SYLLABUS FOR TEST

Chemical Engineering

Chemical Process Calculations
Units and Dimensions, The Chemical Equation and Stoichiometry**,** Material Balances, Energy Balances, Properties of Gases, Vapors, Liquids and Solids, Phase Equilibria, Combustion Calculation, Unsteady-State Material and Energy Balances. **Reference books:** Himmelblau, D. M. "Basic principles & calculations in chemical Engg", PHI, 6th ed., 1997. Felder, R. M. & R. W. Rousseau, "Elementary Principles of Chemical Processes", John Wiley & Sons, Inc., 3rd ed., 2000.
Fluid Flow Operations
Fundamental Concepts and Fluid Statics, Integral and Differential Analyses for Fluid Motion, Internal and External Fluid Flow and Flow through Packed Bed, Dimensional Analysis and Fluid Machinery, Agitation and Introduction to Compressible Flow. **Reference books:** Fox, R. W. and A. T. McDonalds, Introduction to Fluid Mechanics (5th edition) John Wiley and Sons Inc., 2001. McCabe, W. L., J. C. Smith and P. Harriott Unit Operations of Chemical Engineering (7th edition), McGraw Hill Inc., 2005.
Chemical Engineering Thermodynamics
First & Second Laws, PVT behavior & Heat Effects, Properties of pure fluids and thermodynamics of flow processes, Solution thermodynamics, VLE and chemical reaction equilibrium. **Reference books:** J. M.Smith, and Others,"Introduction to Chemical Engineering Thermodynamics", MGHFSE, 6th ed., 2001 YVC Rao, "Chemical Engineering Thermodynamics", Universities Press, 1997. KV Narayanan, "A Textbook of Chemical Engineering Thermodynamics". Prentice Hall of India, 2001.
Mass Transfer Operations
Molecular diffusion and mass transfer coefficients, Interphase mass transfer, Gas absorption, Distillation, Liquid extraction and leaching. **Reference books:** Treybal, R.E., "Mass Transfer Operations," 3rd Ed., McGraw-Hill Book Company, Singapore, 1980. Foust, A. S., Wenzel, L.A., Clump, C.W., Anderson, L.B., "Principles of Unit Operations," 2nd Ed., John Wiley and Sons, New York, 1980.
Heat Transfer Operations
Steady and Unsteady state heat conduction, Natural & Forced convection, Radiation, Condensation, boiling and evaporation, Heat Exchangers. **Reference books:** Holman, J. P., "Heat Transfer (9th Ed.)", McGraw-Hill, 2002. Frank P. Incropera, David P. DeWitt, "Fundamental of Heat & Mass Transfer (6th Ed.)", John Wiley & Sons, 2006. D. Q. Kern, "Process Heat Transfer", Tata McGraw Hill. McCabe & Smith, "Unit Operations of Chemical Engineering (7th ed)", McGraw-Hill, 2004.
Selected Chemical Engineering Operations
Properties and Handling of Particulate Solids, Mechanical Separations, Adsorption and Fixed-Bed Separations, Drying of Solids, Membrane Separation Processes and Crystallization. **Reference books:** McCabe W. L., and Smith J. M., & Harriott P., *Unit Operations of Chemical Engineering*, 7th Ed., McGraw-Hill International Edition, 2006. Chemical Engineering (Volumes 1-6), Coulson J. M., Richardson J. F. & others, Pergamon Press, London, 1978 & 1997.
Kinetics & Reactor Design
Mole balances and reactor sizing, Rate laws and stoichiometry, Isothermal reactor design for single and multiple reactions, Analysis of laboratory reactor data, and reaction mechanisms for nonelementary reactions, Non isothermal reactor design for single and multiple reactions, Heterogeneous reactors, Data analysis & design, Non Ideal reactors. **Reference books:** H. Scott Fogler "Elements of Chemical Reaction Engineering", PHI, 3rd Ed, 2002. O. Levenspiel, "Chemical Reaction Engineering", John Wiley, 3rd Ed., 1999. J.M. Smith, "Chemical Engineering Kinetics", McGraw Hill, 3rd Ed., 1981.
Chemical Process Technology
Process synthesis concepts for flow sheet generation; species allocation; separation task sequence and task integration, Technologies related to Inorganic Chemical Industries, Technologies related to Natural Product Industries, Technologies related to synthetic organic chemical industries, Technologies related to Polymerization industries. **Reference books:**

Rao, G. and Sittig M., "Dryden's outlines of chemical technology for 21st century", East West Press, 1997. Austin, G T, "Shreve's chemical process industries", McGraw Hill, 1984.
Process Design Decisions
Engineering Economics; Economic Decision Making, Input Information and Batch versus Continuous; Input-Output Structure, Recycle Structure; Separation System, Heat Exchanger Networks (Energy Integration), Cost Diagrams; Preliminary Process Optimization; Process Retrofits. **Reference books:** James M. Douglas. Conceptual Design of Chemical Processes. McGraw-Hill International Editions (Chemical Engineering Series), Mc Graw Hill Book Company, New York, 1988. Max S. Peters, Klaus D. Timmerhaus, Ronald E. West, Max Peters. Plant Design and Economics for Chemical Engineers. 5th Edition, Mc Graw Hill, New York, 2003.
Process Control
Dynamic modeling and simulation of momentum, energy, mass transfer and reacting systems, Analysis of the dynamic behavior of chemical processes, Analysis and design of simple feedback and advanced control systems, Design of control systems with multiple input and multiple output, Digital sampling, filtering and control. **Reference books:** Stephanopoulos, G., "Chemical Process Control: An Introduction to Theory and Practice," Prentice-Hall, Englewood Cliffs, N.J., 1984 Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., "Process Dynamics and Control," 2nd Ed., John Wiley and Sons, 2004. Coughnowr, D. R., and Koppel, I. B., "Process Systems Analysis and Control," 2nd Ed., McGraw-Hill, New York, 1991.

Electrical and Electronics Engineering

Analog Electronics:
Operational amplifier basics, ideal and practical Op-amp configurations, special purpose linear Op-amp circuits: instrumentation amplifiers, isolation, programmable, negative feedback amplifiers etc., Active filters, IC filters; non-linear operational amplifier circuits, analog multipliers, precision and wave shaping circuits, comparators and Schmitt triggers and applications, Signal generators: sinusoidal and non- sinusoidal oscillators, integrated circuits timers. function generators, PLL, Voltage Regulators; voltage regulator IC, switched capacitor voltage converters, switching regulators, Power amplifiers and output stage circuits, IC power amplifiers, high frequency amplifiers, tuned amplifiers. **Reference books:** L K Maheshwari & M M S Anand " Analog Electronics" PHI Private Ltd. 2005. Adel S Sedra & K C Smith" Microelectronic Circuits" OUP, 5th edition,2005.
Digital Electronics & Computer Organization:
Number systems & Codes, Boolean algebra & Simplification, Digital Logic Families, Combinational logic Design – Decoders, Encoders, MUX, DeMUX, Arithmetic Circuits, Sequential Logic design- Flip-flops, State machines, ASM Counters & Registers, PLDs & FPGAs & Computer Organization. **Reference books**: M. Morris Mano, " Digital Design", PHI, 3rd Edition, 2002.
Microprocessors:
Architectures of Intel - x85 & x86 Processors, Instruction set & Assembly Language programming, Memory Interfacing, Data Transfer Schemes, Peripherals & I/O Interfacing using 8255, 8253, 8251, Disk Organization **Reference books**: Barry B Brey, C R Sarma, The Intel Microprocessors. Pearson, Sixth Ed. 2005.
Circuits & Signals, Digital Signal Processing:
Linear convolution, Fourier Transforms, DFT & FFT, Laplace Transforms & its application to system analysis, Z-transform & its application to system analysis, Analog & digital filter design (FIR, IIR), Multirate signal processing. **Reference books**: B P Lathi " Signal Processing & Linear Systems" Oxford Univ. Press, 2004. 2.Sanjit K Mitra " Digital Signal Processing" Tata MCGra Hill 3 rd Edition, 2006.
Electrical Sciences:
Basic Circuit elements and laws, Analysis Techniques & Theorems, Time-domain analysis of 1st & 2nd Order Circuits, AC Circuit Analysis, Frequency domain analysis, Series and Parallel RCL Circuit, Important Power Concepts, Semiconductors, Construction, operation and application of Junction Diode, Zener Diode, Transistor (BJT's), FET's, MOSFET etc., Feedback in Amplifier Circuits, AC Generation and Magnetic

Circuits, Single- phase circuit analysis**,** Magnetic Circuit Calculations**,** Three- phase Circuit analysis, Electrical Machines (Construction, Operation & usage), Transformers, DC Machines, Three-phase synchronous generator, Three-phase induction motors, Single-phase induction motor, Fractional KW motors**.** **Reference books:** Leonard S Bobrow " Fundamental of Electrical Engineering" OUP, 2nd ed.,1996.
Electronic Devices & Integrated Circuits, Microelectronics Circuits:
Semiconductor materials and their properties, Carrier transport and excess carriers in semiconductors; Single p-n junction devices- rectifier diodes, switching diodes, microwave diodes, optoelectronic devices, Bipolar junction transistors; JFET; MOSFET; MOS and CMOS devices; Device fabrication techniques and introduction to ICs, Basic single and two stage transistor amplifier; current mirrors and current sources; active load biasing in integrated circuits, Voltage sources and voltage references, differential and multistage amplifiers; frequency response and frequency compensation, Operational amplifiers-2 stage, stability analysis and compensation techniques. **Reference books:** B G Streetman & Sanjay Banerjee" Solid state Electronic Devices" PHI? Pearson Edu, 6th ed.,2006. Adel S Sedra & K C Smith" Microelectronic Circuits" OUP, 5th edition,2005.
Control Systems, Power Electronics:
Mathematical model of physical systems (Differential equations, Block diagram, signal flow graph, transfer function) feedback characteristics of control systems, control systems components, Time response analysis, stability, Root locus concepts, frequency response (Bode plots, Polar plots, Nyquist plots), state space analysis and compensation concepts, Phase control resistors, DC-DC step down chopper, Step up chopper, inverters. **Reference books:** I. J. Nagrath & M Gopal " Control Systems Engineering" NAIL, 5th Edition, 2007. N. Mohan, T.M. Undeland, W.P. Robbins, John Wiley, 3 rd edition.
Electromechanical Energy Conversion, Power Systems:
DC Machines, construction, Operation, Characteristics & design, AC motors & generators, Transformers, Transmission lines: modeling & analysis, Steady state power system analysis & load flows. **Reference books:** I.J. Nagrath & D.P. Kothari, "Electric machines" TMH third edition 2004. I.J. Nagrath and D.P. Kothari, "Power system engineering" TMH.
Communication Systems:
Electromagnetic Fields, Telecom Switching:
Maxwell's equation in free space and time varying fields, plane waves in dielectric and conducting media, wave reflection, refraction, diffraction and polarization, transmission lines and resonators, Smith chart and its application in stub and impedance matching calculations, Antennas and radiation, half-wave dipole, loop, helical, directive antenna, reflector, lens and horn antennas, antenna practice and measurements, Voice digitization, digital transmission and multiplexing, digital switching, Data and asynchronous transfer mode networks, telecommunication traffic analysis. **Reference books:** John D Kraus and D.A. Fleisch, "Electromagnetics & applications". John C Bellamy "Digital Telephony" John Wiley 3 rd Edition, 2003.

Computer Science

Discrete Mathematics & Theory of Computation:
Principles of Counting, Recurrence Relations., Sets, Functions, Relations, Propositional Logic and Predicate Logic., Strings and Languages, Regular Expressions, Finite Automata., Context Free Grammars and Pushdown Automata., Turing Machines and Decidability. Recursive Languages and Recursively Enumerable Languages. **Reference books**: Mott, Kandel, and Baker. Discrete Mathematics for Computer Scientists & Mathematicians, PHI 2003. Harry Lewis and Christos Papadimitriou. Elements of theTheory of Computation 2nd Edition, Pearson Education.
Data Structures and Algorithms :
Algorithm Analysis, Asymptotic notion, Sorting – Comparison based Sorting, Distribution Sorting, External Sorting., ADTs, stacks and queues. Searching-lists, sequences, dictionaries and hash tables. Priority queues and heaps., Trees – Traversals and applications. Binary Trees – Structure, Representation and Search. Search Trees – Binary Search Trees, Balanced Search Trees (AVL, Red-black). Multi-way Trees

and Trees for External Storage., Graphs – Structure and Representation, Traversals, Path Problems, Spanning Trees, Flow Problems., Design techniques-greedy method, divide and conquer, dynamic programming, and backtracking. Complexity classes-P and NP. Reductions, NP-hard problems and NP-completeness. **Reference books**: Cormen T.H., Leiserson, C.E., Rivest, R.L., and C. Stein. Introduction to Algorithms, MIT Press, 2nd Edition.
Digital Electronics and Microprocessors:
Combinational Logic Design, Adders, Multiplexers, De-Multiplexers, Encoders, Decoders. Sequential Logic Design, Counters, Registers., Programmable Logic Devices and Logic Families., 8085, 8086 architecture and assembly programming., Memory interfacing ,Programmable peripheral devices and interfacing (8253, 8255,8259, 8251). **Reference books**: Digital Design by M. Morris Mano, Third edition, Pearsoned The Intel Microprocessors by Barry B Brey, Seventh edition, PHI
Operating Systems:
Tasks, Processes, and Threads. Process States & Transitions. Process organization. Process Scheduling. Concurrency, Mutual Exclusion, Process synchronization, Deadlock and Deadlock handling., Memory allocation, Paging and Segmentation. Locality. Virtual memory. Frame allocation and Page replacement algorithms. Thrashing., File systems - Interface, Structure and Implementation., I/O system. Secondary Storage and Mass Storage Structure. **Reference books**: Silberschatz, A and Galvin, P.B. “Operating System Concepts” 7th edition, Addison Wesley, 2005.
Computer Organization and Architecture :
Instruction Set Architecture - RISC & CISC processors., Computer Arithmetic & Control Unit., Cache Memory & Main Memory., I/O, Secondary Memory, RAID System, Bus & Interconnections., Pipelining, Superscalar Processors, and Introduction to Parallel Processing. **Reference books**: William Stallings, "Computer Organization and Architecture", Seventh Ed., Pearson Ed., 2006.
Computer Networks:
Physical Layer (Basics, Encoding schemes, Wireline and wireless Transmission media, WIreless and Wireline Protocols)., Data Link Layer (Basics, Wireless and Wireline Protocols, Performance, Secuity)., Network Layer (Basics, Protocols, Performance, Security)., Transport Layer (Basics, Protocols, Performance, Security)., Application Layer (Basics, Protocols, Performance, Security)., **Reference books**: A.S. Tanenbaum, "Computer Networks", Fourth Edition, PHI / PE, New Delhi, 2006.
Database Management Systems :
Data Modeling – ER Model, Relational Model, Object-oriented Model, Object-relational Model., Query Languages – Relational Algebra, Relational Calculus, & SQL., Normalization & Indexing – Functional Dependencies (FDs), Closure of set of FDs, Attribute Closure, Cannonical Cover, Normal forms upto 4NF. Primary, Clustering, & Secondary Indices, Tree-based Indexing., Query Evaluation & Optimization: Algorithms for evaluation of relational operators, Cost-based & heuristic query optimization techniques., Transaction Management – Concurrency: Locking & Timestamping & Crash Recovery: Log-based & Shadow Paging., **Reference books**: Ramakrishna R. & Gehrke J, *Database Management Systems*, 3e, Mc-Graw Hill, 2003. Silberschatz A, Korth H F, & Sudarshan S, *Database System Concepts*, 5e, TMH, 2005.
Programming Languages and Compiler Construction:
Imperative Programming Languages – Control Abstraction and Statements, Data Types and Data Representations., Imperative Programming Languages – Procedure Calls, Call Stack, Parameter Passing, Scope and Lifetime of Variables, Dynamic Memory Allocation., Syntax Analysis – Lexical Analysis, Parsing (Top-down and Bottom-up Parsing), Abstract Syntax and Symbol Tables., Semantic Analysis. Types, Representations and Type Checking. Syntax Directed Translation. Intermediate Code., Code Generation – Basic Blocks and Flow Graphs, Register Allocation and Assignment, Code Generation Techniques. **Reference books**: Sethi, R., Programming Languages - Concepts & Constructs, 2nd Ed., Addison-Wesley, 1996. (Indian reprint 1999). Aho, A. V., Sethi, R., and Ullman, J. D., Compilers - Principles, Techniques and Tools, Addison-Wesley, 1988. (Indian reprint 2000).
Software Engineering:
Software Development – Lifecycle, Process Models, Project Management., Requirements Analysis, SRS, Structured Analysis, Object Oriented Analysis and Modeling based on UML., Structured Design, Object

Oriented Design, Architectural Design, Design Patterns, Use of UML in Design., Software Testing – Black Box and White Box Testing, Test Cases, Testing Process, Testing for object oriented applications and Testing for web applications., Software Metrics and cost Measurement. Product and Process management. Software complexity. Software coding styles., Quality attributes and CMM Model..,

Reference books:

Pressman, R.S., Software Engineering: A Practitioner's Approach, MGHISE, 6th Ed. 2004.

Artificial Intelligence:

Searching Strategies., Knowledge Representation., Reasoning (Certainty and Uncertainty based)., Machine Learning., Multiagent Systems.

Reference books:

Russell and Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, PE.

Instrumentation

Analog Electronics:

Operational amplifier basics, ideal and practical Op-amp configurations, Special purpose linear Op-amp circuits: instrumentation amplifiers, isolation, programmable, Negative feedback amplifiers etc., Active filters, IC filters; Non-linear operational amplifier circuits, analog multipliers, precision and wave shaping circuits, Comparators and Schmitt triggers and applications, Signal generators: sinusoidal and non- sinusoidal oscillators, integrated circuits timers. function generators, PLL, Voltage Regulators; Voltage regulator IC, Switched capacitor voltage converters, Switching regulators, Power amplifiers and output stage circuits, IC power amplifiers, High frequency amplifiers, Ttuned amplifiers.

Reference books:

L K Maheshwari & M M S Anand " Analog Electronics" PHI Private Ltd. 2005.

Adel S Sedra & K C Smith" Microelectronic Circuits" OUP, 5th edition,2005.

Digital Electronics & Computer Organization:

Number systems & Codes, Boolean algebra & Simplification, Digital Logic Families, Combinational logic Design – Decoders, Encoders, MUX, DeMUX, Arithmetic Circuits, Sequential Logic design- Flip-flops, State machines, ASM

Counters & Registers, PLDs & FPGAs & Computer Organization.

Reference books:

M. Morris Mano, " Digital Design", PHI, 3rd Edition, 2002.

Microprocessors:

Architectures of Intel - x85 & x86 Processors, Instruction set & Assembly Language programming, Memory Interfacing, Data Transfer Schemes, Peripherals & I/O Interfacing using 8255, 8253, 8251, Disk Organization

Reference books:

Barry B Brey, C R Sarma, The Intel Microprocessors. Pearson, Sixth Ed. 2005.

Circuits & Signals, Digital Signal Processing:

Linear convolution, Fourier Transforms, DFT & FFT, Laplace Transforms & its application to system analysis, Z-transform & its application to system analysis, Analog & digital filter design (FIR, IIR), Multirate signal processing.

Reference books:

B P Lathi " Signal Processing & Linear Systems" Oxford Univ. Press, 2004.

2.Sanjit K Mitra " Digital Signal Processing" Tata MCGra Hill 3 rd Edition, 2006.

Electrical Sciences:

Basic Circuit elements and laws, Analysis Techniques & Theorems, Time-domain analysis of 1st & 2nd Order Circuits, AC Circuit Analysis, Frequency domain analysis, Series and Parallel RCL Circuit, Important Power Concepts, Semiconductors, Construction, operation and application of Junction Diode, Zener Diode, Transistor (BJT's), FET's, MOSFET etc., Feedback in Amplifier Circuits, AC Generation and Magnetic Circuits, Single- phase circuit analysis**,** Magnetic Circuit Calculations**,** Three- phase Circuit analysis, Electrical Machines (Construction, Operation & usage), Transformers, DC Machines, Three-phase synchronous generator, Three-phase induction motors, Single-phase induction motor, Fractional KW motors**.**

Reference books:

Leonard S Bobrow " Fundamental of Electrical Engineering" OUP, 2nd ed.,1996.

Electronic Devices & Integrated Circuits, Microelectronics Circuits:

Semiconductor materials and their properties, Carrier transport and excess carriers in semiconductors; Single p-n junction devices- rectifier diodes, Switching diodes, Microwave diodes, Optoelectronic devices, Bipolar junction transistors; JFET; MOSFET; MOS and CMOS devices; Device fabrication techniques and

introduction to ICs, Basic single and two stage transistor amplifier; Current mirrors and current sources; Active load biasing in integrated circuits, Voltage sources and voltage references, Ddifferential and multistage amplifiers; Frequency response and frequency compensation, Operational amplifiers-2 stage, Stability analysis and compensation techniques.

Reference books:

B G Streetman & Sanjay Banerjee" Solid state Electronic Devices" PHI? Pearson Edu, 6th ed.,2006.
Adel S Sedra & K C Smith" Microelectronic Circuits" OUP, 5th edition,2005.

Control Systems, Power Electronics:

Mathematical model of physical systems (Differential equations, Block diagram, signal flow graph, transfer function) feedback characteristics of control systems, control systems components, Time response analysis, stability, Root locus concepts, frequency response (Bode plots, Polar plots, Nyquist plots), state space analysis and compensation concepts, Converters, Inverters and Choppers, Step up chopper, inverters.

Reference books:

I. J. Nagrath & M Gopal " Control Systems Engineering" NAIL, 5th Edition, 2007.
N. Mohan, T.M. Undeland, W.P. Robbins, John Wiley, 3 rd edition.

Industrial Instrumentation & Control , Analysis Instrumentation

Elements of process control loop, mathematical modeling, dynamic closed loop characteristics, Controller principles & tuning, DDC loop, Hydraulic, Pneumatic, Electronic controller, Complex multivariable control schemes, final control elements, PLCs, DCS, SCADA, AI techniques: Expert system, ANN, Fuzzy Logic, UV/VIS/IR Spectrophotometer, FES/AAS, X-ray analyzers, NMR, Mass spectrometers, Sampling systems for online analyzers, TC analyzer, Paramagnetic O_2 Analyzer, Fluid density monitors, GLC.

Reference books:

Curtis D. Johnson. "Process control instrumentation technology" Prentice Hall of India.
Stephanopolous George, "Chemical process controls.
Computer based industrial control by Krishan Kant, Prentice Hall of India
Analysis Instrumentation by R P Khare (CBS).
Handbook of Instrumental Techniques for analytical Chemistry by Frank Settle (Pearson).

Transducers & Measurement systems :

Generalized measurement system, functional elements, Static and dynamic characteristics, Resistive, inductive, capacitive, piezoelectric, Hall effect, photoelectric, fiber optic transducer, MEMS based transducers, Measurement of Motion, pressure, flow, temperature level, viscosity, pH, humidity, vibration, Signal conducting techniques using op-amps, instrumentation amplifier, bridges, carrier amplifier, chopper amplifier, charge amplifier and Isolation amplifier, Data converter, filters, Data acquisition system, inverse transducers & feed back measurement systems.

Reference books:

Measurement Systems, application and design by E.O Doebelin and Dhanesh N. Manik, Tata McGraw-Hill.

Electronic Instruments and Instrumentation Technology + Medical Instrumentation

Electronic indicating, display, Recording & Analysis instruments, Signal generators, Frequency synthesizers, Counters, Grounding and Shielding techniques, Instrumentation in hazardous areas, Industrial data communication, Transducers for biomedical measurements, Cardio vascular measurements, Patient care monitoring systems, Instrumentation for respiratory and nervous system, clinical lab measurements.

Reference books:

Electronic Instruments and Instrumentation Technology by M.M.S. Anand, Prentice Hall of India.
Biomedical Instrumentation and measurements, by L. Cromwell, et al. PHI.
Introduction to Biomedical equipment & Technology, J.J Carr and J.M. Brown (Pearson).