M.G.S. UNIVERSITY BIKANER, BIKANER

SYLLABUS

FACULTY OF SCIENCE

M.Sc. (PHYSICS)

M.Sc. Physics (Previous) - 2020

M.Sc. Physics (Final) - 2021

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Maharaja Ganga Singh University, Bikaner

keyboard display using 8255).
Interrupts : Basic interrupt processing, Hardware interrupts, Expanding the interrupt structure, 8259A PIC.
Direct Memory Access : Basic DMA Operation, 8237 DMA controller, shared bus operation, Disk memory systems, Video displays.
Text and Reference Books :
Barry, B. Brey, "The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium pro processor architecture, programming and interfacing", IV Edition, PHI, 1999.
Douglas V. Hall, "Microprocessors and interfacing, programming and Hardware", II Edition, McGraw Hill International Edition, 1992.
Muhammad Ali Maxidi and Janice Gillispie Mazidi, "The 80x86 IBM PC and Compatible Computers (Volumes I & II), II Edition, Prentice Hall International, 1998.
M.Phil.: Laboratory/Practical
Note : Students are required to perform at least eight experiments from the list given below. Few other experiments may be set at the college/university level, at par with the standard of M.Phil. class. In each laboratory, each batch for practical must not be of more than 08 students.
List of experiments :
1. Study of various exercises of Microprocessor 8085
2. Study of analog to digital convertor
3. Design and study a 4 line to 16 line decoder
4. Study the ?-spectrum with the help of ?-ray spectrometer.
5. Study the Compton profile and calculation of change in wave length of ?-rays of various sources.
6. Study the dielectric permittivity of given solid sample at various microwave frequencies.
7. Study the piezo electric effect and design a crystal oscillator
8. Study the crystal delector
9. Study the electron spin resonance spectrometer and its application
10. Study the nuclear magnetic resonance spectrometer
11. Study of variation of modulus of rigidity with temperature for a given sample.
12. Study of Compton scattering using different targets.
13. Study of linear air track.
14. Determination of thermal parameters using DSC & TPS.
15. Determination of mechanical parameters using DMA.

M.Sc. PHYSICS
M.Sc. Previous Examination, 2020
M.Sc. Final Examination, 2021
M.Sc. (PREVIOUS) PHYSICS - 2020

Scheme of examination :

Four Theory Papers			Max. Marks 300
Practical			Max. Marks 150
Paper-I :	Mathematical Physics and Classical Mechanics	3 hrs. duration	75 marks
Paper-2 :	Statistical Mechanics and Plasma physics	3 hrs. duration	75 marks
Paper-3 :	Quantum Mechanics	3 hrs. duration	75 marks
paper-4 :	Electronic Devices, Computational Methods and Programming	3 hrs. duration	75 marks
Practical :	Two laboratory each	5 hrs. duration	150 marks (75+75)

Note: There will be one experiment of 5 hrs. duration. The distribution of marks will be as follows:

One experiment	40
Viva	20
Record	15
Total	**75**

A candidate for pass the M.Sc. (Previous) Physics examination shall be required to obtain at least 36% marks in aggregate both in four theory papers and practical separately. Apart from that candidate shall be required to obtain at least 25% marks in each individual theory paper.
If a candidate clears any paper (s) / practical after a continuous period of three years, than for the purpose of working out his/ her division, the minimum pass marks only viz 25% in case of theory (or 36% in case of practical) shall be taken into account in respect of such paper (s)/ practical.
Note: Non-collegiate candidates are not eligible to appear in the examination where practical is involved.
Work load: Each theory paper must be given 4 Hrs. (Or 6 periods) per week for theory and 1 pds per week for theory tutorial.
Practical must be given 30 periods per week per batch. Each laboratory batch for practical must not be of more than 10 students. This gives 120 Hrs. for each theory paper with 30 weeks of teaching every year.

PAPER-I :

MATHEMATICAL PHYSICS AND CLASSICAL MECHANICS

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Vector Spaces and Matrices : linear independence; Bases; Dimensionality; Inner product; Linear transformations; Matrices; Inverse; Orthogonal and unitary matrices; Independent elements of a matrix; Eigenvalues and eigenvectors; Diagonalization; Complete Orthonormal sets of functions.

UNIT-02

Differential Equations and Special Functions; Second order linear ODEs with variable coefficients; Solution by series expansion; Legendre, Bessel, Hermite and Lagaurre equations; Physical application; Generating functions; recursion relations.

UNIT-03

Integral Transforms : Laplace transform; First and second shifting theorems; inverse LT by partial fractions; LT; derivative and integral of a function; Fourier series; FS or arbitrary period; Half-wave expansions; Partial sums; Fourier integral and transforms; F T of delta function.

Preliminaries; Newtonian mechanics of one and many particle systems; conservation laws, work-energy theorem; open systems (with variable mass).

Constraints; their classification, D'Alembert's principle, generalized coordinates. Lagrange's equations; gyroscopic forces; dissipative system; Jacobi integral; gauge invariance; generalized coordinates and momenta; integrals of motion;

UNIT-04

Principle of least action; derivation of equations of motion; Hamilton's principle and characteristic functions; Hamilton-Jacobi equation. symmetries of space and time with conservation laws; invariance under Galilean transformations.

Canonical transformation; generating functions; Properties; group property; examples; infinitesimal generators; Poisson bracket; Poisson theorms; angular momentum PBs; small oscillations; normal modes and coordinates.

Text and Reference Books :

Nanotechnology Molecularly designed materials by Gan-Moog Chow, Kenneth E. Gonsalves, American chemical society.

Quantum dot heterostructures by D. Bimerg M. Grundmann and N.N. Ledenntsov, John Wiley & Sons, 1998.

Nano Technology : Molecular Speculations on global abundance by B.C. Crandall, MIT Press, 1996.

Physics of low dimensional semiconductors by John H. Davies, Cambridge Univ. Press, 1997.

Physics of semiconductor nano structures by K.P. Jain, Narosa, 1997.

Nano fabrication and bio system : Integrating materials science engineering science and biology by Harvey C. Hoch, Harold G. Craighead and Lynn Jelinski, Cambridge Univ. Press, 1996.

Nano particles and nano structured films : Preparation characterization and application, Ed. J.H. Fendler, John Wiley & Sons, 1998.

Liquid Crystals : Chandrasekhar

Thermotropic Liquid Crystals : Fundamentals Vertpgem & de Jei,

The Physics of Liquid Crystals : de Gennes & Prost

Introduction to Liquid Crystals : Physics and Chemistry (1997, Taylor and Francis)

Elston & Sambles : The Optics of Thermotropic Liquid Crystal

Collyer : Liquid Crystal Polymers : From Structures to Applications

Goodby et al. : Ferroelectric Liquid Crystal : Principles, Properties and Application

PAPER III(C)

APPLIED ELECTRONICS

Microprocessors and Micro computers

Microprocessors and Architecture : Internal Microprocessor Architecture, Real Mode and Protected modes of memory addressing, memory paging.

Addressing Modes : Data addressing modes, Program memory addressing modes, stack-memory addressing modes.

Instruction Set : Data movement instructions, Arithmetic and Logic Instructions, Program control instructions, Assembler details.

Programming the Microprocessor : Modular programming, using the keyboard and video display, data conversions, Disk files, Example programs.

Hardware specifications : Pin-outs and the pin functions, clock-generator (8284A), Bus buffering and latching, Bus timing, ready and wait state, Minimum mode versus maximum mode.

Memory Interface : Memory devices, address decoding, 8088 and 80188 (8 bit) memory interface, 8086, 80186, 80286 and 80386 (16 bit) memory interface, 80386DX and 80486 (32-bit) memory interface, dynamic RAM.

Basic I/O interface : Introduction to I/O interface, I/O port address decoding, 8255, 8279, 8254, 16550, ADC and DAC (excluding multiplexed display and

Elliot : Physics of Amorphous materials.III ed. Cambridge press UK
Brodsky: amorphous semiconductors Springer , Berlin.
J Tauc : amorphous and liquid semiconductors Plenum press NY

PAPER III(B)

PHYSICS OF NANOMATERIALS

Time : 3 hrs. Max.Marks 100

Note : Ten questions will be set in the question paper. Candidates are required to attempt five question in all. Each question carry equal marks.

1. Free electron theory : Free electron theory (qualitative idea) and its features, Idea of band structures, Metals, insulators and semiconductors, Density of state in bands, variation of density of states with energy, Variation of density of state and band gap with size of crystal.
2. Quantum size effect : Electron confinement in infinitely deep square well, confinement in two and one dimensional well, Idea of quantum well structure, quantum dots, quantum wires.
3. Determination of Particle size, Increase in width of XRD peaks of nanoparticles, shift in photoluminescence peaks, variations in Raman spectra of nanomaterials.
4. Different methods of preparation of nanomaterials, Bottom up : Cluster beam evaporation, Ion beam deposition, Chemical bath deposition with capping techniques and top down : Ball Milling.
5. Classification and Liquid Crystals : Symmetry, structure and classification of liquid crystals, Polymorphism in thermotropics, Reentrant phenomena in liquid crystals. Blue phases, Polymer liquid crystals, Distribution functions and order parameters, macroscopic and microscopic order parameters. Measurement of order parameters magnetic resonance electron spin resonance. Raman Scattering and X-Ray diffraction.
6. Theories of Liquid Crystalline Phase Transitions : Nature of phase transitions and critical phenomena in liquid crystals, hard particle, Maier-Saupe and Van der Waals theories for nematic - isotropic and nematic-smectic A transitions : Landau theory : Essential ingredients, application to nematic-isotropic, nematic-smectic Atransitions and transitions involving smectic phases.
7. Dynamical Properties of Nematics and Optical Properties of Cholesterics : The equations of nematodynamics, Laminar flow, molecular motions. Optical properties of an ideal helix, agents influencing the pitch, liquid crystal displays.
8. Ferroelectric Liquid Crystals : The properties of smectic C, continuum description, smectic C smectic A transition, applications.
9. Discotic Liquid Crystals : Symmetry and structure, mean-field description of discotic liquid crystals, continuum description Lyotropic liquid crystals and biological membrane. Application of liquid crystals.

UNIT-05

Rotating frames; inertial forces; terrestrial and astronomical applications of coriolis force.

Central force; definition and characteristics; Two-body problem; closure and stability of circular orbits; general analysis of orbits; Kepler's laws and equation; artificial satellites; Rutherford scattering.

Text and Reference Books:

Mathematical Methods for Physics, by G Arfken
Matrices and Tensors for Physicists, by A W Joshi
Advanced Engineering Mathematics, by E Kreyzing
Special Functions, by E D Rainville
Special Functions, by W W Bell
Mathematical Methods for Physics and Engineerings, by K F Reily . M P Hobson and S J Bence
Mathematics for Physics, by Marry Boas
Classical Mechanics, by N.C. Rana and P.S. Joag (Tata McGraw-Hill, 1991)
Classical Mechanics, by H. Goldstein (Addison Wessley, 1980).
Mechanics, by A Sommerfeld (Academic Press, 1952).
Introduction to Dynamics, by I. Perceival and D. Richards (Cambridge University Press, 1982).

PAPER-II :

STATISTICAL MECHANICS, ELECTRODYNAMICS AND PLASMA PHYSICS

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Foundations of statistical mechanics; specification of states of a system, contact between statistics and thermodynamics, classical ideal gas, entropy of mixing and Gibb's paradox. Micro canonical ensemble, phase space, trajectories and density of states, Liouville's theorem, canonical and grand canonical ensembles; partition function, calculation of statistical quantities, Energy and density fluctuation.

UNIT-02

Density matrix, statistics of ensembles, statistics of indistinguishable particles,

Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein statistics, properties of ideal Bose and Fermi gases, Bose-Einstein condensation.
Correlation of space-time dependent fluctuations, fluctuations and tranport phenomena, Brownian motion, Langevin theory, Fluctuation dissipation theorem. The Fokker-Planck equation.

UNIT-03

Cluster expansion for a classical gas, Virial equation of state, Ising model, mean-field theories of the Ising model in three, two and one dimensions Exact solutions in one-dimension. Landau theory of phase transition, critical indices, scale transformation and dimensional analysis.
Review of Four-Vector and Lorentz Transformation in Four-Dimensional Space, Electromagnetic Field Tensor in Four Dimension and Maxwell's Equations, Dual Field Tensor, Wave Equation for Vector and Scalar Potential and their Solutions.

UNIT-04

Retarded Potential and Lienard-Wiechart Potential, Electric and Magnetic fields due to a Uniformly moving Charge and an accelerated Charge, Linear and Circular Acceleration and Angular Distribution of power Radiated, Bramsstrahlung, Synchrotron radiation and Cerenkoy Radiation, reaction Force of Radiation.
Motion of charged Particles in Electromagnetic Field: Uniform E and B Fields, Non-uniform Fields, Diffusion Across Magnetic Fields, Time varying E and B Fields, Adiabatic Invariants: First, Second Third Adiabatic Invariants.

UNIT-05

Elementary Concepts; Derivation of moment equations from Boltzmann equation, Plasma oscillations, Debye Shielding, Plasma Parameters, Magnetoplasma, Plasma Confinement. Hydrodynamical description of Plasma Fundamental. Hydromagnetic Waves: Magnetosonic and Alfven Waves.
Wave phenomena in Magneto plasma: Polarization, Phase velocity, Group velocity, Cut- offs, Resonance for Electromagnetic Wave propagating Parallel and Perendicular to the Magnetic Field, Propagation at Finite Angle and CMA Diagram, Appleton-Hartee Formula and Propagation through Ionosphere and Magnetosphere: Helicon, Whistler, Faraday Rotation.

Text and Reference Books

Statistical and Thermal Physics, by F Reif
Statistical Mechanics, by K Huang
Statistical Mechanics, R K Pathria
Statistical Mechanics, R Kubo
Statistical Physics, Landau and Lifshitz
Panofsky and Phillips : Classical Electricity and Magnetism.
Bittencourt : Plasma Physics.
Chen : Plasma Physics.
Jackson : Classical Electrodynamics.

Physics of Vibration : Vierk
Electricity and Magnetism : Panofsky and Philips Addision Wesley
Introduction to Dynamics : Percival and D. Richards
Nonlinear Dynamics I & II : E.A. Jackson
Introduction to Dynamical Systems : R.L. Devaney
Regular and Stochastic Motion : A.J. Lichtenberg and M.A. Lieberman Chaos in Classical and Quantum Mechanics:M.C.Gulzwiller,E.Ott M. Tabor

ELECTIVE

(ANY ONE OUT OF III(A) OR III(B) OR III(C))

PAPER III(A) PHYSICS OF AMORPHOUS SOLIDS

Time : 3 hrs Max Marks : 100

Note : Ten questions will be set in the question paper. Candidates are required to attempt five question in all. Each question carry equal marks.

1. Preparation : Basic Definitions, preparation of amorphous materials : Thermal evaporation, sputtering, Glow discharge decomposition, Chemical vapour deposition, Melt quenching, Gel desiccation, Electrolytic deposition, Reaction amorphization, irradiation pressure induced amorphization, solid state diffusional amorphization.
2. Glasses : The glass transition - theories for the glass transition - Thermodynamic phase transition, Entropy, Relaxation processes. Dynamical theories, Free volume factor determining the glass - transition temperature - Glass forming systems and ease of glass formation, structure and topology, Eutectic compositions, crystalline polymorphs, constraint theory, Electronic structure.
3. Structure (over view of following) : Microscopic structure - Experimental techniques like diffraction, x-ray absorption spectroscopy, magnetic resonance, Mossbauer spectroscopy, vibrational spectroscopy - short range order, medium range order experimental probes of medium range order structural modeling - continuous random networks. Macroscopic structure - Microscopy, small angle scattering.
4. Electronic transport in Amorphous Semiconductors : Chemical bond description of covalent non crystalline semiconductors dang ling bonds. Overview of band-model - CFO Model, Davis-Mott Model, Small Polaron model Electrical Properties - DC electrical conductivity Thermo power, Hall effect, ac conduction, Transit time, photoconductivity and small poloran motion.
5. Amorphous silicon solar cells : Amorphous Semiconductors cells,: Deposition of hydrogenated amorphous Si:, Properties- Role of H, optical properties, Resistivity, photoconductivity, carrier mobility and lifetime, DOS; Solar cell structures, photovoltaic charecteristics- I V behaviour, effect of impurities, effect of substrate temperature, analysis of a- Si:H solar cell

Text and Reference Books :

Mott and Davis : Electronic Processes in Non-Crystalline materials

PAPER - II
NONLINEAR DYNAMICS AND ELECTRODYNAMICS

Time : 3 hrs. Max. Marks : 100

Note : Ten questions will be set in the question paper. Candidates are required to attempt five question in all. Each question carry equal marks.

1. Introduction to Dynamical Systems : Physics of nonlinear systems, dynamical equations and constants of motion, phase space, fixed points, stability analysis, bifurcations and their classifications, Poincare section and iterative maps.
2. Dissipative Systems : One-dimensional noninvertible maps, simple and strange attractors, iterative maps, period doubling and universal ity, intermittency, invariant measure, Lyapunov exponents, higher di mensional system, Henon map, Lorenz equation. Fractal geometry, generalized dimensions, examples of fractals.
3. Hamiltonian Systems : Integratibility, Liouville's theorem, action-angle variables, introduction to perturbation techniques, KAM theorem, area preserving maps, concepts of chaos and stochasticity.
4. Coherence : Superposition of waves, coherence-spatial and temporal, couple signal representation of quasiomonochromatic light, theory of partial coherence, power spectrum and intensity distribution, La ser-principle and working elements of holography.
5. Radiation by moving charges : Power radiated by an accelerated charge. Larmor's formula and its relativistic generalization, frequency and angular distribution emitted by an accelerated charge, extreme relativistic case, Thomson scattering, scattering of radiation by quasi-free charges, coherent and incoherent scattering, transition radiation.
6. Radiation by Collision : Bremsstrahlung radiation in coulomb colli sion, non relativistic and relativistic case, screening effects, method of virtual quanta, radiation emitted during data decay and orbital electron capture disappearance of charge and magnetic moment.

Reference Books :

Section-(1) is based on A.P. - French (I) Vibrations (Arnold-Meinemann India, 1973) Ch., Section 2 on L.A. Pipes. L.R. Harvell, Applied Mathematics for Engineers and Physicist (McGraw Hill Book Co., 1970), Chapter-5 for section 3, this is defined by G.R.Fowels. An Introduction to Modern Optics (Mait, Rinchart and Winston INC., 1968) Chapter-2, Section 4 and 5 are in accordance with J.D. Jackson, classical electrodynamics. (Wiley-Eastern Limited, 1975) Chapter 14, 15.

Other References :

The Physics of Vibrations : H.J.Pain John Wiley and Sons, 1968.
Waves Physics Course : F.S. Grawford, Jr. McGraw Hill, Vol. 3, 1968
Optical Physics : S.C.Lipson, Cambridge Univ. Press, H. Lipson

PAPER-III :
QUANTUM MECHANICS

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Why Quantum Mechanics? Revision; Inadequacy of classical mechanics; Schrödinger equation; continuity equation; Ehrenfest theorem; Admissible wave function; Stationary states. One-dimensional problems, wells and barriers; Solution of Harmonic oscillator by Schrodinger equation and by operator method.

Uncertainty relation, x and p States with minimum uncertainty product, General formalism of wave mechanics, Commutation relations, Representation of states and dynamical variables.

UNIT-02

Completeness of eigenfunctions; Dirac delta function; bra and ket notation; Matrix representation of an operator; Unitary transformation.

Angular momentum in Quantum Mechanics; Addition of angular momentum, CG coefficient, Wigner-Eckart theorem, Central force problem; Solution of Schrödinger equation for spherically symmetric potentials; application in Hydrogen atom.

UNIT-03

Time-independent perturbation theory; Non-degenerate and degenerate cases; Applications Stark effect, Zeeman effect (normal and anomalous).

Time-dependent perturbation theory; Harmonic perturbation; Fermi's golden rule; Adiabatic and sudden approximations. Semi classical theory of radiation; Transition probability for absorption and induced emission; Electric dipole and forbidden transitions; Selection rules.

UNIT-04

Variational method; Helium and its excited states, WKB approximation; Alpha decay Identical particles; Symmetric and antisymmetric wave functions; collision of identical particles; Spin angular momentum; Spin functions for a many-electron.Klein-Gordan and Dirac's equation.

UNIT-05

Collision in 3-D and scattering; Laboratory and reference frames; Scattering amplitude; differential scattering cross section and total scattering cross section; Scattering by spherically symmetric potentials; Partial wave analysis and phase shifts; Scattering by a perfectly rigid sphere and by square well potential; complex potential and absorption.Born approximation

Text and Reference Books

L.I. Schiff, Quantum Mechanics (McGraw-Hill)
S. Gasiorowicz, Quantum Physics (Wiley)
B Craseman and J.D. Powell, Quantum Mechanics (Addison Wesley)
A.P. Messiah, Quantum Mechanics
J.J. Sakurai, Modem Quantum Mechanics
Mathews and Venkatesan Quantum Mechanics

PAPER-IV :
ELECTRONIC DEVICES,
COMPUTATIONAL METHODS AND PROGRAMMING

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Transistors : JEET, BIT, MOSFET, and MESFET : Structure, Working, Derivations of the equations for I-V characteristics under different conditions. High frequency limits.

Photonic Devices ; Radiative and non-radiative transitions. Optical Absorption, Bulk and Thin film Photoconductive devices (LDR), diode photodetectors, solar cell (open circuit voltage and short circuit current, fill factor). LED (high frequency limit, effect of surface and indirect recombination current, operation of LED),

UNIT-02

Memory Devices : Static and dynamic random access memories, SRAM and DRAM, CMOS and NMOS, non-volatile—NMOS, magnetic, optical and ferroeletric memories, charge coupled devices (CCD).

Other Electronic Devices: Electro-Optic, Magneto-Optic and Acousto-Optic

2. Acoustic Phonons: Discrete elastic line quantum theory of the continuous line. Long wavelength acoustic mode phonons in isotropic crystals. Superfluidity, second sound in crystals. Frequency distribution for phonons.
3. Plasmons : Optical phonons and polarization waves, Plasmos. Long wavelength optical phonons in isotropic crystals, interaction of optical phonons with photons.
4. Magnons : Ferromagnetic Magnons. Helstein - Primakeff transformation Hamiltonian in spin-wave-variables. Magnon heat capacity. Magnons interaction magnetization reversal. Anti ferromagnetic magnon, zero point energy, zero point sublattice magnetization. Temperature dependence of sublattice magnetization. Microscopic magnon theory.
5. Fermion Fields and the Hartree-Fock Approximation : Particle field equation of motion method for the Hartree Fock equation. Koopman's theorem. Fermion Quasi particles. Electron gas in the Hartree and Hartree-Fock Approximations. Modified Hartree model. Two electron correlation functions. Coulomb's interactions and the formation.
6. Polarons : Current carrier spectrum, renormalization and effective mass of polarons, Strong coupling polarons. Londan and Pekar theory. Theory of small radium polarons.
7. Superconductivity : Indirect electrons. Electron interaction via phonons. Bound electron pairs in a fermi gas. Superconductivity ground state. Solution of the CS equation spin-analog method. Solution of the CS equation. Equation of the motion method. Ground state wave function. Electrodynamics of superconductors. Coherence length. Matrix elements coherence effects. High temperature superconductivity (basic ideas). Fullerence superconductors (basic ideas) organic superconductors (basic ideas).
8. Superfluidity : Basic properties of superfluid 4 He. Elementary excitation in He-II and their interaction. Elementary excitation spectrum of superfluid-3 He. Helium-II. The two fluid model. The fountain effect and heat transport in Helium-II. The propagation of sound in Helium-II. Superconductivity in Liquid 3 He.

References :

1.Quantum Solid State Physics : Vensovsky and Kalsnelson (Springer Verlag).
2.High-Tc superconductivity : R.P. Sinha & S.L. Kakani - Nova. Sc. Publisher.
3.Superconductivity Current Problems : S.L. Kakani Arihant Jaipur.
4.Condensed Matter Physics : Stephen W. Levessy Benjamin : Dynamic Correlations II ed.
5.Superfluidity and Superconductivity : D.R. Tilley and J. Cilley : Adam Highler-1986, II ed.
6.Quantum theory of solids : Kittel

compute the Directional gain of the Antenna.

5. To determine the dielectric constant of a given sample at Microwave frequency.
6. To determine the dielectric constant of a Benzene using plunger tech nique at room temperature.
7. To determine the unknown impedance using slotted line section Smith chart in the K-band.
8. To study the microwave absorption in dielectric sheets.

Any other experiments of the equivalent standard can be set.

M.Phil. PHYSICS EXAMINATION - 2020

M. Phil. PHYSICS

Scheme of examination :

Three Theory Papers

Max. Marks 300

Practical / Dissertation Max. Marks 100

Paper	Nomenclature	Duration	MM
I	Quantum Solid State Physics	3 hrs.	100
II	Nonlinear Dynamics and Electrodynamics	3 hrs.	100
	Elective Papers		
III(a)	Physics of Amorphous Solids	3 hrs.	100
	OR		
III(b)	Physics of Nanomaterials & Liquid crystals	3 hrs.	100
	OR		
III(c)	Applied Electronics	3 hrs.	100
IV	Practical / Dissertation	6 hrs	100

Note : Minimum pass marks in each paper has to be 40% while in aggregate it has to be 50% for a pass. 20 marks in each paper and Practical/Dissertation will be awarded through internal assessment and 80 marks through external assessment. Four periods of one hour each per week shall be provided for each theory paper and two periods for dissertation. The lab. work per batch will be 18 hours per week. In each laboratory, each batch for practical must not be of more than 08 students.

PAPER-I

QUANTUM SOLID STATE PHYSICS

Time : 3 hrs. Max. Marks : 100

Note : Ten questions will be set in the question paper. Candidates are required to attempt five questions in all. Each question will carry equal marks.

1. Mathematical introduction: Basic Hamiltonian and Hartree-Fock ap proximation.

Effects. Material Properties related to get these effects. Important Ferro electric, Liquid Crystal and Polymeric materials for these devices. Piezoelectric,

UNIT-03

Electrostrictive and magneto strictive effects, Important materials exhibiting these properties, and their applications in sensors and actuator devices. Acoustic Delay lines, Piezoelectries resonators and filters. High frequency piezoeelectric devices-Surface Acoustic Wave Devices.

Sources of errors, Round off errors, Computer arithmetic error analysis, condition and stability, Appoximations.

Solution of linear and nonlinear equations: Direct, iterative, Bisection method, Newton's method, modified Newton's method.

UNIT-04

Interpolation: The method of undetermined coefficients, Finite differences, Newton's, Gauss's Central difference and Stirling's Formulae, Lagrange's Interpolation Formulae, Double interpolation.

Methods of integration: Method of integration for a system of equation and functions, error estimates, Newton's method for complex roots, Trapezoidal and Simpson's rules, Newton-Cotes formulae, Gauss method, Quadrature formula, Singular Integrals, Double Integration.

UNIT-05

Numerical differentiation by Newton's Forward, backward formula; By Stirling Formula, Numerical solution of ordinary differential equations, Euler and Runge-Kutta methods.

Elementary information about Digital computer Principles, Compilers, Interpreters and Operating systems, Fortran77/C programming, Flow Charts Integer and Floating Point Arithmitic, Expressions, built in functions, executable and non-executable statements assignment, control and input- output elements Subroutines and functions, Operation with files. Introduction to MATLAB.

Text and Reference Books

Semiconductor Devices-Physics Technology, by SM Sze (Wiley 1985)
Introduction to semiconductor devices, by M.S. Tyagi, John Wiley & Sons
Measurement, Instrumentation and Experimental Design in Physics and Engineering by M. Saver and A. Mansingh. Prentice Hall, India (2000)
Optical electronics by Ajoy Ghatak and K. Thyaearajan. (Cambridge Univ. Press)
Shastry : Introductory Methods of Numerical Analysis
Rajaraman : Numerical Analysis, Rajaraman : Fortran Programming
Vetterming, Teukolsky, Press and Flannery : Numerical Recipes

PRACTICALS

LIST OF EXPERIMENTS :

Number of experiments to be performed by the students during the academic session should be atleast eight from each Laboratory.

Laboratory A General

1. To determine e/m by Thomson Method.
2. To determine e/m by Helical Method.
3. To analyze Elliptically Polarized light by Babinet's Compensator.
4. To verify Fresnel's Relations using prism and spectrometer.
5. To determine the Young's Modulus of rod using Cornu's Optical Method.
6. To determine e/m by Millikan's oil Drop method.
7. To determine Resolving Power of a Telescope.
8. To plot B-H Hysteresis curve using a solenoid on CRO and study it.
9. To determine velocity of Sound in Air by Standing Wave Method.
10. To determine the Magnetic Susceptibility of a Paramagnetic salt using Quinke's method .
11. To study Energy Transfer between Coupled Oscillators.
12. To use a Michelson Interferometer to determine :

a. l,-the wave length of Sodium yellow light

b. (11- l2), the difference between the wave length of the two sodium D-lines. (iii) the thickness of a mica sheet.

13. To test the validity of the Hartmann's prism dispersion formula using the visible region of mercury spectrum.
14. To find the refractive index of air by means of a Fabry-Perot Etalon, the thickness between the plates being given.
15. Determination of wave length of Neon light taking Hg source as a standard source Appling Hartmann formula.
16. Determine Stefan's constant.
17. X-ray diffraction by Telexometer.
18. Determination of ionization potential of Lithium.
19. Determination of e/m of electron by Normal Zeeman Effect.
20. Determinations of dissociation energy of Iodine (I) molecules by photography, the absorptions band of I in the visible region.
21. Using He-Ne laser light :

a. Measure of wavelength with the help of ruler. (b) Measure of thickness of the wire.

22. Testing goodness of fit of Poisson distribution to cosmic ray busts by Chi-square test.
23. To study Faraday effect using He-Ne laser.

Laboratory B - Electronic

1. To Study Mathematical Operations using OPAMP.
2. To study OPAMP as Comparator using Inverting and Non-inverting configuration
3. To study Clipping and Clamping circuits.
4. To study Differentiating and Integrating circuits using diode.
5. To study Miller Sweep Generator.

24. Determine of Lande's 'g' factor for IRRH crystal using electron spin resonance spectrometer.

Any other experiments of the equivalent standard can be set

B. Electronic Devices Laboratory Course

1. To Study LC Transmission Line
2. To Study Wide Band Amplifier.
3. To study RF oscillator using Hartley and Colpitts Method.
4. To study Wein bridge Oscillator.
5. To study Phase Shift Oscillator.
6. To study RS & JK Flip Flop Circuits and to verify the Truth Tables.
7. To study the SCR circuit.
8. To study Absorption Coefficient of a Liquid using Photovoltaic cell.
9. To study Fourier Analysis.
10. To study Decade and Binary Counters.
11. To study Two-input Multiplexer and to verify its Truth Table.
12. Create a Pspice model of square wave generator/ Wein bridge oscil lator using 741 Op-amp.
13. To determine e/m of an electron by magnetron valve method.
14. To determine e/k using transistor characteristics.
15. To study dark and illumination characteristic of p-n junction solar cell and to determine (i) Its internal series resistance (ii) Diode ideality factor
16. To study the characteristics of following semiconductor devices (i) VDR (ii) photo transistor (iii) Thermistor (iv) IED
17. To study the characteristics of MOSTET and MSSFET amplifier.
18. To study dark and illumination characteristics of p-n junction solar cell and to determent its (i) Maximum power available (ii) Fill factor.
19. To study the frequency and phase Characteristic of band pass filter.
20. Study the wave from characteristic of transistorized astable symmetri cal multivibrator.
21. CRO & determine its frequency by various C& R.
22. Artificial transmission line.

Any other Experiments of the equivalent standard can be set.

C. Special Lab/Project and Seminar :

1. To study the characteristic curve of Klystron.
2. To study the mode characteristics of reflex Klystron and hence to determine mode number, Transmit time, electronics, tunning range, electronic tunning sensitivity.
3. To study the E-Plane radiation pattern of pyramidal horn antenna and compute the beam width of Antenna.
4. To study the H-plane radiation pattern of pyramidal horn antenna and

NCRP Publications(ALL)
Hobbie,Russell 1988, Intermediate physics for medicine and biology(Wiley, NY)
Guyton A.C.1976 Text book of medical physiology 5 th ed (W.B.Saunders co. Philadelphia)
Ganong W F 1975 Review of medical physiology 7 th ed (Lange Los Altos CA)

PRACTICALS

LIST OF EXPERIMENTS :

Number of experiments to be performed by the students during the academic session should be atleast eight from each Laboratory.

A. General Laboratory Course

1. To Study frequency versus energy curve using magnet-magnet inter action using air track.
2. To study potential energy curve of magnet-magnet interaction using air track.
3. To study parametric amplifier for different initial length and variation of damping with mass of bob.
4. To draw the characteristic curve of GM counter.
5. To determine the end point energy of a beta ray source.
6. To write and run program using microprocessor 8085A.
7. To determine Resolving Power of a Telescope.
8. To write numerical analysis program and solving them using BASIC.
9. To determine velocity of Sound in Air by Standing Wave Method.
10. To study modulus of rigidity with temperature using tortional pendu lum.
11. To determine Dielectric constant of liquid using Lechar wire method.
12. To determine wavelength of laser beam and study beam divergence.
13. Determine fine structure constant using sodium doublet.
14. Verify Cauchy's relation & determination of constants.
15. To determine e/m for an electron by Zeeman effect.
16. Determine the dissociation energy of Iodine molecute.
17. Determine of energy of a given ray from Re-De source.
18. Find out the percentage resolution of given scintillation spectrometer using Cs137
19. Find out the energy of a given X-ray source with the help of scintilla tion spectrometer.
20. Plot the Gaussian distribution for a radioactive source.
21. Determine the dielectric constant of turpentine oil with the Leacher wire system.
22. To determine velocity of waves in water using ultrasonic interferom- eter.
23. To determine the magnetic susceptibility of two given samples by

6. To study Bootstrap Sweep Generator.
7. To study the Recovery Time of Diode.
8. To study Free-running Multivibrator.
9. To study Mono- and Bi-stable Multivibrator circuits.
10. To study RC coupled Two-Stage Amplifier.
11. Design of a Regulated Power supply.
12. Design of a Common Emitter Transistor Amplifier.
13. Experiment on Bias Stability
14. Characteristics and applications of Silicon Controlled Rectifier.
15. Experiment on FET and MOSFET characterization and application as an amplifier.
16. Experiment on Uni-junction Transistor and its application,
17. Digital I : Basic Logic Gates, TTL, NAND and NOR.
18. Digital II: Combinational logic.
19. Flip-Flops.
20. Operational Amplifier (741)
21. Differential Amplifier.

M.Sc. (FINAL) PHYSICS

Scheme of examination :

Four Theory Papers		Max. Marks 300
Practical		Max. Marks 150
Paper-V : Condensed Matter Physics	3 hrs. duration	75 marks
Paper-VI : Nuclear And Particle Physics	3hrs. duration	75 marks
Paper-VII A : Electronics, Digital Electronics & Communication Electronics	3 hrs. duration	75 marks
OR		
Paper-VII B : Analog, Digital Systems & Communication	3 hrs. duration	75 marks
OR		
Paper-VII C : Medical Physics - I	3 hrs. duration	75 marks
Paper -VIII A : Physics of Lasers and Science & Technology of Solar Hydrogen	3 hrs. duration	75 marks
OR		
Paper-VIII B : Physics of Nanomaterials & Environmental Physics	3 hrs. duration	75 marks
OR		
Paper-VIII C : Medical Physics - II	3 hrs. duration	75 marks
Practical : Three laboratory each 5 hrs. duration,		150 marks (50+50+50)
General Lab	:	50 marks (30+10+10)
Electronic Lab	:	50 marks (30+10+10)

Project and Seminar : 50 marks (40+10)

Note: There will be one experiment of 5 hrs. duration for each lab on separate day for project and seminar. Supervisor for each student will be appointed in the beginning of the session and the viva-voice examination will be conducted by the Board consisting of two teacher one from the same college and other from the different university.

A candidate for pass the M.Sc. (Final) Physics examination shall be required to obtain at least 36% marks in aggregate both in four theory papers and practical separately. Apart from that candidate shall be required to obtain at least 25% marks in each individual theory paper.

If a candidate clears any paper (s) / practical after a continuous period of three years, than for the purpose of working out his/ her division, the minimum pass marks only viz 25% in case of theory (or 36% in case of practical) shall be taken into account in respect of such paper (s)/ practical.

Note: Non-collegiate candidates are not eligible to appear in the examination where practical is involved.

Work load: Each theory paper must be given 4 Hrs. (Or 6 periods) per week for theory and 1 pds per week for theory tutorial.

Practical must be given 30 periods per week per batch. Each laboratory batch for practical must not be of more than 10 students. This gives 120 Hrs. for each theory paper with 30 weeks of teaching every year.

M.Sc. PHYSICS

(Paper V) : CONDENSED MATTER PHYSICS

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Crystalline solids, unit cells and direct lattice, two and three dimensional Bravais lattices, closed packed structures.

Interaction of X-rays with matter, absorption of X-rays. Elastic scattering from a perfect lattice. The reciprocal lattice and its applications to diffraction techniques. The Laue, powder and rotating crystal methods, crystal structure factor and intensity of diffraction maxima.

censing, approval of devices, installations, sites and packages containing radioactive material. Source of radioactive waste and classification of waste, treatment techniques for solid, liquid and gaseous effluents, permissible limits for disposal of waste, sampling techniques for air,water and solids, ecological consideration, general methods of disposal, management of radioactive waste in medical and research institutions.

UNIT 4

Radiation Shielding

Shielding calculation for gamma radiation, choice of material, Primary and secondary radiation, source geometry, discrete sources, point, kemel method, introduction to Monte Carlo method, Beta shielding, Bremsstrahlung. Neutron shielding, scattering and absorption, activation of the shielding material, heat effects. Optimization of shielding, gamma, electron, neutron irradiation facilities. Transport and storage of containers for high activity sources. Shielding requirements for medical and research facilities including accelerator installations.

UNIT 5

Diffusion: (a) Ficks first law(b)diffusion related to viscosity (c) Ficks second law and applications Transport through semipermeable membranes; (a)Osmotic pressure (b)plasma exchange in capillaries (c) Edema: osmotic diureses:Osmotic fragibility of red blood cells(d) Volume transport ;solute transport:the artificial kindney (e) external factors on solute molecules;ionic solute and equilibrium electric fields in membranes(f) Ion movement in solution involving diffusion,solvent drag and electrical fields (g) Nernst-Plank equation and the Goldman equation

Books for Study and Reference

Jacobson and Webster; Medicine and clinical engineering,Prentice Hall of India,New Delhi,1979

R.S.Khandpur,Hand book of biomedical instrumentation,Tata McGraw Hill,New Delhi,1990

M.Arumugam, Biomedical instrumendation, Anuradha publishing Co, Kumbakonam, Tamilnadu 1992.

Richad Aston,Principles of biomedical instrumendation and measurements,Merrill publishing Co,London,1990.

R.F.Mould, Radiation Protection in Hospital, Adam Hilger Ltd., Bristol, 1985.

The essential Physics of Medical Imaging; Jerrold. T. Bushberg et.al, Lipcontt Williams & Wilkins 2002.

Faiz. M. Khan, The Physics of Radiationtherapy, Lippincott Williams & Wilkins, Philadelphia, 3rd edtion 2003.

A.Martin and S.A.Harbison, An introduction to Radiation Protection, John Wiley &'Sons Inc., New York, 1981.

ICRP Publications (ALL)

AERB Safety codes(ALL)

M.SC. PHYSICS (Paper VIII C) :
MEDICAL PHYSICS -II

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT 1

Biosignal acquisition, Bioelectric signal recording and Physiological assist devices

Physiological signal amplifiers-isolation amplifiers-differential amplifiers-bridge amplifiers-chopper amplifiers-noises and CMRR –medical preamplifier design, Bioelectric potentials-resting and action potentials-half cell potential-surface,needle and micro electrodes,electrical equivalent circuits-ECG,EMG,EEG recording circuits.

Cardiac pace makers-natural and artificial pace makers-pace maker batteries - defibrillator- AC/DC. Synchronised defibrillator-stimulators-bladder stimulators - heart lung machine.

UNIT II

Clinical equipments, Operation theatre equipments, Biotelemetry and safety instrumentation

Various types of oxygenators - kidney machine-hemodialying units-peritonial dialysis. Flame photometer- spectro-flurophotometer - pH meters. Audiometers-endoscopes-electromagnetic and laser blood flow meters-ventilators – diathermy units-ultrasonic,micro wave diathermy techniques.

Design of a biotelemetry system, radiotelemetry with subcarrier-multiple channel telemetry systems-problems in implant telemetry-uses of biotelemetry-physiological effects of 50 HZ current –microshock and macro shock-electrical accidents in hospitals-devices to protect against electrical hazards.

UNIT 3

Radiation Protection Standards and Regulations

Need for protection, philosophy of radiation protection, basic radiation protection criteria, External and internal exposure, additive risk model and multiplicative risk model. Risk coefficients. Dose to the foetus. Dose limits for occupational exposure, for public and special exposure situations. ICRP and AERB recommendations. Basic safety standards. Source, practices, types of exposures, interventions. Atomic energy act, Radiation protection Rules, Notifications, Transport regulations, Waste disposal rules, Food irradiation rules, li-

Unit-02

Point defects, line defects and planer (stacking) faults. The role of dislocations in plastic deformation and crystal growth. The observation of imperfections in crystals, X-ray and electron microscopic techniques.

Electrons in a periodic lattice: Bloch theorem, band theory, classification of solids, effective mass. Tight-binding, pseudo potential methods.

Unit-03

Fermi surface, de Hass von Alfen effect, cyclotron resonance, magneto resistance, quantum Hall effect.

Paramagnetism- Langavin theory, Weiss theory of ferromagnetism, Heisenberg model and molecular field theory. Spin waves and magnons. Curie-Weiss law for susceptibility, Ferri- and antiferro-magnetic order . Domains and Bloch-wall energy.

Unit-04

I Superconductivity : critical temperature, persistent current, Meissner effect, superconducting phase transitions, manifestations of energy gap. London theory, Cooper pairing due to phonons.

Unit-05

BCS theory of superconductivity, Ginzsburg-Landau theory and application to Josephson effect : d-c Josephson effect, a-c Josephson effect, macroscopic quantum interference. Vortices and type II superconductors, high temperature superconductivity (elementary).

Text and Reference Books

Verma and Srivastava: Crystallography for Solid State Physics
Azaroff: Introduction to Solids
Omar: Elementary Solid State Physics
Aschroft & Mermin: Solid State Physics
Kittel: Solid State Physics
Chaikin and Lubensky: Principles of Condensed Matter Physics
Madelung: Introduction to Solid State Theory
Callaway: Quantum Theory of Solid State
Huang: Theoretical Solid State Physics
Kittet: Quantum Theory of Solids

(Paper VI) : NUCLEAR AND PARTICLE PHYSICS

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C

(30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Nucleon - nucleon interaction - Exchange forces and tensor forces - Meson theory of nuclear forces - Nucleon - nucleon scattering - Effective range theory - Spin dependence of nuclear forces - Charge independence and charge symmetry of nuclear forces - Isospin formalism -Yukawa interaction.

Direct and compound nuclear reaction mechanisms - Cross sections in terms of partial wave amplitudes - Compound nucleus - Scattering matrix - Reciprocity theorem - Breit - Wigner one -level formula - Resonance scattering.

UNIT-02

Liquid drop model - Bohr - Wheeler theory of fission - Experimental evidence for shell effects -Shell model - Spin - Orbit coupling - Magic numbers - Angular momenta and parities of nuclear ground states - Qualitative discussion and estimates of transition rates - Magnetic moments and Schmidt lines - Collective model of Bohr and Mottelson.

UNIT-03

Beta decay - Fermi theory of beta decay - Shape of the beta spectrum - Total decay rate-Angular momentum and parity selection rules - Comparative half - lives - Allowed and forbidden transitions - Selection rules - Parity violation - Two-component theory of neutrino decay -Detection and properties of neutrino - Gamma decay - Multipole transitions in nuclei - Angular momentum and parity selection rules - Internal conversion - Nuclear isomerism.

Unit-04

Ionizing radiations : Ionization and transport phenomena in gases, Avalanche multiplication.

Detector Properties : Detection, Energy measurement, Position measurement, Time measurement.

Gas Counters : Ionization chambers, - Proportional counters – Multiwire proportional counters -Geiger - Muller counters - Neutron detectors.

Solid State Detectors: Semiconductor detectors - Surface barrier detectors.

Scintillation counters: Organic and inorganic scintillators, Theory, characteristics and detection efficiency.

Unit-05

High Energy Particle Detectors: General principles, Nuclear emulsions, Cloud chambers, Bubble chambers, Cerenkov counter.

Types of interaction between elementary particles - Hadrons and leptons - Symmetry and conservation laws - Elementary ideas of CP and CPT invariance - Classification of hadrons -Lie algebra, SU(2) - SU(3) multiplets - Quark model - Gell - Mann - Okubo mass formula for octet and decuplet hadrons - Charm, bottom and top quarks.

Waste disposal. Heat island effect. Land and see breeze. Puffs and plumes. Gaseous and paniculate matters. Wet and dry deposition

UNIT-05

Energy sources and combustion processes. Renewable sources of energy. Solar energy, wind energy, bio-energy, hydropower, fuel cells, nuclear energy. Forestry and bioenergy.

Elements of weather and climate. Stability and vertical motion of air. Horizontal motion of air and water. Pressure gradient forces. Viscous forces. Inertia forces. Reynolds number. Enhanced Greenhouse Effect. Energy balance- a zero-dimensional Greenhouse model. Global climate models.

Text and Reference Books

Nanotechnology Molecularly designed materials by Gan-Moog Chow, Kenneth E. Gonsalves, American Chemical Society

Quantum dot heterostructures by D. Bimerg, M. Grundmann and N.N. Ledentsov, John Wiley & Sons, 1998.

Nano technology : Molecular speculations on global abundance by B.C. Crandall, MIT Press 1996.

Physics of low dimensional semiconductors by John H. Davies, Cambridge Univ. Press 1997. Physics of semiconductor nano structures by K.P. Jain, Narosa 1997.

Nano fabrication and bio system : Integrating materials science engineering science and biology by Harvey C. Hoch, Harold G. Craighead and Lynn Jelinski, Cambridge Univ. Press 1996.

Nano particles and nano structured films; Preparation characterization and applications Ed. J.H Fendler, John Wiley &Sons 1998.

Egbert Boeker & Rienk Van Groundelle : Environmental Physics (Joha Wiley).

J.T. Hougtion : The Physics of Atmosphere (Cambridge University Press, 1977).

J.Twidell and J. Weir : Renewable Energy Resources (Elbs, 1988).

Sol Wieder : An Introduction to Solar Energy for Scientists and Engineers (John Wiley, 1982).

R.N. Keshavamurthy and M. Shanker Rao : The Phisics of Monsoons (Allied Publishers, 1992).

G.J. Haltiner and R.T. Williams : Numerical Weather Prediction (John Wiley, 1980).

M.SC. PHYSICS (Paper VIII B) : PHYSICS OF NANOMATERIALS & ENVIRONMENTAL PHYSICS

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Free electron theory [qualitative idea] and its features, Idea of band structure, Metals, insulators and semiconductors, Density of state in bands, Variation of density of states with energy, Variation of density of state and band gap with size of crystal.

UNIT-02

Electron confinement in infinitely deep square well, confinement in two and one dimensional well, Idea of quantum well structure, Quantum dots, Quantum wires.

Determination of particle size, Increase in width of XRD peaks of nanoparticles, Shift in photoluminescence peaks, Variations in Raman spectra of nanomaterials

UNIT-03

Different methods of preparation of nanomaterials, Bottom up: Cluster beam evaporation, Ion beam deposition, Chemical bath deposition with capping techniques and Top down : Ball Milling.

Nanotechnology's Application to Environment: Nanotechnology for waste reduction and improved energy efficiency, nanotechnology based water treatment strategies. Nanoporous polymers and their applications in water purification, Nanotoxicolog

Structure and thermodynamics of the atmosphere. Composition of air. Greenhouse effect. Transport of matter, energy and momentum in nature. Stratification and stability of atmosphere. Laws of motion, hydrostatic equilibrium. General circulation of the tropics. Elements of weather and climate of India.

UNIT-04

Physics of radiation. Interaction of light with matter. Rayleigh and Mie scattering. Laws of radiation (Kirchoffs law, Planck's law, Beer's law, Wien's displacement law, etc.). Solar and terrestrial spectra. UV radiation. Ozone depletion problem. IR absorption energy balance of the earth atmosphere system.

Elementary fluid dynamics. Diffusion. Turbulence and turbulent diffusion. Factors governing air, water and noise pollution. Air and water quality standards.

Text and Reference Books

A. Bohr and B.R. Mottelson, Nuclear Structure, Vol. 1 (1969) and Vol.2, Benjamin, Reading, A, 1975.

Kenneth S.Kiane, Introductory Nuclear Physics.Wiley, New York,1988.

Ghoshal, Atomic and Nuclear Physics Vol. 2,

P. H. Perkins, Introduction to High Energy Physics, Addison-Wesley, London, 1982.

G. E. Brown and A. D. Jackson, Nucleon - Nucleon Interaction, North - Holland, Amsterdam, 1976.

S. de Benedetti, Nuclear Interaction, John Wiley and Sons, New York, 1964.

P. Marmier and E.Sheldon, Physics of Nuclei and Particles, Vol. I & II, Academic Press, New York, 1970.

H. A. Enge, Introduction to Nuclear Physics, Addison - Wesley, 1975.

S. S. Kapoor and V. S. Ramamurthy, Nuclear Radiation Detectors, Wiley - Eastern, New Delhi, 1986.

W. H. Tail, Radiation Detection. Butterworths, London, 1980.

W. J. Price, Nuclear Radiation Detection, Me Graw Hill, New York, 1964. R.M. Singru

(Paper VII A) : Electronics, Digital Electronics & Communication Electronics

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Differential amplifier - circuit configurations, dual input, balanced output differential amplifier, DC analysis , AC analysis, inverting and non inverting inputs CMRR , constant current bias level translator.

Block diagram of a typical Op-Amp-analysis. Open loop configuration inverting and non-inverting amplifiers. Op-amp with negative feedback, voltage series feed back, effect of feed back on closed loop gain input resistence output resistance bandwidth and output offset voltage, voltage follower.

Unit-02

Practical op-amp input offset voltage - input bias current - input offset current, total output offset voltage, CMRR frequency response.

DC and AC amplifier summing scaling and averaging amplifiers instrumentation amplifier, integrator and differentiator, Voltage regulators - fixed regulators

- adjustable voltage regulators switching regulators

Unit-03

Oscillators principles, oscillator types, frequency stability, response, The phase shift oscillator. Wein bridge oscillator, LC tunable oscillators, Multivibrators - Monostable and Astable, comparators, square wave and Triangle wave generators.

Klystrons, Magnetrons and Traveling Wave Tubes, Velocity modulation, Basic principles of two cavity Klystrons and Reflex Klystrons, principles of operation of magnetrons.

Unit-04

Helix Traveling Wave Tubes, Wave Modes. Transferred electron devices, Gunn Effect, Principles of operation. Modes of operation, Read diode, IMPATT diode, TRAPATT Diode.

Advantages and disadvantages of microwave transmission, loss in free space, propagation of microwaves, atmospheric effects on propagation, Fresnel zone problem, ground reflection, fading sources, detectors, components, antennas used in MW communication systems.

Unit-05

Radar block diagram an operation, radar frequencies, pulse considerations. Radar range equation, derivation of radar range equation, minimum detectable signal, receiver noise, signal to noise ratio, Integration of radar pulses. Radar cross section. Pulse repetition frequency. Antenna parameters, system Losses and Propagation losses. Radar transmitters, receivers. Antennas, Displays.

Orbital satellites, geostationary satellites, orbital patterns, look angles, orbital spacing, satellite systems. Link modules.

Text and Reference Books

"Microelectronics" by Jacob Millman, Megraw-hill International Book Co., New Delhi, 1990

"Optoelectronics: Theory and Practice", Edited by Alien chappa). Me GrawHill Book Co., New York.

"Microwaves" by K.L. Gupta, Wiley Eastern Ltd., New Delhi, 1983

"Advanced Electronics Communications Systems" by Wayne Tomasi., Phi.Edn.

"Electronic Devices and circuit theory" by Robert Boylested and Louis Nashdsky PHI, New Delhi -110001,1991

"OP-Amps & Linear integrated circuits," by Ramakanth A. Gayakwad PHI, Second Edition, 1991

"Digital principles and Applications" by A.P. Malvino and Donald P. Laach, Tata Megraw - Hill company. New Delhi,

1993. "Microprocessor Architecture, programming and Applications with 8085/8086 by Ramesh S. Gaonkar, Wiley - Eastern

Ltd., 1987 (for unit v)

and its applications, Propagation of light in a medium with variable refractive index. Optical Fibers. Light wave communication. Qualitative treatment of Medical and Engineering applications of Lasers.

UNIT-03

Ruby Laser, Nd-YAG Laser, Semi Conductor Lasers, Diode-Pumped Solid State Lasers, Nitrogen Laser, Carbon-dioxide Laser, Excimer Laser, Dye Laser, High Power Laser Systems.

Fundamentals of photovoltaic Energy Conversion Physics and Material Properties Basic to Photovoltaic Energy Conversion: Optical properties of Solids. Direct and indirect transition semiconductors, interrelationship between absorption coefficients and band gap recombination of carriers.

UNIT-04

Types of Solar Celts, p n junction solar cell, Transport Equation, Current Density, Open circuit voltage and short circuit current, Brief descriptions of single crystal silicon and amorphous silicon solar cells, elementary ideas of advanced solar cells e.g. Tandem Solar Cells. Solid Liquid Junction Solar Cell.

Elements of Solar Thermal Energy, Wind Energy and Ocean Thermal Energy Conversion.

UNIT-05

Principles of Photoelectrochemical solar cells, Relevance in relation to depletion of fossil fuels and environmental considerations.Solar Hydrogen through Photoelectrolysis and Photocatalytic process. Physics of material characteristics for production of Solar Hydrogen.

Brief discussion of various storage processes, special features of solid state hydrogen storage materials, structural and electronic characteristics of storage materials. New Storage Modes.

Various factors relevant to safety, use of Hydrogen as Fuel, Use in Vehicular transport, Hydrogen for Electricity Generation, Fuel Cells, Elementary concepts of other Hydrogen Based devices such as Air Conditioners and Hydride Batteries.

Text and Reference Book

Svelto: Lasers

Yariv: Optical Electronics

Demtroder: Laser Spectroscopy

Letekhov: Non-Linear Laser Spectroscopy

Fonash : Solar Cell Devices – Physics

Fahrenbruch & Bube : Fundamentals of Solar Cells Photovoltaic Solar Energy

Chandra : Photoelectrochemical Solar Gells

Winter & Nitch (Eds.) : Hydrogen as an Energy Carrier Technologies Systems Economy

other protocols for dosimetry of photon beams.
Standardization of Brachy therapy sources and sealed source in terms their radiation output, calibration of protection level dosimeters in terms of dose equivalent units.

BOOKS FOR STUDY AND REFERENCE

H.E. Jones and J.R. Cunnigham, The Physics of Radiology, Charles C.Thomas. New York (1980).
B.H. Brown, R.H. Smallwood, D.C. Barber, P.V. Lawford and D.R. Hose, Medical Physics and Biomedical Engineering, Overseas Press India Private Limited, New Delhi (2005).
The Physics of Radiation Therapy Faiz .M. Khan, Williams & Willkinds (2003).
IAEA Technical Reports Series Number 398, Vienna 2000.
Advanced Medical Radiation Doseimetry, Govindharajan; Prentice Hall of India(Pvt) Ltd 1992.
Physics of electron beam therapy: SC Klevenhagen, Medical physics handbooks 13; Adem Hilger Ltd,Bristol and Boston (1985) M.

M.SC. PHYSICS (Paper VIII A) :
PHYSICS OF LASERS AND SCIENCE & TECHNOLOGY OF SOLAR HYDROGEN

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Laser Characteristics
Gaussian beam and its properties. Stable Two-Minor Optical Resonators, Longitudinal and Transverse Modes of Laser Cavity. Mode Selection, Gain in a Regenerative Laser Cavity. Threshold for 3 and 4 level Laser Systems. Mode Locking Pulse Shortening - Picosecond & femtosecond operation, Spectral Narrowing and Stabilization.

UNIT-02

Laser Fluorescence and Raman Scattering and their use in pollution studies, Non-Linear interaction of Light with matter, Laser induced multiphoton processes and their applications, Ultrahigh resolution Spectroscopy with lasers

(Paper VII B) : Analog, Digital Systems & Communication

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT-01

Analog computation, active filters, comparators, logarithmic and anti-logarithmic amplifiers, sample and hold amplifiers, waveform generators. Square and triangular wave generators, pulse generator.
Read-only Memory (ROM) and applications. Random Access Memory (RAM) and applications.
Digital to-analog converters, ladder and weighted resistor types Analog to digital converters -counter type, successive approximation and dual slope converters, Applications of DACs and ADCs.

UNIT-02

Photo detectors : Photo detectors with external photo effect, photo detectors with internal photo effect, photo conductors and photo resistors, junction photo detectors.
Circuits with Light Emitting Diodes, Diode tester. Polarity and voltage tester, measuring instruments with LED indication, LED, Numeric and alphanumeric display units.

UNIT- 03

Semiconductor switches and potential isolation, The phototransistor as a switch in the optocouplers, steady state performance, dynamic performance, use of optocouplers.
Amplitude modulation - Generation of AM waves - Demodulation of AM waves - DSBSC modulation. Generation of DSBSC waves, Coherent detection of DSBSC waves, SSB modulation, Generation and detection of SSB waves. Vestigial sideband modulation. Frequency Division multiplexing (FDM).

Unit-04

The transistor as a switch, OR, AND and NOT gates, NOR and NAND gates, Boolean algebra, Demorgan's theorems, Exclusive OR gate, Decoder/ Demultiplexer, Data selector/multiplexer, Encoder.
Flip - Flops : A I - bit memory, The RS Flip - Flop, JK Flip – Flop, JK master slave Flip – Flops, T Flip – Flop, D Flip – Flop, Shift registers, synchronous and asynchronous counters, cascade counters.

Unit-05

Introduction to microcomputers, memory, input/output, Interfacing devices 8085 CPU, Architecture, BUS timings, Demultiplexing the address bus generating control signals, Instruction set, addressing modes, Illustrative programmes, writing assembly language programmes looping, counting and indexing, counters and timing delays, stack and subroutine,

Text and Reference Books

"Electronic Devices and circuit theory" by Robert Boylested and Louis Nashdsky PHI, New Delhi -110001,1991

"OP-Amps & Linear integrated circuits," by Ramakanth A. Gayakwad PHI, Second Edition, 1991

"Digital principles and Applications" by A.P. Malvino and Donald P. Laach, Tata Megraw - Hill company. New Delhi,

1993. "Microprocessor Architecture, programming and Applications with 8085/8086 by Ramesh S. Gaonkar, Wiley – Eastern Ltd., 1987

"Microelectronics" by Jacob Millman, Megraw-hill International Book Co., New Delhi, 1990

"Optoelectronics: Theory and Practice", Edited by Alien chappa). Me GrawHill Book Co., New York.

"Advanced Electronics Communications Systems" by Wayne Tomasi., Phi.Edn.

(Paper VII C) : MEDICAL PHYSICS - I

Time : 3 hrs. Max. Marks : 75

Note: The question paper shall contain three sections. Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. The answers should not exceed 50 words. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words. Section C (30 marks) shall contain 5 questions, one from each Unit. Each question shall be of 10 marks. The candidate is required to answer any three questions. The answers should not exceed 500 words.

UNIT 1

Radiation Detection and Measurement

Principles of measurements of radiation and radioactivity. Gas filled Ionization chamber, proportional counters, GM counters, Scintillation detectors, semiconductor detectors, BF3 counters for neutron detection.

TLD dosimetry: process and properties, glow curves and dose response, photon energy dependence, fading, physical form of TLD materials, residual TL and annealing for reuse, repeated read out of TLD's. TL instrumentation, ultrathin TLD's, graphite /boron carbide mixed TLD'S glow curve analysis.

UNIT 2

Ionization Dosimetry

Theoritical aspects of ionization dosimetry-Bragg-Gray theory-Models and equations-practical aspects of ionization dosimetry-characteristics of ionization chambers-polarity effect-stability and collection efficiency-principles of low current measurements.

Measurement of absorbed dose: calculation of absorbed dose from exposure-Bragg-gray cavity theory-.Other methods of measuring absorbed dose: calorimetry- Chemical dosimetry-solid state methods; -Silicon diodes-Radiographic film-Radiocromic film.

UNIT 3

Low and medium energy dosimetry and high energy Dosimetry

In phantom measurements–reference conditions-comparison with ICRU equations-in air measurements-comparison of two methods-Exposure and kerma calibrations(in air)-K-curves-D-curves-concept of CPE and TE-Determination of in water absorbed dose-Graphite dosimetric calibration.

Historical developments-High energy photon dosimetry-CSDM,SAM models-cfactors-development of electron beam dosimetry-concept of cavity gas calibration factor for high energy dosimetry-development of new high energy dosimetry formalism-reference depth-Gradient correction-saturation correction-average stopping power ratio-comparison of electron and photon dosimetry-electron beam dose transfer formalism.

UNIT 4

Dosimeters and survey meters

Dosimeters: Primary standard dosimeters, secondary standard dosimeters, Victoreen R meter, dosimeter based on current measurements, radio isotope calibrator, multi purpose dosimeters -water phantom dosimetry systems, Brach therapy dosimeters. Calibration and maintenance of dosimeters.

Instruments for personal monitoring, digital pocket dosimeters using solid state devices, and GM counters, teledetectors, portable survey meters, gamma area (zone) alaram monitors, contamination monitors for alpha, beta and gamma radiations, scintillation monitors for X ray and gamma radiation –neutron monitors- tissue equivalent survey meter-flux meters, dose equivalent monitors.

UNIT 5

Standardization of electrons,x-ray and gamma rays beams

Determination of exposure and air kerma, conditions for the realization of exposure, ionization chamber for low, medium and high energy x-rays and gamma rays, determination of absorbed dose, Bragg Gray theory and its validity, Burlin's theory for measurement for radiation quantities,

Standardization of x-ray and high energy beams, design of free air chambers, characteristics of free air chambers and graphite chambers, intercomparision of standard chambers for ensuring traceability, standardization of electron beams used in radiotherapy – calibration of secondary standards.Details of IAEA and