Principles of the Metaphysics of Morals (Selection)
  - Maximizing Utility
  - Mill Utilitarianism (Selection)
  - Turning Values of Upside Down
  - Nietzsche Human, All too Human and Beyond Good and Evil (Selection)
  - Creating Ourselves
  - Sartre Existentialism is a Humanism (Selection)
  - Hearing the Feminine Voice
  - Gilligan In a Different Voice (Selection)
  - Baier What do Women Want in a Moral Theory (Selection)

- Political and Social Philosophy
  - The State as Natural
  - Plato the Republic (Selection)
  - Aristotle Politics (Selection)
  - The State as a Social Contract
  - Hobbes Philosophical Rudiments Concerning Government and Society (Selection)
  - Locke the Second Treatise of Government (Selection)
  - Liberty of the Individual
  - Mill On Liberty (Selection)
  - Alienation in Capitalism
  - Marx Economic and Philosophic Manuscripts of 1844 (Selection)
  - Justice and Social Trust
  - Rawls A Theory of Justice (Selection)
  - Nozick Anarchy, State, and Utopia (Selection)
  - Held Rights and Goods (Selection)
  - Women in Society
  - Wollstonecraft A Vindication of the Rights of Women (Selection)
  - De Behaviour The Second Sex (Selection)

- The Value of Philosophy
- Russel The Problems of Philosophy (Selection)
- Midgley Philosophical Plumbing (Selection)

BOOKS RECOMMENDED

1. Abel Donald C., Stumpf Samuel Enoch, 2002. Elements of Philosophy: An Introduction, 4th Ed. McGraw Hill.
2. Scruton Roger, 2001. A short History of Modern Philosophy, 2nd ed. Routledge.

MANAGEMENT COURSES

Entrepreneurship

Objective:

Entrepreneurship is an important component in the process of economic development. The purpose of this course is to analyse the theories of entrepreneurship and to go for case studies of successful entrepreneurs.

Course Contents:

Introduction: The concept of entrepreneurship, The economist view of entrepreneurship, The sociologist view, Behavioural approach, Entrepreneurship and Management

The Practice of Entrepreneurship: The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, The new venture

Entrepreneurship and Innovation: The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, The innovation process, Risks involved in innovation

Developing Entrepreneur: Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, The environment, Socio cultural factors, Support systems

Entrepreneurship Organization: Team work, Networking organization, Motivation and compensation, Value system

Entrepreneurship and SMES: Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs

Entrepreneurial Marketing: Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design

Entrepreneurship and Economic Development: Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience

Case Studies of Successful Entrepreneurs

Text Books:

- Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship
- P.N. Singh: Entrepreneurship fo0r Economic Growth
- Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker
- John B. Miner: Entrepreneurial Success

Principles Of Management

Objectives:

This is a rudimentary course for the students of business administration. The focus of attention will be given to learning fundamental principles of management and of managing people and organization in a historical as well as contemporary world. Students are expected to develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

Course Contents:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system and process and techniques of controlling
- Management and Society: future perspective

Text Books:

- Stephen P. Robins, Mary Coulter: Management
- H. Koontz Odonnel and H. Weihrich: Management
- Mc Farland: Management: Foundation and Practice
- Robert M. Fulmer: The New Management