B.Sc . Second Year : Annual Mode

Paper 1: Heat Thermodynamics and Statistical Physics MM 75

Paper 2: Optics MM 75

Practical (100 Marks)

B.Sc . Third Year : Annual Mode

Paper 1: Modern Physics MM 75

Paper2: Electronics MM 75

Practical (100 Marks)

B.Sc. 2nd Year (2022-23)

Programme: *B.Sc.*	Year: II	Paper-I
Subject: Physics		
Course Code:	**Course Title: Heat, Thermodynamics and Statistical Physics**	

Course Outcomes:

1. Recognize the difference between reversible and irreversible processes.
2. Understand First and Second Law of Thermodynamics and concept of Entropy.
3. Understand the physical significance of thermodynamical potentials.
4. Comprehend the kinetic model of gases w.r.t. various gas laws.
5. Study the implementations and limitations of fundamental radiation laws.

Unit	Topic	No. of Lectures
Unit I	**First and Second Law of Thermodynamics and Entropy** Thermodynamic Systems, Thermal equilibrium and Zeroth law of thermodynamics, Equation of state and First law of thermodynamics, Discussion of Heat and Work, Quasi-static Work; Reversible and Irreversible; Path Dependence; Heat Capacities Adiabatic Processes, Vander Wall equation, Distinction between Joule, Joule-Thompson and Adiabatic expansion of a gas. Insufficiency of first law of thermodynamics, Condition of Reversibility, Carnot‟s Engine and Carnot‟s Cycle, Second law of thermodynamics, Carnot‟s Theorem, Thermodynamic scale of temperature and its identity to perfect gas, scale of temperature. Entropy, Mathematical formulation of Second law of thermodynamics, Entropy of an ideal gas, T-S diagram and its applications, Evaluation of Entropy changes in simple cases, Third law of thermodynamics.	**15**
Unit II	Thermodynamic potentials, Maxwell's equation from thermodynamic potentials, Some useful manipulations with partial derivatives (cooling in adiabatic processes and Adiabatic stretching of a wire), The Clausius–Clapeyron's equations, Triple point, Applications of Maxwell's thermo dynamical relations.	**10**
Unit III	**Transport of Heat** Modes of heat transfer via Conduction, Convection and Radiation, Fourier‟s law, One dimensional steady state conduction, Heat conduction through plane Thermal conductivity and its experimental detection, Newton‟s law of cooling, Dimensional analysis applied to forced and free convection. Black body radiation, Thermodynamics of radiations inside a hollow enclosure, Kirchoff‟s	**10**

	Laws, Derivation of Stefan Boltzmann Law, Wein‟s displacement law, Black body spectrum formulaearly attempts, Raleigh Jean‟s Law, Quantum theory of Radiation, Planck‟s formula for black body spectrum, Wien‟s law, Radiation as a photon gas.	
Unit IV	**Kinetic Theory of Gases** Kinetic theory of gases, Microscopic description of an Ideal gas, Degrees of freedom, Law of Equipartition of Energy, Distribution law of velocities, Most probable speed, Average speed and root mean square velocity of molecules, Pressure exerted by a perfect gas, Kinetic Interpretation of Temperature	**10**
Unit V	**Basic Concepts in Statistical Physics** Basic postulates of Statistical Physics, Macro and Micro States, Phase Space, Density distribution in phase space, μ space representation and its division, Statistical average values, Condition of equilibrium, Stirling's Approximation, Entropy and Thermodynamic probability, Boltzmann entropy relation. Ensembles, Micro -canonical, Canonical and Grand Canonical ensembles, Statistical definition of temperature and interpretation of second law of thermodynamic, Pressure, Entropy and Chemical potential. Entropy of mixing and Gibb's paradox, Partition function and Physical significances of various statistical quantities.	**15**

Suggested Reading

1. S. Loknathan : Thermodynamics, Heat and Statistical Physics
2. Sharma and K.K. Sarkar : Thermodynamics, and Statistical Physics
3. Brijlal and Subrahmanyam : Heat and Thermodynamics
4. Garg, Bansal and Ghose : Thermal Physics, McGraw Hill, 2012.
5. M.W. Zemansky, R. Dittman, "Heat and Thermodynamics", McGraw Hill, 1997.
6. Enrico Fermi, "Thermodynamics", Dover Publications, 1956.
7. MeghnadSaha, B.N. Srivastava, "A Treatise on Heat", Indian Press, 1973
8. F.W. Sears, G.L. Salinger, "Thermodynamics, Kinetic theory & Statistical thermodynamics", Narosa Publishing House, 1998.

Practicals: (4 hrs per week) Total: 60hrs

List of Expts. for B.Sc. year-II (at least fifteen experiments which cover understanding oftheory course)

1. Thermal conductivity of bad conductor.
2. Mechanical equivalent of heat by Searle's method.
3. Thermal conductivity of a good conductor by searle's method.
4. To study the variation of Thermo-emf of a Thermocouple with Different Temperature.
5. Stefan's Law and to determine the Stefan's constant.
6. Platinum resistance thermometer.
7. J-Callendar and Barne's method.
8. Newton's law of cooling - Specific heat of kerocene oil.
9. To determine the Critical temperature and critical pressure of a gas.
10. To measure temperature with the help of Joule's constant volume air thermometer.
11. Nodal slide assembly, Location of cardinal points of lens system.
12. Newton's formula.
13. Dispersive power of prism.
14. Resolving power of a telescope.
15. To determine the Resolving Power of a Prism.
16. Biprism- determination of λ.
17. Newton's ring experiment- Determination of λ.
18. Determination of λ by a transmission grating.
19. Cauchy's formula.
20. Zone-plate experiment study of different orders.
21. Absorption of light.
22. Malus' Law.
23. Specific rotation in cane sugar solution.
24. To determine the thickness of mica-sheet by using Biprism.
25. Random events- Statistical board method.

Programme: *B.Sc.*	Year: II	Paper-II
Subject: Physics		
Course Code:	**Course Title: Optics**	

Course Outcomes:

1. Study of Fermat's Principle of Extremum Path and understand fundamental physics behind reflection and refraction of light.
2. Understand the theory of image formation by an optical system.
3. Study of different types of optical Aberrations and techniques for their reduction.
4. Study of different types of optical instruments used in industry and research

Unit	Topic	No. of Lectur
Unit I	**Fermat's Principle and Theory of Image Formation** Fermat's principle of extremum path and its application to deduce laws of reflection and refraction, Refraction at concave surface, Principal foci, Lateral and longitudinal magnifications, Aplanatic points of spherical surface. Gauss's general theory of image formation, Coaxial symmetrical system, Cardinal points of an optical system, General relationships, Thick and Thin lens, lens combinations, Newton's formula, Coaxial lens system, Lagrange's equation of magnification, Refraction through a thick lens. Nodal Slide, Eyepiece, Ramsden's, Huygen's and Gaussian eyepieces, Their comparison, Astronomical refracting telescope, Microscopes, Spectrometer and its uses, Oil immersion objectives meniscus lens.	**15**
Unit II	**Optical Aberrations and Dispersion** Aberrations in images, Spherical aberration, Monochromatic and Chromatic aberration, Condition of achromatism, Achromatic combination of lenses in contact and separated lenses, Spherical mirrors and Schmidt corrector plates, Theory of dispersion. .	**10**
Unit III	**Interference** The principle of superposition, Two slit interference, coherence, Division of wave front and amplitude, Optical path retardations lateral shift of fringes, Fresnel biprism, Interference with multiple reflection, Thin films, Application	**15**

	for precision measurements, Haidinger fringes, Fringes of equal thickness and equal inclination. Michelson intereferometer and its application for precise measurement of wavelength, Wavelength difference and width of spectral lines, Twyman-Green interferometer, Tolansky fringes, Fabry-Perot interferometer and Etalon. .	
Unit IV	**Diffraction** Fresnel's and Fraunhofer diffraction: Diffraction of single slit, Zone plates, intensity distribution, Resolution of image, Rayleigh criterion, Resolving power of telescopes and microscopes, Diffraction due to 2-slits and N-slits, Diffraction grating, Resolving power of grating and comparison with resolving powers of prisms.	**10**
Unit V	**Polarization** Plane polarized, Circular polarized and elliptically polarized light, Malus law, Brewster's law, Double reflection and uniaxial crystals, Application of bi-refringence, Dichroism, Optical rotation, Rotation of plane of polarization, Optical rotation in liquids and crystals, Polarimeter.	**10**

Suggested Reading

1. D.P. Khandelwaland : Optics and Atomic Physics
2. Jenkins and White : Fundamentals of Optics
3. A.K. Ghatak : Physical Optics
4. Brijlal and Subrahmanyam : Optics
5. K.D. Moltev : Optics
6. B. K. Mathur : Optics
7. B. D. Guenther : Modern Optics, Oxford Press
8. E. Hecht: Optics, Pearson.

B.Sc.3rd year

Programme: *B.Sc.*		Year: III	Paper-I
	Subject: Physics		
Course Code:	**Course Title:** Modern Physics		
	Course Outcomes: 1. Study of different atomic models. 2. Study of optical spectra and X- rays. 3. Understand the theory of LASERS which are widely used in industry and research. 4. Understanding fundamentals of molecular spectroscopy. 5. Study of structure of atomic nucleus and radioactive decay. **6.** Study of Elementary Particle Physics.		
Unit	**Topic**		**No. of Lectures**
Unit I	**Origin of Quantum Mechanics and its Operator Formulation** Origin of quantum theory, limitation of Classical Physics, Black body Radiation, Planck's radiation law and Einstein's explanation, The photo electric effect and Einstein correction,Compton effect. De Broglie's Hypothesis, Wave-Particle Duality, Davisson-Germer Experiment, G.P Thomson experiment, Taylor's experiment, Wave description of Particles by Wave Packets, Group and Phase Velocities, Principle of Complimentarity, Heisenberg Uncertainty principle, Gamma ray microscope, Single slit experiment. Linear vector space, Linear Operator, Definition of position, momentum , Energy and Angular momentum operator, Eigen value and Eigen functions, Hermitian operators, Postulates and basic theorems of Quantum mechanics, Operator method for solving Eigen values problem, Energy of Harmonic oscillator.		**15**
Unit II	**Schrodinger Equation and its Applications** Origin of non relativistic Quantum Mechanics, Overview of wave mechanics, Simple one dimensional quantum system Oscillator, Time independent and time dependent one dimensional Schrödinger equation, Steady state solutions, Physical interpretation of wave functions, probability current density, Ehrenfest's theorem, Particle in a box, Idea of Tunneling		**15**

UNIT III	**Atomic Models and Optical Spectra** Thomson model, Rutherford model, Bohr model and spectra of hydrogen atom, Fine structure, Bohr Magnetron, Larmor's precession, Somerfield model, Stern-Gerlach experiment, Vector atomic model, Space Quantization and Spinning of an electron. Optical spectra, Spectral notations, L-S, J-J coupling, Selection rules and intensity rules, Explanation of fine structure of Sodium D line, Zeeman effect, X-ray spectra(characteristics and continuous), Moseley's law.	**10**
Unit IV	**Theory of Lasers and Molecular Spectroscopy** Einstein A and B coefficients, Spatial and Temporal coherence, Optical pumping, Population inversion, Laser action, Basic idea of LASER and MASER, Ruby Laser and He-Ne laser, Someapplications. Franck-Condon Principle, Molecular spectra, Rotational, Vibration and Electronic spectra of diatomic molecules, General features of electronic spectra, Luminescence, Basics of Raman effect.	**10**
Uniit V	**Basics of Subatomic and Particle Physics** Structure of atomic nucleus, nuclear properties (charge, mass, spin, shape), nuclear binding energy, liquid drop model and semi-empirical mass formula, elementary particles and theirclassification schemes.	**10**

Suggested Reading

1. L.I. Schiff, "Quantum Mechanics" (McGraw Hill Book Co.)
2. Chris J. Isham, "Lectures on Quantum Theory" (Allied Publisher)
3. B.S. Rajput , "Advanced Quantum Mechanics" (Pragati Prakashan)
4. Ghatak and Lokanathan , "Quantum Mechanics" (Macmillan Pub.)
5. Mathew and Venkatesan , "Quantum Mechanics"(Tata McGraw-Hill)
6. A. Beiser , Perspective of Modern Physics, (Tata McGraw Hill)

Programme: *B.Sc*		Year: III	Paper-II
Subject: Physics			
Course Code:	**Course Title: Electronics**		

Course Outcomes:

1. Study of different Network Theorems for simplifying complicated electronics circuits.
2. Study of Regulated Power Supply. Understand different types of Rectifiers, Filters and Voltage Regulator.
3. Study of different types of special diodes and their applications
4. Study of Transistors and their applications in different types of Amplifiers.

Unit	Topic	No. of Lectures
Unit I	**Network Theorems and Applications** Kirchhoff's Laws, Superposition Theorem, Constant voltage source and constant current source, Conversion of voltage source into current source, Thevenin's Theorem and procedure for finding thevenin equivalent circuit, Norton's Theorem and procedure for finding Norton equivalent circuit, Maximum power transfer theorem, Applications of Network Theorems, Four terminal Network and h-parameters.	**10**
Unit II	**Power Supplies** Semiconductor diode: P-N Junction diode, Diode Parameters, Equation of diode current, Diode circuits with DC and AC Voltage sources, Diode as a rectifier: Half and Full wave rectifiers, Bridge rectifiers, Peak inverse voltage, Efficiency, Ripple factor, Filters: Low pass and High pass filters, Band pass and Band stop filters, L and π – filters (Series inductor, Shunt capacitor, LC, CLC filters), Zener diode, its characteristics, Voltage regulation.	**10**
Unit III	**Solid State Devices** Special Diodes: Tunneling effect, Tunnel diode, Varactor diode, Point contact diode, V-I characteristic of these diodes, Optoelectronic devices: Light emitting diode, Photodiode, Photo multiplier tube, Bipolar junction transistor, Transistor operation and its Biasing rule, Transistor currents, Transistor circuit configuration (CB, CE, and CC configuration), Transistor characteristics in different configuration, cut-off and saturation points, Active region, Leakage current in transistor and thermal runaway, Relation between transistor current in various configuration, General idea of FETs	**15**
Unit IV	**Amplifiers** Single-stage transistor amplifiers, Common base (CB) amplifier, various gains of a CB amplifier, Common emitter (CE) amplifier, various gains of a	**15**

	CE amplifier, characteristics of a CE amplifier, Common collector (CC) amplifier, various gains of a CC amplifier, characteristic of a CC amplifier, Comparison of a amplifier configurations, Amplifier classification based on biasing condition, Power amplifiers (Class A, Push-Pull amplifier, Class B and Class C), Noise and Distortion in amplifiers, Multistage amplifier, Amplifier coupling, RC- coupled two stage amplifier and its frequency response, Advantage of RC coupling, Transformer coupled two stage amplifiers and its frequency response, Advantage of transformer coupling.	
Unit V	**Basics of Digital Electronics** Number systems, Decimal, Binary, Octal and Hexadecimal number systems, Binary to decimal conversion, Double-Dadd method, Binary operations, Binary addition, Binary subtravtion, Complement of a number (1's complement and 2's complement), Binary divison, Representation of a Binary number as electrical signals, Conversion of Binary to octal, Binary to hexadecimal and vice-versa (Inter-conversion), BCD, GREY, EXCESS-3 codes, Boolean algebra, Features of Boolean algebra, Laws of Boolean algebra, Equivalent switching circuit, Demorgan's theorems and Duals. Positive and Negative logic, Two input OR gate, Diode OR gate and transistor OR gate, Three input OR gate and its truth table, Exclusive OR gates, The AND gate, Diode AND gate and transistor AND gate, The NOT gate, Bubbled gates, The NOR gate, The NAND gate, NAND and NOR as universal gates, The XNOR gate, Adders and subtractors, Half Adders, Full adders,Paralled binary adder, Half subtractor and Full subtractor.	**10**

1. M.K. Baagde, S.P. Singh and Kamal Singh, Elements of Electronics (S. Chand and Co).
2. B.L. Theraja, Basic Electronics (S.Chand and Co.)
3. V.K. Mehta, Elements of Electronice (S.Chand and Co.)
4. J.D. Ryder: Networks, Lines and Fields (Pritice Hall Edition)
5. Brophy, Communication Electronics (McGraw-Hill Education)
6. R Boylested , Electronic Devices & Circuit theory (PHI)

Practicals: (4 hrs per weeks) (Total 60 hrs)

List of Experiments for B.Sc. Year III (at least fifteen experiments which cover theunderstanding of theory course)

1. To study characteristics of R-C coupled Amplifier.
2. To study the characteristics of integrating and differentiating circuit.
3. To draw the characteristics of P-N junction diode.
4. To draw the characteristics of PNP and NPN junction transistor.
5. Measurements of h-parameters of a transistor.
6. Study of different types of Rectifiers and Filters.
7. Verification of Network theorems.
8. Child Langmuir law.
9. Triode/ Tetrode/ Pentode characteristics and constants.
10. Study of power supply (Ripple factor).
11. Study of Zener diode and regulation (taking different source voltage and loads).
12. Phase measurement using a C.R.O.
13. Study characteristics of T.C. Amplifier and B.W.
14. To study the Characteristics of a Photo-diode.
15. Inverse square law using Photo-Voltaic Cell.
16. Frank-Hertz Experiment.
17. Determination of 'h' Planck's constant by Photoelectric effect.
18. Spectrum of Hydrogen and Rydberg constant.
19. Speed of light by Leacher's wires.
20. 'e/m' by Thomson method.
21. 'e/m' Magnetron method.
22. 'e/m' Helical method
23. Wave shapes and frequency of Multivibrators.
24. Ionization potential of mercury.
25. Band gap energy of semiconductor using a junction diode.
26. Study of logic gates.
27. To study characteristics of R-C coupled Amplifier with and without feedback