MPAT-2013
University of Rajasthan,Jaipur
Subject: NANO–TECHNOLOGY (CCT)(Code: 136)

Section A

SOLID STATE DEVICES & QUANTUM MECHANICS

Semiconductors: Intrinsic semiconductors, electrons and holes, Fermi level. Temperature dependence of electron and hole concentrations. Doping; impurity states, n and p type semiconductors, conductivity, mobility, Hall effect, Hall coefficient.

Origin of the quantum theory: Failure of classical physics to explain the phenomena such as black-body spectrum, photoelectric effect, Ritz combination principle in spectra, stability of an atom. Planck's radiation law, Einstein's explanations of photoelectric effect, Bohr's quantization of angular momentum and its applications to hydrogen atom, limitations of Bohr's theory.

Wave-particle duality and uncertainty principle: De Broglie's hypothesis for matter waves; the concept of wave and group velocity evidence for diffraction and interference of 'particles'.Consequences of De Broglie's concepts; quantization in hydrogen atom; energies of a particle in a box, wave packets, Heiesnberg's uncertaintity relation for p and x, its extension to energy and time.

Consequences of the uncertainty relation: Gamma ray microscope, diffraction at a slit, particle in a box, position of electron in Bohr orbit.

Quantum Mechanics : Schrodinger's equation. Postulatory basis of quantum mechanics; operators, expectation values, transition probabilities, applications to particle in a one and three dimensional boxes, harmonic oscillator, reflection at a step potential, transmission across a potential barrier.

PHYSICAL CHEMISTRY

ATOMIC STRUCTURE : HYDROGEN SPECTRUM, PLANK'S QUANTUM THEORY Bohr's theory of hydrogen atom, Energy levels and explanation of hydrogen spectra, limitations of Bohr's Theory. Quantum numbers, wave nature of electron and uncertainty principle – Schrodinger wave equation Dependence of probability functions on distance from nucleus and directions – shapes of atomic orbitals (Calculation involving frequency and Rydberg's constants), Concept of chemical bonding ionic bonding and covalent bonding.

CHEMICAL EQUILIBRUM : Reversibility – Dynamic nature of equilibrium Kp, Kc and their interrelation, derivation of quantitative expression for equilibrium constants for a few typical reactions, factors effecting the equilibrium constants.

GASEOUS STATE: Kinetic theory of gases – Derivation of kinetic equation and deduction of gas laws – Mean free path, collision number and collision diameter – principles of equipartition of energy – Heat capacities for mono, di and tri atomic molecules deviation from gas laws –

Vander wall's equation Critical phenomena – Isotherms of carbon dioxide – Determination of critical constants – Derivation of relation between Vander wall's constants and critical constants – law of corresponding states and its usefulness / applications.

Section B

PROGRAMMING IN C, DATA STRUCTURES & DISCRETE MATHEMATICS:

Data types, Operators and Expressions, Input Output Statements, Control Statements, Functions, Arrays, Pointers, Structures & Unions, Preprocessors, Programming in C.

Searching and Sorting Techniques, Expression, Evaluation, Stacks, Queues, Linked Lists, Trees, Graphs and applications.

Sets and relations, Fundamentals of prepositional logic, inference, elementary combinatories, Probability, Mathematical Induction.

ELECTRONICS & CONTROL SYSTEMS:

POWER SUPPLY : Diode as a circuit element, load line concept, rectification, ripple factor, zener diode, voltage stabilization, IC voltage regulation, characteristics of a transistor in CB, CE and CC mode, graphical analysis of the CE configuration, low frequency equivalent circuits, h-parameters, bias stability, thermal runaway.

System concept – mathematical models of physical systems – block diagram algebra – feedback characteristics – reduction in parameter variations by use of feed back – PID controllers – time response analysis – concept of stability – frequency response analysis.

Section C

NANO TECHNOLOGY

Synthesis of Nano materials – various methods; Thinfilm fabrication methods; Biological building blocks, Nucleic acids – DNA double Nano wires, genetic code; MEMS & NEMS, Nano biosensors, DNA computing and quantum computing,, size effects and properties of nano materials; various methods of Nano materials characterization, Molecular electronics quantum electronic devices, short channel M O S Transistor, RTD, RTBT multiplexer; Spintronics, spatial al computing as molecular electronics, carbon nano tubes synthesis and types, fullerenes, applications.

NANO MATERIIALS FOR ENERGY AND ENVIRONMENT AND NANO ETHICS:

Energy characteristics – Fundamentals of environment, Environmental impact assessment of nano materials used in energy and environmental applications and their properties. Device applications, Energy – Hydrogen storage and production – Fuel cells – Solar energy conversion; Nano materials in Automoibiles. Nano ethics, Impact on society and environment.