FT-401  NUCLEAR PHYSICS

Max. Marks: 85  Pass Marks: 29

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I  Nucleus and its Properties
The constitution of the nucleus and its general properties: Proton-electron hypothesis, Nucleus as a quantum system, Proton-neutron hypothesis, Nuclear mass, Basic components of mass spectroscopy, Mirror nuclei and isotopic spin (introductory), Packing fraction and binding energies, Nuclear radius- its determination and interpretation of results (experimental details not required). Natural radioactivity, successive radioactive transformation, radioactive equilibrium, Gamow theory of alpha decay, nuclear spin, parity, magnetic moments, electric dipole and quadrupole moments (experimental details not required).

Unit – II  Two body Problems
Binding energies and the Saturation of nuclear forces, Charge independence of nuclear force, The ground state of the deuteron (central forces), Comparison with experimental data on deuteron, Spin dependence of nuclear force, Tensor force, Neutron-proton scattering at low energies (below 10 MeV), Cross-section, Laboratory and center of mass coordinate systems, Scattering length, Spin dependence of nuclear force, Singlet and triplet potentials. Effect of chemical binding, Coherent scattering of neutrons by protons (scattering by ortho- and para-hydrogen), Proton-Proton scattering at low energies (elementary theory). Exchange forces (elementary Yukawa theory).

Unit – III  Nuclear Models
Liquid drop model, Semi empirical mass formula, Isobaric mass paralolas, Nuclear fission, The mass and energy distributions of the fission products, The energy release in fission, Application of liquid drop model to fission, Magic numbers, Single particle model of the nucleus, Spin-orbit coupling, Application to prediction of spin and magnetic moments (Schmidt values).

Unit – IV  Nuclear Decay
Beta particle spectra, The continuous spectrum, Neutrino hypothesis, Fermi theory of beta-decay (non-relativistic), Kurie plots, Comparative half lives, Allowed and forbidden transitions, Selection rules, Symmetry laws and the non-conservation of parity in beta-decay, Gamma transitions, Multipole moments (mathematical results of theory to be assumed), Selection rules, Internal conversion (qualitative only), Nuclear isomerism

Unit – V  Nuclear Reactions
Conservation laws for nuclear reactions, Q-value. The compound nucleus, Independence hypothesis, Resonances, Single level Breit-Wigner formula, Direct reaction (introductory ideas about stripping and pickup reactions).

Books Recommended:

1. Nuclear physics: Kaplan
2. Nuclear physics: Engle
3. Nuclear physics: Evans
4. Nuclear physics: Blatt and Wisskopf
PT-402 INSTRUMENTATION AND COSMIC RAYS

Max. Marks: 35 Pass Marks: 29

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit - I Measurement of Temperature

Temperature scales, mechanical temperature sensors, liquid filled sensors, platinum resistance thermometer, principle and construction of resistance thermometer circuits, thermistors and its measuring circuits, thermocouple and its circuits, solid state sensors, temperature measurement by radiation methods, optical pyrometers.

Unit - II X-Ray Spectroscopy and Crystal Growth Techniques

X-ray spectrum, X-ray generating equipment, monochromators, powder and single crystal diffractometer, X-ray absorption meter, basic properties and uses of ESCA, electron probe microanalyser.

Theories of crystal growth. Growth of Single crystals from melt, Czochralski method. Concept of annealing and quenching. Thin film deposition, Vacuum evaporation and chemical vapour deposition.

Unit - III Biomedical Instrumentation

Electrocardiography, ECG amplifiers, electrodes and leads, ECG recorder principles, types of ECG recorders, measurement of blood flow, magnetic blood flow recorder, ultrasonic blood flow meter, principles of ultrasonic measurement, basic modes of transmission, ultrasonic imaging.

Unit - IV Elements of high resolution spectroscopy

Principles of Mössbauer spectroscopy. applications of Mössbauer spectroscopy: chemical shift, quadrupole effect, effect of magnetic field; spin resonance spectroscopy: nature of spinning particles, interaction between spin and magnetic field, Larmor precession; introduction to magnetic resonance spectroscopy and its applications.

Qualitative description of AFM, SEM and TEM.

Unit - V Cosmic Rays

Nature, composition, charge and energy spectrum of primary cosmic rays, production and propagation of secondary cosmic rays, Rossi curve, cascade showers, physical properties of elementary particles, fundamental interactions and conservation laws, associated production and strangeness, leptons and hadrons, Quark model-SU(2) and SU(3) multiplets, Gellmann-Oktubo mass formula.

BOOKS RECOMMENDED:

1. Instrumentation devices and systems: G.S. Rangan et al.
2. Handbook of X-ray: Kelbel
3. Biomedical Instrumentation: L. Cromwell et al
4. Plasma Physics: F.F. Chen
PT – 403  STATISTICAL MECHANICS

Max. Marks: 35  Pass Marks: 12

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I  Microcanonical Ensemble

Concept of $\mu$ and $\gamma$ phase spaces, Liouville's theorem, Concept of Gibbs ensembles: microcanonical ensemble, canonical and grand canonical ensembles, Thermodynamical potential functions and their relations, Partition function of micro-canonical ensembles and its application to (a) classical ideal gas (b) Gibbs paradox, Sackur Tetrode equation.

Unit – II  Canonical Ensemble

Canonical ensemble, Maxwell Boltzmann distribution, Maxwell's distribution of velocities and speeds, Boltzmann energy equipartition theorem, Rotational and vibrational partition function, Their application to diatomic molecules.

Unit – III  Grand Canonical Ensemble – I

Grand canonical partition function, Derivation of Bose Einstein statistics, Weak and strong degeneracy, Applications of Bose Einstein statistics to Bose Einstein condensation and phase transition, Thermodynamical properties of an ideal Bose Einstein gas, Liquid helium and its properties, Two fluid model for liquid helium.

Unit – IV  Grand Canonical Ensemble – II


Unit – V  Fluctuations

Elementary discussion of fluctuations, Fluctuations in ensembles : (Microcanonical, canonical, grand canonical), One-dimensional random walk problem, Brownian motion, Electrical noise: (Nyquist theorem).

BOOKS RECOMMENDED

1. Statistical Mechanics : ESR Gopal
2. Statistical Mechanics : Huang
3. Statistical Mechanics : Merolde
PT – 404A  INTEGRATED ELECTRONICS

Max. Marks: 35       Pass Marks : 20

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I  Materials for Integrated Circuits


Unit – II  Integrated circuit fabrication technology

Optical lithography, photo mask, photo resist and process of lithography, idea of electron beam and X-ray lithography, wet chemical etching, reactive plasma etching.

Unit – III  Growth of Thin Films

Evaporation theory, physical vapour deposition method, design construction of high vacuum coating unit, flash electron beam evaporation system, idea of DC-sputtering system, idea of thick film circuits.

Unit – IV  Diffusion and Ion Implantation


Unit – V  Monolithic circuit fabrication

Fabrication of monolithic diodes in various configuration, fabrication of integrated transistors, Idea of buried layer, fabrication, Monolithic circuit layout design rules, isolation method, Monolithic FET, MOS FET processing, advantages and limitations of MOS devices, CCD devices, Idea of large and medium scale Integration.

Books Recommended:

1. Fundamentals of Electronics. Millman and Maitias
2. Fundamentals of Electronics. Botkar
M.Sc. (Physics) semester system (Session 2010-11 and 2011-12)

PT - 404B MATERIALS SCIENCE - II

Max. Marks: 

Pass Marks: 

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I Dislocation and Plastic Deformation of Materials

Concept of dislocation, Dislocation of Movement, Stress field and strain energy of a dislocation, Forces on dislocation and between dislocations, Homogeneous nucleation of dislocations, Typical tensile stress-strain curve, Strength of a material, Work hardening by impurity atoms, yield drops, Shear strength of perfect and real solids, Creeps and their mechanism, Toughness, Fatigue, Methods of observing dislocations (their introduction, merits and demerits).

Unit – II Transport Properties of Solids

Electrical conductivity of , metals and alloys, Extrinsic, intrinsic semiconductors and amorphous semiconductors, Scattering of electrons by phonons, impurity, etc, Relaxation time, Carrier mobility and its temperature dependence, Mathieson’s rule for resistivity, temperature dependence of metallic resistivity.

Unit- III Degradation of materials, electronic properties in magnetic field

Mechanism of oxidation, Oxidation-resistant materials, Corrosion and protection against it, Classical theory of magneto-conductivity, Cyclotron resonance, k-space analysis of motion in uniform magnetic field, de Hass von Alphen effect, Ultrasonic attenuation and skin effect.

Unit-IV Many Electron Problem In Solids


Unit-V Electron Phonon Interaction And Superconductivity

Interaction of electron with acoustic and optical phonon, Polarons, Superconductivity, Manifestation of energy gap, Isotope effect, Cooper Pairing due to Phonons, BCS theory, Ginsburg-Landau theory and applications to Josephson effect, (D.C. and A.C. both ), Macroscopic quantum interference, Vortices and Type II - Superconductors, Idea of high Tc superconductivity.

BOOKS RECOMMENDED

1. Introduction to Dislocations : Hull
2. Material Science and Engineering : Raghvan
4. Introduction to Solid State Physics - Kittel
5. Introduction to Superconductivity : Roseinmes and Rhodrick
6. Quantum theory of Solids - Kittel
PT – 404C  COMPUTER APPLICATIONS IN PHYSICS – II

Max. Marks: 35  Pass Marks: 12

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I  Networking and Multimedia

Network types of architecture: LAN, WAN, MAN topology, interfaces and devices, multimedia, technique of data compression, voice, video, interactive video-on-demand over the net, mobile computing. Fundamental of network and management (NM), elements of NM its need and functional areas, configuration, performance and security managements.

Unit – II  Computer Graphics – I (2-D)

Types of graphic devices, CRT display, Random and raster scan graphics, DDA, Line drawing, Algorithms, Bresenham’s algorithms, Cell encoding, Frame buffers, Raster addressing, Line and character display, Transformation of points, Lines and objects, Homogeneous coordinate systems and transformation matrices for various operations, Sequential transformations, Viewport planning, Window clipping. Window to Viewport mapping, Physical device coordinates. Zooming.

Unit – III Computer Graphics – II (3-D)

3-D transformations: Translational, Rotational and Scaling, Clipping in three-dimension, 3-D viewing transformation, 3-D drawing: direct projection, quadratic surfaces, removing hidden surfaces, drawing a cube and a sphere

Unit – IV Assembly Language Programming

Concept of machine language, Assembly language and assembler, Instruction set of 8085, Op-codes, Mnemomics, Instruction and data format, Addressing modes, Instruction set: data transfer group, arithmetic group, logical group, branch group and stack, I/O and machine control group. Programs based on these statements

Unit – V  Development of Scientific Packages

Preparation of programs to model simple physical problems: Solution of Schrodinger equation: Potential well problem in one- and three-dimension, Interaction between two charged particles, penetration of charge particles through a potential barrier and variation in the nature of transmitted waves.

BOOKS RECOMMENDED

1. Computer graphics by S Harrington
2. Computer graphics by D.Reams and P.M.Baker
3. Procedural elements for computer graphics by D.F.Rogers
5. Introduction to Microprocessor by Mathur