2007-2008

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

B.TECH. CHEMICAL ENGINEERING

IV YEAR II SEMESTER
COURSE STRUCTURE

Subject	T	P	C
Industrial Pollution Control Engineering	4+1*	0	4
Elective-III	4+1*	0	4
Industrial Safety and Hazard Management			
Design and Analysis of Experiments			
Technology of Pharmaceuticals and Fine Chemicals			
Computer Organization			
Elective – IV	4+1*	0	4
Optimization of Chemical Processes			
Operations Research			
Energy Engineering			
Operating Systems			
Industry Oriented Mini Project	0	0	2
Seminar	0	0	2
Project Work	0	0	10
Comprehensive Viva	0	0	2
Total	15	0	28

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	4+1*	**0**	**4**

INDUSTRIAL POLLUTION CONTROL ENGINEERING

Unit-I
Types of emissions from chemical industries and effects of environment, environment legislation, Type of pollution, sources of wastewater, Effluent guidelines and standards,

Unit-II
Characterization of effluent streams, oxygen demands and their determination (BOD, COD, and TOC), Oxygen sag curve, BOD curve mathematical, controlling of BOD curve, self purification of running streams, sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

Unit-III:
General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry.

Unit-IV
Air pollution sampling and measurement: Types of pollutant and sampling and measurement, ambient air sampling: collection of gaseous air pollutants, collection of particulate air pollutants. Stack sampling:
sampling system, particulate sampling, and gaseous sampling. Analysis of air pollutants: Sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and Ozones, hydrocarbons, particulate matter.

Unit-V
Air pollution control methods and equipments: Source collection methods: raw material changes, process changes, and equipment modification. Cleaning of gaseous equipments particulate emission control: collection efficiency, control equipment like gravitational settling chambers, Cyclone separators, fabric filters, ESP and their constructional details and design aspects. Scrubbers: wet scrubbers, spray towers, centrifugal scrubbers, packed beds and plate columns, venturi scrubbers, their design aspects. Control of gaseous emissions: absorption by liquids, absorption equipments, adsorption by solids, equipment and the design aspects.

Unit-VI
Introduction to waste water treatment, biological treatment of wastewater, bacterial and bacterial growth curve, aerobic processes, suspended growth processes, activated aerated lagoons and stabilization ponds,
Attached growth processes, trickling filters, rotary drum filters, anaerobic processes.

Unit-VII:
Methods of primary treatments: screening, sedimentation, flotation, neutralization, and methods of tertiary treatment. A brief study of carbon absorption, ion exchange, reverse osmosis, ultra filtration, chlorination, ozonation, treatment and disposal.

Unit-VIII
Hazardous waste management: Nuclear wastes: health and environment effects, sources and disposal methods. chemical wastes: health and environmental effects, treatment and disposal: treatment and disposal by industry, off site treatment and disposal, treatment practices in various countries. Biomedical wastes: types of wastes and their control.

TEXT BOOKS:

1. Environmental pollution and control engineering, Rao C. S. – Wiley Eastern Limited, India, 1993.
2. Pollution control in process industries by S.P. Mahajan TMH.,1985.

REFERENCES:

1. Waste water treatment by M.Narayana Rao and A.K.Datta,Oxford and IHB publ. New Delhi.
2. Air pollution control by P.Prathap mouli and N.Venkata subbayya. Divya Jyothi Prakashan, Jodhpur.
3. “Industrial Pollution Control and Engineering.” Swamy AVN, Galgotia publications, 2005. Hyderabad

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INDUSTRIAL SAFETY AND HAZARD MANAGEMENT
(Elective III)

Unit I:
Introduction:
Safety program, Engineering ethics, Accident and loss statistics, Acceptable risk, Public perception.

Unit II:
Toxicology:
How toxicants enter biological organisms, How toxicants are eliminated from biological organisms.

Unit III:
Industrial Hygiene:
Government regulations, Identification, Evaluation, Control.

Unit IV:
Fires and Explosions:
The fire triangle, Distinction between fire and explosions; Definitions, Flammability characteristics of liquids and vapors, MOC and inerting, ignition energy, Auto ignition, Auto oxidation, Adiabatic compression, Explosions.

Unit V:
Designs to prevent fires and explosions:
Inerting, Explosion proof equipment and instruments, Ventilations, Sprinkler systems.

Unit VI:
Introduction to Reliefs:
Relief concepts, Definitions, Location of reliefs, Relief types, Data for sizing reliefs, Relief systems.

Unit VII:
Relief Sizing:
Conventional spring operated relief's in liquids, Conventional spring operated relief's in vapor or gas service, Rupture disc relief's in liquid, vapour or gas service.

Unit VIII:
Hazards Identification:
Process hazards checklists, Hazard surveys, Hazop safety reviews.

TEXT BOOK:
1 D.A.Crowl & J.F.Louvar – Chemical Process Safety (Fundamentals with applications), Prentice Hall (1990).
2. Industrial Hygiene and Chemical safety

REFERENCES:
1. H.H.Fawcett and W.S.Wood –Safety and Accident Prevention in Chemical Operations, 2nd edition, John Wiley and sons, New York 1982
2. Coulson and Richardson's – Chemical engineering – R.K.Sinnot, Vol.6, Butterworth-Heinmann Limited 1996.

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DESIGN AND ANALYSIS OF EXPERIMENTS
(ELECTIVE - III)

Unit I :
Introduction to the role of experimental design; basic statistical concepts; sampling and sampling distribution;

Unit II :
Testing of hypotheses about differences in means- randomized designs and paired comparison designs; testing of hypotheses about variances

Unit III :
Analysis of variance (ANOVA) –one-way classification ANOVA; analysis of fixed effects model; comparison of individual treatment means; the random effects model; the randomized complete block design

Unit IV
Factorial design of experiments; two-factor factorial design-fixed effects and random effects model;

Unit V :
General factorial design; analysis of 2^k and 3^k factorial designs

Unit VI :
Conforming in the 2^k factorial design in 2p block; confounding in the 3^k factorial design in 3p block;

Unit VII:
Fractional replication of the 2^k factorial design and the 3^k factorial design

Unit VIII:
Regression analysis- Simple and multiple linear regression and hypothesis testing; response surface methodology-the method of steepness ascent : response surface designs for first-order and second-order models. Evolutionary operation(EVOP)

TEXT BOOK:. “Design and analysis of experiments” by D.C. Montgomery, 2nd edition John Wiley and sons, NewYork (1984).

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TECHNOLOGY OF PHARMACEUTICALS AND FINE CHEMICALS
(ELECTIVE - III)

Unit I:
A brief outline of grades of chemicals, sources of impurities in chemicals, principles (without going into details of individual chemicals) of limit test for arsenic, lead, iron, chloride and sulfate in Pharmaceuticals.

Unit II:
Outlines of Preparation, properties, uses and testing of the following Pharmaceuticals - sulfacetamide, paracetamol, , riboflavin, nicotinamide,

Unit III:
Outlines of Preparation, properties, uses and testing of the following fine chemicals - Methyl orange, fluorescence, procaine hydrochloride, paramino salicylic acid, isonicatinic acid hydrazide.

Unit IV:
Manufacture with flowsheets, properties uses and testing of the following Pharmaceuticals – aspirin, penicillin, calcium gluconate,

Unit V:
Manufacture with flowsheets, properties uses and testing of the following ferric ammonium citrate, pthallic anhydride and phenol flourobenzene process and benzene sulfate process, other processes in outline only.

Unit VI:
Tablet making and coating, granulation equipments

Unit VII:
Preparation of capsules, extraction of crude drugs.

Unit VIII:
Sterilization: introduction, risk factor, methods of sterilization, heat (dry and moist), heating with bactericide, filtration, gaseous sterilization and radiation sterilization, suitable example to be discussed.

TEXT BOOKS :
1. Remington's Pharmaceutical Science, Mac publishing company, 13th ed. 1965.
2. TEXT BOOK of Pharmaceutical Chemistry by Blently and driver. Oxford University press, London, 8th ed. 1960.

REFERENCES :
1. Blently's TEXT BOOK of Pharmaceutical Chemistry by H A Rawlins, B Tindell and Box, 8th ed. OU Press, London, 1977.
2. Industrial Chemicals by Faith, Kayes and Clark, John Wiley & Sons, 3rd Ed. 1965.

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COMPUTER ORGANIZATION
(ELECTIVE - III)

UNIT-I

BASIC STRUCTURE OF COMPUTERS : Computer Types, Functional unit, Basic OPERATIONAL concepts, Bus structures, Software, Performance, multiprocessors and multi computers. Data Representation. Fixed Point Representation. Floating – Point Representation. Error Detection codes.

UNIT-II

REGISTER TRANSFER LANGUAGE AND MICROOPERATIONS : Register Transfer language. Register Transfer Bus and memory transfers, Arithmetic Mircrooperatiaons, logic micro operations, shift micro operations, Arithmetic logic shift unit. Instruction codes. Computer Registers Computer instructions – Instruction cycle.

Memory – Reference Instructions. Input – Output and Interrupt. STACK organization. Instruction formats. Addressing modes. DATA Transfer and manipulation. Program control. Reduced Instruction set computer.

UNIT-III

MICRO PROGRAMMED CONTROL : Control memory, Address sequencing, microprogram example, design of control unit Hard wired control. Microprogrammed control

UNIT-IV

COMPUTER ARITHMETIC : Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating – point Arithmetic operations. Decimal Arithmetic unit Decimal Arithmetic operations.

UNIT-V

THE MEMORY SYSTEM : Basic concepts semiconductor RAM memories. Read-only memories Cachememories performance considerations, Virtual memories secondary storage. Introduction to RAID.

UNIT-VI

INPUT-OUTPUT ORGANIZATION : Peripheral Devices, Input-Output Interface, Asynchronous data transfer Modes of Transfer, Priority Interrupt Direct memory Access, Input –Output Processor (IOP) Serial communication; Introduction to peripheral component, Interconnect (PCI) bus. Introduction to standard serial communication protocols like RS232, USB, IEEE1394.

UNIT-VII

PIPELINE AND VECTOR PROCESSING : Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors.

UNIT-VIII

MULTI PROCESSORS : Characteristics or Multiprocessors, Interconnection Structures, Interprocessor Arbitration. InterProcessor Communication and Synchronization Cache Coherance. Shared Memory Multiprocessors.

TEXT BOOKS :

1. Computer Systems Architecture – M.Moris Mano, IIIrd Edition, Pearson/PHI
2. Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill.

REFERENCES :

1. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI
2. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition PHI/Pearson
3. Fundamentals or Computer Organization and Design, - Sivaraama Dandamudi Springer Int. Edition.
4. Computer Organization, Anjaneyulu, Himalaya Pub house.

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OPTIMIZATION OF CHEMICAL PROCESSES
(ELECTIVE - IV)

Unit-I:
Nature and organization of optimization problems: what optimization is all about, Why optimize, scope and hierarchy of optimization, examples of applications of optimization, the essential features of optimization problems, general procedure for solving optimization problems, obstacles to optimization. Classification of models, how to build a model, fitting functions to empirical data, the method of least squares, factorial experimental designs, fitting a model to data subject to constraints.

Unit-II:
Basic concepts of optimization: Continuity of functions, unimodal versus Multimodel functions. Convex and Concave functions, Convex region, Necessary and sufficient conditions for an extremum of an unconstrained function, interpretation of the objective function in terms of its quadratic approximation.

Unit-III:
optimization of unconstrained functions: one-dimensional search:
Numerical methods for optimizing a function of one variable, scanning and bracketing procedures, Newton's, Quasi-Newton's and Secant methods of uni-dimensional search, region elimination methods, polynomial approximation methods, how the one- dimensional search is applied in a multi-dimensional problem, evaluation of uni-dimensional search methods.

Unit-IV:
unconstrained multivariable optimization:
Direct methods, random search, grid search, uni-variate search, simplex method, conjugate search directions, Powell's method, indirect methods- first order, gradient method, conjugate method, indirect method- second order: Newton's method forcing the Hessain matrix to be positive definite, movement in the search direction, termination, summary of Newton's method, relation between conjugate gradient methods and Quasi-Newton method.

Unit – V:
Linear programming and applications:
Basic concepts in linear programming, Degenerate LP's – graphical solution, natural occurrence of linear constraints, the simplex method of solving linear programming problems, standard LP form, obtaining a first feasible solution, the revised simplex method, sensitivity analysis, duality in linear programming, the Karmarkar algorithm, LP applications.

Unit-VI:
Optimization of Unit operations-1 recovery of waste heat, shell & tube heat exchangers, evaporator design, liquid liquid extraction process, optimal design of staged distillation column.

Unit-VII:
Optimization of Unit operations-2 Optimal pipe diameter, optimal residence time for maximum yield in an ideal isothermal batch reactor, chemostat, optimization of thermal cracker using liner programming.

Unit-VIII:
Genetic Algorithms: (Qualitative treatment) Working principles, differences between GAs and traditional methods, similarities between GAs and traditional methods, GAs for constrained optimization, other GA operators, real coded GAs, Advanced Gas

TEXT BOOK:
1. Optimization of chemical processes by T.F.Edgar and Himmelblau DM.Mc- Graw. Hill.2001.
2. Optimization for Engineering Design, Kalyan Moy Deb, PHI-2000

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OPERATIONS RESEARCH
(ELECTIVE - IV)

UNIT – I
Development – Definition– Characteristics and Phases – Types of models – operation Research models – applications.
ALLOCATION: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques -Two–phase method, Big-M method – Duality Principle.

UNIT – II
TRANSPORTATION PROBLEM – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.
Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.
SEQUENCING – Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines.

UNIT – III
REPLACEMENT: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, group replacement.

UNIT – IV
THEORY OF GAMES: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle – m X 2 & 2 X n games –graphical method.

UNIT – V
WAITING LINES: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models– Multichannel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals.

UNIT – VI
INVENTORY: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks – shortages are not allowed – Stochastic models – demand may be discrete variable or continuous variable – Instantaneous production. Instantaneous demand and continuous demand and no set up cost.

UNIT – VII
DYNAMIC PROGRAMMING:
Introduction – Bellman's Principle of optimality – Applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

UNIT – VIII
SIMULATION: Definition – Types of simulation models – phases of simulation– applications of simulation – Inventory and Queuing problems – Advantages and Disadvantages – Simulation Languages.

TEXT BOOK :
1. Operations Research / S.D.Sharma-Kedarnath.

REFERENCES :
1. Operations Research /A.M.Natarajan,P.Balasubramani,A. Tamilarasi/Pearson Education.
2. Operations Research: Methods and Problems / Maurice Saseini, Arhur Yaspan and Lawrence Friedman
3. Operations Research / R.Pannerselvam,PHI Publications.
4. Operations Research / Wagner/ PHI Publications.
5. Operation Research /J.K.Sharma/MacMilan.
6. Introduction to O.R/Hiller & Libermann (TMH).
7. O.R/Wayne L.Winston/Thomson Brooks/cole
8. Introduction to O.R /Taha/PHI

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ENERGY ENGINEERING
(Elective- IV)

Unit I:
Sources of energy, types of fuels- energy and relative forms. Calorific value- gross and net value, calculation of calorific value from fuel analysis, experimental determination energy resources present and future energy demands with reference to India.

Unit II:
Coal: origin, occurrence, reserves, petrography, classification, ranking, analysis, testing, storage, coal carbonization and byproduct recovery, liquefaction of coal, gasification of coal, burning of coal and firing mechanism, burning of pulverized coal.

Unit III:
Liquid fuels: petroleum: origin, occurrence, reserves, composition, classification, characteristics, fractionation, reforming, cracking, petroleum products, specification of petroleum products, burning of liquid fuels.

Unit IV:
Natural gas, coke oven gas, producer gas, water gas, LPG, burning of gaseous fuels, hydrogen (from water) as future fuel, fuel cells, flue gas, analysis: orsat apparatus

Unit V:
Energy auditing: short term, medium term, long term schemes, energy conversion, energy index, energy cost, representation of energy consumption, Sankey diagram, energy auditing.

Unit VI:
Steam Plant: Run time cycle, boiler plant, steam cost, steam distribution and utilization, combined heat and power systems, energy from biomass and biogas plants, gas purification, solar energy, wind energy, energy storage

Unit VII:
Waste heat recovery, sources of waste heat and potential application, various types of heat recovery systems, regenerators, recuperators, waste heat boilers

Unit VIII
Energy conservation: conservation methods in process industries, theoretical analysis, practical limitations.

TEXT BOOKS
1. Fuels , furnaces and refractories by O.P.Gupta.
2. Fuels and combustion by Sami Sarkar 2nd edition orient Longman (1998).

REFERENCES
1. Non-conventional energy resources by G.D.Rai
2. Solar energy by S.P.Sukhathame
3. Conventional energy technology, Fuel and chemical energy by Tata McGraw- Hill book Co.Ltd. (1987)
4. Fuel and energy by harker and Backhurst Academic press London 1981
5. Fuel science- harker and Allen Oliver and Boyd 1972
6 W.R.Murphy, G.Mc.Kay- Energy Management, 1st edition – Butterwolfer &Co.Ltd.(2001)
7. Energy management by Turner

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OPERATING SYSTEMS
(ELECTIVE – IV)

UNIT I :
Computer System and Operating System Overview: Overview of computer operating systems operating systems functions protection and security distributed systems special purpose systems operating systems structures and systems calls operating systems generation

UNIT II :
Process Management – Process concepts threads, scheduling-criteria algorithms, their evaluation, Thread scheduling, case studies UNIX, Linux, Windows

UNIT III :
Concurrency : Process synchronization, the critical- section problem, Peterson's Solution, synchronization Hardware, semaphores, classic problems of synchronization, monitors, Synchronization examples, atomic transactions. Case studies UNIX, Linux, Windows

UNIT IV :
Memory Management : Swapping, contiguous memory allocation, paging, structure of the page table , segmentation, virtual memory, demand paging, page-Replacement, algorithms, case studies UNIX, Linux, Windows

UNIT V :
Principles of deadlock – system model, deadlock characterization, deadlock prevention, detection and avoidance, recovery form deadlock,
I/O systems, Hardware, application interface, kernel I/O subsystem, Transforming I/O requests Hardware operation, STREAMS, performance.

UNIT VI :
File system Interface- the concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection.
File System implementation- File system structure, file system implementation, directory implementation, directory implementation, allocation methods, free-space management, efficiency and performance, case studies. UNIX, Linux, Windows

UNIT VII :
Mass-storage structure overview of Mass-storage structure, Disk structure, disk attachment disk scheduling, swap-space management, RAID structure, stable-storage implementation, Tertiary storage structure.

UNIT VIII :
Protection : Protection, Goals of Protection, Principles of Protection, Domain of protection Access Matrix, Implementation of Access Matrix, Access control, Revocation of Access Rights, Capability- Based systems, Language – Based Protection,
Security- The Security problem, program threats, system and network threats cryptography as a security tool, user authentication, implementing security defenses, firewalling to protect systems and networks, computer –security classifications, case studies UNIX, Linux, Windows

TEXT BOOKS :
1. Operating System Concepts- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley.
2. Operating systems- A Concept based Approach-D.M.Dhamdhere, 2nd Edition, TMH

REFERENCES :
1. Operating Systems' – Internal and Design Principles Stallings, Fifth Edition–2005, Pearson education/PHI
2. Operating System A Design Approach-Crowley, TMH.
3. Modern Operating Systems, Andrew S Tanenbaum 2nd edition Pearson/PHI.

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	0	**0**	**2**

INDUSTRY ORIENTED MINI PROJECT

a. Observation of operating chemical plants. Noting down operating procedures, construction details, management procedures. Doing a project related to the selected industry.
b. Developing experimental setup and studying the effect of operating parameters on process performance

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SEMINAR

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	0	**0**	**2**

PROJECT WORK

The project work may consist of any one of the following works.

a) The project work should consist of a comprehensive design project of a chemical plant in the form of a report with the following chapters.

1. Introduction
2. Physical and Chemical Properties and uses
3. Literature survey for different processes
4. Selection of the process
5. Material and Energy balances
6. Specific equipment design, (Process as well as mechanical design with drawing), including computer programs where possible, of Heat Transfer equipments or separation equipments or reactors
7. General equipment Specifications
8. Plant location and layout
9. Materials of construction
10. Health and Safety factors
11. Preliminary cost estimation
12. Bibliography

b) Modelling & Simulation of any Chemical Engineering Process

c) Any experimental work with physical interpretations

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COMPREHENSIVE VIVA

Questions should be asked from Momentum transfer, Process heat transfer, Chemical Engineering thermodynamics, Mass transfer operations, Chemical Reaction Engineering, Process dynamics & control