

TEACHING & EXAMINATION SCHEME
For the Examination – 2023
PHYSICS

B.Sc. Part II

THEORY

			Pd/W (45mts.)	Exam. Hours	Max. Marks 150
Phy.201	Paper I	Statistical and Thermal Physics	2	3	50
Phy.202	Paper II	Quantum Mechanics and Spectroscopy	2	3	50
Phy.203	Paper III	(A) Electronics (Except for those who opt Electronics as a subject) Or			
	Paper III	(B) Computer Systems and Networking (For the students who have offered Electronics as an Optional subject)	2	3	50
PRACTICAL			6	5	75
Total					225

B. SC. PART-II

PAPER I: STATISTICAL AND THERMAL PHYSICS

Note: The question paper for the examination will be divided in three parts i.e., Section – A, Section – B and Section – C.

Section – A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited upto 30 words. Each question will carry 1 mark.

Section – B: Will consist of 10 questions. Two questions from each unit will be set and students will answer one question from each Unit. Answer of each question shall be limited upto 250 words. Each question carry 3.5 marks.

Section – C: Will consist of total 05 questions. The paper setter will set one question from each Unit and students will answer

any 03 questions and answer of each question shall be limited upto 500 words. Each question will carry 7.5 marks.

UNIT-1 :

Statistical Method: Particle States, distribution of particles in two particle states, Probability of a given distribution, distribution corresponding to maximum probability, relative probability curve with increasing number of particles, binomial distribution, Standard deviation, micro-states and macro-states of a system, principle of equal 'a priori' probabilities, equilibrium state, fluctuations, reversibility and irreversibility, States of a particle inside a box, number of accessible states between an infinitesimally small energy interval, momentum interval, phase space, statistical weight of a configuration of a macro-state, indistinguishable and distinguishable particles, entropy and principle of increase of entropy, statistical ensemble, time and ensemble averages; Thermal interaction between two systems, zeroth law of thermodynamics, concept of temperature.

UNIT-2 :

Canonical ensemble, Boltzmann canonical distribution, partition function, a two state system, paramagnetic susceptibility, heat capacity, Boltzmann formula for entropy, average energy and fluctuations, free energy, adiabatic interaction, enthalpy, general interaction, Gibbs free energy, first law of thermodynamics, phase transitions, Clausius-Clapeyron equation.

Ideal Classical Gas, Maxwell velocity and speed distributions, partition function, entropy (Sackur-Tetrode relation), Gibbs paradox; equation of state, ideal gas temperature scale, Vander-Waal's equation of state; heat capacities of monatomic and diatomic gases, ortho and para hydrogen.

UNIT-3 :

Systems with variable Energy and Particle Number: Chemical potentials, grand canonical distribution, Partition function, number fluctuations, grand potential, equation of state of an ideal classical gas, Saha's ionization formula, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein Statistics, Fermi gas at 0K temperature; thermionic emission, strongly degenerate boson gas; Bose-Einstein Condensation, liquid helium.

UNIT-4 :

Macroscopic Thermodynamics: Second law of thermodynamics; Carnot cycle, Carnot theorem, thermodynamic temperature scale and its identity with perfect gas temperature scale, entropy change in isothermal, and adiabatic expansions of an ideal gas; Thermodynamic potentials, Maxwell's equations C_p-C_v , C_p/C_v , Black body radiation, energy density and pressure, Stefan-Boltzmann law, Wien's displacement law, Planck's law.

UNIT-5 :

Temperature changes in Joule and Joule-Thomson expansions, Regenerative cooling, adiabatic demagnetization and production of low temperatures, third law of thermodynamics, negative temperatures.

Transport Phenomena: Mean free path, collision cross-sections, mean free time, viscosity, thermal conductivity and self-diffusion.

Books suggested:

1. Reif : Statistical Physics, Berkeley, Vol. 5, McGraw Hill.
2. Mandl : Statistical Physics, ELBS and Wiley.
3. Reif : Fundamentals of Statistical and Thermal Physics, McGraw Hill.
4. C. Kittel and H. Kroemer : Thermal Physics, CSS.
5. W.G.V. Rosser: An Introduction to Statistical Physics, Ellis Horwood.
6. Lokanathan and Gambhir: Statistical and Thermal Physics, Prentice Hall.

PAPER II : QUANTUM MECHANICS AND SPECTROSCOPY

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Section – B: Will consist of 10 questions. Two questions from each unit will be set and students will answer one question from each Unit. Answer of each question shall be limited upto 250 words. Each question carry 3.5 marks.

Section – C: Will consist of total 05 questions. The paper setter will set one question from each Unit and students will answer

any 03 questions and answer of each question shall be limited upto 500 words. Each question will carry 7.5 marks.

UNIT-1.:

Development of quantum theory: Blackbody radiation and their characteristics, failure of classical physics to explain spectral distribution of blackbody radiation, Planck's quantum Hypothesis, Average energy of Planck oscillator, Planck's radiation formula, Wien's law, Rayleigh-Jean's Law, Stefan-Boltzmann's Law; Failure of classical physics to explain photo-electric effect and Compton effect, photons as carrier of energy and momentum of electro-magnetic waves.

UNIT-2:

Wave Mechanics and Schrödinger equation: Phase velocity and group velocity of waves, wave particle duality; De Broglie Hypothesis; De Broglie group and phase velocity, wave packet, Heisenberg uncertainty principle, Statement and its equation from wave-packet in space and time; Application of uncertainty principle such as (i) Non-existence of electron in nucleus, (ii) Ground state of H-atom, (iii) Natural line width of spectral lines, X-ray microscope, Particles passing through (a) single slit and (b) double slit and observed on screen behind, explanation of distribution in terms of probability amplitude and interference of probability amplitude.

Postulates of Quantum Mechanics: Wave functions, Schrödinger superposition principle, operators in Quantum mechanics, Hermitian operators, expectation values, Interpretation of wave-function, symmetric and anti-symmetric wave functions, concept of parity; Probability density, Schrödinger equation, Schrödinger equation for free particle; Arguments in favour of this equation.

UNIT-3:

Application of Schrödinger equation: Schrödinger equation for particle moving in potential field, Time dependent and time independent Schrödinger equation, Stationary states, Orthogonality of wave functions, Probability current density, Ehrenfest Theorem, Simple solution of Schrodinger equation (Restricted to one dimensional case), Particle in one dimensional infinite well, Particle in one dimensional finite well (one or both sides of well may be non-rigid), Calculation of reflection and transmission coefficient for potential step and potential barrier.

UNIT-4 :

Atomic Spectroscopy: Orbital angular momentum, electron spin and Stern Gerlac experiment, Total angular momentum, Spin-orbit interaction, Vector model of atom and quantum numbers associated with atom, L-S coupling and j-j coupling, Statement of Hund's Rule and Lande Interval Rule (without derivation), Fine structure of spectral lines, spectral terms up to two valence electron system, Pauli's exclusion principle.

UNIT-5 :

Atom in magnetic field: Magnetic moment of atom, contribution from orbital and spin angular momentum, gyro-magnetic ratio; Interaction energy of atom in magnetic field, splitting of energy levels, using good quantum numbers in Normal Zeeman effect, Anomalous Zeeman effect and Paschen-Back effect, Selection rules for dipole transitions.

Molecular spectroscopy: qualitative features of molecular spectra, rigid rotator, rotational and vibrational energy levels of diatomic molecules, rotational-vibrational spectra.

Books suggested:

1. Semat: Atomic Physics
2. Alonso and Finn: Fundamental University Physics, Vol. – III.
3. Beiser: Concepts in Modern Physics
4. Waghmare: Quantum Mechanics
5. Wehr, Richards, Adair: Physics of the Atom, Narosa.

PAPER III (A): ELECTRONICS

(Except for those students who opt Electronics as a subject)

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UNIT-1:

Intrinsic and extrinsic semi-conductors, Fermi levels, mass-action law; carrier injection, recombination, diffusion and diffusion length, drift and diffusion currents, continuity equation; p-n junction, potential barrier, biasing, current-voltage relation, space charge and diffusion capacitances; varactor diode; Zener diode; tunnel diode; photovoltaic effect, solar cell.

Power supplies: Full wave and half wave rectifiers; ripple factor, voltage regulation; filters; Zener regulation.

UNIT-2:

Network theorems – Thevenin, Norton, Maximum power transfer and Miller theorems.

Dipolar junction transistors, Ebers-Moll equations; CB, CE and CC configurations, BJT characteristics; biasing and thermal stabilization, self bias; hybrid parameters of a two port network; small signal hybrid equivalent model of a BJT at low frequencies, current, voltage and power gains; input and output impedances; high frequency hybrid pi model, short circuit current gain, f_{β} and f_{α} ; current gain with resistive load.

UNIT-3:

Field effect transistors, JFET, MOSFET, construction and characteristics; FETs as voltage Controlled Devices, small signal model.

Large signal amplifiers, class A, B and C operations and efficiencies; distortions; determination of second harmonic distortion; push-pull amplifiers; impedance matching.

UNIT-4:

Negative Feedback: Current and voltage negative feedbacks; effect on stability, input and output impedances, distortion, frequency response; emitter follower.

Oscillators: Positive feedback, Barkhausen criterion; RC phase-shift oscillator; Hartley and Colpitts oscillators, UJT and sweep generators using UJT; Transistor as a switch and Astable multivibrator.

UNIT-5 :

Operational amplifiers, inverting and non-inverting; differential amplifiers, CMRR; measurement of OP AMP parameters; use of OP AMPs as adder, in analog integration and differentiation.

Digital circuits: Laws of Boolean algebra and De-Morgan's theorem, realization of Boolean Expression using logic gates

Books suggested:

1. J. Millman and CC Halkias: Integrated Electronics : Analog and Digital Circuits and Systems, Tata McGraw Hill.
2. A. Mottershead: Electronic Devices and Circuits – An Introduction, Prentice Hall India.

PAPER III (B): COMPUTER SYSTEMS AND NETWORKING

(For the students who have offered Electronics as an Optional subject)

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Unit-1

Introduction to computers: Development of computers with electronic devices, brief history of computers, computer generations, IC technology, LSI and VLSI, classification of computers, applications of computers, basic computer organization, basic processor architecture, types of processors, memory, primary memory, cache, RAM and ROM, secondary memory, HDD, CD drive, Pen drive, Power supply, input and output devices, keyboard, pointing device, optical devices, monitor, projector, printers, plotter (only definitions and functions of the devices).

UNIT-2

System software: Operating system, need of OS, functions of OS, different types of OS, batch processing OS, multi programming OS, single user OS and multi user OS, time sharing OS, OS for Personal Computer, DOS, Windows OS, features of Windows OS, Unix OS, Open source OS Linux. Low level languages: machine language, Assembly language, assembler, high level languages, features of high level languages, interpreters and compilers .

UNIT-3

Application software: Program development in high level languages, algorithm and flow chart, execution of user application programs. Software packages: MS Office package, word processing, MS Word, preparing and printing documents in MS Word, MS Excel; using formulas and functions, plotting graphs, Power point presentation. Computer graphics, graphic software packages, Origin software package, plotting graphs in Origin.

UNIT-4

Basic Network Functions: Overview, evolution of computer networks, elements of LAN and WAN, Network architecture, ISO-OSI architecture, hardware elements: modems, multiplexers, concentrators, transmission media, twisted pair, coaxial cable, optical fibre, LAN topologies: bus, ring and star.

UNIT-5

Network interconnection issues: Internetworking bridges, routers, communication methods, store and forward techniques, circuit switching, packet switching, introduction to TCP/IP protocol family, issues related to network reliability and security.

Books suggested:

A. Mottershed: Electronic Devices and Circuits, PHI.

V. Rajaraman: Fundamentals of Computers, PHI.

Martin, J.: Networks and Distributed Processing, PHI.

R. Thareja: Fundamentals of Computers, Oxford Press.

PRACTICALS

1. Determination of temperature coefficient of platinum resistance thermometer using Carey Foster Bridge.
2. Determine thermal conductivity of a bad conductor by Lee's method.
3. Determination of Ballistic Constant of a Ballistic galvanometer using condenser.
4. Determination of Ballistic Constant of a Ballistic galvanometer by steady deflection method.
5. Determination of high resistance by method of leakage.
6. e/m by Thomson's method.
7. Measurement of inductance of coil by Anderson's bridge.
8. Measurement of capacitance and dielectric constant of a liquid and gas by De-Sauty Bridge.
9. Study of Gaussian distribution using statistical board and disc.
10. Determination of mutual inductance of a coil.
11. Experimental verification of the first law of thermodynamics by discharging the condenser through resistance.
12. To determine the energy Band gap in a semiconductor using junction diode.
13. Study of the characteristics of a given transistor (PNP/NPN) in common emitter configuration and find the value of parameter of given transistor.
14. Study of the characteristics of a given transistor (PNP/NPN) in common base configuration and find the value of parameter of given transistor.
15. Study the characteristics of rectifier junction diode and Zener diode.
16. Study of dependence of velocity of wave propagation on line parameters using torsional wave apparatus.
17. Study of variation of reflection coefficient on nature of termination using torsional wave apparatus.
18. Study of variation of total thermal radiation with temperature.
19. Plot thermo emf versus temperature and find the neutral temperature and temperature of inversion.
20. Determination of Self Inductance of a Coil using Ballistic galvanometer (Rayleigh method).
21. To study the electromagnetic damping of a compound pendulum.
22. Study of phase relationship of RL Circuit.

Note: - New experiments may be added on availability of equipments.