(Approved by Academic Council, RU Ranchi)

MARWARI COLLEGE, RANCHI

(AN AUTONOMOUS UNIT OF RANCHI UNVERSITY FROM 2009)

DEPARTMENT OF PHYSICS

COURSES OF STUDY FOR PHYSICS HONOURS

Number of Papers: 20

(14 Theory papers & 6 Practical Papers)

Full Marks: 1600
Theory: 1200, Practical: 400

Number of Semesters: 6

B.Sc. Hons. Part - I: 400 Marks
(Theory: 300, Practical: 100)

B.Sc. Hons. Part - II: 400 Marks
(Theory: 300, Practical: 100)

B.Sc. Hons. Part - III: 800 Marks
(Theory: 600, Practical: 200)

DISTRIBUTIONS OF MARKS IN PHYSICS HONS.											
ACADEMIC YEAR	SEMESTER	THEORY PAPER	FULL MARKS			PASS MARKS	DURATION	PRACTICAL PAPER	FULL MARKS	PASS MARKS	DURATION
			MSE	ESE	TOTAL						
FIRST YEAR	I	1	25	50	75	34	3 HRS.	3	50	23	4 HRS.
		2	25	50	75	34	3 HRS.				
	II	4	25	50	75	34	3 HRS.	6	50	23	4 HRS.
		5	25	50	75	34	3 HRS.				

DISTRIBUTIONS OF MARKS IN PHYSICS HONS.											
ACADEMIC YEAR	SEMESTER	THEORY PAPER	FULL MARKS			PASS MARKS	DURATION	PRACTICAL PAPER	FULL MARKS	PASS MARKS	DURATION
			MSE	ESE	TOTAL						
SECOND YEAR	III	7	25	50	75	34	3 HRS.	9	50	23	4 HRS.
		8	25	50	75	34	3 HRS.				
	IV	10	25	50	75	34	3 HRS.	12	50	23	4 HRS.
		11	25	50	75	34	3 HRS.				

DISTRIBUTIONS OF MARKS IN PHYSICS HONS.											
ACADEMIC YEAR	SEMESTER	THEORY PAPER	FULL MARKS			PASS MARKS	DURATION	PRACTICAL PAPER	FULL MARKS	PASS MARKS	DURATION
			MSE	ESE	TOTAL						
THIRD YEAR	V	13	30	70	100	45	3 HRS.	16	100	45	6 HRS.
		14	30	70	100	45	3 HRS.				
		15	30	70	100	45	3 HRS.				
	VI	17	30	70	100	45	3 HRS.	20	100	45	6 HRS.
		18	30	70	100	45	3 HRS.				
		19	30	70	100	45	3 HRS.				

B.Sc. - I

SEMESTER – I

PAPER: 1 (Mathematical methods & General Physics) (50 lectures)

Full Marks: 25(MSE) + **50(ESE) = 75** **Time: 3hrs** **Pass Marks: 34**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A Short-answer type questions −two out of four questions are to be answered (2x 5 = 10).

Group B Long-answer type questions − four out of six questions are to be answered (4 x 10 = 40)

MATHEMATICAL METHODS IN PHYSICS (I) (25)

1. **THEORY OF ERRORS**: Standard and probable errors, propagation of errors, Principle of least squares fitting of data(linear case)
2. **DIFFERENTIAL EQUATIONS**: Differential equation of first and second order and first degree (homogeneous and inhomogeneous with constant coefficients) and their solutions.
3. **SPECIAL FUNCTIONS**: Gamma and beta function and their properties.

GENERAL PHYSICS (25)

1. **ELASTICITY:** Relation between different elastic constants, Torsional rigidity of cylinder, Torsional oscillations, Searl's method of determination of elastic constants of a material.
2. **SURFACE TENSION:** Ripple and gravity waves, Determination of surface tension by Ripple and Quinke's methods, Surface tension and evaporation.
3. **VISCOSITY:** Poiseuille's formula for flow of fluid through capillary tubes, Determination of coefficient of viscosity – rotating cylinder method and Rankine's method.
4. **HYDRODYNAMICS:** Equation of continuity. Euler's equation of motion. Bernoulli's theorem from Euler's equation.

Books Recommended:

1. Mathematical Physics by Butkov.
2. Mathematical Method for Physicists by Weber & Arfken.
3. Mathematical Physics by Ghatak, Goyal & Chua
4. Mathematical Physics by Rajput. B.S.
5. Mathematical Phyaics by Gupta, B.D.
6. General Properties of Matter by Newmann & Searle.
7. General Properties of Matter by Mathur, D.S.
8. A Treatise on General Properties of Matter by Chatterjee & Sengupta.
9. Mathematical Physics by Harper.

B.Sc. - I

SEMESTER – I

PAPER: 2 (Mathematical methods & Acoustics) (50 lectures)

Full Marks: 25(MSE) + **50(ESE) = 75** **Time: 3hrs** **Pass Marks: 34**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A Short-answer type questions −two out of four questions are to be answered (2x 5 = 10).

Group B Long-answer type questions − four out of six questions are to be answered (4 x 10 = 40)

MATHEMATICAL MATHODS IN PHYSICS (II) (30)

1. **VECTOR CALCULUS:** Scalar and vector fields, Differentiation of vectors, div, curl and Laplacian operators, Expression for gradient, divergence, curl and Laplacian operator in spherical polar and cylindrical polar co-ordinates.
2. **FOURIER SERIES:** Fourier's theorem and its applications in the analysis of square and saw-tooth waves.

ACOUSTICS (20)

1. Analysis of free and forced vibrations with and without damping, Amplitude and velocity resonance, Sharpness of resonance, Analysis of vibration of a plucked string using Fourier theorem, Sabine's formula and determination of absorption coefficient.

Books Recommended:

1. Mathematical Physics by Ghatak, Goyal & Chua.
2. Vector Analysis by Spiegel.
3. Textbook of Sound by Kinsler & Frey
4. Waves and Acoustics by Chakraborty & Choudhary
5. Sound by Wood, A.
6. A Textbook of Sound by Khanna & Bedi.

B.Sc. - I

SEMESTER – I

PAPER: 3 (Practical)

Full Marks: 50 **Time: 4 hrs** **Pass Marks: 23**

1. Determination of Young's modulus by bending of beam method.
2. Determination of elastic constants by Searl's apparatus.
3. Determination of viscosity of liquid by Poiseuille's method.
4. Verification of Laws of transverse vibration of strings by sonometer.
5. Determination of viscosity of gas by Rankine's apparatus.

B.Sc. - I

SEMESTER – II

PAPER: 4 (Heat & Thermodynamics) (50 lectures)

Full Marks: 25(MSE) + **50(ESE) = 75** **Time: 3hrs** **Pass Marks:34**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A Short-answer type questions −two out of four questions are to be answered (2x 5 = 10).

Group B Long-answer type questions − four out of six questions are to be answered (4 x 10 = 40)

HEAT AND THERMODYNAMICS (50)

1. **KINETIC THEORY OF GASES:** Maxwell's Law of velocity and energy distribution of ideal gas molecules, Experimental verification of the Velocity distribution law (Stern method), Law of equipartition of energy, Mean free path, Maxwell's expression for mean free path.
2. **REAL GASES:** Derivation of Van der Waal's equation of state by Virial theorem, Critical constants of a Van der Waal's gas, Law of corresponding states, Joule-Thomson porous plug experiment and its consequences, Temperature of inversion and its significance in the case of real gases.
3. **THERMODYNAMICS:**
   - **(i)** Carnot's engine, reversible and irreversible processes, reversibility of Carnot's cycle, Carnot's theorem, Absolute scale of temperature.
   - **(ii)** **SECOND LAW OF THERMODYNAMICS:** Different statements, concept of entropy, Clausiuss, inequality, T-ds equations, Maxwell's thermodynamical relations and their applications, Clausius-Clapeyron's relation.
   - **(iii)** **THERMODYNAMICAL POTENTIAL:** Helmholtz free energy, Gibb's free energy, Enthalpy and chemical potential.
   - **(iv)** **THIRD LAW OF THERMODYNAMICS:** Nernst heat theorem and its experimental verification.
4. **RADIATION:** Concept of black body, black body radiation, Stefan Boltzmann's law, and determination of Stefan's constant, pressure due to radiation, Energy distribution in black body radiation, Planck's law and its derivation(Wien's displacement law & Rayligh-Jean's law as special cases).

Books Recommended:

1. A Treatise on Heat by Saha & Srivastava.
2. Heat & Thermodynamics by Chakraboty, P.K.
3. Fundamental of Classical & Statistical Thermodynamics by Roy, B.N.
4. Thermal & Statistical Mechanics by Roy, S.K.

B.Sc. - I

SEMESTER – II

PAPER: 5 (Wave Optics) (50 lectures)

Full Marks: 25(MSE) **+ 50(ESE) = 75 Time: 3hrs Pass Marks:34**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A Short-answer type questions −two out of four questions are to be answered (2x 5 = 10).

Group B Long-answer type questions − four out of six questions are to be answered (4 x 10 = 40)

WAVE OPTICS (50)

1. **INTERFERENCE AND INTERFEROMETERS:** Interference in thin films, Colour of thin films, Newton's ring, Michelson's interferometer – theory and applications.
2. **DIFFRACTION:** Fresnel and Fraunhofer diffraction, Half period zones, Rectilinear propagation of light, Zone plate, Diffraction due to a straight edge, Fraunhoffer diffraction due to a single slit, double slit and N-slits, Plane transmission grating.
3. **RESOLVING POWER:** Rayleigh's criterion of limit of resolution, resolving power of grating specrometer and prism spectrometer.
4. **POLARISATION :** Double refraction, Nicol prism, Propagation of waves in uni-axial crystals, Retardation plates- quarter and half wave plates, Production and detection of plane, circularly and elliptically polarized light, Babinet's compensator- theory and its application in the analysis of elliptically polarized light.
5. **OPTICAL ACTIVITY:** Theory of rotatory polarization, half shade polarimeter.
6. **VELOCITY OF LIGHT:** Group and phase velocity, Measurement of velocity of light by Anderson's method.

Books Recommended:

1. Introduction to Geometrical and Physical Optics by Mathur, B.K.
2. Optics by Ghatak, A.

B.Sc. - I

SEMESTER – II

PAPER: 6 (Practical)

Full Marks: 50 **Time: 4 hrs** **Pass Marks: 23**

1. Determination of Stefan's constant.
2. Determination of wavelength of sodium light using Newton's ring.
3. Determination of refractive index of the material of the prism by (i-δ) method using spectrometer.
4. Determination of wavelength of sodium light using a biprism on optical bench.
5. Determination of wavelength of given light by plane transmission grating.

B.Sc. - II

SEMESTER – III

PAPER: 7 (Electrostatics & Magnetism) (50 lectures)

Full Marks: 25(MSE) + **50(ESE) = 75 Time: 3hrs Pass Marks: 34**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A:Group A Short-answer type questions −two out of four questions are to be answered (2x 5 = 10).

Group B:Group B Long-answer type questions − four out of six questions are to be answered (4 x 10 = 40)

Group C:

ELECTROSTATICS (25)

1. Electric moments, Potential due to a system of charges, Multipole expansion of an arbitray distribution of charges (Monopole, dipole and quardrupole), Poission's and Laplace's equations, Electrical polarization and displacement relation, Energy density in an electric field due to an arbitray distribution of point charges, Arbitray volume distribution of dipoles and corresponding volume and surface distribution of charge($\sigma_p = P\hat{n}$ and $n = -div.P$), Boundary conditions at the interface of two dielectric media and their application to uniform electric field, Electronic, Ionic, and orientational polarisability, Clausius-Mossotti relation, Langevin-Debye equation.

MAGNETISM (25)

2. Boundary conditions at the interface of two media and application to a sphere of magnetic material placed in a uniform magnetic induction, Demagnetizing factor, Magnetic hysteresis, Hysteresis loss and measurement by magnetometer and ballistic galvanometer method, Origin of magnetic moment, Geomagnetic ratio and gyromagnetic anomaly, Stern-Gerlach experiment, Langevin's theory of dia- and para-magnetism.

Books Recommended:

1. Textbook of Electrical Technology by Theraja, B.L.
2. Electrical Technology by Cotton.
3. Electricity & Magnetism by Tayal, D.C.
4. Classical Electricity & Magnetism by Panofsky & Phillips.
5. Electricity & Magnetism by Tewari, K.K.
6. Theory & Problems in Circuit Analysis by Iyer.
7. Electromagnetism : Theory and Application by Pramanik, A.
8. Electromagnetism by B.B. Laud.
9. Electromagnetic waves and Radiation by Jorden & Balrmain.
10. Magnetism by L.F. Bates.
11. Magnetism by Stoner.
12. Electromagnetism by Agrawal and Chopra.

B.Sc. - II

SEMESTER – III

PAPER: 8 (Current Electricity) (50 lectures)

Full Marks: 25(MSE) + **50(ESE) = 75** **Time: 3hrs** **Pass Marks: 34**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A Short-answer type questions −two out of four questions are to be answered (2x 5 = 10).

Group B Long-answer type questions − four out of six questions are to be answered (4 x 10 = 40)

CURRENT ELECTRICITY (50)

Review of Kirchoff's laws, Mesh and loop analysis methods in solving electrical networks, Concept of phasor and phasor diagram, General theory of moving coil aperiodic and ballistic galvanometers and their applications, General theory of a voltage transformer and its phasor diamgram, Autotransformer.

3-phase balanced system, star and delta connections, Rotating magnetic field and single phase induction motor.

Order of a network, Driven and un-driven second order passive network (RLC) in time domain, Steady state analysis of a second order passive networks(RLC).
AC bridges-Schering bridge, Anderson bridge (with vector diagram) and Carey-Foster bridge.

Concept of transducer, Temperature and displacement transducers, Strain gauge and its simple applications.

Seebeck, Peltier and Thomson effects, Thermoelectric power, Thermoelectric diagram, Experimental determination of Peltier and Thomson coefficients, Application of thermodynamics to thermoelectric circuits.

Books Recommended:

1. Textbook of Electrical Technology by Theraja, B.L.
2. Electrical Technology by Cotton.
3. Electricity & Magnetism by Tewari, D.C.
4. Classical Electricity & Magnetism by Panofsky & Phillips.
5. Electricity & Magnetism by Tewari, K.K.
6. Theory & Problems in Circuit Analysis by Lyer.
7. Electromagnetism: Theory and Application by Pramanik, A.
8. Electricity & Magnetism by Starlin.
9. AC Bridges by Hegue.

B.Sc. - II

SEMESTER – III

PAPER: 9 (Practical)

Full Marks: 50 **Time: 4 hrs** **Pass Marks: 23**

1. Verification of Rayleigh's Criteria for limit of resolution of two spectral lines using Grating spectrometer.
2. Verification of Rayleigh's Criteria for limit of resolution of two spectral lines using Prism spectrometer.
3. Determination of figure of merit of moving coil aperiodic Galvanometer.
4. Calibration of ammeter and Voltmeter using Potentiometer.
5. Calibration of Thermocouple to determine melting point of Wax.

B.Sc. - II

SEMESTER – IV

PAPER: 10 (Mathematical methods in Physics & Electromagnetic Theory) (50 lectures)

Full Marks: 25(MSE) + **50(ESE) = 75 Time: 3hrs Pass Marks: 34**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A Short-answer type questions −two out of four questions are to be answered (2x 5 = 10).

Group B Long-answer type questions − four out of six questions are to be answered (4 x 10 = 40)

MATHEMATICAL METHODS IN PHYSICS (III) (20)

1. Series solution of 2^{nd} order differential equation, Legendre, Bessel and Hermite differential equations and their solutions.
2. **INTEGRAL TRANSFORMS :** Laplace transform and its basic properties Laplace transform of elementary functions, Transform of derivatives and intergrals, Inverse transform, Convolution theorem, Applications to simple problems described by first and second order differential equations.

ELECTROMANETIC THEORY (30)

3. Maxwell's field equations in vacuum and in linear isotropic media, Boundary conditions on the fields at interfaces, Poynting's vector, Plane waves in vacuum and in continuous media, Reflection and refraction of electromagnetic waves at interface of two dielectric media, Radiation from an accelerated charged particle along and perpendicular to the direction of motion, Propagation of electromagnetic waves in a conduction media, Electromagnetic theory of dispersion.

Books Recommended:

1. Electrodynamics by Griffith.
2. Electromagnetic Theory by Chopra & Agarwal.
3. Electromagnetic Theory & Electrodynamics by Satya Prakash.
4. Electromagnetic Theory by Gupta & Kumar.
5. Laplace Transform by Spiegel.

B.Sc. - II

SEMESTER – IV

PAPER: 11 (Plasma, Special theory of relativity & Atomic Physics) (50 lectures)

Full Marks: 25(MSE) + **50(ESE) = 75 Time: 3hrs Pass Marks: 34**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A Short-answer type questions −two out of four questions are to be answered (2x 5 = 10).

Group B Long-answer type questions − four out of six questions are to be answered (4 x 10 = 40)

PLASMA (15)

1. Basic condition for plasma existence, Concept of Debye length, Paschen's Law, Characteristic plasma oscillations, Particle orbit and drift velocities in a plasma in homogeneous and inhomogeneous magnetic fields, Magnetic moments and its constancy, Magnetic mirrors.
2. **MAGNETOHYDRODYNAMICS:** Hydromagnetic equations, Magnetic pressure and tension, Pinch effect and Alfven wave, Propagation of electromagnetic waves through isotropic plasma.

SPECIAL THEORY OF RELATIVITY (20)

3. Galilean transformation, Inertial frame of reference, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformation, Length contraction and time dilation, Addition of velocities, Velocity dependence of mass, Mass-energy equivalence, Four-vector, Minkowski's space.

ATOMIC PHYSICS (15)

4. Bohr's theory of hydrogen atom, Bohr-Sommerfeld theory, statement of selection rule for atomic transition and their applications to sodium atom, Concept of electron spin, Vector model of atom, L-S and j-j couplings, Normal and anomalous Zeeman effect using vector model of atom.

Books Recommended:

1. Elements of Spectroscopy by Gupta & Kumar.
2. Atomic & Nuclear Physics by Ghosal, S.N.
3. Atomic Spectra by White.
4. Introduction to Special Relativity by Resnick.
5. Relativistic Mechanics by Satya Prakash.
6. Plasma Physics by S.N. Sen.
7. Plasma Physics by S. Chandrashekhar.

B.Sc. - II

SEMESTER – IV

PAPER: 12 (Practical)

Full Marks: 50 **Time: 4 hrs** **Pass Marks: 23**

1. Investigation of the temperature dependence of radiation from a hot filament.
2. Determination of ballistic constant of a moving-coil Ballistic Galvanometer.
3. Measurement of inductance of a given coil using Anderson's bridge.

B.Sc. - III

SEMESTER – V

PAPER: 13 (Classical Mechanics & Quantum Mechanics - I) (50 lectures)
Full Marks: 30(MSE) + **70(ESE) = 100 Time: 3hrs Pass Marks: 45**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A: Short-answer type questions −two out of four questions are to be answered (2 x 5 = 10).

Group B: Long-answer type questions − four out of six questions are to be answered (4 x 15 = 60)

CLASSICAL MECHANICS (25)

1. Generalized co-ordinates and momenta, Lagrange's function, Derivation of Lagrange's equation using Hamilton's principle, Application of Lagrange's equaton to simple and compound pendulum. Hamilton's function. (Derivation of Hemilton's Canonical equation of motion using principle of least action and application to simple and Compound pendulum) Cyclic co-ordinates, Conservation laws, Canonical transformations, Poisson's bracket Poisson's Theorem, Hamilton-jacobi equations and application to harmonic oscillator.
2. Motion in central field, Kepler's laws and its derivation.
3. Rotating frame of reference, Centrifugal and coriolis forces, Euler's equations of motion for a rotating body, Euler's angle**s.**

QUANTUM MECHANICS (I) (25)

4. Inadequacy of classical mechanics, Origin of old quantum theory, Discreteness of energy, Franck and Hertz experiment, Wave-particle duality of matter and radiation (Photoelectric effect, Compton effect, Davisson and Germer experiment,). Statement of Heisenberg uncertainty principle & its simple applications, Wave function and its physical meaning, wave packets, Schrodinger time-dependent and time-independent equations, Concept of stationary states, Probability density and probability current density.

   One-dimensional potential problems, Rectangular potential barrier, Square well potential of infinite and finite height, Tunnel effect, Particle in a rectangular box, Simple harmonic oscillator, Rigid rotator.

Books Recommended:

1. Quantum Mechanics by Ghatak & Loknathan.
2. Introduction to Quantum Mechanics by Ghatak, A.
3. Quantum Mechanics by Venkatesh & Mathew.
4. Quantum Mechanics by Schiff.
5. Classical Mechanics by Gupta & Kumar.
6. Classical Mechanics by Goldstein.
7. Introduction to Classical Mechanics by Takwale.
8. Quantum Theory by David Park.
9. Quantum Mechanics by Satya Prakash.
10. Quantum Mechanics by R.K. Sriwastawa.

B.Sc. - III

SEMESTER – V

PAPER: 14 (Solid State Physics - I & Statistical Physics = I) (50 lectures)
Full Marks: 30(MSE) + **70(ESE) = 100 Time: 3hrs Pass Marks: 45**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A: Short-answer type questions −two out of four questions are to be answered (2 x 5 = 10).

Group B: Long-answer type questions − four out of six questions are to be answered (4 x 15 = 60)

SOLID STATE PHYSICS (I) (30)

1. **PERIODIC STRUCTURE :** Space-lattice, Lattice translational vector, Primitive lattice cell, Wigner-Seitz cell, Bravais lattice in two and three dimensions, Miller indices, Simple crystal structure (sodium chloride and Cesium chloride), Periodic function and reciprocal lattice, properties of reciprocal lattice, Diffraction condition and Bragg's law, Brillouin zone.
   CRYSTAL BINDING: Van der Walls, Ionic, Covalent, Metallic and Hydrogen bonded crystals, Cohesive energy of inert gas crystals, Madelung energy and Madelung constant.
2. **SPESIFIC HEAT OF SOLIDS:** Dulong-Petit's law, Einstein and Debye theories of specific heat of solids at low temperature.

STATISTICAL PHYSICS – I (20)

(i) Need for statistical physics, Phase space, Liouvelle's theorem and its consequences, Entropy and statistical weight, Gibbs ensemble: Microcanonical distribution, Gibbs paradox, Canonical ensemble, distribution function, Partition function and thermodynamical functions, Grand ensemble distribution function, Grand partition function and thermodynamical functions.

Books Recommended:

1. Solid State Physics by Gupta, Saxena & Gupta.
2. Introduction to Solid State Physics by Kittel.
3. Solid State Physics by Dekker.
4. Solid State Physics by Singhal, R.L.
5. Fundamentals of Statistical Mechanics by Laud, B.B.
6. Statistical Mechanics by Huang.
7. Thermodynamics & Statistical Mechanics by Greiner.
8. Statistical Physics by Patharia.
9. Statistical Mechanics by Gupta & Kumar.
10. Statistical Mechanics by Satya Prakash.
11. Statistical Mechanics by Srivastwa & J. Ashok.

B.Sc. - III

SEMESTER – V

PAPER: 15 (Analog Electronics –I & Digital Electronics-I) (50 lectures)
Full Marks: 30(MSE) + **70(ESE) = 100 Time: 3hrs Pass Marks: 45**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A: Short-answer type questions −two out of four questions are to be answered (2 x 5 = 10).

Group B: Long-answer type questions − four out of six questions are to be answered (4 x 15 = 60)

ANALOG ELECTRONICS – I (25)

1. **NETWORK THEOREMS:** 2-port network and its T and π representations, Thevenin, Norton, Superposition, Reciprocity and Maximum power transfer theorems, Miller theorem.
2. Entrinsic and Extrinsic Semiconductros, p-n junction, Biasing and energy level diagram. **Diode and Waveshaping circuits:-** Diode as a circuit element, Diode parameters, Diode rectifier circuits(Half and Full wave), Ripple factor, Smoothing RC filters, Limitation of diode as a rectifier, Clipping and clamping circuits, Zener diode regulator and Zener diode regulated power supply.
3. **BJT-BASED CIRCUITS:** Bipolar junction transistor structure, modes of operation, dc characteristics and dc parameters, Load line and Q- point, Biasing circuits (voltage divider and emitter bias) and Small-signal equivalent models(low and high frequencies).
4. **JFET:** Structure, Modes of operation, DC Characteristics curve & parameters, Biasing JFET using voltage divider and self Biasing.

DIGITAL ELECTRONICS-I (25)

Decimal, binary, octal, hexadecimal, BCD number systems and their inter-conversion, Decimal number addition and subtraction using 9's and 10's compliment, Binary addition and subtraction using 1's and 2's complement, Multiplication and division, Conversion of fractional and mixed decimal numbers into binary and vice-versa, Logic gates(AND, OR, NOT, NAND, NOR, XOR, XNOR), Conversion of a given truth table into its Boolean expression and logic realization and vice-versa, Logic simplification using Boolean Algebra and Karnaugh's map

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Books Recommended:

1. Electronic Principles by Malvino.
2. Handbook of Electronics by Gupta & Kumar.
3. Integrated Electronics Analog and Digital Circuits and Systems by Millman & Halkais.
4. Electronic Devices by Floyd.
5. Principle of Electronics by Mehta, V.K.
6. Digital Computer Electronics by Malvino & Brown.
7. Fundamentals of Digital Circuits by A. Anand Kumar.
8. Digital Principles and Application by Malvino & Leach.
9. Digital Fundamentals by Floyd.
10. Electronics: Fundamentals and Applications by Chattopadhyay & Rakshit.

B.Sc. - III

SEMESTER – V

PAPER: 16 (PRACTICAL)

Full Marks: 100 **Time: 6 hrs** **Pass Marks: 45**

1. Evaluate the parameters of a p-n junction diode and draw the characteristic curves Verity the diode equation.
2. Obtain the V-I Characteristic of a Zener diode and evaluate its parameters. Use the Zener diode as a voltage regulator.
3. Study the validity of reciprocity and the maximum power transfer theorem.
4. Obtain the basic logic gates using NAND gates and verify their truth tables.
5. Set up the full wave bridge rectifier and determine the ripple factor in each case.
6. Obtain the BJT characteristics curves in CB and CE configurations and the evaluation of BJT and hence evaluate the BJT small signal hybrid parameter.
7. JFET characteristic curves in CS mode and the evaluation of JFET small-signal parameter.

B.Sc. - III

SEMESTER – VI

PAPER: 17 (Nuclear Physics, Quantum Mechanics –II & Laser Physics) (50 lectures)

Full Marks: 30(MSE) + **70(ESE) = 100** **Time: 3hrs** **Pass Marks: 45**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A: Short-answer type questions −two out of four questions are to be answered (2 x 5 = 10).

Group B: Long-answer type questions − four out of six questions are to be answered (4 x 15 = 60)

NUCLEAR PHYSICS (20)

1. **BASIC PROPERTIES OF NUCLEI:** Nuclear size, Nuclear mass and Density, binding energy and Stability, Semi-empirical mass formula. Law of radioactive decay, Radioctive growth and decay, Statistical errors in nuclear physics. Theory of ground state of deuteron and elementary discussions about the possible nature of nuclear forces.
2. **INSTRUMENTS AND MEASUREMENTS:**
   a. **Detector:-**Ionization Counter, Proportional Counter, GM Counter.
   b. **Accelarators:**-Cyclotron, Synchro-Cyclotron, Betatron.
   c. **Mass Spectrograph:** Aston's mass spectrograph, Bainbridge and Jordon double focusing mass spectrograph.

QUANTUM MECHANICS -II (20)

3. Linear operator, Hermitian operator, Eigenvalues and eigenfunction of Hermitian operator, Physical quantities as Hermitian operator, Properties of Hermitian Operator Simultaneous measurement and commutability of operators, Derivation of uncertainty relation using Schwartz inequality. Expectation value and its time variation, Ehrenfest theorem.

LASER PHYSICS (10)

Elementary idea of spontaneous and induced emission. Life time of excited states(metastable States). Population inversion, Characteristics properties of laser, Thershold condition for laser oscillation. Rate equations in two and three level systems. Actual laser systems: He-Ne laser, Ruby laser.

Books Recommended:

1. Fundamentals of Statistical Mechanics by Laud, B.B.
2. Statistical Mechanics by Huang.
3. Thermodynamics & Statistical Mechanics by Greiner.
4. Quantum Mechanics by Ghatak and Loknathan.
5. Introduction to Quantum Mechanics by Ghatak, A.
6. Quantum Mechanics by Venkatesh & Mathew.
7. Quantum Mechanics by Schiff.
8. Nuclear Physics by S.B. Patel.
9. Nuclear Physics by Herldey.
10. Laser and its Application by Ghatak & Tyagrajan.
11. Laser by Laud, B.B.
12. An Introduction to Laser Theory and Applications by Avadhanulu, M.N.
13. Laser Application by Sirohi.

B.Sc. - III

SEMESTER – VI

PAPER: 18 (Solid State Physics –II & Statistical Physics-II) (50 lectures)
Full Marks: 30(MSE) + **70(ESE) = 100 Time: 3hrs Pass Marks: 45**

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A: Short-answer type questions −two out of four questions are to be answered (2 x 5 = 10).

Group B: Long-answer type questions − four out of six questions are to be answered (4 x 15 = 60)

SOLID STATE PHYSICS -II (35)

1. **LATTICE WAVES:** Vibration of monatomic and diatomic linear chain, Acoustical and optical branches.
2. **FREE ELECTRON THEORY:** Free electron gas in metals. Weidmann-Franz law, Fermi energy, Fermi surface, Hall effect, Failure of free electron gas model**.**
3. **ELEMENTARY BAND THEORY:** Periodic potential and Elementary proof of Bloch's theorem, Kroning-Penny model, Band gap, Effective mass, Band Structue of metals, insulators and semiconductors**.**

STATISTICAL PHYSICS -II (15)

1. **MONATOMIC IDEAL GAS:** Boltzmann distribution law, Equation of state, Free energy, Specific heat.
2. **QUANTUM MONATOMIC GAS:** Fermi-Dirac distribution, Degenerate electron gas, Specific heat of degenerate electron gas, Bose-Einstein distribution law, Application to black body radiation, Planck's law, Stefan's law.

Books Recommended:

1. Fundamentals of Statistical Mechanics by Laud, B.B.
2. Statistical Mechanics by Huang.
3. Solid State Physics by Gupta, Saxena & Gupta.
4. Introduction to Solid State Physics by Kittel.
5. Solid State Physics by Dekker.
6. Solid State Physics by Singhal, R.L.

B.Sc. - III

SEMESTER – VI

PAPER: 19 (Analog Electronics-II & Digital Electronics-II) (50 lectures)
Full Marks: 30(MSE) + 70(ESE) = 100 Time: 3hrs Pass Marks: 45

Instructions to paper setter & Examinee

Examiners are advised to select questions in both the theory papers in two groups:

Group A: Short-answer type questions −two out of four questions are to be answered (2 x 5 = 10).

Group B: Long-answer type questions − four out of six questions are to be answered (4 x 15 = 60)

ANALOG ELECTRONICS -II (35)

1. **AMPLIFIERS:** features of amplifier configurations, Analysis and design of RC coupled voltage amplifiers using BJT (CE mode) and JFET (CS mode), Classes of amplifiers, Push-pull class- B amplifier.
2. **FEEDBACK:** Feedback concept and feedback equation, Positive and negative feedback, Characteristics of negative feedback, Criteria of oscillation, RC phase shift and Wein bridge oscillators.
3. **OPERATIONAL AMPLIFIER CIRCUITS:-** BJT and FET based difference amplifiers and the performance analysis(including CMRR), Ideal opamp characteristics and parameters, Opamp symbol and its ideal equivalent model, Basics op-amp circuits such as: inverting, non-inverting, voltage amplifier, adder, difference, differentiating and integrating circuits.

DIGITAL ELECTRONICS-II (15)

Half and Full adder, R-S, J-K and Master-Slave Flip-flops and their timing diagrams.

Books Recommended:

1. Electronic Principles by Malvino.
2. Handbook of Electronics by Gupta & Kumar.
3. Electronic Devices by Floyd.
4. Principle of Electronics by Mehta, V.K.
5. Electronic: Fundamentals and Applications by Chattopadhyay & Rakshit.

B.Sc. - III

SEMESTER – VI

PAPER: 20 (PRACTICAL)

Full Marks: 100 Time: 6 Hrs. Pass Marks: 45

1. Determine the z,y, h-parameters of a given "black box" and verity it using the data sheet.
2. Design of a BJT based voltage amplifier in CE configuration and study its frequency response.
3. Design of an n-channel JFET-based voltage amplifier in CS configuration and Study of its frequency response.
4. Study the frequency response of an OP-AMP based inverting and non-inverting voltage amplifier as a function of frequency.
5. To measure the diameter of a circular aperture using Fresnel's diffraction with a LASER Source.
6. To measure the Brewster's angle of a glass plate and hence the refractive index of glass.