West Bangal State University
Syllabus
B.Sc. (General) - PHYSICS
Paper I
Group A : Mechanics and General Properties of Matter

50 Lectures

1. Dimensions of Physical Quantities : Principle of dimensional homogeneity

2. Vectors : Axial and polar vectors, dot product and cross product, scalar triple
product and vector triple product. Scalar and vector fields - gradient, divergence and curl,
statement of divergence theorem, statement of Stokes' theorem.

3, Mechanics of a Particle : (a) Newton's laws of motion, principle of conser-
vation of linear momentum, time and path integral of force, conservative force field, concept of
potential, conservation of total energy, equation of motion of a system with variable mass.
(b) Rotational motion, angular velocity, angular acceleration, angular momentum, torque, fun-
damental equation of rotational motion, principle of conservation of angular momentum, radial
and cross-radial acceleration.

4. Dynamics of Rigid Bodies : Moment of inertia and radius of gyration - their
physical significance, theorems of parallel and perpendicular axes, rotational kinetic energy,
calculation of moment of inertia for some simple symmetric systems.

5. Gravitation : Gravitational potential and intensity due to thin uniform spherical shell and solid
sphere, escape velocity.

6. Elasticity : Elastic moduli for isotropic homogeneous bodies and their interrelations, torsion of a
cylinder, internal bending moment, cantilever, simply supported light beam with concentrated load at
the centre, strain energy.

7. Viscosity : Streamline and turbulent motion, Poiseuille's formula, critical
velocity, Reynolds number, Bernoulli's theorem, Stokes' law (statement only).

8. Surface Tension : Surface tension and surface energy, molecular theory,
angle of contact, elevation and depression of liquid columns in a capillary tube, excess pressure
in a spherical bubble and spherical drop.

Group B : Heat and Thermodynamics

30 Lectures

9. Kinetic Theory of Gases : Perfect gas, pressure exerted by it, Maxwell's law of
distribution of molecular velocities (statement only) - rms, mean and most probable velocities,
degrees of freedom, principle of equipartition of energy - application in simple cases. Equation
of state - defects of ideal gas equation, van der Waals equation (qualitative study), critical
constants.

10. Thermal Conductivity : Steady state and variable state, thermal and thermometric conductivity, Fourier equation for one-dimensional heat flow and its solution, Ingen Hausz's experiment, cylindrical flow of heat.

11, Thermodynamics : Basic concepts (equilibrium state, state function, exact and inexact differential), internal energy as state function. First law of thermodynamics and its applications. Isothermal and adiabatic changes - relations, indicator diagrams. Reversible and irreversible processes, cyclic processes, second law of thermodynamics, Carnot cycle and its efficiency, entropy and its physical interpretation.

12. Radiation : Nature of radiant heat, emissive and absorptive power, Kirchhoff's law, black body radiation, Stefan's law, Newton's law of cooling, Planck's distribution law (only statement), Wien's displacement law, pyrometer.

Group C : Vibration - Waves and Acoustics

20 Lectures

13. Simple Harmonic Motion : Differential equation and its solution.

14. Superposition of Simple Harmonic Motion : Analytical treatment, Lissajous figures, natural, damped and forced vibration, resonance, sharpness of resonance.

15. Differential Equation of Wave Motion : Plane progressive wave - energy and intensity. Bel, decibel and phon. Superposition of waves, stationary wave, beats. Velocity of longitudinal wave in solid and in gas, velocity of transverse wave in string, Doppler effect.

Group D : Electricity I

15 Lectures

(Use of Vectors are to be encouraged. Only SI units are to be used)

 16. Electrostatics: Quantization of charge, Milikan's oil drop experiments. Coulomb's law, intensity and potential - example of point charge, Gauss' theorem- simple applications, potential and field due to an elcetric dipole, mechanical force on the surface of a charged conductor.

17.   Dielectric medium, polarization, electric displacement. Capacitor: parallel-plates and cylindrical, energy stored in parallel plate capacitor.

 18.   Steady Current: Network analysis - Kirchoff's laws, Thevenin and Norton's theorem, Wheatstone bridge, potentiometer.

19. Thermoelectricity : Seebeck, Peltier, and Thomson effects, laws of thermoelectricity, ther-moelectric curve — neutral and inversion temperature, thermoelectric power.

Paper II
(Only SI units are to be used)
Group A: Geometrical Optics

15 Lectures

1. Geometrical Optics: Fermat's Principle, laws of reflection and refraction at a plane surface, refraction at a spherical surface, lens formula. Combination of thin lenses - equivalent focal length.

2. Dispersion and dispersive power, chromatic aberration and its remedy, different types of Seidel aberration (qualitative) and their remedy. Eye-piece : Ramsden and Huygen's type. Astronomical telescope and compound microscope - their magnifying power.

Group B : Physical Optics

20 lectures

3. Light as an electromagnetic wave, Full electromagnetic spectrum, properties of electromagnetic waves, Huygens' principle - explanation of the laws of reflection and refraction

4. Interference of light: Young's experiment, intensity distribution, conditions of interference, interference in thin films, Newton's ring.

5. Diffraction: Fresnel and Fraunhofer class, Fresnel's half-period zones- zone plate. Fraunhofer diffraction due to a single slit and plane transmission grating (elementary theory)- resolving power.

6. Polarization: Different states of polarization, Brewster's law, double refraction, retardation plate, polaroid, optical activity.

Group C : Electricity II

45 Lectures

7. Magnetic effect of current: Biot Savart's law, Ampere's circuital law (statement only), magnetic field due to a straight conductor, circular coil, solenoid, endless solenoid, Magnetic field due to a small current loop - concept of magnetic dipole, Ampere's equivalence theorem.

8. Lorentz force, force on a current carrying conductor in a magnetic field. Torque on rectangular current loop in a uniform magnetic field.

9. Magnetic materials: intensity of magnetization, relation between B, H and M - illustration in the case of bar magnet, magnetic susceptibility - dia, para and ferromagnetic materials - statement of Curie's law. Hysteresis in a ferromagnetic material - hysteresis loss.

10. Electromagnetic induction: self and mutual inductances in simple cases, energy stored in inductor.

11. Varying currents: growth and decay of currents in L-R circuit; charging and discharging of capacitor in C-R circuit.

12. Alternating current: mean and r.m.s. Values of current and emf with sinusoidal wave form; LR, CR and series LCR circuits, reactance, impedance, phase-angle, power dissipation in AC circuit — power factor, vector diagram, resonance in a series LCR circuit, Q-factor, principle of ideal transformer.

Group D : Electronics

15 lectures

13. p-n junction diode — bridge rectifier — capacitance input filter, Zener diode — voltage regulator, Transistors — α and β parameters and their interrelations; output characteristics in CE mode, single stage CE amplifier — approximate expressions of current and voltage gain with the help of 'Load Line'.

14. Digital circuits : binary systems, binary numbers. Decimal to binary and reverse conversions; binary addition and subtraction.

15. Logic gates : OR, AND, NOT gates — truth tables.
Statement of de Morgan's theorems, NOR and NAND as universal gates.

Group E : Modern Physics

30 Lectures

16. Postulates of the Special Theory of Relativity, Lorentz transformation equations (statement only)-formulae of (i) Length contraction; (ii) Time dilation; (iii) Velocity addition; (iv) Mass variation, and (v) Mass-energy equivalence.

17. Quantum theory of radiation : Planck's concept — radiation formula (statement only) — qualitative discussion of photo-electric effect and Compton effect in support of quantum theory; Raman effect.

18. Bohr's theory of hydrogen spectra — concept of quantum number, Pauli exclusion principle.

19. Crystalline nature of solid, diffraction of X-ray, Bragg's law; Moseley's law — explanation from Bohr's theory.

20. Wave nature of material particles, wave-particle duality, wavelength of de Broglie waves, Heisenberg uncertainty principle, Schroedinger equation, particle in a one-dimensional infinite well — energy eigenvalues, wavefunction and its probabilistic interpretation.

21. Binding energy of nucleus — binding energy curve and stability; Radioactivity — successive disintegration — radioactive equilibrium, radioactive dating, radioisotopes and their uses, nuclear transmutation — fission and fusion — nuclear reactor.

Paper – III (Practical.)
Full Marks 100
(*Duration of Examination --- 6 hrs.*)
In the final examination two experiments have to be performed by each candidate – one from Group A
(marks – 30, time – 2.5 hrs.) and another from Group B (marks – 40 , time – 3.5 hrs)
(L. N. B. - 10 marks, Viva-Voce – 20 marks)
Group A Marks – 30 Time – 2.5 hrs.
1. Determination of modulus of rigidity of the material of a wire by dynamical method.
2. Determination of moment of inertia of a metallic cylinder – rectangular bar about an axis passing through its C. G.
3. Determination of the coefficient of linear expansion of a metallic rod using an optical lever.
4. Determination of the pressure coefficient of air.
5. Determination of the refractive index of the material of a lens and that on a liquid using a convex lens and a plane mirror.
6. Determination of the focal length of a concave lens by auxiliary lens method or by combination method.
7. Determination of the frequency of a tuning fork with the help of a sonometer (either by using formula or by n-e curve).
8. Determination of the horizontal component of the Earth's magnetic field using a deflection and an oscillation magnetometer.
9. Determination of the resistance of a suspended coil galvanometer by the method of half-deflection and to calculate the figure of merit of the galvanometer (using the same data).
10. To draw I – V characteristics of (i) resistor and (ii) a P-N junction diode in forward biased condition . (Plot both the characteristic curves on the same graph paper. Estimate from the graphs (i) the resistance of the resistor and (ii) the dynamic resistance of the diode for three different currents. One current should correspond to the intersecting point of the two curves.

Group B Marks – 40 Time – 3.5 hrs.
Atleast ten experiments must be performed
1. Determination of Young's modulus of the material of a beam by the method of flexure. (single length only)
2. Determination of the coefficient of viscosity of water by Poiseuille's method. (the diameter of the capillary tube to be measured by the travelling vernier microscope)
3. Determination of the surface tension of water by capillary rise method. (Capillary tubes to be supplied)
4. Determination of the refractive index of the material of a prism by drawing i-δ curve using spectrometer.
5. To determine the wavelength of a monochromatic light by Newton's ring method.
6. To calibrate a polarimeter and hence to determine the concentration of sugar solution.
7. Determination of the temperature coefficient of the material of a coil using a Carey-foster bridge. (3 sets of reading for both temperatures)

(Resistance per unit length of the bridge wire has to be measured)
8. To draw the e-t curve of a thermocouple using potentiometer and dead-beat galvanometer, and

hence to find out the thermo-electric power of the couple at a specified temperature. (Resistance of the potentiometer wire has to be measured using a P. O. box).

9. To draw the I-V characteristics of the bridge rectifier (i) without using any filter and (ii) using a capacitance input filter. (The bridge rectifier should be fabricated by the student using four diodes. % voltage regulations has to be calculated from each graph at a specified load current.)

10. To draw the reverse characteristics of a Zener diode and to study its voltage regulation characteristics using a variable load. (Breakdown region should be identified in the graph. % voltage regulation has to be calculated for two load currents.)

11. To draw the output characteristics of a transistor in CE configuration (for atleast five base currents) and hence to determine the A. C. current gain from the active region of the characteristics.

12. To verify the truth tables of OR and AND logic gates using diodes. To construct AND, OR and NOT gates from NOR/NAND IC gates on breadboard.

13. To measure the voltage across the inductance (L) , capacitance (C) and resistance (R) of a series LCR circuit for different frequencies of the input voltage with the help of a A. C. milli-voltmeter (or suitable digital meter). Hence to study the variation of impedence of L and C with frequency of the impressed voltage. (value of R should be known)

OR

14. To draw the resonance curve of a series LCR circuit and hence to determine the Q-factor of the circuit.

N. B. All data should be recorded directly in the Laboratory Note book and signed regularly by the attending teachers. This Note Book should be submitted at the time of final practical examination. No separate fair L. N. B. need be maintained.

Paper IV

Mechanics and thermodynamics Production and measurement of high vacuum : Rotary and diffusion pump, Mcleod, Pirani, and Penning gauges.(6 lectures)

Heat engines, thermal efficiency, indicated Horse-power and brake Horse-power, Otto cycle and Diesel cycle, four-stroke petrol and diesel engines, calculation of efficiency and comparison.(8 lectures)

Energy sources : Conventional energy sources: thermal power plant, relevance of Rankine cycle (qualitative discussion), steam turbine, hydro-electric power plant — basic principle. (8 lectures)

Non-conventional energy sources: solar, wind, tidal, geothermal, and biogas sources, elementary idea of production and uses.(8 lectures)

Electronics : Feedback — basic principle — positive and negative feedback, Barkhausen criterion, oscillator, OPAMP — characteristics, uses of OPAMP as amplifier, oscillator, and filter; light-emitting diodes, 7-segment display, SCR, diac and triac. (12 lectures)

Digital electronics : combinational circuits — adder and subtractor, multiplexer, demultiplexer, encoder, decoder, sequential circuits — flip-flop, D and J-K, registers and counters.(8 lectures)

Instruments : cathode-ray oscilloscope, digital multimeter, L and C measurements.(5 lectures)

Communications : Propagation of electromagnetic waves in atmosphere, various layers of atmosphere — ground and sky waves.(4 lectures)

Transmission of electromagnetic waves — amplitude and frequency modulation, calculation of power in amplitude modulation, sideband generation in frequency modulated wave; demodulation — linear diode detector, detection of FM waves, signal-to-noise ratio.(10 lectures)

Transmission through media : coaxial cables, optical fibre — cladding, energy loss, band width and channel capacity, information carrying capacity of lightwaves (qualitative); satellite communication, microwave link — modem and internet.(6 lectures)

Computer :

Computer hardware: basic building blocks, central processing units; memory, hard disk, RAM, ROM, floppy, CD-ROM, memory units — bits and bytes, input-output devices. Computer software : Operating systems — DOS, Unix, Windows.(7 lectures)

Programming in C : basic structure, character set, keywords, identifiers, constants, variables, type declaration, operators — arithmetic, rational, logical, assignment, increment, increment and decrement, operator precedence and associativity, arithmetic expression, evaluation and type conversion character I/O, escape sequence and formatted I/O, branching and looping, if, if-else, while, do-while, for, arrays (one and two dimensional).(8 lectures)

OR

Programming in Fortran : constants, variables, arrays, dimension-type statements, arithmetic expressions, input and output statements, control statements — jumping, branching, and looping.

Tutorial classes on Programming in C or Fortran.(8 lectures)

Tutorial classes on programming in C or FORTRAN (10 lectures)

Total lecture periods : 106

(A college will have the option of teaching either of the two programming languages)

Part IV B Practical paper　　　　　　　Total Marks 30

Final Examination of three hour duratiuon will be held at the end of the third year. Distribution of marks in the examination would be as follows:

Experiment 20　　Project Report 5　　Viva 5

All the experiments are porject type

1. To conver a given an ammeter into a volt meter and a given a voltmeter into an ammeter.

To calibrate the instrument and to measure the internal resistance in each case.

    2. To construct an adjustable voltage power source using IC and to study its regulation.

    3. To measure the internal resistance of an analog voltmeter and to increase its internal resistance by using an OPAMP.

    4. To use OPAMP as inberting, noninverting, differential amplifier and as an adder.

    5. To calibrate a given temperature sensor and to use the sensor to control the temperature of a heat bath.

    6. To develop a photosensor using a phototransistor followed by an amplifier and to use the same to control the switching of a bulb.

    7. To familiarise with the operating system and to solve simple problems by programming in C or Fortran as per theoretical syllabus.