GOVT. D. B. GIRLS' P. G. (AUTO.) COLLEGE

RAIPUR CHHATTISGARH

DEPARTMENT OF PHYSICS

SYLLABUS OF M. Sc. PHYSICS

SESSION 2018 – 2019

Scheme of M. Sc. (PHYSICS)

Semester - I (JULY - 2018)

Semester	paper	Title of Theory/Practical Paper	Marks
I	I	Mathematical Methods-1	80
	II	Classical Mechanics	80
	III	Numerical Methods and Programming	80
	IV	Electronics-I	80
	Lab.Course A	General	100
	Lab.Course B	Electronics	100
		Class test (each paper)	20
		TOTAL MARKS	600

M. Sc. (PHYSICS)

SEMESTER - I

PAPER – I

(Mathematical Methods - I)

UNIT –I

Vector space and Matrices, Linear independence, Bases, dimensionality, Inner product, Linear transformation, matrices, Inverse, Orthogonal and Unitary matrices, Independent element of a matrix, Eigen values and eigen Vectors, Diagonalization, Complete orthonormal sets of functions

UNIT – II

Complex Variables: Cauchy- Riemann condition, analytic functions,Cauchy's theorem,Cauchy integral formula, Laurent series, singularities, residue theorem, contour integration, evaluation of definite integrals, problems.

UNIT – III

Differential equations, first order differential equation, second order differential equation with constant coefficients, second order linear ODEs with variable coefficients, Solution by series expansion, nonhomogenous differential equations and solution by the method of Green's functions

UNIT-IV

Special functions, Legendre, Bessel, Hermite and Laguerre functions with their physical applications, generating functions, orthogonality conditions, recursion relations, Integral transforms, Fourier integral and transforms, inversion theorem, Fourier transform of derivatives, convolution theorem

Text and Reference Books:

1. Mathematical Methods or Physics, by g Arfken
2. Matrices and Tensors for Physicists, by AW Joshi
3. Advanced Engineering Mathematics, by E Kreyszig
4. Special Functions, by ED Rainville
5. Special Functions, by W W Bell
6. Mathematical Method for Physicists and Engineers. By KF Reilly, M P Hobson and S J Bence
7. Mathematics for Physicists, by Mary L Boas

M. Sc. (PHYSICS)

SEMESTER - I

PAPER – II
(Classical Mechanics)

UNIT -I

Conservation Principles, Mechanics of a particle conservation Principles for system of
particles. Constrained motion constraints and degrees of freedom generalised coordinates,Generalised Notations (i) Generalised Displacement , velocity , Acceleration, momentum force and potential , limitations of Newton's laws.
D'Alembert's Principle, Lagrange's equation from D'Alembert's principle . Application of
Lagrange's equation of motion (i) Linear Harmonic oscillator (ii) Simple pendulum (iii)
spherical pendulum (iv) Isotropic oscillator (v) Atwood's Machine, conservation of linear
momentum angular momentum and energy in Lagrangian formulation Lagrange's equation for nonholonamic system procedure to eliminate consideration of Ignorable coordinates theRouthian function.

UNIT – II

Variational Principle, calculus of variation, some techniques of calculus of variables ,
Euler Lagrange differential equation. Hamilton variational principle Deduction of Hamilton's Principle from D'Alembert's principle. Deduction of Newton's second law of motion from Hamilton's Principle. Deduction of Lagrange's equations of motion from Hamilton's Principle for conservation and for non conservative systems Non conservative forces. Dissipative system, Rayleigh's Dissipation function , Lagrangian for a charged particle in an electromagnetic field.

UNIT – III

Hamiltonian formulation of mechanics: Phase space and the motion of the system,
Hamiltonian function , Hamilton's canonical equation of motion. Physical significance of H
Deduction of Canonical equation from variational principle. Hamilton's canonical equations of motion in different coordinate systems. Application of Hamilton equation of motion (i) Simple pendulum (ii) compound pendulum (iii) Two dimensional Isotropic Harmonic oscillator (iv) Linear Harmonic

oscillator (v) Particle in central field of force. Hamiltonian for a charged particle in an electromagnetic field . Principle of least action statement and its proof.

UNIT – IV

Canonical or constant transformation, its advantage example of canonical transformation , necessary and sufficient condition for a trans formation to be canonical ,Infinitesional contact transformations. Hamilton-Jacobi partial differential equation for Hamilton's Principle function. Solution of Harmonic oscillator problem by Hamilton-Jacobi method . Hamilton- Jacoby theory . Poisson Bracket: Definition and properties. Invariance of Poisson-Brackets with respect to canonical transformation , Equations of motion in Poisson bracket form Jacoby identity. Infinitesimal contact transformations interpretation in terms of Poisson Brackets. The angular momentum and Poisson Bracket Lagrange's Brackets: definition& Properties , Relation with Poisson Brackets .

Text and Reference Books:

1. Classical mechanics . H. Goldstein
2. Principle of mechanics – Synge and Griffith
3. Classical mechanics – Gupta Kumar , Sharma
4. Classical mechanics of particles and Rigid body- Kiran C. Gupta

M. Sc. (PHYSICS)

SEMESTER - I

PAPER – III
(Numerical Method and Programming)

UNIT - I

Problem analysis and solving scheme. Computational procedure, programming outline,
flow chart. Branching and looping writing. Character set, constants, (numeric string) variables(numeric string) rules for arithmetic expressions and hierarchy of operators, rational expressions, logical expressions,and operators, library functions. Identifiers, qualifiers, define statements, value Initialized variables, operators, and expressions. Operator precedence and associativity. Scanf with specifier, search set arrangements and suppression Character, format specifier for scanf.

UNIT - II

Control structure,If statement, if else statement, multiway decision,compound statement. Loops: for loop, while loop, do while loop, break statement , compound statement continue statement , go to statement Function: function main , function accepting more than one parameter, user defined and library function concept associatively with functions, function parameter, return value, recursion comparison. Arrays , strings, multidimensional array, array of strings function in string.

UNIT - III

(Without Programming)
Method for determination of zeroes of linear, non linear, algebraic equations. And
transcendental equations and their convergence. Solution of simultaneous linear equations Gaussian elimination pivoting, iterative method matrix inversion. Eigen values and Eigen vectors of matrices. Power and Jacobi method , curve fitting polynomial least squares.

UNIT - IV

(Without Programming)
Finite deference interpolation with equally spaced and unequally spaced points, Numerical differentiation and Integration , Newton cote's formula , Monte Carlos evaluation of Integral Numerical solution of ordinary

differential equation . Euler and Runga Kutta methods. Predictor corrector method

Text and Reference Books:

1. Sastry: Introductory methods of numerical analysis
2. Vetterming, Teukolsky press and Flannery : Numerical Recipes
3. Let Us C : Yashwant Kanitkar
4. Programming in C : E. Balaguruswami.
5. Numerical Methods : P.Kandasamy

M. Sc. (PHYSICS)

SEMESTER - I

PAPER – IV
(Electronics – I)

UNIT – I

Transistors : Bipolar Junction transistor (BJT) – basics working principle of NPN and PNP transistor, characteristic curve and different modes of transistor, current gain in different modes and relation between them. Junction Field Effect Transistor (FET) – N channel and P channel FET, Working principle, static and dynamic characteristic curves, pinched off voltage, Coefficient of FET, and relation between different coefficient. Metal Oxide Field Effect Transistor (MOSFET) – DE MOSFET and E-MOSFETconstruction and working principle, static and dynamic characteristics. Uni-junction transistor (UJT) – basics structure, working principle, Voltage – Current characteristics and important parameters .

UNIT – II

MIS Diode : Introduction , Energy band diagram, accumulation, depletion and inversion
condition concept of surface space charge, surface potential, surface capacitance, Ideal MIS curves . MOS diode: structure , Ideal MOS, surface depletion region , Ideal MOS curves, Si-SiO_2 MOS diode-(real case) interface trapped charge, oxide charges.Charged Couple Device (CCD) : Basic structure, working principle, charge transfer with clock voltage.

UNIT – III

Microwave devices: Tunnel Diode – Introduction, Definition, Tunneling Phenomenon,
Energy band Structure, Volt-Ampere Characteristics, Negative Resistance of tunnel diode
(Characteristics of tunnel diode) Transfer Electron Devices: Transfer Electron Effect, Gun Diode- Introduction and characteristics.
Backward Diode: Introduction and Characteristics.
IMPATT Diode : Introduction, Structure, Principle of operation, Static and Dynamic
Characteristics.

UNIT – IV

Modulation : Definition , Types of Modulation, Mathematical expression of modulation,
Percentage of modulation, Amplitude modulation, Generation of Amplitude modulation,
Demodulation, Demodulation of Amplitude modulated wave, side bands, band width, DSBSC modulation, Generation of DSBSC waves. SSB modulation, Generation and Detection of SSB waves, Multiplexing: Frequency division multiplexing (FDM)

Text and Reference Books:

1. Principles of Electronics – V.K. Mehta , Rohit Mehta (S.Chand & Company Ltd.)
2. Basic Electronics (Solid state) – B.L. Theraja (S. Chand & Company Ltd.)
3. Electronic Devices and Circuits – Jacob Millman , Christos C. Halkias (Tata McGraw Hill)
4. foundation of Electronics – D. Chattopadhyay, P.C. Rakshit, B. Saha, N. N. Purkait.
5. Hand Book of Electronics – Gupta Kumar (Pragati Prakashan)
6. Physics of semiconductor Devices – S.M. Sze (Wiley Eastern Ltd.)

Scheme of M. Sc. (PHYSICS)

Semester - II (JAN. 2019)

Semester	paper	Title of Theory/Practical Paper	Marks
I	I	Quantum mechanics-1	80
	II	Laser physics and applications	80
	III	Electrodynamics	80
	IV	Electronics-II	80
	Lab.Course A	Computer programming	100
	Lab.Course B	Electronics / General	100

M. Sc. (PHYSICS)

SEMESTER - II

PAPER – I
(Quantum mechanics-1)

UNIT - I

Inadequacy of classical mechanics, Plank quantum hypothesis and radiation law, Photoelectric effect, de-broglie's theory. Schrödinger equation, continuity equation, Ehrenfest theorem, admissible wave functions, stationary states, one-dimensional problems; walls and barriers, Schrödinger equation for harmonic oscillator and its solution, uncertainty relations, states with minimum uncertainty product.

UNIT –II

Superposition principle, general formalism of wave mechanics, representation of states and dynamical variables, commutation relationship, completeness and normalization of eigen functions, Dirac-delta function, Bra & Ket notation, matrix representation of an operator, harmonic oscillator and its solution by matrix method, Heisenberg equation of motion.

UNIT -III

Angular momentum in quantum mechanics, commutation relationships, eigen values, Spin angular momentum, Pauli`s matrices, addition of angular momentum, Clebsch-Gordon coefficients. Central force problem, spherically symmetric potentials in three dimensions, separation of wave equation, parity, three-dimensional square-well potential and energy levels

UNIT – IV

Hydrogen atom; solution of the radial equation, energy levels and stationery state wave functions, discussion of bound states, degeneracy.Time-independent perturbation theory, non-degenerate case, first order and second perturbations with the example of an oscillator, degenerate cases, removal of degeneracy in second order, Zeeman effect without electron spin, first-order Stark effect in hydrogen, perturbed energy levels, correct eigen function, occurrence of permanent electric dipole moments.

TEXT AND REFERENCE BOOKS:

1. L.I. Schiff: quantum mechanics (McGraw-Hill).
2. S.Gasiorowicz, Quantum Physics (Wiley).
3. Landau and Lifshitz : Non-relativistic quantum mechanics.
4. B.Craseman and Z.D.Powell: quantum mechanics (Addison Wesley)
5. A.P. Messiah: Quantum Mechanics.
6. J.J. Sakurai : Modern Quantum Mechanics.
7. Mathews and Venkatesan : Quantum Mechanics.

M. Sc. (PHYSICS)

SEMESTER - II

PAPER – II
(Laser physics and applications)

UNIT- I

Laser Characteristics –

Spontaneous and stimulated emission, Einstein's quantum theory of radiation, theory of some optical processes, coherence and monochromacity, kinetics of optical absorption, line broadening mechanism, Basic principle of lasers, population inversion, laser pumping, two & three level laser systems, resonator, Q-factor, losses in cavity, threshold condition, quantum yield.

UNIT – II

Laser Systems

Solid state lasers- the ruby laser, Nd:YAG laser, ND: Glass laser, semiconductor lasers – features of semiconductor lasers, intrinsic semiconductor lasers, Gas laser -neutral atom gas laser, He-Ne laser, molecular gas lasers, CO2 laser, Liquid lasers, dye lasers and chemical laser.

UNIT-III

Advances in laser Physics

Production of giant pulse -Q-switching, giant pulse dynamics, laser amplifiers, mode locking and pulling, Non-linear optics, Harmonic generation, second harmonic generation, Phase matching, third harmonic generation, optical mixing, parametric generation and self-focusing of light.

UNIT – IV

Multi-photon processes; multi-quantum photoelectric effect, Theory of two-photon process, three- photon process, second harmonic generation, parametric generation of light, Laser spectroscopy : Rayleigh and Raman scattering, Stimulated Raman effect, Hyper-Raman effect, Coherent anti-stokes Raman Scattering, Photo-acoustic Raman spectroscopy.Laser Applications **–** ether drift and absolute rotation of the Earth**,** isotope separation, plasma, thermonuclear fusion, laser applications in chemistry, biology, astronomy, engineering and medicine.

TEXT AND REFERENCE BOOKS:

1. Laud, B.B.: Lasers and nonlinear optics, (New Age Int.Pub.1996).
2. Thyagarajan, K and Ghatak, A.K.: Lasers theory and applications (Plenum press, 1981).
3. Ghatak, A.K.and Thyagarajan, K : Optical electronics (Cambridge Univ. Press 1999).
4. Seigman, A.E.: Lasers (Oxford Univ. Press 1986)
5. Maitland, A. and Dunn, M.H. : Laser Physics (N.H.Amsterdam, 1969).
6. Hecht, J.The laser Guide book (McGraw Hill, NY, 1986).
7. Demtroder, W. : Laser Spectroscopy (Springe series in chemical physics vol.5,Springe verlag, Berlin, 1981).
8. Harper, P.G.and Wherrett B.S. (Ed.): Non-linear-optics (Acad.press, 1977).

M.Sc. (PHYSICS)

SEMESTER - II

PAPER – III

(Electrodynamics)

UNIT – I

Equation of continuity, Maxwell's equations (SI unit) and its derivation, Integral form of equation, Maxwell's equations in some particular cases , Electromagnetic energy: Poynting Theorem. The wave equation. Plane electromagnetic waves in free space. Plane electromagnetic waves in a non-conducting isotropic medium (i.e. Isotropic dielectrics) . Plane electromagnetic waves in Anisotropic Non-conducting medium (Anisotropic dielectric) , Plane electromagnetic waves in conducting medium. A simple model for dynamic conductivity. Propagation of electromagnetic waves in ionized gases.

UNIT – II

Boundary conditions at the interface of two media, Reflection and Refraction of electromagnetic waves at the interface of Non-conducting media,. Fresnel's equations experimental verification of fresnel's equations. Reflection and transmission coefficients at the interface between two non conducting media, Brester's law and degree of polarisation , Total internal reflection , Group velocity Propagation of Electromagnetic waves between parallel conducting planes. Wave guides. TM modes and TE modes, Rectangular wave guides.

UNIT – III

Postulates of Einstein's special theory of relativity, Galliean transformations. Lorentz's transformations and it's consequence, Transformation of differential operator, Invariance of D'Alembertian operator, Invariance of charge, Transformation of charge density, Electric field measured in different frames of reference, Minkowski space, concept of four vector, Lorentz transformation of space and time in four vector form, Transformation for charge and current density, Transformation of electromagnetic potential A and □ . Lorentz condition in covariant form, Covariance or Maxwell field equation in terms of four vector.

UNIT – IV

Electromagnetic vector and scalar potential , Lorentz Gauge, Lienard Wiechart potentials, the electromagnetic field of a uniformly moving point charge, Radiation from an accelerated charge at low velocity – Larmer's formula , Relativistic generalization of Larmer's formula, Angular distribution of radiation emitted by an accelerated charge, Radiation damping, The Abraham Lorentz formula, Cherenkov radiation, Radiation due to an oscillating electric dipole, electric quadra pole radiation, Radiation due to small current element, Radiation from linear antenna, Half wave antenna, Antenna array.

Text and Reference Books:

1. Classical electrodynamics by –J.D. Jackson
2. Electromagnetic theory and electrodynamics by Satyaprakash.
3. Classical theory of fields – by Landau L.D. and lifshitz
4. Electrodynamics of continuous media- Landau L.D. and lifshitz
5. Electromagnetic theory – Chopra and Agrawal .

M. Sc. (PHYSICS)

SEMESTER - II

PAPER – IV
(ELECTRONICS – II)

UNIT – I

Radiative and non-radiative transistors , Optical Absorption, bulk and thin film,
photoconductive devices (LDR) , Emission spectra , Luminescent efficiency , method of
excitation. Light emitting diode (LED) : high frequency limit, effect of surface and indirect combination current , operation of LED, Visible LEDs and Infrared LEDs. Diode Laser (Condition for population inversion in active region, light confinement factor , optical gun and threshold current for lasing, Fabry-Perrot Cavity Length for losing and the separation.

UNIT – II

Photo detectors: Photoconductor, equivalent circuit of photoconductor. Phototransistor.
Bipolar phototransistor, photo – Darlington transistor, V-I characteristic of bilateral hetero structure phototransistor, Solar cells, Solar radiation, solar spectrum, ideal conversion efficiency, Energy band diagram of solar cell, IV characteristics of solar cell, PN junction solar cells, Hetero junction, Interface thin film solar cells.

UNIT – III

Basic Op-amp. Differential amplifier – circuit configurations, dual input, balanced output, differential amplifier –DC analysis, Ac analysis, inverting and non-inverting inputs, CMRR, Constant current bias level transistor. Block diagram of a typical Op-amp. Analysis, open loop configuration, inverting and non-inverting amplifier, Op-amp. With negative feedback, Voltage series feed back, effect of feed back on closed loop gain input persistence output , resistance bandwidth and output offset voltage , voltage follower.

UNIT – IV

Practical Op-amp. Input offset voltage, Input offset current, total output offset voltage, CMRR frequency response, DC and AC amplifier summing scaling and averaging amplifiers instrumentation amplifier, integrator and differentiator Oscillators principles, oscillator types, frequency stability response, The phase shift oscillator. Wein bridge oscillator, Multivibrators, Monostable and Astable , Comparators, square wave and triangle wave generators.

Text and Reference Books :

1. Semiconductor Devices – Physics and Technology – S.M. Sze, Wiley, 1985
2. Introduction to Semiconductor Devices – M.S.Tyagi, John Wiley & sons
3. Electronic Devices and circuit theory – Robert Baylested and louis Nashdsky, PHI, New Delhi, 1991
4. Electronic Fundamentals and applications – John D. Ryder PHI, New Delhi, 1987.
5. Operational Amplifier and their applications – Subir Kumar Sarkar, S.Chand & Sons, NewDelhi1999.
6. Op-amps & linear integrated circuits- Ramakanth A. Gayakward, PHI, 2 Ed. 1991

Scheme of M. Sc. (PHYSICS)

Semester - III (JULY 2018)

Semester	paper	Title of Theory/Practical Paper	Marks
I	I	Quantum mechanics-II	80
	II	Statistical mechanics	80
	III	Solid State Physics	80
	IV	Electronics-III	80
	Lab.Course A	Electronics	100
	Lab.Course B		
		CLASS TEST(EACH PAPER)	20
		TOTAL	600

M. Sc. (PHYSICS)

SEMESTER - III

PAPER – I
(QUANTUM MECHANICS -II)

UNIT-I

Variational method, expectation value of energy, application to excited states, ground state of He-atom, Zero point energy of one dimensional harmonic oscillator, Vander-waals interaction, the W.K.B. approximation, approximate solutions, asymptotic nature of the solution, solution near turning point, connection formulae, energy levels of a potential well and quantization rule.

UNIT -II

Theory of scattering: differential and total scattering cross section, wave mechanical picture of scattering & the scattering amplitude, Green's functions and formal expression for scattering amplitude, The Born approximation and its validity, Partial wave analysis, asymptomatic behavior of partial waves and phase shifts, optical theorem, scattering by a square well potential, scattering by a hard sphere, scattering by a Coulomb potential..

UNIT– III

Time-dependent perturbation theory, first order perturbation, Harmonic perturbation, Fermi`s Golden rule, Ionization of a H-atom, absorption and induced emission, Selection rules. Identical particles, symmetric and anti symmetric wave functions

UNIT –IV

Relativistic quantum mechanics, formulation of relativistic quantum theory, the Klein-Gordon equation; plane wave solutions, charge and current densities, The Dirac equation for a free particle, matrices alpha and beta, Lorentz covariance of the Dirac equation, free particle solutions and the energy spectrum, charge and current densities.

TEXT AND REFERENCE BOOKS –

1. L.I. Schiff: Quantum Mechanics (McGraw-Hill).
2. S.Gasiorowicz: Quantum Physics (Wiley).
3. Landau and Lifshitz : Quantum Mechanics.
4. B.Craseman and Z.D.Powell : Quantum Mechanics (Addison Wesley)
5. A.P. Messiah: Quantum Mechanics.
6. J.J. Sakurai: Modern Quantum Mechanics.
7. Mathews and Venkatesan: Quantum Mechanics.
8. Bjorken and Drell : Relativstic Quantum Mechanics.

M. Sc. (PHYSICS)

SEMESTER - III

PAPER – II
(STATISTICAL MECHANICS)

UNIT-I

Foundation of statistical mechanics : macroscopic and microscopic states, contact between statistics and thermodynamics, physical significance of Ω(N, V, E), the classical gas, entropy of mixing and Gibb's paradox, phase space of classical system, Liouville`s theorem and its consequences, quantum states and phase space.

UNIT- II

Elements of ensemble theory – A system in microcanonical, canonical, andgrand canonical ensembles, partition functions, physical significance of statistical quantities, example of classical system, energy and energy-density fluctuations and mutual correspondence of various ensembles.

UNIT-III

Formulation of quantum statistics – Quantum mechanical ensemble theory, density matrix, statistics of various quantum mechanical ensembles, system composed of indistinguishable particles.

Theory of simple gases –Ideal gas in various quantum mechanical ensemble, Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac distributions, statistics of occupation number.

UNIT - IV

Ideal Bose and Fermi gases -Thermodynamic behavior of an ideal Bose gas, Bose-Einstein condensation and, elementary excitations in liquid helium II, Thermodynamic behavior of an ideal Fermi gas, the electron gas, nonrelativistic and relativistic degenerate electron gas, theory of white dwarf stars.Statistical Mechanics of interacting systems – the method of cluster expansion for a classical gas, Virial expansion of the equation of state.

TEXT & REFERENCE BOOKS –

1. R. K. Pathria, Statistical Mechanics (Pergamon Press).
2. L. D. Landau & E. M. Lifshitz (Butter worth and Heinemann Press).
3. Federick Reif, Fundamental of statistical and thermal physics (McGraw-Hill publishers).
4. Kerson Huang, Statistical Mechanics (Wiley Eastern).

M. Sc. (PHYSICS)

SEMESTER - III

PAPER – III
(SOLID STATE PHYSICS-I)

Unit- I: Electrons in Solids and Electronic Properties

Energy bands: nearly free electron model, origin of energy gap and its magnitude, Bloch function, Kronig-Penny model, Wave equation of electron in periodic potential, restatement of Bloch theorem, crystal moment of an electron, solution of Central equation, Kronig-Penny model in reciprocal space, empty lattice Approximation, approximate solution near zone boundary, Number of orbitals in a band, metals and insulators.

Unit -II: Fermi surfaces and metals

Effect of temperature on F-D distribution, free electron gas in three dimension. Different zone schemes, reduced and periodic zones, construction of Fermi surfaces, nearly free electrons, electron, hole, open orbits, Calculation of energy bands, Tight binding, Wigner-Seitz, cohesive energy, pseudo potential methods. Experimental methods in Fermi surface studies, quantization of orbits in a magnetic field, de Haas van Alphen Effect, External orbits, Fermi surface of copper.

Unit- III: Crystal vibration and thermal properties

Lattice dynamics in monoatomic and diatomic lattice: two atoms per primitive basis, optical and acoustic modes, quantization of elastic waves, phonon momentum, inelastic neutron scattering by phonons, Anharmonic crystal interactions-thermal expansion, thermal conductivity, thermal resistivity of phonon gas, umklapp processes, imperfections.

Unit–IV:Electron-Phonon interaction- superconductivity

Experimental survey: occurrence of superconductivity, Destruction of superconductivity by magnetic field, Meissner effect, heat capacity, energy gap, MW, and IR properties, isotope effect. London equation, Coherence length, Cooper pairing due to phonons, BCS theory of superconductivity, BCS ground state, flux quantization of superconducting ring, duration of persistent currents, Type II superconductors, Vortex states, Josephson superconductor tunneling, DC/AC Josephson effect,.

TEXT AND REFERENCE BOOKS

1. C. Kittel: Introduction to Solid State Physics (Wiley and Sons).
2. J.M.Ziman: Principles of theory of solids (Cambridge Univ.Press).
3. Azaroff: X-ray crystallography.
4. Weertman and weertman : Elementary Dislocation Theory.
5. Verma and Srivastava: Crystallography for Solid State Physics.
6. Azeroff and Buerger: The Power Method.
7. Buerger: Crystal Structure Analysis.
8. Thomas: Transmission Electron Microscopy.
9. Omar: Elementary solid state physics.
10. Ashcroft and Mermin: Solid State Physics.
11. Chalking and Lubensky: Principles of Condensed Matter Physics.
12. Madelung: Introduction to solid state theory.
13. Callaway: Quantum theory of solid state physics.
14. Huang: Theoretical Solid State Physics.
15. Kittel: Quantum theory of solids.

M. Sc. (PHYSICS)

SEMESTER - III

PAPER – IV
(ELECTRONICS – III)

UNIT - I

Number system : Decimal, Binary, Octal and Hexadecimal Number System with mutual
conversion, BCD addition and subtraction, 1's and 2's compliments, multiplication & division BCD code (8421), Excess –3 code, gray code, binary to gray code and gray code to binary code conversion.
Logic gates: Positive and negative logic , Basic gates, Universal building block. Basic laws of Boolean Algebra, De-Morgan's Theorem, two, three and four variable K-Map, mapping and minimization of SOP and POS expressions, pairs, quads, octet, overlapping, Rolling, concepts of Don't care condition.

UNIT – II

Ex-OR gate, Ex-NOR gate circuitry, Half adder, Full adder, binary parallel adder, Serialadder, Half Subtractor, Full Subtractor, 1's complements Subtractor circuit and 2's complements Subtractor circuit. Digital logic Families : Introduction, Basic concepts of RTL, DTL, TTL, ECL and CMOS logic. Decoder : 2 line to 4 line decoder, 1 of 16 decoder, BCD to decimal decoder, BCD to seven segment decoder, Encoder : decimal to BCD encoder. Multiplexer : 2-input, 4-input, 16 input Multiplexer, DeMultiplexer : 1 line to 2 line , 1 line to 4 line and 1 line to 16 line DeMultiplexer.

UNIT – III

Flip-flop and timing diagram, RS flip-flop using NOR gate, RS flip-flop using NAND gate, Clocked RS flip-flop, D- latch flip-flop, Preset and Clear, JK flip-flop, Positive and negative edge triggered flop-flops., JK Master Slave flip-flop. Counters : Binary ripple counter , up counter , down counter, decade counter and Ring counter and time diagram
Registers : Parallel and shift Register, Scaling, PIPO, SIPO, PISO, SOSI Bi-directional
shift Register, Application of shift register.

UNIT – IV

Digital to analog converter and Analog to Digital converters : D/A converters using binary weighted resistor network and R-2R ladder Network; Counter type A/D converter, Successive approximation A/D converter and dual slope converters , applications of DACs and ADCs.

Intergraded Circuit : Introduction, Technology, Advantages and disadvantages, Basic technology of monolithic IC, Basic processes used in monolithic technology, Fabrication of components on monolithic IC, IC packing, symbol and scale of Integration.

Text and Reference Books :

1. Digital Principles and applications – Malvino and Leach, Tata McGraw Hills, New Delhi,
1991.
2. Digital and Analogue Technique- Navneet Gokhale and Kale, Kitab Mahal
3. Hand Book of Electronics – Gupta and Kumar, Pragati Prakashan, Meerut, 2008
4. Digital integrated Electronics _ Taub and Schilling, McGraw International Edition, 1977
5. Fundamentals of Digital Circuits – A.Anand Kumar, Prentice Hall of India, N.Delhi. 2007.

Scheme of M. Sc. (PHYSICS)
Semester - IV (JAN. - 2019)

Semester	paper	Title of Theory/Practical Paper	Marks
I	I	SOLID STATE PHYSICS- II	80
	II	ATOMIC AND MOLECULAR PHYSICS	80
	III	NUCLEAR AND PARTICLE PHYSICS	80
	IV	Electronics-IV	80
	Lab.Course A	Digital Electronics	100
		Project	200
		Seminar (each paper)	20
		TOTAL MARKS	700
Grand Total [SEMESTER I (600) + SEMESTER II (600) + SEMESTER III (600) + SEMESTER IV (600)]=			2400

M. Sc. (PHYSICS)

SEMESTER - IV

PAPER – I
(SOLID STATE PHYSICS- II)

Unit- I: Plasmons, Polaritons

Dielectric function of the electron gas, Plasma optics, Dispersion relation for EM wave, Transverse optical modes in Plasma, Transparency of Alkali metals in the ultraviolet, Longitudinal Plasma oscillations, Plasmon, electrostatic screening and screened Coulomb potential, Mott metal-insulator transition, screening and phonons in metals, Polaritons, LST relation .

Unit –II: Dielectric and ferroelectrics

Maxwell's equations, polarization, macroscopic electric field, depolarization filed, E1;local electric field at an atom, Lorentz filed E2, fields of dipoles inside cavity E3; dielectric constant and polarizability, electronic polarizability; structural phase transition; ferro-electric crystals, classification; displacive transition, soft optical phonons, Landau theory of phase transitions, first and second order transition, antiferro-electricity, ferro-electric domain, piezoelectricity, ferro-elasticity, optical ceramics.

Unit –III: Magnetism

General ideas of dia- and para- magnetisms, quantum theory of paramagnetism, rare earth ions, Hund rule, iron group ions, crystal field splitting, quenching of orbital angular momentum, spectroscopic splitting factor, van vleck temperature dependent paramagnetism, Cooling by isentropic demagnetization, nuclear demagnetization, paramagnetic Susceptibility of conduction electrons.

Unit –IV: Ferromagnetism and anti ferromagnetism

Ferromagnetic order, Curie point and exchange integral, temp dependence of saturation magnetization, saturation magnetization at absolute zero; magnons, quantization of spin waves, thermal excitation of magnons; neutron magnetic scattering, Ferrimagnetic order, Curie temp and susceptibility of ferrimagnets, iron garnets. Antiferromagnetic order, susceptibity below neel temp, antiferromagnetic magnons, ferromagnetic domains.

TEXT AND REFERENCE BOOKS

1. C. Kittel: Introduction to Solid State Physics (Wiley and Sons).
2. J.M.Ziman: Principles of theory of solids (Cambridge univ.press).
3. Azaroff : X-ray crystallography.
4. Weertman and weertman : Elementary Dislocation Theory.
5. Verma and Srivastava: Crystallography for Solid State Physics.
6. Azeroff and Buerger: The Power Method.
7. Buerger: Crystal Structure Analysis.
8. Thomas: Transmission Electron Microscopy.
9. Omar: Elementary solid state physics.
10. Aschroft and Mermin : Solid State Physics.
11. Chalking and Lubensky: Principles of Condensed Matter Physics.

M. Sc. (PHYSICS)

SEMESTER - IV

PAPER – II
(NUCLEAR AND PARTICLE PHYSICS)

UNIT-I

Nuclear Interactions :

Nucleon-nucleon interaction, Two-nucleon system, The ground state of the deuteron, Tensor forces, Nucleon-nucleon scattering at low energy, Scattering length, Effective range theory, Spin dependence of nuclear forces, Charge independence and charge symmetry of nuclear forces, Iso-spin formalism, Exchange forces, Meson theory of nuclear forces and the Yukawa interaction.

UNIT-II

Nuclear Decay :

Beta decay, Femi's 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, Multiple transitions in nuclei, Angular momentum and Parity selection rules, Internal conversion, Nuclear isomerism.

UNIT-III

Nuclear models :

Liquid drop model, Bohr-Wheeler theory of fission, Shell Model,
Experimental evidence for shell effects, Single particle shell model, Spinorbit
interaction and magic numbers, Analysis of shell model predictions,Magneticmoments and Schmidt lines, Collective model of Bohr and Mottelson.

UNIT–IV

Elementary particle Physics:

The fundamental interactions, Classification of elementary particles, Leptons and Hadrons, Symmetries, groups and conservation laws, SU(2) and SU(3) multiplets and their properties, Quark model, Properties of

Quarks, the standard model. Q-equation and threshold energies, Reactions cross sections, Resonance: Breit-Wigner single-level formula, Direct and compound nuclear reactions, Formal reaction theory: Partial wave approach and phase shifts, Scattering matrix, Reciprocity theorem,

TEXT AND REFERENCE BOOKS:

1. A.Bohr and B.R.Mottelson, Nuclear structure, vol. 1 (1969) and vol.2, Benjamin, Reading, A, 1975.
2. Kenneth S.Kiane, Introductory Nuclear Physics, Wiley, New York, 1988.
3. Ghoshal, Atomic and Nuclear Physics vol.2.
4. P.H.Perking, Introduction to high energy physics, Addison-Wesley, London, 1982.
5. Shriokov Yudin, Nuclear Physics vol.1 & 2, Mir Publishers, Moscow, 1982.
6. D.Griffiths, introduction to elementary particles, harper and row, New York, 1987.
7. H.A.Enov, introduction to Nuclear Physics, Addison-Wesley, 1973.
8. G,E.Brown and A.D.Jackson, Nucleon-Nucleon interaction North-halland Amsterdam, 1976.
9. S.D.Benedetti, Nuclear interaction, John Willey and sons, NewYork, 1964.
10. M.K.Pal, theory of Nuclear structure, affiliated East West, Madras, 1982.
11. Y.R.Waghmare,introductory nuclear physics, Oxford, IBH, Bombay, 1981.
12. J.M.Longo, elementary particles, McGraw Hill, New York, 1971.
13. R.R.Roy and B.P.Nigam, Nuclear Physics, Wiley-Easterm Ltd. 1983.

M.Sc.(PHYSICS)

SEMESTER - IV

PAPER – III
(ATOMIC AND MOLECULAR PHYSICS)

UNIT – I

Bohr theory of spectra of hydrogen and hydrogen like atoms, reduced mass of electron, variation of Rydberg constant. Sommerfeld's elliptical orbit. Space quantization, Pauli's vector atom model, four quantum numbers. Spectra of alkali atoms, Fine structure in alkali spectra, selection and intensity rules Spectral terms arising from l-s coupling, spin orbit interaction, screening constants for alkali spectra Spectra of Alkaline earth atoms, singlet-triplet series, LS and JJ coupling, interaction energy, selection and intensity rules.

UNIT – II

Effect of magnetic field on energy levels (mono valent atoms) Gyromagnetic ratio for orbital and spin motion, vector model, Lande's g-factor, normal and anamolous Zeeman effect, Paschen Back effect. Stark effect Line broadening mechanism. Electron spin resonance, Nuclear magnetic resonance.

UNIT – III

Types of molecules-Diatomic linear symmetric top, asymmetric top and spherical top
molecules, energy levels and spectra. Rotational energy and spectra of diatomic molecules as rigid rotor and non rigid rotor, inter nuclear distance and isotope effect.
Vibrational energy levels and spectra of diatomic molecules as harmonic oscillator-
Anharmonicity of molecular vibrations, energy levels and spectrum, Morse potential energy curve, isotope effects and force constants

UNIT – IV

Molecule as vibrating rotor- rotator vibrational spectrum of diatomic molecules-PQR
branches Electronic spectra of diatomic molecules- Born Oppenheimer approximation vibrational coarse structure of electronic bands-progression and sequences-Intensity of
electronic bands-Franck Condon principle-Rotational fine structure of electronic bands.

Text and Reference Books:

1. H.E. White Introduction to atomic physics
2. Barrow Introduction to molecular physics
3. G.Herz berg Molecular spectra and molecular structure
4. H.Kuhn Atomic spectra
5. Walker and straugh Spectroscopy Vol I,II,III

M.Sc. (PHYSICS)

SEMESTER - IV

PAPER – IV
(ELECTRONICS – IV)

UNIT – I

Microprocessor & Micro Computers :

Evolution of Microprocessor, Internal Microprocessor, Architecture, Architecture of
digital Computer

Memory : - Semiconductor memories (RAM, ROM, PROM, EPROM, Shift register).

Magnetic Memory: - Floppy disks, Hard disks, Optical Disks, Magnetic Bubble Memory.

Networking : Local Area Networking (LAN) , LAN topology (Bus, Star, Ring) .

UNIT – II

Intel 8085 : ALU, Timing and Control Unit, Registers, Data and Address Bus, Pin
Configuration.

Instruction Cycle : Op-code and Operands, Fetch Operation, Execute Operation, Machine Cycle, Instruction and Data flow.

Time Diagram : Opcode Fetch Cycle, Memory read, I/O Read, Memory write, I/O Write.

UNIT – III

Addressing Modes : Direct Addressing, Register addressing, Register Indirect
Addressing, Immediate Addressing, Implicit Addressing.

Instruction set of 8085 : Data transfer group, Arithmetic group, Logical group.

Assembly Language Programs: Addition of Two 8-bit number, Sum 8-bit , Addition of
Two 8-bit number, sum 16-bit, 8-bit subtraction, Find the largest number in a data array, To arrange a series of numbers in Descending order, Find the smallest number in a data array, To arrange a data array in ascending order, Shift of 8-bit number of left by one bit and two bit , Shift of 16-bit number left by one and two bit.

UNIT – IV

Optical Fibers: Introduction, Structure, Classification, Refraction and Snell's law, Total
internal refraction, Light propagation through and optical fiber, Acceptance angle for
incident ray, Numerical Aperture, number of modes and cut-off parameter, single mode
propagation, comparison of step and graded index fiber.
Types of Optical Fiber : HPSUU, HPSIR, Halide fiber
Optical fiber cables : Multifibre cable, Splicing and connectors.
Advantage and Disadvantage of optical fiber.

Text and Reference Books :

1. Fundamental of microprocessor and microcomputer – B. Ram, Dhanpat Rai Publication ,New Delhi
2. Introduction to microprocessor – Aditya Mathur, Tata McGraw Hills, New Delhi
3. Microprocessor Architecture, programming and application with 8085/8086- Ramesh S.Gaonkar Wiley Eastern Ltd. 1987.
4. Optical Fibres and Fibre Optic Communication Systems – Subir Kumar Sarkar (S.Chand & company Ltd.)
5. Optical Fiber Communications (Principle and Practice) John M. Senior Prentice Hall of India Pvt. Ltd.