

Department of Chemical Engineering

Chemical engineering is about transformation. It's about gaining fundamental knowledge about a substance by manipulating and analyzing it, then using that knowledge to synthesize a solution to an important need. The work may lead to a better product, process, or therapy.

Chemical Eng. is concerned with the design, development, operation and management of industrial processes to transform raw materials into valuable and desirable products that we use every day through series of chemical, biochemical and physical processes.

Chemical engineers translate molecular knowledge and discoveries into products and processes. The job of the chemical engineer is to develop manufacturing processes for chemical products that emerged from laboratories, using commercially available equipment inputs instead of the glass beakers and expensive reagents used in laboratories. The objective is to produce unit at costs to make the product commercially viable by scaling up production to produce large quantities of output in a continuous flow plant.



From its inception chemical engineering has adopted the open spirit of science, developed principles susceptible to modified generalization and ready to jump on new knowledge to make it productive. Chemical engineering occupies a unique position at the interface between molecular sciences and engineering. Intimately linked with the fundamental subjects of chemistry, biology, mathematics, and physics-and in close collaboration with fellow engineering disciplines like materials science, computer science, and mechanical, electrical, and civil engineering-chemical engineering offers unparalleled opportunities to do great things.

Chemical engineers are spearheading new developments in medicine, biotechnology, microelectronics, advanced materials, energy, consumer products, manufacturing, and environmental solutions.

Chemical industry contributes 21.2 per cent value added of Pakistan's manufacturing sector. It is capital-intensive sector and its share in employment is 8.9 per cent. Petroleum refining and products, fertilizers, Pharmaceuticals, synthetic resins constitute bulk of the sector's value added. The total production of chemicals in Pakistan is around \$ 3 billion while the import of chemical related products constitutes more than US\$ 2 billion. Thus, there is a vast potential for developing this sector through import substitution and self reliance. The major issues of the chemical sector include the non-availability and high cost of inputs and utilities, obsolete technology base, limited Research and Development, quality control and environmental problems.

Chemical Engineering at Dawood College of Engineering and Technology has provided leadership in the field since its inception in 1964. We have well equipped laboratories, state of the art analytical equipment, and Workshop. Rs 50.0 million has been utilized through Strengthening of Academic Infrastructure (SAIN) project to update our laboratories.

At present the Department has laboratory facilities in Unit operation, Fluid flow, Heat Transfer, Mass Transfer, Fuel testing, Environmental Testing, Petro-chemical, Bio-Chemical, Reaction Engineering & Control. The facilities of the chemistry laboratories are also available for practical in Chemical process technology, unit process and chemistry. Department has recently strengthened the laboratory facilities with

addition of Automated Pilot scale distillation plant, Hydrogenation Plant, Reverse Osmosis Plant and Liquid Extraction Plant. The new laboratories and Pilot plants provide unique learning opportunities and maintain our position at the forefront.

In order to cope with the changing opportunities and challenges faced by graduating chemical engineers in Pakistan as a consequence of technological developments and globalization, chemical engineering curriculum at College of Engineering and Technology has developed to meet those challenges. The changes in curriculum have been made are based upon an assessment of the capacity of the following in order to meet the current challenges, namely: syllabus/subjects; teaching courseware; teaching methodology; and learning materials. Courses were added that were based more on general principles, rather than the description of various chemical processes.

The local industry opens horizons for graduates to contribute in the national development. In recent time leading Chemical Industries including Fatima Group of Fertilizers, Fuiji Fertilizers, Engro Polymers Limited, Pakistan Petroleum Limited, Nestle Pakistan, Gatron Polymer Limited and PPTA held job fair at the campus. This liaison with industries and prospective employers bring a sense of pride and confidence to the students.

Industrial training is also integrated part of the education programme of the department and students are sent every year to various industries for practical training and visits.

With a wide range of training, analytical skills, and focus on understanding processes, chemical engineers can work successfully in areas ranging from financial analysis to environmental science to process engineering. However some of the new frontiers to which chemical engineers can contribute increasingly in Pakistan are coal technology, polymer engineering, biochemical engineering, advanced materials, energy resources and their processing, and environmental protection and remediation.

Curriculum of B.E (Chemical) for Batch 2009 (Enter Year 2009)

Student shall have to complete 135 credit Hours in minimum 8 Semesters for award of degree of B.E

Course No.	Course Title	Lec	Lab	CR	Course No.	Course Title	Lec	Lab	CR
First Year 33 (28, 5) (Batch 2009)									
First Year (Sem 1)					First Year (Sem 2)				
EN-	English Comprehension & Composition	3	0	3	BS-131	Applied Chemistry-I	3	1	4
HUM-	Islamic Studies/ Ethics	2	0	2	MUH-	Pakistan Studies	2	0	2
CH-151	Chemical Process Principles-I	3	0	3	BS-112	Maths-II	3	0	3
Met-101	Engineering Drawing	0	1	1	CE-	Computer & Computation	1	1	2
BS-121	Physics	3	1	4	HUM-	Report Writing Skills	2	0	2
BS-111	Maths-I	3	0	3	CH-152	Ch.E Thermodynamics-I	3	1	4
Total Credit hours		14	2	16	Total Credit hours		14	3	17
Second Year 35 (27, 8) (Batch 2009)									
Second Year (Sem 3)					Second Year (Sem 4)				
IND-	Workshop Practices	0	2	2	CH-253	Computer Aided Eng. Drawing	0	1	1
ES-210	Elect. Tech. & Electronics	2	0	2	CH-254	Computer Programming & Software Application	2	1	3
BS-232	Applied Chemistry-II	3	1	4	CH-255	Heat Transfer	3	1	4
CH-251	Chemical Process Principles-II	3	0	3	CH-256	Particulate Technology	3	1	4
BS-233	Maths-III	3	0	3	HUM-	Logic & Critical Thinking	2	0	2
CH-252	Fluid Mechanics	3	1	4	CH-257	Chemical Process Tech.-I	3	0	3
Total Credit hours		14	4	18	Total Credit hours		13	4	17

Third Year Credit Hours: 34 (28, 6) (Batch 2009)

Third Year (Sem 5)					Third Year (Sem 6)				
CH-351	Mass Transfer	3	1	4	CH-356	Engineering Materials	3	0	3
CH-352	Fuels & Combustion	3	1	4	CH-357	Chemical Reaction Engineering	3	1	4
CH-353	Numerical Analysis and Computer Application	2	1	3	CH-358	Simultaneous Heat & Mass Transfer Operations	3	1	4
CH-354	Ch.E Thermodynamics-II	3	0	3	CH-359	Engineering Economics	2	0	2
CH-355	Transport Phenomena	3	0	3	CH-360	Instrumentation & Process Control	3	1	4
						Industrial Training (4-6 Weeks)			
Total Credit hours		14	3	17	Total Credit hours		14	3	17

Final Year Credit Hours: 33 (26, 7) (Batch 2009)

Final Year (Sem 7)					Final Year (Sem 8)				
CH-451	Chemical Process Tech.-II	3	1	4	CH-456	Environmental Engineering	3	1	4
CH-452	Chemical Process design & Simulation	2	1	3	CH-457	Biochemical Engineering	3	0	3
CH-453	Petroleum Refinery Eng.	3	1	3	CH-458	Ch.E Plant Design Project	0	3	3
CH-454	Project Management	2	0	2	CH-459	Production & Operations Management	3	0	3
MUH-	Business Communication	2	0	2	CH-460	Maintenance Eng. & Safety	2	0	2
CH-455	Chemical Plant Design	3	0	3					
Total Credit hours		15	3	18	Total Credit hours		11	4	15
Total Credit Hours		135							

First Year 33 (28, 5) (Batch 2009)									
First Year (Sem 1)					First Year (Sem 2)				
EN-	English Comprehension & Composition	3	0	3	BS-131	Applied Chemistry-I	3	1	4
HUM-	Islamic Studies/ Ethics	2	0	2	MUH-	Pakistan Studies	2	0	2
CH-151	Chemical Process Principles-I	3	0	3	BS-112	Maths-II	3	0	3
Met-101	Engineering Drawing	0	1	1	CE-	Computer & Computation	1	1	2
BS-121	Physics	3	1	4	HUM-	Report Writing Skills	2	0	2
BS-111	Maths-I	3	0	3	CH-152	Ch.E Thermodynamics-I	3	1	4
Total Credit hours		14	2	16	Total Credit hours		14	3	17

1. English Comprehension & Composition 3(3, 0, 0) (Batch 2009)

Prerequisites:

Course Outline:

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:

- i.** Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
- ii.** Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
- iii.** Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
- iv.** Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford
- v.** Supplementary Skills. Third Impression 1992. ISBN 0 19 453402

2. Islamic Studies/ Ethics

2(2, 0, 0) (Batch 2009)

Prerequisites:

Course Outline:

Fazail-E-Quran, Surat Hujraat With Translation, Surat Al-Furgan (Ayat 63 60 77), Kitab and Sunnat, Importance of Sunnat, Twenty Selected Hadiths With Translation, Islam in the Light of Quran and Hadiths, Tauheed, Risalat, Aakhrat, Prayer (Salaat), Fasting (Soam), Zakaat, Hajj, Jihad, Seerat-un- Nabi, Study of Seerat-ul-Nabi, Makkah Life of Holy Prophet (Peace Be Upon Him), Birth, Hijrat and Methods of Teaching, Madina Life of Holy Prophet (Peace Be Upon Him), Fatah-e-Makkah and Hajjat-UI-Wida.

3. Chemical Process Principles-I

3(3, 0, 0) (Batch 2009)

Prerequisites:

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 stoichiometric 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.

Books Recommended:

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

4. Engineering Drawing 1(0, 1, 0) (Batch 2009)

Prerequisites:

Course Outline:

Use & Care Of Drawing Instruments, Projection Of Points, Lines & Solids In Simple Position , First & Third Angle Projections, Oblige & Auxiliary Planes Projection Of Planes, Projection Of Curves & Curved Surface , Sections Of Solids Conic Sections' Lettering, Planning, Drawing Dimension, Standard Drafting Conventions, Representation Of Rivets, Riveted Joints, Screw Fastened & Screw System Keys, Cutters, Pulleys Etc. Representation of Both Details & Assembly Drawing

Practical

Practical Will Be Based On Theory Course

Recommended Books:

- A First Year of Engineering Drawing By Parkinson
- Fundamentals of Engineering Drawing By Warren J. Lutzjader
- Elementary Engineering By N.D Butt

5. Physics 4(3, 1, 0) (Batch 2009)

Prerequisites:

Course Outline:

Electrostatics: Coulomb's law, electric field and potential, capacitance, dielectrics. Electrodynamics: Magnetic field and force, sources of magnetic field, electromagnetic induction, inductance. Solid-state physics: Crystal lattices, unit cells, energy bands, allowed and forbidden states, conductors, semiconductors, insulators. Semiconductors:

Thermometry, heat transfer, heat insulation, properties of materials for use in building geometrical optics, the focal length of a lens, magnification, compound lenses, resolving power, laws of illumination and photometry, sextant spectrometer. Principles of refracting telescope, polarization of light. Waves and oscillation, sound waves, resultant to two simple harmonic motions, response and beats, acoustics and its application, interference, wave length and frequency, units and measurement of intensity, reflection and refraction of sound, reverberation time. Magnetic effect of current, CGS and practical units, relation between magnetism and electricity, magnetic field due to current in a long wire, force on a current carrying conductor in magnetic field, laws of electromagnetic induction, galvanometer, ammeter, voltmeter, avometer, condensers and dielectrics, Magnetic materials, B-H curves, hysteresis, magnetic circuits calculations, solenoids, pull of an electromagnet, principles of diode & triode, cathode ray tube and photo-multiplier tube. Atomic & nuclear physics, atomic structure, nuclear structure, radioactivity, nuclear theory, fission & fusion.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

David Halliday, Robert Resnick, and Jearl Walker, "Fundamentals of Physics," Seventh Edition, 2005, John Wiley & Sons, ISBN: 0471465097.

Arthur Beiser, "Schaum's Outline of Applied Physics," Fourth Edition, 2004, McGraw-Hill, ISBN: 0071426116.

Stan Gibilisco, "Applied Physics", McGraw-Hill, 2002, ISBN 0071382011

Kittle C, "Introduction to Solid State Physics", Wiley New York, 2000

Arthur Beiser, "Applied Physics", McGraw-Hill, 4th ed., 2004 ISBN-10: 0071426116

John. D Cutnel, "Physics" Wiley; 7th ed., 2006, ISBN-10: 0471663158

Douglas, C., Giancoli, "Physics Principles and Applications", Pearson Education, 2004, ISBN-10: 0131846612

6. Maths-I 3(3, 0, 0) (Batch 2009)

Prerequisites:

Course Outline:

Introduction to functions, introduction to limit, derivatives and their applications, integral calculus with applications, vector algebra, vector calculus, introduction to analytical geometry, straight line in R^3 , planes, cylindrical and spherical coordinates, surfaces, cylinders and cones, spherical trigonometry.

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, homogeneous equations, equations reducible to homogeneous, 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/characteristic equations. Solution of higher order differential equation according to the roots of auxiliary equation. Non-homogeneous linear equations. Working rules for finding particular integral. Cauchy Euler Equation. Matrices: Addition & multiplication of matrices, determinant of matrices. Hyperbolic and inverse Hyperbolic functions.

Recommended Books:

- George B. Thomas and Ross L. Finney, "Calculus and Analytic Geometry, Addison- Wesley, ISBN: 0201531747.
- George F. Simmons, "Calculus with Analytic Geometry", McGraw-Hill, ISBN: 0070576424.
- Gerald B. Folland, "Advanced Calculus", Prentice Hall, ISBN: 0130652652.
- Monty J. Strauss, Gerald L. Bradley and Karl J. Smith, "Calculus", Prentice Hall, ISBN: 0130918717.
- Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, ISBN: 0471728977.
- John Polking, Al Boggess, & David Arnold "Differential Equations", Prentice Hill, ISBN: 0131437380
- Stephen Goode, "Differential Equations and Linear Algebra", Prentice Hill, ISBN: 013263757X.

7. Applied Chemistry-I 4(3, 1, 0) (Batch 2009)

Prerequisites:

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 potentiometry, pH-Metry: liquid solid chromatography: high performance liquid chromatography, ion exchange, gas chromatography, plane chromatography. Spectroscopy, Basics of spectroscopy UV and visible spectroscopy, atomic absorption spectroscopy

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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

8. Pakistan Studies 2(2, 0, 0) (Batch 2009)

Prerequisites:

Course Outline:

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.

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

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.

9. Maths-II 3(3, 0, 0) (Batch 2009)

Prerequisites:

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.

Recommended Books:

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

10. Computer & Computation 2(1, 3, 0) (Batch 2009)

Prerequisites:

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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.

11. Report Writing Skills 3(3, 0, 0) (Batch 2009)

Prerequisites:

Course Outline:

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:

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).

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

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

The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors:

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).

12. Chemical Engineering Thermodynamics-I 4(3, 3, 0) (Batch 2009)

Prerequisites:

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. Compressibility factors; Heat engines, various cycles and turbine.

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.

Practical

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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

Second Year 35 (27, 8)									
Second Year (Sem 3)					Second Year (Sem 4)				
IND-	Workshop Practices	0	2	2	CH-253	Computer Aided Eng. Drawing	0	1	1
ES-210	Elect. Tech. & Electronics	2	0	2	CH-254	Computer Programming & Software Application	2	1	3
BS-232	Applied Chemistry-II	3	1	4	CH-255	Heat Transfer	3	1	4
CH-251	Chemical Process Principles-II	3	0	3	CH-256	Particulate Technology	3	1	4
BS-233	Maths-III	3	0	3	HUM-	Logic & Critical Thinking	2	0	2
CH-252	Fluid Mechanics	3	1	4	CH-257	Chemical Process Tech.-I	3	0	3
Total Credit hours		14	4	18	Total Credit hours		13	4	17

13. Workshop Practices 1(0, 1, 0) (Batch 2009)

Prerequisites:

Course Outline:

Plumbing: Name And Use Of Common Plumbing Tools And Materials, Symbols Used For Water Pipe Line, Checking And Determination Of Pipe Sizes, Threading Practice On Pipe, Use And Care Of Die, Cutting Of Pipe And Bend, Fitting Of Main Line And -Branch Line Of Pipe Water Connection, Assembly Of Stop Cock With Threaded Nipple. Fitting Of Tapes And Closing Of Pipe End.

Electrical Shop: Electric Shock And Its Treatment, Use Of Meager, Wire-Gauge, Phase ester And Other Electricians Tools, Cables & Their Sizes, Current Ratings And Jointing, Solders And Soldering, Main Features Of Domestic Installations And Appliance, E.G. D.B. Systems, Fluorescent Lamps, Fans Etc, Necessity And Methods Of Earth, Faults & Remedies In Wiring Circuits & Winding Practice Of Machine Coils

Wood Workshop: The Names, Care and Maintenance Of Carpenter's Hand Tools, Practical Wood Working Practice, The Use Of Hand Tools On Making Joints And Finished Articles

Recommended Books:

1. T.L Choudhary, Workshop Technology" Part-I., Khanna Publishcation

14. Electrical Technology & Electronics 2(2, 0, 0) (Batch 2009)

Prerequisites:

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

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).

15. Applied Chemistry-II 4(3, 3, 0) (Batch 2009)**Prerequisites:****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.

Practical

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Recommended Books:

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.

16. Chemical Process Principles-II 3(3, 0, 0) (Batch 2009)

Prerequisites: Chemical Process Principles-I

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.

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 Wiley & 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

17. Maths-III 3(3, 0, 0) (Batch 2009)

Prerequisites:

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.

Recommended Books:

- Jyotiprasad Medhi "Statistical Methods", New Age Publishers, 2005, ISBN 8122404197
- Kenneth. Lange, "Statistical Methods", Springer, 2002, ISBN 0387953892
- Montgomery, D.C., and Runger, G.C., "Applied Statistics and Probability for Engineers", John Wiley & Sons, 2001
- N. A. Weiss, "Introductory Statistics", Addison Wesley, 1995

18. Fluid Mechanics 4(3, 3, 0) (Batch 2009)

Prerequisites:

Course Outline: After second semester

Dimensional Analysis: Buckingham –Pi Theorem, Reynold's law of Similarity.

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

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.

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

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.

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 .

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.

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.

Flow of Non-Newtonian Fluids

Elementary viscometry, Rabinowitsch-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

Practical

Practical Will Be Based On Theory Course

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

19. Computer Aided Engineering Drawing 1(0, 1, 0) (Batch 2009)

Prerequisites:

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

Recommended Books:

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

20. Computer Programming & Software Application 3 (2, 3, 0) (Batch 2009)

Prerequisites:

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. Plotting 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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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

21. Heat Transfer 4(3, 3, 0) (Batch 2009)

Prerequisites: After third semester

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

- 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.

22. Particulate Technology

4(3, 3, 0) (Batch 2009)

Prerequisites:

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

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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

23. Logic & Critical Thinking 2(2, 0, 0) (Batch 2009)

Prerequisites:

Course Outline:

Critical Thinking: 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 n'lan

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

Recommended Books:

Vaughn Lewis, 2005, the power of critical thinking, oxford University Press

24. Chemical Process Technology-I Credit hours: 3(3, 0, 0) (Batch 2009)

Prerequisites:

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;

Recommended Books:

1. Austin George T. "Shreve's Chemical Processes Industries" 6th Ed. 1997, McGraw Hill Int. 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.

Third Year Credit Hours: 34 (28, 6)

Third Year (Sem 5)					Third Year (Sem 6)				
CH-351	Mass Transfer	3	1	4	CH-356	Engineering Materials	3	0	3
CH-352	Fuels & Combustion	3	1	4	CH-357	Chemical Reaction Engineering	3	1	4
CH-353	Numerical Analysis and Computer Application	2	1	3	CH-358	Simultaneous Heat & Mass Transfer Operations	3	1	4
CH-354	Ch.E Thermodynamics-II	3	0	3	CH-359	Engineering Economics	2	0	2
CH-355	Transport Phenomena	3	0	3	CH-360	Instrumentation & Process Control	3	1	4
						Industrial Training (4-6 Weeks)			
Total Credit hours		14	3	17	Total Credit hours		14	3	17

25. Mass Transfer 4(3, 3, 0) (Batch 2009)

Prerequisites: After fourth semester

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

McCabe Warren L., Smith Julian C., Harriott Peter "Unit Operations of chemical Engineering" 7th Ed. 2005. McGraw Hill Inc.

Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-II, 5th Ed. 2002. The English Book Society and Pergamon Press.

Incropera Frank P., De Witt David P. "Fundamentals of Heat and Mass Transfer" 3rd Ed. 1990. John Wiley and Sons.

Treybal Robert E. "Mass Transfer Operations", 1981, McGraw Hill Book Company.

Diran Basmadjian. "Mass Transfer and Separation Process (Principles and Applications) CRC Press Taylor and Francis Group.2007

Schweitzer, "Handbook of Separation Techniques for Chemical Engineers", 1979, McGraw Hill Book Co.

Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-I, 1999. The English Book Society and Pergamon Press

Alan S.Foust, Leonard A.Wenzel "Principles of Unit Operations" 2nd Ed.1980. John Wiley & Sons.

26. Fuels & Combustion Credit hours: 4(3, 3, 0) (Batch 2009)

Prerequisites:

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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. Probst, "Synthetic Fuels", McGraw Hill.
5. Marion Smith, "Fuels and Combustion", McGraw Hill.

27. Transport Phenomena

3(3, 0, 0) (Batch 2009)

Prerequisites:

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.

Recommended Books:

1. Bennett C.O., Myers J.E. "Momentum, Heat & Mass Transfer" 3rd Ed. 1983. McGraw Hill Book Company.
2. Bird R. Byron, Stewart 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. Wily, "Heat Mass and Momentum Transfer"

28. Chemical Engineering Thermodynamics-II: (3, 0, 0) (Batch 2009)

Prerequisites: Chemical Engineering Thermodynamics-I

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.

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

29. Numerical Analysis and Computer Application (Batch 2009)

Prerequisites: After fourth semester

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. Plotting 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.

Recommended Books:

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.

30. Engineering Materials 3(3, 0, 0) (Batch 2009)

Prerequisites:

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, Nickel, Hastaloy, Copper alloys, Aluminum and its alloys, Lead Titanium and tantalum, PVC, Teflon, polyolefins, polytetra fluoro 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.

Recommended Books:

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.

31. Chemical Reaction Engineering: 4(3, 3, 0) (Batch 2009)

Prerequisites: After fourth semester

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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.

32. Simultaneous Heat & Mass Transfer Operations: 4(3, 3, 0) (Batch 2009)

Prerequisites:Heat Transfer, Mass Transfer

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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.

33. Engineering Economics 2(2, 0, 0) (Batch 2009)

Prerequisites:

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.

Recommended Books:

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

34. Instrumentation & Process Control : 4(3, 3, 0) (Batch 2009)

Prerequisites: After fourth semester

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 gas 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, feed forward. Use of analyzer and chromatographs, Modeling: Lumped parameter models to plant, e.g. jacketed 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 advanced control system, cascade & selective control system.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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. Stephanopoulos, Prentice Hall 2002
- Essentials of Process Control, W.L. Luyben McGraw Hill 1997

Final Year Credit Hours: 33 (26, 7)									
Final Year (Sem 7)					Final Year (Sem 8)				
CH-451	Chemical Process Tech.-II	3	1	4	CH-456	Environmental Engineering	3	1	4
CH-452	Chemical Process design & Simulation	2	1	3	CH-457	Biochemical Engineering	3	0	3
CH-453	Petroleum Refinery Eng.	3	1	3	CH-458	Ch.E Plant Design Project	0	3	3
CH-454	Project Management	2	0	2	CH-459	Production & Operations Management	3	0	3
MUH-	Business Communication	2	0	2	CH-460	Maintenance Eng. & Safety	2	0	2
CH-455	Chemical Plant Design	3	0	3					
Total Credit hours		15	3	18	Total Credit hours		11	4	15
Total Credit Hours		135							

35. Chemical Process Technology-II: 4 (3, 3, 0) (Batch 2009)

Prerequisites:

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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.

36. Chemical Process design & Simulation: 3(2, 3, 0) (Batch 2009)

Prerequisites: Instrumentation & Process Control

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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.

37. Elective-I (Petroleum Refinery Eng.) 4(3, 3, 0) (Batch 2009)

Prerequisites: After sixth semester

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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.

38. Project Management 2(2, 0, 0) (Batch 2009)

Prerequisites: After sixth semester

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

Recommended Books:

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

39. Communication Skills 3(3, 0, 0) (Batch 2009)

Prerequisites:

Course Outline:

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 and minutes of the meeting, use of library and internet resources

Presentation skills

Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended books:

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
3. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
4. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford
5. Supplementary Skills. Third Impression 1992. ISBN 0 19 453402

40. Chemical Plant Design: 3(3, 0, 0) (Batch 2009)**Prerequisites:****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.

Recommended Books:

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)

41. Elective-II (Environmental Engineering): 4(3, 3, 0) (Batch 2009)

Prerequisites: After sixth semester

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.

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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

42. Elective-III (Biochemical Engineering): 4(3, 3, 0) (Batch 2009)

Prerequisites: After sixth semester

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;

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.

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

Practical

Practical Will Be Based On Theory Course

Recommended Books:

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/> >

43. Production & Operations Management 3(3, 0, 0) (Batch 2009)

Prerequisites: After sixth semester

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 chart; 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.

Recommended Books:

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.

44. Maintenance Engineering & Safety 2(2, 0, 0) (Batch 2009)

Prerequisites: After sixth semester

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

Recommended Books:

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

Curriculum of B.E (Chemical) for Batch 2008 (Enter Year 2008)

Student shall have to complete 144 credit Hours in minimum 8 Semesters for award of degree of B.E

(Batch 2008)

40 (33, 7)

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
First Year (Sem 1)				First Year (Sem 2)			
Chemistry-I	3	1	4	Linear Algebra and analytical Geometry	3	0	3
Applied Calculus	3	0	3	English-II	3	0	3
Engineering Drawing	3	1	4	Islamic Studies	2	0	2
Basic Chemical Engineering	3	0	3	Engineering Mechanics	3	1	4
Pakistan Studies	2	0	2	Basic Electrical Technology	3	1	4
English	2	0	2	Ch. Process Technology-I	3	1	4
Workshop Practice	0	2	2				
Total	16	4	20	Total	17	3	20

Second Year (Batch 2008)

33 (28, 5)

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Second Year (Sem 3)				Second Year (Sem 4)			
Chemistry-II	3	1	4	ChE Thermodynamics-II	3	0	3
Industrial Stoichiometry-I	3	1	4	Ch. Process Technology-II	3	0	3
Material Science	2	0	2	Unit Operation-I	3	1	4
ChE Thermodynamics-I	3	1	4	Complex Variable and Laplace Transform	3	0	3
Differential Equations	3	0	3	Computer Programming & Software applications	2	1	3
Total	14	3	17	Total	14	2	16

Third Year (Batch 2008) 35 (29, 6)

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Third Year (Sem 5)				Third Year Sem 6			
Numerical Analysis & Computer Applications	2	1	3	ChE Plant Design and Economics	3	0	3
Unit Operation-II	3	1	4	Maintenance Engineering	3	0	3
Industrial Stoichiometry-II	3	0	3	Fuel and Combustion	3	1	4
Heat Transfer	3	1	4	Unit Operation-III	3	1	4
Fluid Mechanics	3	1	4	Statistical Methods & Estimation:	3	0	3
Total	14	4	18	Total	15	2	17

Final Year (Batch 2008) 36 (26, 10)

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Final Year (Sem 7)				Final Year (Sem 8)			
Biochemical Engineering	3	1	4	Industrial Management	3	0	3
Transport Phenomena	3	0	3	Chemical Engineering Kinetics	3	1	4
Instrumentation and Control	3	1	4	Petrochemical Eng.	2	1	3
Petroleum Refinery Eng.	3	1	4	Nuclear Engineering	3	0	3
Environmental Engineering	3	1	4	Project/ Thesis	0	4	4
Total	15	4	19	Total	11	6	17

First Year (Batch 2008) 40 (33, 7)

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
First Year (Sem 1)				First Year (Sem 2)			
Chemistry-I	3	1	4	Linear Algebra and analytical Geometry	3	0	3
Applied Calculus	3	0	3	English-II	3	0	3
Engineering Drawing	3	1	4	Islamic Studies	2	0	2
Basic Chemical Engineering	3	0	3	Engineering Mechanics	3	1	4
Pakistan Studies	2	0	2	Basic Electrical Technology	3	1	4
English	2	0	2	Ch. Process Technology-I	3	1	4
Workshop Practice	0	2	2				
Total	16	4	20	Total	17	3	20

Chemistry-1 4 (3, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Introduction: Introduction of Chemistry, Application in Industries, the Nature of Chemical Bonds, Bond Energies.

Aliphatic Hydrocarbons: Nomenclature, Preparations, Physical & Chemical Properties Of Alkane & Alkene, Nature Of Alkene Double Bond, Addition To Alkene, Electrophilic & Nucleophilic Reagents, Hydrogenation Of Alkene, Orientation In Addition To Alkene, Alkylation Of Alkene, Reaction Of Dienes Diels Alder Reaction.

Alcohol: Nomenclature, Preparations, Chemical Reaction Involving O-H Bond & Reaction Involving C-O Bond.

Aldehyde & Ketone: Nomenclature, Preparations of Aldehyde & Ketone, Chemical Reactions of Aldehyde & Ketone, Aldol Condensation, Benzoin Condensation.

Aromatic Hydrocarbons: Nomenclature, Sources of Aromatic Compounds, Preparation & Structure Of Benzene.

Atomic Structure & Periodic Table: System, Classification, Occurrence, Physical & Chemical Properties of Alkali Metals & Alkaline Earth Metals.

Chemistry of P-Block Elements: Systemic Classification, Physical & Chemical Properties of Boron, Aluminum, Carbon, Silicon, Oxygen & Sulfur.

Production of Some Important Metals: Iron & Steel, Copper & Aluminum

PRACTICALS:

Practical to be based on theory:

Recommended Books:

1. Organic Chemistry for B.Sc. Students by Ibne-Raza & M.A. Rahman Inorganic Chemistry for B.Sc. Students by Badaruddin
2. Basic Principles of Organic Chemistry by John D. Roberts & Marjorie C. Caserio
3. Inorganic Chemistry by I. V oga!
4. Engineering Chemistry by O.P. Aggarwal

Engineering Drawing 4 (3, 1, 0) (Batch 2008)**Prerequisites:****Course Outline:**

Use & Care Of Drawing Instruments, Projection Of Points, Lines & Solids In Simple Position , First & Third Angle Projections, Oblige & Auxiliary Planes Projection Of Planes, Projection Of Curves & Curved Surface , Sections Of Solids Conic Sections' Lettering, Planning, Drawing Dimension, Standard Drafting Conventions, Representation Of Rivets, Riveted Joints, Screw Fastened & Screw System Keys, Cutters, Pulleys Etc. Representation of Both Details & Assembly Drawing

Practical

Practical Will Be Based On Theory Course

Recommended Books:

1. A First Year of Engineering Drawing By Parkinson
2. Fundamentals of Engineering Drawing By Warren J. Lutzjader
3. Elementary Engineering By N.D Butt

English-I 2 (2, 0, 0) (Batch 2008)**Prerequisites:****Course Outline:**

Grammar: Students should be able to: identify verbs in the present tense and past tense. Classify these verbs as regular or irregular; manipulate verb forms, e.g. changing verbs from active. Voice to passive voice etc. Listening and speaking comprehension. Although students will not be tested on their listening and speaking skills, they will be expected to take part in normal class room activities which require listening and speaking in English. This may include activities, like following instructions, answering questions, completing work tasks; etc. Two specific aims of the listening component of the course are to enable students to extract relevant information from a listening passage. Make notes from a listening passage. Vocabulary: Match vocabulary items with their corresponding definitions, identifying odd items out from a list. Classify vocabulary items into lexical sets.

Recommended Books: -

1. Arthur Thomas Quiller-Co.uch, "Oxford Book of English Verse", Clarendon 2006
2. Tom McArthur, -"English Language", OUP, 2006; ISBN-10: 019214183X
3. Yorkey,-"Study Skills", McGraw Hill, 1998
4. Alice Oshima, ~"Writing Academic English", Addison Wesley, 2000
5. Thomson.and Martinet, "College English Grammar", OUP, 1998

Pakistan Studies 2 (2, 0, 0) (Batch 2008)**Prerequisites:****Course Outline:**

An Outline of Emergence of Pakistan: A brief historical survey of Muslim community in the sub-continent. War of Independent 1857 and Aftermath. Sir Syed Ahmed Khan, Development of Two-Nation Theory. Formation of Muslim League. Lucknow Pact. Khilafat & Non-Cooperation Movement. Political Events from 1924 to 1937. Pakistan Resolution - Struggle for Pakistan from 1940 to 1947. Emergence of Pakistan.

Land of Pakistan: Geophysical conditions, Territorial situation and its importance, Natural Resources - Mineral and Water. Constitutional Process: Early effects to make constitution - Constitution of 1956 and its abrogation. The constitution of 1962: Constitutional - and Political Crisis of 1971. The constitution of 1973. Recent constitutional developments. Post Independence development: Education in, Pakistan; Brief survey of Pakistan Economy, Industrial. Agricultural Development. Internal and external, trade. Economic planning and prospects, Cultural Development in, Pakistan. Definition Contents and Contributing factors in 'culture, Development of Art Philosophy and literature.

Foreign Policy: Relations: With neighbours, Super power and the Muslim world

Recommended Books:

6. Saeed Shafiqat, "Pakistan Studies", OUP, 2006
6. Charles H. Kennedy and Cynthia Botteron, "Pakistan 2005", OUP, 2006
6. Shahid Javed Burki, "State & Society in Pakistan", The Macmillan, Press Ltd
6. 1997
6. Raza. Rafi, "Pakistan in perspective - 1947-1997" OUP, 1997
6. Mujahid al Sharif, "The ideology of Pakistan" National Book Foundation, 2006 • Hussain, Ismat, "Pakistan's Foreign Policy", 2000

Applied Calculus 3 (3, 0, 0) (Batch 2008)

Prerequisites:

Course Outline:

1. Review of Function of Real Variables and Their Graphs
2. **Complex Numbers & Functions:** Complex Numbers and Their Graphical Representation. De-Moivre's Theorem and Its Applications, Hyperbolic and Inverse Hyperbolic Functions, Circular and Inverse Circular Functions, Logarithmic Function (Complex Form)
3. **Vector Algebra:** Scalars and Vectors, Equality Of Vectors, Collinear Vectors, Addition Of Vectors, Product Of Vectors By A Constant, Commutative And Associative Laws Of Addition, Subtraction Of Vectors, Coplanar Vectors, Scalar Or Dot Product Of Two Vector x. Angle B/W Two Vectors, Geometrical Meaning Of Dot Product, Meaning Of U.K., Vector Of Cross Product, Right Handed And Left Handed System, Vector Areas As A Vector Product, Triple Product Geometrical Meaning Of Scalar Tripple Product. Distributive Law, Theorems: $(A \times B) \times C = (A \cdot C) B - (B \cdot C) A$, $(A \times B) \cdot (C \times D) = (A \cdot C)(B \cdot D) - (A \cdot D)(B \cdot C)$, Trigonometry and Mechanics.
4. **Determinants:** Definition, Co-Factors, Minors, Properties of Determinants, Solution of System of Linear Equations by Creamer's Rule, Multiplication of Determinants.
5. **Matrix Algebra:** Definition and Basic Concept, Equality Of Matrices, Addition Of Matrices, Multiplication Of Matrices By Scalar, Multiplication Of Two Matrices, Transpose Of Matrix, Adjoint Of Matrix, Inverse Of Matrix, Transpose Of Product And Sum Of Two And More Matrices, Inverse Of Product Of Two And More Matrices, Rank Of Matrix, Determinant Of Matrix, Solution Of Non-Homogeneous And Homogenous System Of Linear Equations (Gauss Elimination And Gauss-Jordan Method).

Analytical Geometry of Three Dimensions (Batch 2008)

POINT: Definition, Distance B/W Two Points, Division Of formula

Straight Line: Direction Ratios and Direction Cosines of a Line, Equation of a Line in Symmetric and Vector form, Angle B/W Two Lines, Conditional of Two Lines to Be Parallel or Perpendicular

The Plane; Definition And Equation Of A Plane, Angle B/W Two Planes, Intersection Of Two Spheres, General Equation Of Spheres Through A Given Circle, Tangent Plane, Angle Of Intersection Of Two Spheres

The Cylinder; Definition and Equation of Cylinder

Recommended Books:

- Mathematical Method by Dr. SM. Yousuf
- Vector Analysis by Dr. S.M. Yousuf
- Calculus and Analytical Geometry Dr. SM. Yousuf
- A first Course on Vectors by Dr. M. Afzal
- Trigonometry Part-Ii by S.L. Loney
- Matrices by Schaum's Series

6. **Basic Chemical Engineering 3 (3, 0, 0) (Batch 2008)**

Prerequisites:

Course Outline:

Introduction: Chemical Engineering, Its Origin, Historical Developments and Relations With Other Branches Of Engineering, Importance Of Chemical Industries, Professional Fields With In Chemical Engineering, Analysis Of Modern Chemical Processes, Batch Verses Continuous Processes, Types Of Equipment Used In Chemical Industries And Their Symbols.

Raw Materials, Fuel and Power: Raw Material and Its Importance for Chemical Industries Sources of Industrial, Raw Materials, Raw Materials Beneficiation Methods, Economic Utilization Of Raw Materials, Types Of Energy Use In Chemical Industry, Importance Of Fuel And Power In Chemical Industry, Economics Utilization Of Fuel And Power

Basic Laws Of Chemical Engineering: Law Of Conservation Of Mass And Energy And Their Applications, Homogenous And Heterogeneous Processes, Reversible And Irreversible Processes, Chemical Equilibrium And Rate Of Reaction, Concurrent, Counter Current, Parallel Cross Current, Flow Pattern.

Industrial Waste; Definition Of Industrial Waste, Types Of Industrial Waste, The Effects Of Industrial Waste On Environment, Waste Disposal Methods, Treatment Of Industrial Waste

Plant Location And Safety: Importance Of Plant Location, Factors Affecting Plant Location, Safety In Chemical Industry , Industrial Hazards And Their Presentation.

Basic Chemical Engineering Calculation: Dimensions, Units And Conversion Factors, Composition Of Mixtures And Solution, Elementary Treatment Of Materials And Energy Problems, • Industrial Calculations Based On Pvt. Relations.

Recommended Books:

1. Introduction To Chemical Engineering By Andersons & Wenzel
2. Chemical Engineering By D. Khuznetsov.

Workshop Practice 2 (0, 2, 0) (Batch 2008)**Prerequisites:****Course Outline:**

Plumbing: Name And Use Of Common Plumbing Tools And Materials, Symbols Used For Water Pipe Line, Checking And Determination Of Pipe Sizes, Threading Practice On Pipe, Use And Care Of Die, Cutting Of Pipe And Bend, Fitting Of Main Line And -Branch Line Of Pipe Water Connection, Assembly Of Stop Cock With Threaded Nipple. Fitting Of Tapes And Closing Of Pipe End.

Electrical Shop: Electric Shock And Its Treatment, Use Of Meager, Wire-Gauge, Phase ester And Other Electricians Tools, Cables & Their Sizes, Current Ratings And Jointing, Solders And Soldering, Main Features Of Domestic Installations And Appliance, E.G. D.B. Systems, Fluorescent Lamps, Fans Etc, Necessity And Methods Of Earth, Faults & Remedies In Wiring Circuits & Winding Practice Of Machine Coils

Wood Workshop: The Names, Care and Maintenance Of Carpenter's Hand Tools, Practical Wood Working Practice, The Use Of Hand Tools On Making Joints And Finished Articles

Recommended Books:

1. T.L Choudhary, "Workshop Technology" Part-I., Khanna Publishcation

Matrix Algebra and analytical Geometry 3 (3, 0, 0) (Batch 2008)**Prerequisites:****Course Outline:**

Introduction to Matrices and Elementary Row Operation: Brief Introduction To Matrices. Symmetric and Hermitian Matrices. Introduction to Elementary Row Operations. Echelon Form And Reduced, Echelon Form. Rank Of A Matrix Inverse Of A Matrix By Using Elementary, Row Operation.

System of Linear Equation: System of Non-Homogeneous Linear Equation, Gauss Elimination Method, Gauss-Jordan Method. Consistency Criterion, For Solution Of Homogeneous And Non-Homogeneous System Of Linear Equation., Applications Of System Of Linear Equations.

Determinants: Introduction to Determinants. Properties Of Determinants Of Order N, Axiomatic Definition Of A Determinant. Applications Of Determinants, (Cramer's Rule)

Analytical Geometry of 3-Dimensions. Introduction. Coordinates Of A Point Dividing A Line Segment In A Given Ratio.

Straight Line in R^3 : Vector Form of A Straight Line, Parametric Equations Of A, Straight Line, Equation of a Straight Line In Symmetric Form, Direction Ratio and Direction Cosines, Angle Between Two Straight Lines, Distance Of A Point From A Line.

Planes: Equation of a Plane, Angle between Two Planes, Intersection of Two, Planes, a Plane and a Straight Line, Skew Lines.

Cylindrical and Spherical Coordinate: Introduction To Cylindrical and Spherical Coordinates.
 Surfaces: Quadratic Surfaces, Degenerate Surfaces, Symmetry, Traces, Intercepts of the Surfaces, Surface Of Revolution.
 Cylinder and Cone: Cylinder, Directrix of Cylinder, Right Cylinder. The Cone
 Sphere: General Equation of Sphere, Great Circle
 Conics: Ellipsoid, Elliptic Paraboloid, Hyperbolic Paraboloid, Hyperboloid of One Sheet, Hyperboloid Of Two Sheets, Elliptic Cone, Ruled Surfaces, General Quadratic Surfaces.
 Spherical Trigonometry: The Cosine, Sine, Cotangent Formulae. Latitude And Longitude, Direction Of Qibla.

Multiple Integrals

Definition, Double Integral As Volume, Evaluation Of Double Integral, Change Of Order Of Integration. Application of Double Integrals, Area, Mass of an Element, Moment Of Inertia, Center Of Gravity. Triple Integrals, Evaluation of Triple Integrals, Application of Triple Integrals, Volume, Mass of an Element, Center Of Gravity, Moment Of Inertia By Triple Integrals, Triple Integration in Cylindrical and Spherical Coordinates.

Recommended Books:

1. Calculus And Analytical Geometry By Dr. S.M. Yusuf
2. Mathematical Method By Dr. S.M. Yusuf
3. Brief Calculus And Its Applications By Doniel D. Benice
4. Applied Calculus By Raymond A. Barnett

English-II 3 (3, 0, 0) (Batch 2008)

Prerequisites:

Course Outline:

Principles of writing good English, understanding the composition process: writing clearly; words, sentence and paragraphs. Comprehension and expression. Use of grammar and punctuation. Process of writing, observing, audience collecting, composing, drafting and revising, persuasive writing, reading skills, listening skills and comprehension, skills for taking notes in class, skills for exams.

Business communications; planning messages, writing concise but with impact. Letter formats, mechanics of business, letter writing, letters, memo and applications, summonses, proposals, writing resumes, styles and formats, oral communications, verbal and nonverbal communication, conducting meetings, small group communication, taking minutes. Presentation skills; presentation strategies, defining the objective, scope and audience of the presentation, material gathering material organization strategies, time management, opening and concluding, use of audio-visual aids, delivery and presentation.

Recommended Books:

1. Lesikar, Raymond V. & Flatley, Marie E. "Basic Business Communication", 9th Ed. McGraw-Hill, 2002, ISBN 0-07-112225-7
2. Richard Ellis, "Communication Skills", Intellect Books, 2003, ISBN 1841500879
3. Carol Ann Skinner, J. A. Senn, "English Communications in the New Millennium", Barrett Kendall Pub, 2001, ISBN 1580791174
4. Henk T. and Van der Molen, "Communication in Organizations", Taylor & Francis Group, 2005, ISBN: 9781841695556
5. Sarah Jones-Macziola, Greg White "A Communication Skills Course For Business English", Cambridge

University Press 2001

6. Ral h, G. 1 ochols, "Effective Communications", Harvard Press, 1999

Islamic Studies 2 (2, 0, 0) (Batch 2008)

Prerequisites:

Course Outline:

Thematic Study of Holy Quran. Tauheed: Al-Ambiya-22, Al-Baqarah-163-164 Prophethood: Al-Imran-79, Al-Huda-7 Al-Maidah-3_Here-After: Al-Hajj-5, Al-Baqarah- . 48_Two Hadith_Al-Mu'minun-I-II The Concept of Good & Evil.

Importance & necessity of Da'Wat-e-Deen Al-Imran-liO. Method of Da'Wat-e-Deen. An-Nehl-125, Al-Imran-104 Two Hadith Al-Imran-103, Al-Hujurat-10, Al-Imran-64, AI-An'am-108 Two Hadith Taha-81, Al-A'raf-32-33, Al-Baqarah-188 Two Hadith.

Protection of Life: AI-Maidah-32 Right to Property: An-Nisa-29 ' Right of Respect & Dignity: AI-Hujurat-11-12

Freedom of Expression: AI-Baqarah-256 Right of Equality: AI-Hujurat-13 Economic Security: AI-Ma'arij-24-25 Employment Opportunity on Merit: An-Nisa

Excession Right to Jlistice~: An-Nisa~ 135 An-Nehl-97, AI-Ahiab-35, An~N"isa-07 AI-Mumtahanah-8-9, AI-Anfcil-61. . .

Last sermon of Hajj at Arafat Translatiori & the important points of the sermon.

Birth, Life at Makkah: Declaration: of Prophethood, preaching & its difficulties migration to Madina.

Brotherhood & Madiria Charter. The Holy War of the prophet "(Ghazwat-e-Nabawi) iujjat':ul-'Wida

Impacts of Islamic civilizatk on the sub-contiri'entThed-&ilizatibn bf'sJ,ib-ci;>ntinent. before Islam.. The Political, Social & Moral impacts of IsfamicCivilization on subbcontinent. Academic, Intellectual, Social & Cultural Impacts ofIslam on the World.

Ethical Behaviour, Nature, Scope and methods of Ethics and religion. Ethical teachings of world religions. Basic Moral concepts Right arid wrong, Good and evil. An outline of Ethical systems in philosophy; Hedonism, Utilitarianism, Rationalism and Kant.. Self Realization Theories, In.tuitionisiII. Ethics of Qtiran and its philosophical basis. Ethical precepts- from Quran and Hadith and romotion of moral values in Socie

Recommended Books:

1. Abu Ameenah Bilal Philips, "Islamic Studies", International Islamic Publishing House, 2005
2. Akbar Shah Najeebadi, "History ofIslam", Daml Salam, 2005
3. Allama Iqbal Open University Islamabad "Islamic Studies"
4. Abul Ala Moudioodi, " Ethical View Point of Islam"
5. Mazhar-u-ddin Sidiq, " World Religions"
6. Allama Iqbal Open University Islamabad" Pakistan Studies",AIOU, 2000

Engineering Mechanics 4 (3, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Law of Triangle, Parallelogram, Polygon of Forces, Moments Parallel Forces and Couples.

Resultant of Coplanar Forces, General Condition Of Equilibrium, Basic Concept Of Free Body Diagram And Application To Engineering Mechanics.

Motion along a Straight Line with Uniform Acceleration.

Newton's Law of Motion, Connected Bodies.

Tangential and Normal Components of Accelerations, Banking of Tracks Simple, Harmonic Motion.

Friction, Work and Energy, Angular Velocity Energy of Rotations Torque, Power Momentum and Conservation Of Momentum and Energy.

Mechanical Advantages and Efficiency of Simple Machines Tension, Compression Shear Stress, Stress, Strain and Hook's Law.

Graphic Static Resultant Of Coplanar Concurrent Forces Funicular Polygon Condition Of Equilibrium For A System Of Coplanar Concurrent And Concurrent Forces.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

1. Strength of Materials by Tamo Shungo Young
2. Strength of Materials by A. Pytel, F.L. Singer.
3. Mechanics of Materials by R.C. Hibbeler.
4. Mechanics of Engineering Materials by F.V. Warnock, P.P. Benham
5. ASTM Standard 2005.

Basic Electrical Technology

4 (3, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Introduction: Concept of Electric Field, Equi Potential Surface, Permittivity, Electric Stress, Stored Energy, Motion of Charged Particles in a Uniform Electrostatic Field, Calculation of Capacitance of Parallel Plates.

Electromagnetism: Concept Of Magnetic Field, Permeability, Magnetic Properties Of Ferromagnetic Materials, Magnetic Circuit, Generation Of Emf., Faradays Law Of Electromagnetic Induction, Electric Circuit: Resistivity, Ohm's Law, Kirchhoffs Law, Simple D.C. Network Problems Temperature Coefficient.

Alternating Currents: Mean & r.m.s Values, Effect Of Resistance, Inductance & Capacitance In A.C. Circuit, Vectorial Representation, Power & Power Factor.

Secondary Batteries: Types of Construction, Charging & Discharging Rates, Efficiency, Care & Maintenance.

Transformers: The Magnetic Circuit Of Transformers, Transformation Ratio, Voltage Current & Power Relationship

Electronics: Diodes, Transistors & Simple Rectifier Circuits

Practical:

Practical Will Be Based On the Theoretical Course

Recommended Books:

1. Electrical Technology By B. L. Thraja
2. Electrical Technology By Huges
3. Basic Electronics By Grob

Chemical Process Technology-I 4 (3, 1, 0) (Batch 2008)

Course Outline:

History and developments of Chemical Process Industry in Pakistan; Basic Industries,

Fuel Gases & Industrial Gases: Purification of Natural Gas, Manufacture of Substitute Natural Gas, Manufacture and Uses of Carbon dioxide, Acetylene, Oxygen and Nitrogen.

Glass Industry: Types of Glass, Raw Materials Used In Glass Industry, Manufacture of Soda Lime Glass and Others

Nitrogen Industry: Manufacture and Uses of Ammonia, Urea, Ammonium Nitrate.

Phosphorous Industries: Manufacture And Uses Of Phosphoric Acid, Super phosphate, Triple Super phosphate

Industrial Carbon: Manufacture And Uses of Carbon Black, Graphite and Activated Carbon, Caustic Soda

Acid & Alkali's: Manufacture and Uses of Sulfuric Acid, Soda Ash, Caustic Soda

Cement: Types of Cement, Raw Materials Used In Cement, Manufacture Of Port Land Cement

Water Conditioning & Treatment: Importance Of Water For Chemical Process Industries, Sources Of Water And Their Purification, Water Conditioning And Treatment Methods (Ion Exchange, Demineralization, Precipitation Processes Etc.).

Practicals:

Practicals Will Be Based On the Theoretical Course

Recommended Books:

8. Austin George T. "Shreve's Chemical Processes Industries" 6th Ed. 1997, McGraw Hill International Edition.
9. Haidari Iqbal "Chemical Industry in Pakistan" .1992. Industrial Research Service Karachi, Pakistan.
10. Pandey G.N. "A Textbook of Chemical Technology" 2nd Ed. Vol-I & II. 2000. Vikas Publishing House (Pvt) Limited
11. Riegels Handbook of Industrial Chemistry, James A. Kent 2000, Springer/ Van Norstrand/ Rein Hold.
12. Kirk Othmer "Encyclopedia of Chemical Technology" 1999, Inter Science Publishers.
13. Government of Pakistan. "Prospects of Chemical Industry in Pakistan" 2003, Export Advisory cell, Ministry of Industries and Production, Islamabad.
14. Government of Pakistan. "Digest of Industrial Sectors in Pakistan" 2003, Export Advisory cell, Ministry of Industries and Production, Government of Pakistan, Islamabad. 2003.

Second Year 33 (28, 5) (Batch 2008)

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Second Year (Sem 3)				Second Year (Sem 4)			
Chemistry-II	3	1	4	ChE Thermodynamics-II	3	0	3
Industrial Stoichiometry-I	3	1	4	Ch. Process Technology-II	3	0	3
Material Science	2	0	2	Unit Operation-I	3	1	4
ChE Thermodynamics-I	3	1	4	Complex Variable and Laplace Transform	3	0	3
Differential Equations	3	0	3	Computer Programming & Software applications	2	1	3
Total	14	3	17	Total	14	2	16

Chemistry-II 4 (3, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

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.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

1. Unit Process in Organic synthesis P.H. Groggens Tata McGraw Hill 5th Ed. 2005.
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.
5. Physical Chemistry By Dr. M. Afzal
6. Shuler, Michael L., and Fikret Kargi. Bioprocess Engineering: Basic Concepts. 2nd ed. Upper Saddle River, NJ: Prentice Hall PTR, 2001.

Industrial Stoichiometry-I 3 (3, 0, 0) (Batch 2008)

Prerequisites:

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 stoichiometric 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.

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 Wiley & Sons.
3. Reklaitis G.V., Schneider Daniel R. "Introduction to Material and Energy Balances" 1983. John Wiley & Sons.
4. Hougden 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

Material Science 2 (2, 0, 0) (Batch 2008)

Prerequisites:

Course Outline:

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

Recommended Books:

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.

Chemical Engineering Thermodynamics-I 4 (3, 1, 0) (Batch 2008)

Prerequisites:

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. Compressibility factors; Heat engines, various cycles and turbine.

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.

PRACTICALS:

Practical to be based on theory:

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

Differential Equations 3 (3, 0, 0) (Batch 2008)

Prerequisites:

Course Outline:

1. In Depth Treatment of Curve Tracing and Some Well Known Curves.
2. Ordinary Differential Equations of 1st Order.
 - i. Basic Concept and Ideas, Geometrical Considerations, Isoclines. Geometrical Interpretation Of the 1st and 2nd Order Differential Equations
 - iii. Separable Equations
 - iv. Equations Reducible To Separable Form
 - v. Exact Differential Equations
 - vi. Integrating Factor
 - vii. Linear First Order Differential Equations
 - viii. Families of Curves. Orthogonal Trajectories
 - ix. Applications.
3. Ordinary Differential Equations of higher Order;
 - i. Homogeneous Linear Equations Of the 2nd Order
 - ii. Homogeneous Equations \Vith Constant Coefficients
 - iii. The General Solution, Initial and Boundary Value Problem
 - iv. Real, Complex And Repeated Roots Of Characteristic Equation
 - v. Differential Operators
 - vi. Catchy Equation
 - vii. Non-Homogenous Linear Equations
4. Series Solution Of Differential Equations.
 - i. Ordinary And Regular Point And Corresponding Series Solution
 - ii. Legender's Equation And Legender Polynomial
 - iii. Basil Equation and Basil Function of 1st Kind
5. Partial Differential Equations.
 - i. Method Of Separable Variables
 - ii. Application To Engineering Problems

Recommended Books:

- Mathematical Methods by S.M Yousaf
- Advanced Engineering Mathematics by Erwin Kreyszing
- Elements of Differential Equation by Keplan W

Chemical Engineering Thermodynamics II 3 (3, 0, 0) (Batch 2008)

Prerequisites: ChE Thermodynamics-I

Course Outline:

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

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 air conditioning.

Practical

Practical Will Be Based On Theory Course

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
- 5.

Chemical Process Technology-II 4 (3, 1, 0) (Batch 2008)

Prerequisites:

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 and Uses of plastics, synthetic fibers; Paints and Varnishes.

Pulp and paper; Pulp manufacture, Comparison, description of different methods available; Paper making.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

11. Austin George T. "Shreve's Chemical Processes Industries" 6th Ed. 1997, McGraw Hill International Edition.
12. Groggins P.H. "Unit Processes in Organic Synthesis" 4th Ed. 2005, Tata McGraw Hill Book Company, Inc.

13. Haidari Iqbal "Chemical Industry in Pakistan" .1992. Industrial Research Service Karachi, Pakistan.
14. Pandey G.N. "A Textbook of Chemical Technology" 2nd Ed. Vol-I & II. 2000. Vikas Publishing House (Pvt) Limited
15. Riegels Handbook of Industrial Chemistry, James A. Kent 2000, Springer/ Van Norstrand/ Rein Hold.
16. Kirk Othmer "Encyclopedia of Chemical Technology" 1999, Inter Science Publishers.

Unit Operation-I 4 (3, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Introduction and classification of Unit Operations

Solids handling: Characteristics of particulate materials. Particle size distribution. Classification screening and sieving. Mechanism of size reduction. Study of machinery for crushing & grinding, Closed/open circuit grinding operations. Electrostatic precipitation;. Solids storage and handling. Pneumatic and hydraulic conveying. Screw, vibratory, belt conveyors and elevators.

Mixing and agitation: Survey of principal types of mixers and agitators for use in cylindrical vessels. Mixing with propellers and turbines. Flow patterns and baffles. Rate of mixing and power consumption. Scale-up considerations. Power and modified Reynolds numbers and correlations thereof.

Filtration: Mechanism of filtration. Filter media. Preliminary treatment. Flow through filter cake and/or cloth. Cake resistance and relation between thickness of cake and volume of filtrate. Compressible cakes. Operation at constant pressure or throughput. Optimum time cycle. Studies of different types of filter including the filter presses, Nutsch filter and drum filter. Combination with washing and spraying. Integrated pressure and vacuum operations.

Liquid-solid separations: Nature of flow around particles. Concept of drag force and terminal velocity; Settling rates. Stokes' law and correlations for spherical particles. Sedimentation. Types of suspension and settling. Specification of vessel diameter. Design of thickeners. Coagulation and flocculation.

Centrifugation: Basic theory for liquid - liquid and solid - liquid separation. Shape of liquid surface. Filtration in a centrifuge. Study of different types of centrifuges: Batch and continuous operation.

PRACTICALS:

Practical to be based on theory:

Books Recommended

- 1.M Cabe 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-II, 1972. The English Book Society and Pergamon Press.
- 3.Perry Robert H., Green Don W. "Perry's Chemical Engineering handbook" 7th Ed. 1997. McGraw Hill Inc.
- 4.Foust and Wenzel "Unit Operations of Chemical Engineering"
- 5.George Granger Brown, "Unit Operatio" CBS Publishers & Distributors.
- 6.Noel de Nevers, "Fluid Mechanics for Chemical Engineers", 2005, McGrawHill Inc.
- 7.Chopy and Hicks., Handbook of Chemical Engineering calculations,

Complex Variable and Laplace Transform 3 (3, 0, 0) (Batch 2008)

Prerequisites:

Course Outline:

Laplace Transform · Definition of Laplace Transform. Laplace Transform Of Elementary Function, Linearity, Shifting, Change Of Scale Properties Of Lapels Transform · Lapels Transform Of Derivatives,

Periodic Functions. · Unit Step, Direct Delta And Unit Impulse Functions And Their Lapels Transforms.· Inverse Laplace Transform And All The Related Properties · Heavy Side Function · Solution Of Ordinary Differential Equations By Laplace Transforms.

Complex Variable Theory · Analytical Function. Catchy-Rehman Equations · Catchy Integral Formula · Line Integral, Green Theorem · Singularities, Poles, Residues And Contour Integration

Infinite Series & Fourier series · convergent of an Infinite Series · Ratio Test, Compression Test, Rabbi's Test, M-Test ~ The Concept of Fourier series. Fourier series With Period 2 and Ordinary Period 2L (L>0, L Is Real No.) · Fourier Series Of Even And Add Functions · Applications Of Fourier Series.

Books Recommended

1. Mathematical Methods by S. M. Yousuf
2. Mathematical Methods in Science and Engineering by J. Heading Arnold
3. Operational Mathematics By Churchill. R.V.
4. Advance Engineering Mathematics By E. Kreyszing
5. Complex Variable - Schaum Series 5. Laplace Transform - Schaum Series.

Computer Programming & Software applications 3(2, 1, 0) (Batch 2008)

Prerequisites:

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. Plotting 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.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

- 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

Third Year 35 (29, 6) (Batch 2008)

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Third Year (Sem 5)				Third Year Sem 6			
Numerical Analysis & Computer Applications	2	1	3	ChE Plant Design and Economics	3	0	3
Unit Operation-II	3	1	4	Maintenance Engineering	3	0	3
Industrial Stoichiometry-II	3	0	3	Fuel and Combustion	3	1	4
Heat Transfer	3	1	4	Unit Operation-III	3	1	4
Fluid Mechanics	3	1	4	Statistical Methods & Estimation:	3	0	3
Total	14	4	18	Total	15	2	17

Numerical Analysis and Computer Applications 3 (2, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Error Analysis · What Is Error · Kinds of Errors and Their Importance in the Study of Numerical Analysis · Case Study.

Solution Of Non-Linear Equation · Various Methods Of Solution Of Non-Linear Equation $F(X)=0$. · Bisection Method. · Regular False Method · Newton-Raphson Method · Fixed Point Iteration Methods and Their Error Analysis Treatment. · Case Study.

Interpolation & Curve Fitting · What Is Difference B/W Interpolation And Curve Fitting Linear Interpolation · The Error Of Interpolating Polynomial · Interpolation By Lagrange Polynomial Method · The Finite Difference Calculus · Interpolating Polynomials Based On Difference (Newton Forward And Backward Interpolating Polynomial). Case Study.

Numerical Differentiation & Integration/Quadrature · Numerical Differentiation · Extrapolation to the Limit. · Numerical Integration · The Trapezoid Rule · Simpson Rule · Gaussian Quadrature And Their Error Treatment · Case Study.

Matrices & System Of Linear Equation · Properties Of Matrices And Determinants · The Linear System In Matrix Notation · The Solution Of Linear System By Elimination · Matrix Inversion And Evaluation Of Determinants · The Eigen Value Problem · Iterative Methods · Convergence Of Iterative Methods

Solution of Differential Equation · Simple Differential Equations · Numerical Integration By Taylor's Series · Range-Quota Method · Predictor-Corrector Method · The Adam-Moulton Method · Stability Of Numerical Methods.

Boundary Value Problem in Ordinary Differential Equations · Finite-Difference Methods · Second and Fourth Order Equations.

PRACTICALS:

Practical to be based on theory:

Books Recommended

1. Applied Numerical Methods For Digital Computation With Fortran & Camp By M.L. James G.M. Smith, I.C Badford Happen International Edition.

Industrial Stoichiometry-II

3 (3, 0, 0) (Batch 2008)

Prerequisites: Industrial Stoichiometry-I

Course Outline:

Mass balances for items of plant, Choice of basis/reference line for balances. Over all 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.

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.

Books Recommended

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

Professional Publishing.

- B.I. Bhatt, “ Stoichiometry” , 2004, McGraw Hill

Unit Operation-II 4 (3, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Fundamentals and 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.

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.

Crystallization: Growth and properties of crystals. Saturation and nucleation. Crystallization rate. Effect of temperature on solubility. Solubility and phase diagrams. Fractional crystallization. Principles of operation: batch and continuous Crystallization: Design of crystallizers

PRACTICALS:

Practical to be based on theory:

Recommended Books:

7. McCabe Warren L., Smith Julian C., Harriott peter “Unit Operations of chemical Engineering” 7th Ed. 2005. McGraw Hill Inc.
8. Coulson J.M., Richardson J.F. “Chemical Engineering” Vol-II, 5th Ed. 2002. The English Book Society and Pergamon Press.
9. Coulson J.M., Richardson J.F. “Chemical Engineering” Vol-I, 1999. The English Book Society and Pergamon Press
10. 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.
11. Incropera Frank P., De Witt David P. “Fundamentals of Heat and Mass Transfer” 3rd Ed. 1990. John Wiley and Sons.
12. Treybal Robert E. “Mass Transfer Operations” , 1981, McGraw Hill Book Company.

Heat Transfer 4 (3, 1, 0) (Batch 2008)

Prerequisites: After fourth semester

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, vapor compression evaporators, The heat pump cycle, Evaporator operation, Equipments for evaporation.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

8. Kern Donald Q. "Process Heat Transfer" , 1997, McGraw Hill Book Company.
9. Cengel Yunus A. "Heat Transfer-A Practical approach" , 1988, McGraw Hill Book Company.
10. Incropera Frank P., De Witt David P. "Fundamentals of Heat and Mass Transfer" 5rd Ed. 2002. John Wiley and Sons.
11. Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-I, 1999. The English Book Society and Pergamon Press
12. Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-II, 5th Ed. 2002. The English Book Society and Pergamon Press
13. Hewitt & Bott. "Process Heat transfer"
14. J.P. Holman, "Heat Transfer", 2002, McGraw Hill Book Company.

Fluid Mechanics 4 (3, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Concept & Use of Units, Dimensional Analysis: Buckingham –Pi Theorem, Reynold's law of Similarity.

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

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.

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

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.

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 .

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.

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.

Flow of Non-Newtonian Fluids; Elementary viscometry, Rabinowitsch-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

Pumping: Principal features of positive displacement and centrifugal pumps, Principles of operation. Flow-head characteristics. Effect of pipework. Suction head and cavitation. Sizing and specification. Compressors and blowers; principles, operation and sizing.

Flow Measurement: The principles, description, calculation and specification of flow measuring instruments including Venturi and Orifice meters, Pitot tubes, Area meters, Nozzles, notch and manometers.

PRACTICALS:

Practical to be based on theory:

Books Recommended

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

Ch.E Plant Design and Economics 3 (3, 0, 0) (Batch 2008)

Prerequisites:

Course Outline:

Economics, its definition, principles and applications. Characteristics of chemical industry, Cost estimation and its techniques. Cash flow for industrial operations (cumulative cash position); factors affecting investment and production cost; Capital investments, Estimation of capital investment; Types of capital cost estimates; cost indexes; cost factors in capital investment; estimation of total product cost; interests and investment cost; types of interests; present worth and discount; Annuities; special types of Annuities; Perpetuities and capitalized cost; Taxes and insurance; types of tax; federal income tax; insurance and legal responsibilities; types of insurance; Depreciation. Types of depreciation; Cost for maintenance and repairs. Service life. Salvage value. Present value; methods of determining the depreciation; evaluation of depreciation methods ; Profitability. Alternative investments and replacements; Profitability standards; Mechanical methods of profitability evaluation (Rate of return on investment) Determining the acceptable returns; Alternative investments; Replacements; Market survey; Plant location; Cost accounting; Book keeping; financial statements.

Introduction. Process design development. General design consideration. Health and safety; Fire and explosion hazards; Optimum design. Materials of fabrication and selection. Introduction to vessel design. Review of design of mass transfer, material transfer, material handling and heat transfer including furnaces and refrigeration units. Introduction to piping design. Introduction to computer aided design. Introduction to Product Design.

Recommended Books:

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

Fuel and Combustion

4 (3, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Fuels: Survey of available fuels; Industrial fuels. Classification and properties of solid, liquids and gaseous fuels. Criteria for the selection of fuels for industrial purposes; Combustion calculations; Coke and its industrial manufacture and uses; Petroleum and its distillation products; Synthetic fuels.

Thermochemistry/Chemical Kinetics: First law of Thermodynamics, Enthalpy of Formation, Enthalpy of Combustion and Heating Values, Adiabatic Flame Temperature, Chemical Equilibrium.

Laminar Premixed & Diffusion Flames: 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 Flames: 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

Droplet Evaporation and Burning: 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

Burning of Solids: Coal combustion, Coal-fired Boilers, Burning of Coal – one-film model, two-film model, Coal combustion and particle burning times.

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, Production of Hydrogen from Biomass. Characterization of peat and biomass liquids, Fermentation to Ethanol, bio-diesel and Biogas. Biodiesel, 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.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

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.
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.
 8. 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.
 9. 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.
 10. 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.
 11. 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.
 12. Meinel B Aden, and Meinel P. Marjorie, "Applied Solar Energy – an Introduction", 1976, Addison Wesley publishing Co. London, UK, ISBN 0 201 04719 5.
 13. Roger Henri Charlier," Tidal Energy" 1982, Van Nostrand Reinhold Co. NY, USA, ISBN 0 442 24425 8.
 14. Bhadra S.N, Kasta D, and Banerjee S, "Wind Electrical Systems", 2005, Osford University Press, ISBN 0 195 67093 0.

Maintenance Engineering 3 (3, 0, 0) (Batch 2008)

Prerequisites:

Course Outline:

Main Theory and Scope of Maintenance Engineering · Theory & Scope of Maintains Engineering, Design considerations; Layout and construction; maintenance of rotary and stationery equipment, inspection techniques. Non-destructive testing techniques, basics of rigging and lifting.

Overall safety of plant and personnel; Industrial Safety and Hazards · Health and Safety Hazards · Chemical Hazards · Classification of Fire and Fire Prevention · Procedure to Be Followed In Case Of Fire.

Materials Of Construction And Fabrication Of Equipment's · Introduction To Materials Of Construction · Floors And Types Of Floor · Introduction To The Fabrication Of Equipment · Steps For Fabrication Of Equipment's.

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, etc. Types of Corrosion · Factors Which Influence Corrosion · Methods of Prevention of Corrosion · Inhibitors.

Preparation for start-up and shut down. Preventive and predictive maintenance; Lubrication and lubricants. Maintenance of safety equipment. Accident prevention;

Books Recommended

- 1.Hand Books of Maintenance Engineering
- 2.A. Kelly & M.J. Harris, Management of Industrial Maintenance, Butter Worth, London, Boston.
- 3.Salih O. Tuffuaa, A. Rauf & John Dixon Compbell "Planning & Control of Maintenance Systems: Modeling & Analysis" John Willey and Sons.
- 4.Mobley, R. "Maintenance fundamentals", 1999. ISBN.0-7506-7151-3.

Unit Operation-III

4 (3, 1, 0) (Batch 2008)

Prerequisites: Unit Operation-II

Course Outline:

Vapor-liquid equilibria: Partial vaporization and condensation. T-X-Y and X-Y diagrams. Composition calculations.

Distillation: Vapor-liquid equilibria: Partial vaporization and condensation. T-X-Y and X-Y diagrams. Composition calculations, Differential and flash distillation, rectification. The fractionating column. Concept of constant molal overflow. Calculation of number of plates required for binary separations. Lewis-Sorel, McCabe-Thiele. 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 equations. 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. Batch distillation: operation at constant product composition or constant reflux ratio. Calculation of column, diameter and height.

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.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

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. 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.

Statistical Methods & Estimation:

3(3, 0, 0) (Batch 2008)

Prerequisites:

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.

Recommended Books:

- Jyotiprasad Medhi "Statistical Methods", New Age Publishers, 2005, ISBN 8122404197
- Kenneth. Lange, "Statistical Methods", Springer, 2002, ISBN 0387953892
- Montgomery, D.C., and Runger, G.C., "Applied Statistics and Probability for Engineers", John Wiley & Sons, 2001
- N. A. Weiss, "Introductory Statistics", Addison Wesley, 1995

Final Year 36 (26, 10) (Batch 2008)

Course Title	Lec	Lab	CR	Course Title	Lec	Lab	CR
Final Year (Sem 7)				Final Year (Sem 8)			
Biochemical Engineering	3	1	4	Industrial Management	3	0	3
Transport Phenomena	3	0	3	Chemical Engineering Kinetics	3	1	4
Instrumentation and Control	3	1	4	Petrochemical Eng.	2	1	3
Petroleum Refinery Eng.	3	1	4	Nuclear Engineering	3	0	3
Environmental Engineering	3	1	4	Project/ Thesis	0	4	4
Total	15	4	19	Total	11	6	17

Biochemical Engineering 4 (3, 1, 0) (Batch 2008)

Prerequisites: After sixth semester

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;

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.

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

PRACTICALS:

Practical to be based on theory:

Recommended Books:

8. Shuler, Michael L., and Fikret Kargi. Bioprocess Engineering: Basic Concepts. 2nd ed. Upper Saddle River, NJ: Prentice Hall PTR, 2001.
9. Blanch, Harvey W., and D. S. Clark, eds. Biochemical Engineering. New York, NY: Marcel Dekker Incorporated, 1997.
10. Bailey, James E., and David F. Ollis. Biochemical Engineering Fundamentals. 2nd edition, McGraw-Hill, Inc., New York, 1986.

11. 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.
12. Levenspiel, O. Chemical Reaction Engineering, Wiley Eastern Pvt. Ltd., 1999
13. Electronic Journal of Biotechnology < <http://www.ejbiotechnology.info/> >
14. Chemical and Biochemical Engineering Quarterly < <http://www.pbf.hr/cabeq/> >

Transport Phenomena 3 (3, 0, 0) (Batch 2008)

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.

Recommended Books:

1. Bennett C.O., Myers J.E. "Momentum, Heat & Mass Transfer" 3rd Ed. 1983. McGraw Hill Book Company.
2. Bird R. Byron, Stewart 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"

Petroleum Refinery Engineering 4 (3, 1, 0) (Batch 2008)

Prerequisites: After sixth semester

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.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

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

Instrumentation and Control 4 (3, 1, 0) (Batch 2008)

Prerequisites: After sixth semester

Course Outline:

Introduction · the System · Steady-State Design · Process Control · the Steady-State Process · Feedback Control · Transient Responses · Integral Control · Block Diagram

The Laplace Transform · Definition of the Transform · Transform Of Simple Function · Transforms Of Derivatives · Solutions of Differential Equations · Inversion by Partial Fraction · Final Value Theory · Translation of Transform · Translation of Function · Transform Of An Integral.

Response of First- Order System · Transfer Function · Properties of Transfer Function · Transient Response · Forcing Functions. Physical Examples of First-Order Systems " Liquid Level System · Mixing Process · R C Circuit · Time Constant of A First-Order System · Linearization. Response of First-Order System in Series · Non-Interacting System · Generalization · Several Non-Interacting Systems in Series · Interacting System

Higher-Order System · Second-Order- System · Step Response · under damped System · Impulse Response · Sinusoidal Response · Transportation Lag.

The Control System · Components of Control System · Block Diagram of A Control System · Negative Feed-Back a Positive Feedback · Measuring Element · Controller and Final Control Element

Controllers & Final Control Elements · Pneumatic Control Valve · Proportional Control · On-Off Control · Proportional Integral Control · Measuring Element · Controller · Transportation Lag · Block Diagram.

Closed-Loop Transfer Function · Overall Transfer Function For Single Loop Systems · Overall Transfer Function For Change in Set Point · Overall Transfer Function For Change in Load · Overall Transfer Function For Multiloop Control Systems.

Transient Response of Simple Control System · Proportional Control For Set Point Change · Proportional Control For Load Change · Proportional Integral Control For Load Change · Proportional Integral Control For Set Point Change · Proportional Control Of System With Measurement Lag.

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 gas 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, feed forward. Use of analyzer and chromatographs, Modeling: Lumped parameter models to plant, e.g. jacketed vessel.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

7. Smith, C. A, Corripio, A. B, Principles and Practice of Automatic Process Control, John Wiley, 1985.
8. Marlin, T.E., Process Control, 2nd Ed., McGraw Hill Book Co., 2000.
9. Ogunnaike, B. A., et al., Process Dynamics, Modeling, and Control, Oxford University Press, 1997.
10. Coughanown, D.R. and Koppel, C.B., Process system Analysis & Control, McGraw Hill 1991.
11. Process Control Instrumentation Technology, Curtis D. Johnson, Person Education 2003.
12. Chemical Process Control, G. Stephanopoulos, Prentice Hall 2002
13. Essentials of Process Control, W.L. Luyben McGraw Hill 1997.

Environmental Engineering

4 (3, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Scope of environmental pollution. Present state of the environment, Pollution Concept.

Air Pollution · Air Quality Characteristics · Definition Air Pollution (Classification of Pollutants) · Sources Of Air Pollution And Meteorology · Effects Of Air Pollution On Humans, Animals, Vegetation · Buildings, Metallic Structures And Works Of Arts · Detection Air Pollution · Prevention Of Air Pollution · Air Pollution Control Devices

Water Pollution · Water Quality Parameter · Definition Of Water Pollution · Sources Of Water Pollution · Effects Of Water Pollution · Waste Water Treatment And Disposal

Land Pollution · Types of Solid Waste · Definition of Land Pollution · Sources of Land Pollution · Effects of Land Pollution · Solid Waste Management.

Waste generated from local industries specially chemical and petrochemical industries.

Designing of Wastewater treatment system. Biotechnology for environment, industrial pollution control.

Environmental Monitoring (Air, Water & Soil): Objectives of sampling and monitoring programme.

PRACTICALS:

Practical to be based on theory:

Books Recommended

1. Davis Mackenzie L., Cornwell David A. "Introduction to Environmental Engineering" 2nd Ed. 1991. McGraw Hill Inc.
2. Pandey G.N., Garney G.C. "Environmental Engineering" , 2001, Tata McGraw Hill Publishing Company Limited.
3. Environmental Engineering By Peavey Howards

Industrial Management and Quality 3 (3, 0, 0) (Batch 2008)

Prerequisites: After sixth semester

Course Outline:

Personnel management: Introduction, Job description and personnel specifications. Recruitment. Training and Career development. Appraisal. Motivation. Employment Law. Disciplinary procedures and appeals. Payment systems. Shift scheduling. Personal & Industrial safety. Health & Insurance. Superannuation, Holidays and Medical coverage.

Labour and Engineering Laws; A study of national/international laws in practice.

Works & plant management: General principles, growth of Management Thought and Functions. Management and Organization Structures. Liaison & coordination of departments. Delivery and despatch of goods. Productivity Improvement. Production Management. Project Management. PERT/CPM. Purchase, Sale and Inventory Management Systems. Budget and Budgetary controls. Inspection and Quality Control Systems. ISO certification. Total Quality Management and New Trends.

Books Recommended

1. Freeman-Bell Gail, Blakwill James "Management in Engineering Principles and Practice" 2nd Ed., 1996, Prentice-Hall (Pvt) Limited.
2. Buffa, "Production and Operations Management".
3. Saiyadian Mirza S. "Human Resources Management" 2nd Ed., 2000, Tata McGraw –Hill Publishing Company Limited
4. Beach, "Personal Management"

Chemical Engineering Kinetics 4 (3, 1, 0) (Batch 2008)

Prerequisites: After sixth semester

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, Design of fluid-solid catalytic reactors.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

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.

Petrochemical Engineering

2 (2, 1, 0) (Batch 2008)

Prerequisites:

Course Outline:

Recent trends in research and development in Petrochemical industries. Hydrocarbon Sources and Raw materials; their characterization, availability and pricing. The production of basic precursors of petrochemical from feedstock. Conversion of precursors into intermediates and final petrochemical products. Coal chemicals.

Polymers: Polymers Methods of Preparing Polymers, Carbon-Carbon Chain Polymer Compounds, Organ-Element Polymer Compounds. Compounds Of Polymers Plasticizers, Fillers, Day's And Pigments Extenders, Stabilizers.

Polymerization: Polymerization, Types of Polymerization, Methods of Polymerization, Polymerization of Acetylene, Ethylene, Propylene and Butylene.

Rubber: Natural and Synthetic Rubber I! Manufacturing Processing And Compounding Of Rubber, Vulcanized Rubber, Chlorinated Rubber, Acrylonitrile Rubber · Neoprene Rubber, Styrene-Butathylene-Butadiene Rubber.

Plastics: Description of Plastic, Thermo Plastic and Thermosetting Plastic, Manufacturing and Production of Pvc Polyethylene High Pressure And Low Pressure Methods, Plastic from Polyamides and Basritite.

Fibers . Description of Natural And Synthetic Fibbers. Manufacturing and Production Of Nylon Fibers · AcryloNitrite Fibers.

PRACTICALS:

Practical to be based on theory:

Recommended Books:

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.

Nuclear Engineering

3 (3, 0, 0) (Batch 2008)

Prerequisites: After sixth semester

Course Outline:

Role and importance of nuclear energy; Nuclear cross-sections;

Basic Concepts: · Equivalence of the Matter and Energy · Atoms & Nuclei (Binding Energy) · Radioactive Decay.

Radiation Materials · Excitation and Ionization By Electrons ". Heavy Charged Particles · Gamma Rays Interaction with Matter · Nuclear Reactions · Radiation Protection.

Fission · the Fission Processes · Energy Consideration · By Production By Fission · Energy From Nuclear Fuels

Fusion · Fusion Reaction · Electrostatics and Nuclear Forces · Thermonuclear Reaction in Plasma

Isotope-Separation Methods · Mass Spectrograph · Gaseous Diffusion Separation · Gas Centrifuge · Laser Isotope Separation.

Neutron Chain Reaction · Criticality And Multiplication · Multiplication Factors · Neutron Flux And Reactor Power · Reactor Operations · Reactor Safety.

Nuclear Fuel Cycle. Economics and Uranium Processing · Reactor Fuels

Nuclear Reactor Systems · Reactor Design · Critters · Materials Of Construction · Reactor Design Method Breeder Reactors · the Concept of Breeding · The Fast Breeder Reactor · Breeding And Uranium Resources

Nuclear Waste Disposal · Nuclear Waste Types, Waste Disposal Methods

Useful Reaction Effect · On Medical Side · On Agriculture Side & Others.

Reference Books:

1. Nuclear Engineering Technology, By: Knife 2. Nuclear Engineering By Glastone.
2. Lamarsh, J. R, Introduction to Nuclear Engineering, 3rd Edition, Prentice Hall, 2001.
3. . Nuclear Energy By Raymond L. Murray

Project/ Thesis4 (0, 4) (Batch 2008)

Thesis/ Project