SYLLABUS FOR PH.D. 2012-13.

ELECTRONICS & COMMUNICATION ENGG.

1. Circuits Theory
2. Signals and Systems
3. Analog Electronics
4. LIC
5. Digital Circuits and Systems
6. Analog & Digital Communications
7. EM Theory
8. Microprocessors
9. Microwave and Antennas.

COMPUTER ENGG./INFORMATION TECH.

1. Programming
2. Data Structure and algorithms.
3. Operating System
4. DBMS
5. Computer Architectures
6. Software Engineering

INSTRUMENTATION AND CONTROL ENGG.

1. Electrical Engineering
2. Circuits and Systems
3. Electronics
4. Electrical Machines
5. Control Engineering
6. Measurements & Instrumentation
7. Medical Instrumentation
8. Digital Signal Processing.

MANUFACTURING PROCESSES & AUTOMATION ENGG.

Engineering Materials: Structure and properties of engineering materials and their applications; effect of strain, strain rate and temperature on mechanical properties of metals and alloys; heat treatment of metals and alloys, its influence on mechanical properties.

Applied Mechanics: Engineering mechanics-equivalent force systems, free body concepts, equations of equilibrium;strength of materials-stress, strain and their relationship, Mohr's circle, deflection of beams, bending and shear stress, Euler's theory of columns.

Theory of Machines and Design: Analysis of planar mechanisms, cams and followers; governers and fly wheels; design of elements-failure theories;design of bolted, riveted and welded joints;design of shafts, keys,spur gears, belt drives, brakes and clutches.

Thermal Engineering: Fluid mechanics-fluid statics, Bernoulli's equation, flow through pipes, equations of continuity and momentum; thermodynamics-zeroth, first and second law of thermodynamics, thermodynamic system and processes, calculation of work and heat for systems and control volumes; air standard cycles; basics of internal combustion engines and steam turbines;heat transfer-fundamentals of conduction, convection and radiation, heat exchangers.

Metal Casting: Casting processes-types and applications;patterns-types and materials; allowances; moulds and cores-materials, making,and testing; casting techniques of cast iron, steels and nonferrous metals and alloys; solidification; design of casting, gating and risering;casting inspection, defects and remedies.

Metal Forming: Stress Strain relations in elastic and plastic deformation; concept of flow stress deformation mechanisms;hot and cold working-forging,rolling,extrusion,wire and tube drawing;sheet metal working processes such as blanking,piercing,bending,deep drawing,coining and embossing;analysis of rolling,forging,extrusion and wire/rod drawing;metal working defects.

Metal Joining Processes: Welding processes-manual metal are, MIG,TIG, plasma are, submerged are, electroslag, thermit,resistance,forge,friction, and explosive

welding;other joining processes-soldering,brazing,braze welding;inspection of welded joints, defects and remedies; introduction to advanced welding processes-ultrasonic,electron beam,laser beam;thermal cutting.

Machining and Machine Tool Operations: Basic machine tools;machining processes-turning,drilling,boring,milling,shaping,planning,gear cutting, thread production, broaching, grinding,lapping,honing,super finishing; machanics of machining-geometry of cutting tools, chip formation,cutting forces and power requirements, Merchant's analysis; selection of machining parameters, tool materials, tool wear and tool life, econmics of machining. thermal aspects of machining, cutting fluids, machinability;principles and applications of nontraditional machining processes-USM,AJM,WJM,EDM and Wire cut EDM,LBM,EBM,PAM,CHM,ECM.

Tool Engineering: Jigs and fixtures-principles, applications, and design;press tools - configuration, design of die and punch;principles of forging die design.

Metrology and Inspection: Limits, fits, and tolerances, interchangeability, selective assembly;linear and angular measurements by mechanical and optical methods, comparators;design of limit gauges;interferometry;measurement of straightness,flatness,roundness,squareness and symmetry;surface finish measurement;inspection of screw threads and gears;alignment testing of machine tools.

Powder Metallurgy: Production of metal powders, compaction and sintering.

Polymers and Composites: Introduction to polymers and composites;plastic processing-injection, compression and blow molding, extrusion,calendaring and thermoforming;molding of composites.

Manufacturing Analysis: Sources of errors in manufacturing;process capability;tolerance analysis in manufacturing and assembly;process planning;parameter selection and comparison of production alternatives;time and cost analysis;manufacturing technologies-strategies and selection.

Computer Integrated Manufaturing: Basic concepts of CAD,CAM,CAPP, cellular manufacturing,NC,CNC,DNC,Robotics,FMS,and CIM,Robot systems;present status and future trends, Reviews of physical configurations and

motions;mobility,Sensors;techniques and evaluation; analysis sensor data;special applications of sensors. Matrix algebra of coordinate transformation, kinematic analysis;geometric and dynamic analysis of robot manipulators, Robot control,Robot Vision,Robot controlled CNC. Path planning, Obstruction avoidance, Computer aided Materials Management-inventory control, Materials requirement planning, Computer controlled parts handling and equipments, Manufacturing Automation protocol, Cross functional implementation Technology for system integration.

Product Design and Development: Principles of good product design, tolerance design; quality and cost considerations;product life cycle;standardization, smplification, diversification,value engineering and analysis,concurrent engineering.

Engineering Economy and Costing: Elementary cost accounting and methods of depreciation;break-even analysis, techniques for evaluation of capital investments, financial statements.

Work System Design: Taylor's scientific management, Gilbreths's contributions; productivity-concepts and measurements;method study, micro-motion study, principles of motion economy;work measurement-stop watch time study, work sampling, standard data, PMTS;ergonomics; job evaluation, merit rating, incentives schmes, and wage administration; business process reengineering.

Facility Design: Facility location factors and evaluation of alternate locations;types of plant layout and their evaluation;computer aided layout design techniques;assembly line balancing;materials handling systems.

Production Planning and Inventory Control: Forecasting techniques-causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning;master production scheduling;MRP and MRP-II, order control and flow control;routing,scheduling and priority dispatching; push and pull production systems, concept of JIT manufacturing system;logistics, distribution, and supply chain management; Inventory-functions, costs, classifications,deterministic and probalilistic inventory models, quantity discount;perpetual and periodic inventory control systems.

Operation Research: Linear programming-problem formulation, simplex method, duality and sensitivity analysis;transportation and assignment models;network flow

models, constrained optimization and Lagrange multipliers;simple queuing models;dynamic programming;simulation-manufacturing applications;PERT and CPM, time-cost trade-off, resource leveling.

Quality Management: Quality: Concept and costs, quality circles, quality assurance;statistical quality control,acceptance sampling,zero defects, six sigma;total quality management;ISO 9000;design of experiments-Taguchi method.

Reliability and Maintenance: Reliability, availability and maintainability; distribution of failure and repair time; determination of MTBF and MTTR, reliability models; system reliability determination; preventive maintenance and replacement, total productive maintenance-concept and applications.

Finite Element Method: Introduction to FEM, Variational principle, Relationship with other methods, Development of Finite Element Method with emphasis on energy principles, virtual work, potential energy. Application to line elements, beams, plane stress, plane strain and three dimensional stress.

BIO-TECH. Division

1. Cell Biology
2. Biochemistry
3. Microbiology
4. Molecular Biology and Genetics
5. Methods and Instrumentation in Biotechnology
6. Structural Biology
7. Immunology
8. Recombinant-DNA Technology
9. Plant and Animal Biotechnology
10. Bioinformatics
11. Biochemical and Bioprocess Engineering.

APPLIED SCIENCES
MATHEMATICS :

Real Analysis: Sequences and series of functions. Uniform convergence and its relation to continuity, differentaiation and integration.Riemann Integration, Measurable sets, Measurable functions and Lebegue Integration.

Complex Analysis: Contour and Contour Integrals. The Cauchy and Goursat Theorem. The fundamental theorem of integration, The theorems of Morera and Liouville and some applications. Uniform Convergence, Taylor's Series, Laurent's Singularity, Zeros and Ploles, Application of Taylor's and Laurent's Series. Isolated singularities and residues, The residue theorem. Evaluations of real integrals. The argument principle and Rouche's theorem.

Vector Analysis: The operators gradient, divergence and curl and their geometrical significance, Integration of vectors, Work done in vector fiels, Green's, Stokes and Gauss divergence theorem.

Algebra: Group, Ring, Integral Domain, Field, Vector Space, Linear Dependence and Linear Independence, Linear Transformation, Matric Representation, Rank & Nullity of a Transformation, Eigen values and Eigen vectors, Banach Space, Normed Linear Space, Inner Product Space.

Ordinary Differential Equations: General linear diffential equations with constant coefficients, Operator D,Complementary function, particular integral, Wronskian, Simultaneous linear differential equations, Solution of differential equations in power series, Frobenius method.

Partial Differential Equations: First Oder PDE's, Heat Equation, Wave Equation, Potential Equation.

Numerical Methods: (i) Solution of a system of linear equations;Gaussian Elimination and Gauss-Seidel Methods.(ii) Solution of Nonlinear equations: Bisection Method, Secant Method, Method of False Position, Newton-Raphson Method, Chebyschev Method, Rate of Convergence, System of nonlinear equations.

(iii) Interpolation by polynomials; Divided difference, Error of the interpolating polynomial, Least square approximation, Piecewise linear and cubic spline interpolation. (iv) Numerical Integration: Composite Rules, Gaussian Quadrature formula, Error formula. (v) Numerical solution of differential equations; Euler and Runge-Kutta methods, Multistep methods, and Predictor-corrector Methods, Order of convergence.

PHYSICS:

1. Solid State Physics :

a) Semiconductor Physics
b) Dielectrics
c) Metallic conduction
d) Superconductivity
e) Magnitison.

2. Fundamentals of Quatum Mechanics :

a) Schrodinger Wave Equation & its applications.
b) De Broglic Waves & Uncertainty principle.

3. Mathematical Physcis :

a) Matrics
b) Vector Algebra
c) Numerical Methods.

CHEMISTRY

CHEMICAL SCIENCES

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo-and heteronuclear molecules, including shapes of molecules(VSEPR Theory)
3. Concepts of acids and bases, hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry- separation, spectroscopic, electro-and thermoanalytical methods.
10. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron-transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mossbauer,UV-vis, NQR,MS,electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta: tunneling.

2. Approximate methods of quantum mechanaics: Variational principle; perturbation theory up to second order in energy; applications.

3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.

4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated – electron systems.

5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.

6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities- selection rules; basic principles of magnetic resonance.

7. Chemical thermodynamics; Laws, state and path functions and their applications: thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamics quantitites; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.

8. Statistical thermodynamics; Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamics quantitites-calculations for model systems.

9. Electrochemistry : Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance-Kohlausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.

10. Chemical kinetics: Emprirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

11. Colloids and surfaces: Stablity and properties of colloids; isotherms and surface area; heterogeneous catalysis.

12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

13. Polymer chemistry: Molar masses; kinetics of polymerization.

14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; convariance and correlation coefficient.

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio-and stereoisomers.

2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compound; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.

3. Aromaticity: Benzenoid and non-benzenoid compounds- generation and reactions.

4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.

5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.

6. Common named reactions and rearrangements-applications in organic synthesis.

7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents(organic, inorganic, organometallic and enzymatic). Chemo, regio and stereolselective transformations.

8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umploung of reactivity and protecting groups.

9. Asymmetirc synthesis: Chiral auxiliaries, methods of asymmetric induction-substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution-optical and kinetic

10. Pericyclic reactions- electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.

11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O,N,S).

12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids,nucleic acids, terpenes, steroids and alkaloids. Biogensis of terpenoids and alkaloids.

13. Structure determination of organic compounds by IR, UV-Vis, “H&13C NMR and Mass spectroscopic techniques.

Interdisciplinary topics.

1. Chemisty in nanoscience and technology.
2. Catalysis and green chemistry.
3. Medicinial chemistry.
4. Supramolecular chemistry.
5. Environmental chemistry.