Subject: Syllabus for written test for PhD entrance exam 2011-12

1. Division of Electronics & Communication:

1. Circuit Theory
2. Electronic Devices
3. Analog Electronics Circuits (including Linear Integrated Circuits)
4. Digital Circuits and Systems (including Microprocessors/Microcontrollers)
5. Signal and Systems
6. Digital Signal Processing
7. Control Systems
8. Communication Theory and Systems (including Microwave)
9. Electromagnetic Field Theory

2. Division of Computer Engineering:

1. Programming
2. Data Structures and Algorithms
3. Computer architectures
4. Databases
5. Operating Systems

3. Division of Information Technology:

1. Programming
2. Data Structures
3. DBMS
4. Operating System
5. Computer Architectures

4. Division of Instrumentation & Control Engineering:

1. Basic Electrical Engg. & CKTs & Systems
2. Basic Electrical Machines
3. Basic Control Engg.
4. Basic Measurements & Instrumentation
5. Basic Computer Science
6. Basic Electronics

5. A) **<u>Division of SAS (Physics):</u>**

1. Solid State Physics
    * Semiconductor Physics
    * Dielectrics
    * Metallic Conduction
    * Superconductivity
    * Magnet son

2. Fundamentals of Quantum Mechanics
    * Schrodinger wave equation & its applications.
    * DC Broglie Waves & Uncertainty principle.

3. Mathematical Physics
    * Metrics
    * Vector Algebra
    * Numerical Methods

5. B) **<u>Division of SAS (Physic): Green Building Technology, Energy & Environment Management:</u>**

1. Green Building-Definitions, concepts & General principles.

2. Benefits of Green Buildings.
    * Economic benefits of Green Building.
    * Environmental benefits.

3. Using Natural materials.

4. Reclamation uses a range of solutions.

5. Elements of Green Building design.
    * Sitting.
    * Building orientation.
    * Energy Efficiency.
    * Material Efficiency.
    * Water Efficiency.
    * Occupant Health and Safety.
    * Ventilation and Air Quality.
    * Air Systems.
    * Building Operation and Maintenance.
    * Occupants Discipline and Green effect.

6. Disability Access.
    * Provisions for physically handicapped.
    * Physical human limits.

7. Efficient water management.
    * Waterless Urinals.

8. Green code for Architecture.
    * Environmental Architecture.
    * Ecological Building.

9. Smart Buildings.
    * Active Response to Environment.
    * Essential Requirements of Smart buildings.
    * Essential Provisions to be kept in the Design.
    * Energy Provision to be kept in the Design.

10. Energy Efficiency.

11. Informational Resources on Green Buildings.

12. United State Green Building concepts (USGBC).

13. Establishing Priorities with Green Building.

14. Other method of Employing Green Concepts.
    * Cork Flooring.
    * New Hard wood flooring.

15. Environmentally harmful material and methods.

6. Division of Humanities and Social Sciences:

1. Sociology of Science and Technology

History and nature of science and technology, science and technology as social institutions, Gender science and technology, science and technology based ethical issues, technological determinism, relationship between science and technology and social change.

2. Sociology of Education and profession and Globalization

Theories of education, professions, professional education and vocational learning, education, knowledge and globalization.

7. Division of SAS (Mathematics):

Real Analysis: Sequence and series of functions. Uniform convergence and its relation to continuity, differentiation. 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 series, Singularity, Zeros and Poles, Application of Tylor'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 fields, Green's, Stokes and Gauss divergence theorem.

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

Ordinary Differential Equations: General linear differential 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 solutions of differential equations: Euler and Runge-Kutta methods, Multistep methods, and Predictor- corrector Methods, Order of convergence.

8. **Courses for PHD Entrance Examination in Biotechnology Division**

- Cell Biology
- Biochemistry
- Microbiology
- Molecular Biology and Genetics
- Methods and Instrumentation in Biotechnology
- Structural Biology
- Immunology
- Recombinant-DNA Technology
- Plant and Animal Biotechnology
- Bioinformatics
- Biochemical and Bioprocess Engineering

9. Syllabus for PhD Admission Exams in 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, Mössbauer, 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 mechanics: 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 π-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 thermodynamic quantities; 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 thermodynamic quantities – calculations for model systems.

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

10. Chemical kinetics: Empirical 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: Stability 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; covariance 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 compounds; 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 stereoselective transformations.

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

9. Asymmetric 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. Biogenesis of terpenoids and alkaloids.

13. Structure determination of organic compounds by IR, UV-Vis, ^{1}H & ^{13}C NMR and Mass spectroscopic techniques.

Interdisciplinary topics

1. Chemistry in nanoscience and technology.
2. Catalysis and green chemistry.
3. Medicinal chemistry.
4. Supramolecular chemistry.
5. Environmental chemistry.

Sub: Syllabus for the written test for Ph.D in English & Linguistics.

The following topics may be considered as topics in the syllabus of English and Linguistics :-

(i) History of English Literature, Indian Writing in English, Critical Appreciation of Texts with emphasis on language and stylistics.

(ii) History of English Language and English Language Teaching, Goals of language teaching, functions of language and types of language used in news/advertisements/magazines

(iii) Sociolinguistics, speech community, language change, language & gender, first language and second language acquisition, child language bilingualism & multilingualism, speech disorders, dyslexia, processes and theories of language learning, role of the learner, general linguistics.

Submitted for perusal pl.

16/9/11
Lecturer, Engs.

HOD (SAS & H) / Dean (PGS)

16/9/11

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16/9/11

Syllabus for Phd Entrance MPAE

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 arc, MIG, TIG, plasma arc, submerged arc, 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, planing, gear cutting, thread production, broaching, grinding, lapping, honing, super finishing; mechanics 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, economics 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 Manufacturing: Basic concepts of CAD, CAM, CAPP, cellular manufacturing, NC, CNC, DNC, Robotics, FMS, and CIM. Robot systems; present status and future trends. Review 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, simplification, 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, incentive schemes, 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 probabilistic 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 times; 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.