Unit - I  Approximation methods for bound states - II
Formulation of first order time independent perturbation theory for degenerate levels, Application to first order Stark effect of a hydrogen like atom, Fine structure splitting of atomic energy levels, Zeeman effect with and without electron spin.

Unit - II  Approximation methods for time dependent problems

Unit - III  Identical Particles
Indistinguishability, Exchange degeneracy, Symmetric and antisymmetric wave functions for many particle systems, Spin and statistics, Computation of interaction energy for two particle systems, Exchange interaction, Application to ground state of a helium-like atom, Structure of wave function for excited states of a helium-like atom, Pauli exclusion principle (qualitative), Collisions of identical particles Allowed states of 2-particle systems.

Unit - IV  Scattering theory
Scattering cross section, Laboratory and center-of-mass coordinate systems, Transformation of variables from one system to another, Asymptotic behaviour, Scattering by spherically symmetric potentials, Partial waves and phase shifts, Partial wave expansion of differential cross section, Total cross section, Ramsauer – Townsend effect Scattering by a perfectly rigid sphere, Scattering by a square potential well, Green’s functions in scattering theory, Born approximation, Application to scattering by (i) a square potential well (ii) Yukawa potential, Hypergeometric functions, Scattering in a Coulomb field (separation in parabolic coordinates), Rutherford formula.

Unit - V  Elements of relativistic quantum mechanics
Klein - Gordon equation, Free particle solutions, Dirac equation for a free particle, Free particle solution, Negative energy, Hole theory, Reduction of Dirac equation into covariant form, Gamma matrices and their algebra, Existence of spin, Electromagnetic potentials in Dirac equation, Existence of magnetic moment.

Books Recommended:

1. Quantum Mechanics: L.I. Schiff
2. Quantum Mechanics: J.L. Powell and Crasmann
3. Introduction to Quantum Mechanics: Pauling and Wilson
4. Quantum Mechanics and Field Theory: B. K Agrawal
5. Quantum Mechanics: A.K Ghatak and S. Loknathan
6. The Principles of Quantum Mechanics: Dirac
PT – 302 ATOMIC & MOLECULAR PHYSICS AND NUCLEAR INSTRUMENTATION

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 Atomic Physics

Quantum states of one electron atom, atomic orbitals, Hydrogen spectrum, spectra of alkali elements, spin orbit interaction and fine structure of alkali spectra, normal and anomalous Zeeman effect, Pschenback effect, Stark effect, two electron system, equivalent and non equivalent electrons, Pauli’s exclusion principle, interaction energy, L-S and J-J coupling, Hyperfine structure, line broadening mechanisms.

Unit – II Rotational Spectra

Type of molecules: Linear, non-linear, symmetric top, asymmetric top, spherical top; rotational spectra of diatomic molecules as a rigid rotator, energy level diagram and spectra, rotational spectra of non rigid rotator, energy level diagram and spectra, intensity of rotational lines, applications of rotational spectra and pure rotational Raman spectra.

Unit – III Vibrational and Vibrational-rotational Spectra

Vibrational energy of diatomic molecules, diatomic molecule as a simple oscillator, its energy level diagram and spectrum, Morse potential energy curve, molecules as vibrating rotator, vibration spectrum of diatomic molecules, PQR branches, infrared spectrometry, vibrational Raman spectroscopy, structure determination from Raman and IR spectroscopy.

Unit – IV Fluorescence Spectroscopy

Vibronic interaction, Herzberg Teller theory, fluorescence spectroscopy, Kashas’s rule, Quantum yield, non radiative transition, Jablonski diagram, time resolved fluorescence and determination of excited state life time.

Unit – V Nuclear Instrumentation

Ionization of matter by charge particles, interaction of electromagnetic radiation with matter, stopping power and range, photo electric effect, Compton effect and pair production, radiation detection, gas filled counters, solid state counters, scintillation counter, photomultiplier tube, Cerenkov detector, nuclear emulsions, Betatron, electron synchrotron and proton synchrotron.

BOOKS RECOMMENDED

1. Introduction to Atomic Physics: H.E.White
2. Fundamentals of Molecular spectroscopy: C.N.Banwell and E.M.McCash
3. Spectra of diatomic molecules: Herzberg
5. Nuclear Physics: Kaplan
PT – 303 CONDENSED MATTER PHYSICS – II

Max. Marks: 85

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 Point Defects and Alloys
Lattice vacancies, Interstials and their thermodynamical calculations, Features of point defects, Color centres, Formation of alloys, Order-disorder transformation, Elementary theory of order

Unit – II Dielectric and Ferroelectric

Unit – III Magnetic Properties of Solids
Quantum theory of paramagnetism and ferromagnetism, exchange integral and Heissenberg interaction, Magnon and magnon dispersion relation, Antiferromagnetic and ferrimagnetic orders, Anisotropy energy, Bloch Walls, Idea of ferrites

Unit – IV Superconductivity – I
Concept of superconducting state, Thermodynamical properties of superconductors, London's equation and penetration depths, Magnetic properties and critical magnetic fields, Meissner effect, Flux quantization, Microwave and infrared properties, Coherence length

Unit – V Superconductivity – II
Two fluid model for superconducting state, Ginzburg-Landau theory, Basic features of Pipard's non local theory, elements of BCS theory of superconductivity, Isotope effect, Single particle tunneling, DC and AC Josephson effects, Josephson tunneling, a Qualitative description of high Tc superconductivity in ceramic oxides.

BOOKS RECOMMENDED

1. Introduction to solid state physics: Kittel
2. Solid state Physics: Asheroff and Marmin
4. Superconductivity: Parks
5. Intermediate quantum theory of crystalline solids: Animalu
6. Solid state Physics: Zimam
PT - 304A  MICROWAVE AND OPTICAL COMMUNICATION

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  Microwave Generators and Solid State Devices

Transit time effect at high frequency, failure of triodes/diodes at high frequency, concept of velocity modulation and current modulation, Klystron, Operation and characteristic, Reflex Klystron, Magnetron, Principle of operation and microwave characteristics of Gunn diode and Impatt diode

Unit – II  Microwave Propagation and Components

Wave propagation in circular wave-guide, solution of wave equation in cylindrical coordinates, TE and TM modes in circular wave guides, TEM modes in circular wave guides, power transmission and losses in circular wave guide, Cavity resonators, Wave-guide Tee's (Magic Tee), S-parameters

Unit – III  Microwave Integrated Circuits

Characteristics impedance of microstrip lines, effective dielectric constant, Losses in microstrip lines, Dielectric losses, Ohmic losses, Radiation Losses, The quality factor Q of the transmission line, microstrip line discontinuities, idea of capacitance and inductors, Idea of material used for integrated circuit, Brief idea about microwave integrated circuit

Unit – IV  Optical Fibres

Basic optical laws and definitions, Optical fibre modes and configuration, Mode theory for circular waveguides, Solution of wave equation for index fibres, Power flow in step index fibres, Graded index fibres, Modes in graded index fibres

Unit – V  Integrated Optics

Idea of modes in asymmetric planer wave guide, Strip waveguide, Phase modulators,Mach-Zehnder interferometer modulator, Optical directional couplers, PIN diode photodetectors, Avalanche photodiode detectors, Idea of optical fibre communication system

BOOKS RECOMMENDED

1. Radio and electrical engineering: Terman.
3. Microwave: Atwater.
7. Optical fibre communication: Kaiser.
8. Optical communication system: Gower.
10. An introduction to optical fibres : Cherian.
PT - 304B MATERIALS SCIENCE - I

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 Classification of Materials
Types of materials: Crystalline, Polycrystalline, Amorphous (Introduction and their structure), Elementary idea of polymers (structure and properties) methods of polymerization, Glasses: Structure and properties, Type of Glasses, Fracture in glasses, Composite Materials: Introduction, their types and properties, Different types of bonding, Madelung energy for ionic crystal.

Unit - II Phase Transitions
Thermodynamics of phase transformation, Free-energy calculation, I and II order transformation, Hume-Rothery rule, solid solution and types of solid solutions, Phase rule, One-, Two-component systems, Eutectic and peritectic phase diagrams, Lever rule, Phase diagrams of Mg-Al, Fe-C
Kinetics of transformation, Homogeneous and heterogeneous nucleation, Growth kinetics.

Unit - III Diffusion in Materials and Microscopy

Unit - IV Elastic and Anelastic Behaviour
Atomic models for elastic behaviour, Elastic deformation in single crystals, Elastic anisotropy, Elastic constant and elastic moduli (Cubic system, isotropic body), Rubber like elasticity, anelastic behaviour, Thermo-elastic effect and relaxation process, Idea of viscoelastic behaviour (Spring-Dashpot model), Determination of elastic constant of cubic crystals by ultrasonic wave propagation

Unit - V Exotic Materials
Structure and symmetries of liquids, liquid crystals and amorphous solids, aperiodic solids and quasicrystals, definition and properties of nanostructured materials, methods of synthesis of nanomaterials, their characterization techniques, quantum size effect, idea of quantum well, wire and dots.

BOOKS RECOMMENDED
1. Materials and Engineering, Raghavan
2. Introduction to Solids Wert and Thomson
3. Introduction to solids. L.V. Azaroff
4. Diffusion kinetics for atoms in crystals: Manning
5. Introduction to solid state Physics - Kittel
7. The Physics of Quasi Crystals - Steinhardt and Osrulond.
PT – 304C  COMPUTER APPLICATIONS IN PHYSICS – I

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  Computer Peripherals

Introduction to computer, Computer peripherals: input and output Units, concept about central processing unit; registers, register pairs, Timing and control Unit, fetch and execute cycle, memories: volatile and non-volatile memories, Differences between high and low-level languages, Concept about compiler and interpreter

Unit – II  Assembly Language Programming

Concept of machine language, Assembly language and assembler, Instruction set of 8085, Op-codes, Mnemonics, 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 – III  Operating System and Soft wares

Historical perspective of operating systems: MS-DOS, Windows, Linux, Concepts of batch processing, multi-programming, timesharing, multiprocessing and real-time systems, Operating system services: User view and operators views; File management, File types, Operation on files, Device directory, Access methods, Allocation methods and free space management, Directory systems.

Unit – IV  MS-Office

MS Word: Creating and editing Word document, saving and printing of document, autoformat, format paragraph, line spacing, space before and after paragraph, margins and gutters, page break, repagination, sections, creating headers and footers, setting and clearing tabs, table insertion, use of macro, mail merge creation, sorting and printing merge documents.

MS Excel: Creating and editing worksheet, entering and formatting numbers, dates, formulae, referencing cells, single range, mixed, copying entries, autofill - numbers, dates, time, protecting and un-protecting documents and cells. Moving cells, copying cell, sorting cells data, inserting rows and columns, deleting part of worksheet, changing column and row width,

Power Point: Power point basics, creating presentations, editing and moving text, formatting.

Unit – V  DBMS

Data base file creation, editing, saving structure, entering, listing, removing, updating, sorting, searching and viewing records, closing database; seek, index, sort, time, date, mathematical functions, mathematical commands, control statements, do case, handling multiple database files.

BOOKS RECOMMENDED

1. Microsoft office: Ron Mansfield
2. FoxPro: R K Taxali
3. Windows 95 Made Easy by Tom Sheldon (Tata McGraw-Hill, New Delhi
4. Introduction to Microprocessor by Mathur