AURCET - 2013 SYLLABUS

TEST NO. 71:: CHEMICAL ENGINEERING

(100 MARKS)

Process Calculations and Thermodynamics : Laws of conservation of mass and energy, use of tie components; recycle, bypass and purge calculations; degree of freedom analysis. First and Second laws of thermodynamics. First law application to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: equation of state and departure function, properties of mixtures : partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria : predicting VLE of systems; chemical reaction equilibria.

Fluid Mechanics and Mechanical Operations : Fluid statics, Newtonian and non-Newtonian fluids, Bernoulli equation, Macroscopic friction factors, energy balance, dimensional analysis, shell balances, flow through pipeline systems, flow meters, pumps and compressors, packed and fluidized beds, elementary boundary layer theory, size reduction and size separation; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, mixing and agitation; conveying of solids.

Heat Transfer : Conduction, convection and radiation, heat transfer coefficient, steady and unsteady heat conduction, boiling, condensation and evaporation; types of heat exchangers and evaporators and their design.

Mass Transfer : Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stagewise and continuous contracting and stage efficiencies; HTU & NTU concepts design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.

Chemical Reaction Engineering : Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

Instrumentation and Process Control: Measurement of process variables; sensors, transducers and their dynamics, transfer functions and dynamic responses of simple systems, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response and controller tuning, cascade, feed forward control.

Plant Design and Economics : Process design and sizing of chemical engineering equipment such as compressors, heat exchangers, multistage contractors; principles of process economics and cost estimation including total annualized cost, cost indexes, rate of return, payback period, discounted cash flow, optimization in design.

Chemical Technology : Inorganic chemical industries; sulfuric acid, NaOH, fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries; polyethylene, polypropylene, PVC and polyester synthetic fibers.

AURCET - 2013 SYLLABUS

TEST NO. 71(A) :: BIOTECHNOLOGY

(100 MARKS)

Process Calculations,Thermodynamics,Fluid mechanics and Heat transfer: Laws of conservation of mass and energy, recycle, bypass and purge calculations; First and Second laws of thermodynamics. Fluid statics, Newtonian and non-Newtonian fluids, Bernoulli equation, dimensional analysis, flow meters, pumps and compressors. Conduction, convection and radiation, heat exchangers and evaporators and their design.

Mass Transfer and reaction engineering : Fick's laws, molecular diffusion in fluids, film, penetration and surface renewal theories; stage wise and continuous contracting. Distillation, absorption, leaching, liquid-liquid extraction, drying. Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors.

Instrumentation ,Process Control and bioprocess economics: Measurement of process variables; sensors, transducers dynamic responses of simple systems. Principles of process economics and cost estimation including total annualized cost, cost indexes, rate of return, payback period, discounted cash flow.

Microbiology and Biochemistry : Prokaryotic and eukaryotic cell structure; Microbial nutrition, growth and control; Microbial metabolism (aerobic and anaerobic respiration, photosynthesis); Microbial genetics (plasmids, transformation, transduction, conjugation); Microbial diversity and characteristics features; Viruses. Biomolecules and their conformation; Weak inter-molecular interactions in biomactomolecules; Chemical and functional nature of enzymes; Kinetics of single substrate and bisubstrate enzyme catalyzed reactions; Bioenergetics; Metabolism (Glycolysis, TCA and Oxidative phosphorylation); Membrane transport; Cell cycle and cell growth control.

Molecular Biology and Genetics : Molecular structure of genes and chromosomes; DNA replication and control; Transcription and its control; Translational process; Regulatory controls in prokaryotes and eukaryotes; Mendelian inheritance; Gene interaction; Complementation; Linkage, recombination and chromosome mapping; Extrachromosomal inheritance; Chromosomal variation; Population genetics; Transposable elements, Molecular basis of genetic diseases and applications.

Bioprocess Engineering : Kinetics of microbial growth, substrate utilization and product formation; Simple structured models; Sterilization of air and media; Batch, fed-batch and continuous processes; Aeration and agitation; Mass transfer in bioreactors; Rheology of fermentation fluids; Scale-up concepts; Design of fermentation media; Various types of microbial and enzyme reactors; Instrumentation in bioreactors.

Characteristics of animal cells and Immunology : Metabolism, regulation and nutritional requirements for mass cultivation of animal cell cultures; Kinetics of cell growth and product formation and effect of shear force; Product and substrate transport; Micro & macro-carrier culture; Hybridoma technology; Live stock improvement; Cloning in animals; Genetic engineering in animal cell culture; Anima[1] cell preservation. The origin of immunology; Inherent immunity; Primary and secondary lymphoid organ; Antigen; B and T cells and Macrophages; Major histocompatibility complex (MHC); Antigen processing and presentation; Synthesis of antibody and secretion; Molecular basis of antibody diversity; Polyclonal and monoclonal antibody; Complement; Antigen-antibody reaction; Regulation of immune response; Immune tolerance; Hyper sensivitity; Autoimmunity; Graft versus host reaction.

Recombinant DNA Technology : Restriction and modification enzymes; Vectors; plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome; cDNA and genomic DNA library; Gene isolation; Gene cloning; Expression of cloned gene; Transposons and gene targeting; DNA labeling; DNA sequencing; Polymerase chain reactions; DNA fingerprinting; Southern and northern blotting; In-situ hybridization; RAPD; RFLP; Site-directed mutagenesis; Gene transfer technologies; Gene therapy.

AURCET - 2013 SYLLABUS

TEST NO. 72 :: CIVIL ENGINEERING

(100 MARKS)

STRUCTURAL ENGINEERING

Mechanics: Bending moment and shear force in statically determinate beams. Simple stress and strain relationship: Stress and strain in two dimensions, principal stresses, stress transformation, Mohr's circle. Simple bending theory, flexural and shear stresses, unsymmetrical bending, shear centre. Thin walled pressure vessels, uniform torsion, buckling of column, combined and direct bending stresses.

Structural Analysis: Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/ energy methods, analysis by displacement methods (slope deflection and moment distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

Concrete Structures: Concrete Technology- properties of concrete, basics of mix design. Concrete design- basic working stress and limit state design concepts, analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of prestressed concrete, analysis of beam sections at transfer and service loads.

Steel Structures: Analysis and design of tension and compression members, beams and beam- columns, column bases. Connections- simple and eccentric, beam–column connections, plate girders and trusses.Plastic analysis of beams and frames.

GEOTECHNICAL ENGINEERING

Soil Mechanics: Origin of soils, soil classification, three-phase system, fundamental definitions, relationship and interrelationships, permeability &seepage, effective stress principle, consolidation, compaction, shear strength.

Foundation Engineering: Sub-surface investigations- scope, drilling bore holes, sampling, penetration tests, plate load test. Earth pressure theories, effect of water table, layered soils. Stability of slopes-infinite slopes, finite slopes. Foundation types-foundation design requirements. Shallow foundations-bearing capacity, effect of shape, water table and other factors, stress distribution, settlement analysisinsands & clays. Deep foundations–pile types, dynamic &static formulae, load capacity of piles in sands &clays, negative skin friction.

WATER RESOURCES ENGINEERING

Fluid Mechanics and Hydraulics: Properties of fluids, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, flow measurements in channels, tanks and pipes. Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

Hydrology: Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

Irrigation: Duty, delta, estimation of evapo-transpiration. Crop water requirements. Design of: lined and unlined canals, waterways, head works, gravity dams and spillways. Design of weirs on permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, sodic soils.

ENVIRONMENTAL ENGINEERING

Water requirements: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment Unit operations and unit processes of domestic wastewater, sludge disposal.

Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

TRANSPORTATION ENGINEERING

Highway Planning: Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements.

Traffic Engineering: Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

SURVEYING

Importance of surveying, principles and classifications, mapping concepts, coordinate system, map projections, measurements of distance and directions, leveling, theodolite traversing, plane table surveying, errors and adjustments, curves.

AURCET - 2013 SYLLABUS

TEST NO. 73 :: COMPUTER SCIENCE & SYSTEMS ENGINEERING

(100 MARKS)

1. Data Structures & Algorithms:
   Abstract Data Types, Arrays, Stacks, Linked Lists, Graphs, Trees, Binary Search Trees, Binary Heaps; Space & Time Complexity of Algorithms, Analysis Design, Tree & Graph Traversals, Spanning Trees, Shortest paths, sorting, searching, hashing, Divide & conquer & dynamic programming techniques.

2. Programming Concepts:
   Basic programming Concepts in C:Functions, Recursion, Parameter passing, pointers; Basic concepts in C++ : Classes, inheritance, polymorphism, streams & files; Basic concepts in Java: Classes, methods & interfaces, threading, libraries.

3. Computer Organization & Architecture:
   Computer Registers, Computer Instructions, Instruction Cycle, Memory-Reference Instructions, Input-Output and Interrupt, Complete Computer Description, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

4. Operating Systems:
   Process, Threads, Inter process Communications, Concurrency, Synchronization, Deadlocks, CPU Scheduling, Memory Management and virtual memory, File Systems, IO Systems, and Protection & Security.

5. Theory of Computation:
   Finite Automata, Regular Expressions, Regular sets and Pumping Lemmas, Context Free Languages and Pushdown Automata, Turing Machines and computability.

6. Language Processors & Compilers:
   Lexical Analysis, Parsing, Semantic Checking & Syntax Directed Translation, Code Optimization & Code Generation; Introduction to Assembly Language Programming, Instruction Formats, Data formats - Role of Base Register, Index Register, Single Pass & Double Pass Assemblers, .

7. Data Base Management Systems:
   Overview of File system and DBMS, DBMS structure, E-R Models, Relational Model, Relational Algebra, Tuples Calculus, Database design, Normal forms, Storage data, queries, Query Languages(SQL), File Structures, Sequential files, indexing, B and B+ trees, Transaction Management & Concurrency Control.

8. Data Communications & Computer Networks:
   OSI & TCP IP Reference Models, LAN Technologies, Routing Algorithms, Congestion Control, TCP UDP Socket, Application Layer, Protocols(smtp, dns, pop, ftp, http), Basic concepts of hubs and switches, gateways and routers. Fibre optic & Wireless Communication Technologies**.** RFID System Architecture.

9. Artificial Intelligence & Machine Learning:
   Introduction to AI, Informed and un-informed searching, Symbolic reasoning, semantic nets, frames & scripts, forward & backward reasoning, Reasoning under uncertainty, Expert Systems; Machine learning concepts: Genetic Algorithm, Swarm Intelligence and Ant Colony Optimizations, Software Agent

10. Operation Research & Statistics:
    Linear & Non-linear Programming, Dynamic programming, Simplex methods, Transportation & Assignment problems, Travelling salesman Problems, PERT, CPM techniques; Probability Distributions Binomial, Poisson Negative binominal distributions, Normal, exponential distributions, Correlation & Regression Analysis, Multiple Regression, Sampling distribution, Testing of Hypothesis, Small & Large Sample Tests, χ^2 – test, analysis of variance and Queuing Theory Fundamentals.

11. Object Oriented Software Engineering:
    The nature of software, software engineering , software engineering projects, Domain analysis, Requirement definition, type of requirements, gathering and analyzing of requirements, requirements document, UML diagrams, User-Centred design, Developing use case models of systems, The process of software architecture& design, Design document, Testing and inspecting to ensure high quality, Documentation defects, Writing formal test cases and test plans, Strategies for testing large software, Inspections, Quality assurance, Project management, Software process model, Cost estimation, Project scheduling and tracking, Contents of a project plan

12. Computer Graphics:
    Over view of Graphics systems: Video Display Devices- Raster Scan systems-random scan systems-Graphics monitors and workstations-Input devices-hard copy devices- Graphics software, Output primitives: Points and Lines -Curve Functions-Pixel Addressing- Filled Area Primitives-Filled Area Functions- Cell Array- Character Generation, Transformations & Viewing: Basic Transformations, Matrix Representations, Transformations between Coordinate Systems- Affine Transformations- The viewing Pipeline-Viewing Coordinate Reference Frame-Window-to-Viewport, Two Dimensional Viewing Functions-Clipping Operations-Point Clipping-Line Clipping-Polygon Clipping-Curve Clipping- Text and Exterior Clipping

13. Data Warehousing & Data Mining:
    Data Warehouse Architecture& Design: Data Warehouse Schema, Partitioning strategy , Aggregations, Data Marting, Meta data, System & Process managers, Data Mining Techniques: Similarity Measures, Decision Trees, Neural Networks, Genetic Algorithms; Classification Algorithms: Statistical–based, Distance-based, Decision Tree- based, NN – based and Rule base; Clustering Algorithms: Hierarchical Algorithms, Partitional Algorithms, Clustering large Databases, Clustering with categorical Attributes; Associate Rules: Basic Algorithms, Parallel and Distributed algorithms, Comparative study, Incremental Rules, Web Mining:- Web Content mining, Structure Mining, Usage Mining

14. Bio-Informatics:
    Definitions of Sequencing, Biological sequence/structure, Biological databases, Primary sequence databases, Protein Sequence databases, Secondary databases, Protein pattern databases, and Structure classification databases, DNA Sequence analysis Pair wise alignment techniques

15. Image Processing:
    Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels, distance measures, connectivity , Image Geometry, Photographic film, Image Transformations, Image Enhancement, Image compression, Image Segmentation techniques & Image morphology

16. Neural Networks & Fuzzy Systems: Biological Activations and Signals, Neuron Fields, Neuronal Dynamical Systems, Common Signal Functions, Pulse-Coded Signal Functions. Neuronal Dynamical Systems,, General Neuronal Activations: Cohen-Grossberg and Multiplicative Models. Supervised Function Estimation, Supervised Learning, Neural and Fuzzy Machine Intelligence, The Dynamical-Systems Approach to Machine Intelligence, Intelligent Behavior as Adaptive Model- Free Estimation. Fuzzy and Neural Function Estimators, Fuzzy Hebb FAMs, Adaptive FAMs: Product-Space Clustering in FAM Cells.

17. E-Commerce
    Foundations of Electronic Commerce, Internet Consumers and Market Research, Advertisement in Electronic Commerce, E-Commerce for Service Industries, Business-Business Electronic Commerce, Electronic Payment Systems, EC Strategy and Implementation, Legal Issues to Privacy.

18. Embedded Systems:
    Introduction to embedded systems hardware needs; typical and advanced, timing diagrams, memories (RAM, ROM, EPROM). Interrupts basics, RTOS, Tasks, Scheduler, Shared data reentrancy, priority inversion, mutex binary semaphore and counting semaphore. Inter task communication in an RTOS environment. Embedded system software design using an RTOS , Debugging techniques, Embedded Software development tools.

19. Network Security & Cryptography:
    Network Security basic concepts, Public Key and Private Key Cryptography, Digital signatures & firewalls.

20. Web Technologies: Basic Concepts in Client Server Computing, HTML, XML, JAVA Scripts, JAVA Beans, Web servers & Servelets, JSP Applications and Database access using JDBC & ODBC

AURCET - 2013 SYLLABUS
TEST NO. 74 :: ELECTRICAL ENGINEERING

(100 MARKS)

Electric Circuits and Fields: Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems, two-port networks, three phase circuits; Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere's and Biot-Savart's laws; inductance; dielectrics; capacitance.

Signals and Systems: Representation of continuous and discrete-time signals; shifting and scaling operations; linear, time-invariant and causal systems; Fourier series representation of continuous periodic signals; sampling theorem; Fourier, Laplace and Z transforms.

Electrical Machines: Single phase transformer – equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers – connections, parallel operation; auto-transformer; energy conversion principles; DC machines – types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors – principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines – performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

Power Systems: Basic power generation concepts; transmission line models and performance; cable performance, insulation; corona and radio interference; distribution systems; per-unit quantities; bus impedance and admittance matrices; load flow; voltage control; power factor correction; economic operation; symmetrical components; fault analysis; principles of over-current, differential and distance protection; solid state relays and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts.

Control Systems: Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Niquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state space model; state transition matrix, controllability and observability.

Electrical and Electronic Measurements: Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor; instrument transformers; digital voltmeters and multimeters; phase, time and frequency measurement; Q-meters; oscilloscopes; potentiometric recorders; error analysis.

Power Electronics and Drives: Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs – static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters – fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives.

AURCET - 2013 SYLLABUS
TEST NO. 75 :: ELECTRONICS & COMMUNICATION ENGINEERING

(100 MARKS)

UNIT-I : Fundamentals of Semiconductor Diodes, BJT, JFET'S, and MOSFETS, Small Signal analysis of Transistor Amplifiers, Multistage Amplifiers, Sinusoidal Oscillators and Feedback Amplifiers. Probability Theory, Random Variables, Statistical Averages and Random Process, Fundamentals of Boolean Algebra and Logic circuits, Combinational Logic circuits, Sequential circuits, Asynchronous Sequential Logic circuits

UNIT-II : Signals and its Analysis, Types of Systems, Fourier Representation of Periodic Signals, Fourier Transforms, Signal Transmission through Linear Systems, Convolution and Correlation of Signals, Sampling, Laplace Transforms and z -Transforms and their Applications, Discrete Time Signal and Systems, Discrete Fourier Transforms, FFTS, IIR Filter Design Techniques and Design of FIR Filters and Applications.

UNIT-III : Linear Modulation Systems, FM and Phase Modulation Systems, Radio Transmitters and Receivers, PAM, PPM, PWM, Noise in AM and FM Systems, A/D Conversion Techniques, BPSK, DPSK, DEPSK, QPSK, M- Array PSK, ASK, BFSK and MSK, Data Transmission and Spread Spectrum Modulation.

UNIT-IV : Coulomb's Law, Gauss Law, Faradays Law, Biot-Savrats Law, Amperes Circuit Law, Maxwell's Equations, Wave Equations and Propagation Characteristics of EM Waves in Free Space and Conducting Medium, Poynting Vector Theorem, waveguides.

UNIT-V : Fundamentals and Parameters of Antenna, Radiation Mechanism and Analysis of Thin Wire Antenna and Half-Wave Dipole Antenna, Types of Antennas, Linear Antenna Arrays, Array Synthesis, Microwave Components, Microwave Signal Generators and Amplifiers, Microwave Circuits, Radars and Navigational Electronics, Fundamentals of all type of Radars, Radar Applications.

AURCET - 2013 SYLLABUS

TEST NO. 76 :: GEO - ENGINEERING

(100 MARKS)

Climate, weather, composition, vertical structure of the atmosphere

Environment-meaning, scope, component of environments

Soils and clay minerals, soil strength, porosity and permeability

Data Representation – Representation of Characters in Computers, Representation of Integers, Representation of Fractions, Hexadecimal Representation of Numbers, Decimal to Binary Conversion, Error Detecting Codes.

File Handling in 'C', Arrays, Functions, Console Input / Output functions., Pointer variable, Structures and Unions, Command line Arguments

Introduction to Data base systems – Date base system levels of abstraction in DBMS principles of data base. Model of real world. Introduction to data organization, information management system preliminary study of INGRES, ORACLE, RDBMS and DBASE.

Fundamentals of Photogrammetry and Photo Interpretation – types of photographs; Vertical photographs – principal point; scale; Stereoscopy; Vertical exaggeration – factors involved and determination; Overlap, sidelap and flight planning

Principles of Remote Sensing, History of Remote Sensing and Remote Sensing in India. Electromagnetic Radiation and Electromagnetic Spectrum, EMR quantities: Nomenclature and Units. Spectral signature, Reflectance characteristics of Earths cover types, Remote sensing systems.

Thermal Emission of Radiation, Radiation Principles (Plank's Law, Stephen Boltezman law), Interaction of EMR with the Earth Surface (Wien's displacement law, Kirchoffs Law). Scope of Remote Sensing applications – potentials and limitations. Platforms and sensors.

Introduction – Image processing display systems. Initial statistical extraction – univariate and multivariate statistics, histogram and its significance in remote sensing data.

Preprocessing – Introduction, missing scan lies, desk tripping methods, geometric correction and registration, atmospheric corrections, illumination and view angle effects

Watershed, watershed characteristics-run-off, floods, size, shape, physiography, slope, climate, drainage

Dams and reservoirs, tunnels and air fields.

AURCET - 2013 SYLLABUS
TEST NO. 78 :: MARINE ENGINEERING

(100 MARKS)

ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigen vectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy's integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson,Normal and Binomial distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations Integration by trapezoidal and Simpson's rule, single and multi-step methods for differential equations.

APPLIED MECHANICS AND DESIGN

Engineering Mechanics: Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.

Vibrations: Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; *principles* of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

FLUID MECHANICS AND THERMAL SCIENCES

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

Thermodynamics: Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle.irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

Applications:*Power Engineering*: Steam Tables, Rankine, Brayton cycles with regeneration and reheat. *I.C. Engines*: air-standard Otto, Diesel cycles. *Refrigeration and air-conditioning*: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes. *Turbomachinery:* Pelton-wheel, Francis and Kaplan turbines — impulse and reaction principles, velocity diagrams.

MANUFACTURING AND INDUSTRIAL ENGINEERING

Engineering Materials: Structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

Metal Casting: Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy.

Joining: Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

Machining and Machine Tool Operations: Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems.

Operations Research: Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

AURCET - 2013 SYLLABUS

TEST NO. 79 :: MECHANICAL ENGINEERING

(100 MARKS)

ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigen vectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy's integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson,Normal and Binomial distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations Integration by trapezoidal and Simpson's rule, single and multi-step methods for differential equations.

APPLIED MECHANICS AND DESIGN

Engineering Mechanics: Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.

Vibrations: Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; *principles* of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

FLUID MECHANICS AND THERMAL SCIENCES

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

Thermodynamics: Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle.irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

Applications:*Power Engineering*: Steam Tables, Rankine, Brayton cycles with regeneration and reheat. *I.C. Engines*: air-standard Otto, Diesel cycles. *Refrigeration and air-conditioning*: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes. *Turbomachinery:* Pelton-wheel, Francis and Kaplan turbines — impulse and reaction principles, velocity diagrams.

MANUFACTURING AND INDUSTRIAL ENGINEERING

Engineering Materials: Structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

Metal Casting: Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy.

Joining: Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

Machining and Machine Tool Operations: Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems.

Operations Research: Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

AURCET - 2013 SYLLABUS

TEST NO. 80 :: METALLURGICAL ENGINEERING

(100 MARKS)

(i) Thermodynamics and Rate Processes:

Laws of thermodynamics, activity, equilibrium constant, applications to metallurgical systems, solutions, phase equilibria, Ellingham and phase stability diagrams, thermodynamics of surfaces, interfaces and defects, adsorption and segregation; basic kinetic laws, order of reactions, rate constants and rate limiting steps; principles of electro chemistry- single electrode potential, electro-chemical cells and polarizations, aqueous corrosion and protection of metals, oxidation and high temperature corrosion – characterization and control; heat transfer – conduction, convection and heat transfer coefficient relations, radiation, mass transfer – diffusion and Fick's laws, mass transfer coefficients; momentum transfer – concepts of viscosity, shell balances, Bernoulli's equation, friction factors.

(ii) Extractive Metallurgy:

Minerals of economic importance, comminution techniques, size classification, Flotation, gravity and other methods of mineral processing; agglomeration, pyro- hydro- and electro-metallurgical processes; material and energy balances; principles and processes for the extraction of non-ferrous metals – aluminium, copper, zinc, lead, magnesium, nickel, titanium and other rare metals; iron and steel making – principles, role structure and properties of slags, metallurgical coke, blast furnace, direct reduction processes, primary and secondary steel making, ladle metallurgy operations including deoxidation, desulphurization, sulphide shape control, inert gas rinsing and vacuum reactors; secondary refining processes including AOD, VAD, VOD, VAR and ESR; ingot and continuous casting; stainless steel making, furnaces and refractories.

(iii) Physical Metallurgy:

Crystal structure and bonding characteristics of metals, alloys, ceramics and polymers, structure of surfaces and interfaces, nano-crystalline and amorphous structures; solid solutions; solidification; phase transformation and binary phase diagrams; principles of heat treatment of steels, cast iron and aluminum alloys; surface treatments; recovery, recrystallization and grain growth; industrially important ferrous and non-ferrous alloys; elements of X-ray and electron diffraction; principles of scanning and transmission electron

microscopy; industrial ceramics, polymers and composites; electronic basis of thermal, optical, electrical and magnetic properties of materials; electronic and opto-electronic materials.

(iv) Mechanical Metallurgy:

Elasticity, yield criteria and plasticity; defects in crystals; elements of dislocation theory – types of dislocations, slip and twinning, source and multiplication of dislocations, stress fields around dislocations, partial dislocations, dislocation interactions and reactions; strengthening mechanisms; tensile, fatigue and creep behaviour; super-plasticity; fracture – Griffith theory, basic concepts of linear elastic and elasto-plastic fracture mechanics, ductile to brittle transition, fracture toughness; failure analysis; mechanical testing – tension, compression, torsion, hardness, impact, creep, fatigue, fracture toughness and formability.

(v) Manufacturing Processes:

Metal casting – patterns and moulds including mould design involving feeding, gating and risering, melting, casting practices in sand casting, permanent mould casting, investment casting and shell moulding, casting defects and repair; hot, warm and cold working of metals, Metal forming – fundamentals of metal forming processes of rolling, forging, extrusion, wire drawing and sheet metal forming, defects in forming; Metal joining – soldering, brazing and welding, common welding processes of shielded metal arc welding, gas metal arc welding, gas tungsten arc welding and submerged arc welding; welding metallurgy, problems associated with welding of steels and aluminium alloys, defects in welded joints; powder metallurgy; NDT using dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission and magnetic particle methods.