## First Semester B.Sc. (Physics)

Paper Title: Mechanics and Properties of Matter

**Teaching Hours:** 4 Hrs / Week **Total Hours: 60**  Marks: Th-80+IA-20 Credits : 3

### Unit I

### **Conservation Laws**

Law of conservation of linear momentum (statement). Centre of mass & Expressions for position vector, velocity, acceleration & force of center of mass. Concept of elastic and inelastic collisions. Derivation of final velocities in case of elastic collision in (i) laboratory frame of reference (ii) center of mass frame of reference. Derivation of final velocities in case of inelastic collision in (i) laboratory frame of reference (ii) center of mass frame of reference (ii) center of mass frame of reference. Distinctions between laboratory frame of reference and center of mass frame of reference. Conservation of linear momentum in case of variable mass. Principle of rocket and derivation for equation of motion for single stage rocket. Necessity of multistage rocket (Qualitative). Basics of angular momentum and torque, relation between angular momentum & torque (qualitative). Law of conservation of angular momentum with examples. Concept of work & power in terms of line integral. Law of conservation of energy. Work energy Principle (Qualitative). Problems.

### Unit II

### Gravitation

Newton's law of Gravitation (statement). Expressions for orbital velocity and escape velocity (derivations). Kepler's laws of planetary motion. Derivation for Kepler's 2<sup>nd</sup> and 3<sup>rd</sup> law. Concept of Satellite, derivation for binding energy of satellite. Artificial Satellite: Geostationary satellite and polar orbit satellite with different types of orbits (qualitative). Concept of weightlessness. Basic ideas of GPS and NAVIC. Problems.

### **Rigid Body Dynamics**

Moment of Inertia. Radius of Gyration. Statements of theorem of parallel axis and theorem of perpendicular axis. Derivation of expressions for moment of inertia for (i) rectangular lamina (ii) thin uniform rod and (iii) circular disc. Theory of compound pendulum. Theory of flywheel and its applications. Problems. 15 Hours

### Unit III

### Elasticity

Statement of Hook's law. Behavior of wire under stress. Moduli of elasticity. Derivation of expression for relations between elastic constants. Derivation of work done per unit volume in a deforming body. Derivation of twisting couple of cylindrical rod or wire. Torsion pendulum, Derivation for timeperiod of torsion pendulum. Derivation of bending moment. Derivation of Young's modulus by bending of beam supported at its ends and loaded at middle. Cantilever (mention expression for bending). Problems.

#### **15 Hours**

**15 Hours** 

### Unit IV

### Surface tension

Introduction to surface tension, derivations for Pressure difference across a curved liquid surface and expression for rise of liquid in a capillary tube. Determination of surface tension by Quincke's method with relevant theory. Effect of temperature and impurity on surface tension. Examples. Problems. **Viscosity** 

### Viscosity

Introduction to viscosity, streamline and turbulent flow. Motion of body in a viscous medium-Stoke's law with derivation and expression for terminal velocity example: velocity of rain drop. Derivation of Poiseuille's formula for the flow of viscous fluid through a narrow tube. Problems.

### **REFERENCE BOOKS:**

- 1) Fundamentals of Physics- R.Resnik, D. Halliday and Walker; Wiley (2001)
- 2) Physics-Classical and Modern, FJ Keller, E Gettys and J J Skove, McGraw Hill Second Revised Edition(1993)
- 3) Classical Mechanics-K N Sreenivasa Rao, Universities Press- Orient Longman (2003 ed)
- 4) Concepts of Physics Vol (1)-H C Verma, Bharathi Bhavan Publishers, 2004 Edition
- 5) University Physics- F W Sears, M W Zemansky & H D Young, Pearson Education First ed. (2014)
- 6) Mechanics- J C Upadhaya, Himalaya (2014 ed)
- 7) Properties of Matter-JC Upadhaya, Himalaya (2014 ed)
- 8) Mechanics- Berkeley Physics Course Vol(1)- SI units Charles Kittel etal, McGrawHill Education (India) 2e (2011).
- 9) Elements of Properties of matter D S Mathur, S.chand(GL) 7 Co Ltd, Dehi 1ed(2010)
- 10) Properties of Matter Brijlal & Subramanyam, S Chand & Co, (2002)
- 11) Newtonian Mechanics- A P French, Nelson & Sons UK, (1971)
- 12) Mechanics & Thermodynamics, G Basavaraju & Dipan Ghosh, McGrawHill Education India) 1ed (1985)
- 13) A treatise on general properties of matter, Sengupta and Chatterjee, New Central Book Agency Pvt Ltd, Calcutta (7<sup>th</sup> Revised edition -**2010**)
- 14) Advanced analytical Dynamics : Dynamic of rigid body, Utpal Chatterjee, Academic Publishers, first edition, (2016).
- 15) Theory of mechanics, kinematics and Dynamics : V. R. Gupta, I K International publishing house Pvt. Ltd, (2013).
- 16) Dynamics of Rigid Body : A. K. Sharma, Discovery Publishing Group, (2007).
- 17) Properties of matter : R. Murugeshan, S Chand & Co Ltd Publication.
- 18) Theory of Elasticity : P. N. Chandramouli, Yes Dee publishers(2017).
- 19) An introduction to the theory of elasticity : R. J. Atkin & N. Fox, Dover Publications Inc.(2005).
- 20) Theory of elasticity : Dr. Sadhu Singh, Khanna publishers, (1978).
- 21) B.Sc Physics C. L. Arora.
- 22) Mechanics, S P Taneja, R Chand & Co New Delhi

# Practical

### Paper Title: Practical I

Teaching Hours: 4 Hrs / Week

Marks: Th-40+IA-10

Credits : 2

### **Bridge Course: (04 Hours)**

- Study of some important terms regularly used in Physics (like, 1 newton, 1 calorie, 1 joule, 1 kelvin, 1 poise, etc..)
- ii) Use of Logarithm and Trigonometric tables.
- iii) Study of measuring instruments (vernier calipers, micrometer, travelling microscope)

### **Practicals:**

- 1. Moment of Inertia of Fly wheel.
- 2. Young's modulus (Y) by uniform bending- Load Vs depression graph.
- 3. Bar pendulum- determination of g
- 4. Modulus of rigidity by Torsional pendulum
- 5. Spring Constant by Flat spiral Spring. Verification of Hook's law.
- 6. Verification of parallel axis theorem of Moment of Inertia.
- 7. Coefficient of viscosity by Stoke's method.
- 8. Capillary Rise- Surface Tension of liquid
- 9. Determination of Speed of Ceiling Fan (in RPM) (self-study/demonstration)
- 10. Surface tension by Quincke's method (self-study/demonstration).
- 11. One Physics experiment of student's choice (self-study/demonstration).

### Note :

- 1. Experiments are of four hours duration.
- 2. Minimum of eight experiments to be performed.

### **References:**

- 1. B Saraf etc, Physics through experiments, Vikas Publications (2013)
- 2. D P Khandelwal A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed (**1985**)
- 3. Advanced Practical Physics for Students Worsnop & Flint, Methuen & Co, London.
- 4. An Advanced Course in Practical Physics, D Chattopadhyay, P C Rakshit, B Saha, New Central

Book Agency (P) Limited, Kolkata, Sixth Revised Edition, (2002)

- 5. BSC, Practical Physics, CL Arora, SChand & Co, New Delhi, (2007) Revised Edition.
- 6. B.Sc. Practical Physics, Geeta Sanon R. Chand & Co. New Delhi

(2 hours)

### Physics Certificate Course (First and Second Semester) (20 Hours in First Semester and 20 Hours in second Semester)

Title of the Course: Certificate Course in Electrical Wiring and Servicing of Electrical Appliances

### Syllabus

Theory: 20 hours

Project teaching: Field project.

Total: 40 hours

### A. Basic Concept of Electricity.

- 1. Introduction to Electricity, an Atom, electricity Electron flow, conductors, Insulators. Sources of Electricity. (1 hr)
- 2. Electrical terms: Electromotive force, Current, Resistance, Potential difference. Simple Electric circuit, Closed Circuit, Open Circuit and short circuit. (1 hr)
- 3. Ohm's law Relationship between E, I and R in D.C. Circuits. Laws of Resistance, Resistivity. (1 hr)
- 4. Connection of Resistances: Series Circuit Parallel Circuit, Series and Parallel Circuit. (1 hr)
- 5. Calculation of power, amperage, Voltage, Wattage, kWh, Calculation of load energy consumption. (1 hr)
- 6. Effect of Electric Current: Heating, Magnetic, Chemical, Electric Shock. Fuses. (1 hr)

### B. Electrical Materials

- 1. Conducting materials: Copper, Aluminum, Lead, Tin, Nickel, Chromium, silver, Zinc, Brass, Mercury. Resistance materials: Nichrome, tungsten, Manganin, Constantan, Eureka, Carbon. (1 hr)
- 2. Insulating Materials: Marble, Slate, Porcelain, Mica, Rubber, Bitumen, Asbestos, Wood, Paper, cotton, Jute, Silk, P.V.C., Transformer Oil and Air. Synthetic Materials: Resins, Plastics, Fibreglass, Bakelite, Paints, Varnishes. (1 hr)

### C. Electrical Wiring- I

- 1. Safety precautions, treatment for electrical shock. General idea of wiring tools and their specifications. (1 hr)
- 2. Types of wires. Terms used in Electric Cables, Conducting Materials, and Current carrying capacity of copper, aluminium Cables and stranded cables. (1 hr)
- 3. Applications of power tools in wiring. Electrical Accessories, Mounting Accessories' specifications. (1 hr)
- 4. Earthing systems, Testing of domestic wiring and installations. (1 hr)

### D. AC Circuits.

- 1. Concept of AC, AC current, AC voltage, generating sinusoidal voltage. (1 hr)
- SINE Wave, cycle, period, frequency, Maximum value, average value, R.M.S. value Form factor. (1 hr)
- 3. Single phase A.C. Motors. Transformers. (1 hr)

### E. Electrical Wiring – II

1. Filament lamps working, types. Fluorescent lamps, choke, starter, circuit diagram and uses. LED

### (4 hours)

(3 hours)

(2 hours)

### Practicals: 10 Practicals of 2 hours each.

(6 hours)

(3 hours)

lamps (1 hr)

2. Study of different type of switch used in domestic installations, Selector Switches, D.P. Switches, Fan regulator, Dimmer, etc. (1 hr)

### F. Electrical Wiring – III

- 1. Preparing load chart for AEH installation and selection of cables. Distribution board for lighting circuit. (1 hr)
- 2. Distribution board for Heating and Power installation. Calculation of Load of different circuits and selection of size of wires, cables. (1 hr)
- 3. Panel Board wiring, Meter Board, Single phase service mains, accessories and wiring. (1 hr)

### Practicals:

- 1. Handling of all instruments (toolbox). AC voltmeter and ammeter. Identification of phase, neutral and earthing.
  - Different types of fuses. Determination of fusing current by test. Inverter.
- 2. One lamp, one switch and two lamps, two switches with MCB.
- 3. To control two lamps through two switches to burn dim or one bright, indicators. Two sockets with switches.
- 4. One room wiring with 6 lights with switches.
- 5. One room wiring with 6 lights with switches, 1 fan with regulator and two sockets.
- 6. Kitchen wiring with 3 lights with switches, 1 fan with regulator, 1 exhaust fan and three sockets, heating points (fridge, mixer, oven).
- 7. One room wiring with 4 lights with switches (2 lights with two-way switches). 1 fan with twoway switches.
- 8. Bathroom wiring, 1 light, 1 heating point, 1 socket, 1 exhaust.
- 9. Staircase wiring (single floor, double floor).

### **Project:**

House wiring with 2 Bedroom, Hall, kitchen, bathroom and motor.

Reference Books:

- 1. Electrical Wiring: An Introduction by Satish Kumar
- 2. Electrical Installations in Building by Hari Mohan Johri
- 3. The Complete Guide to Wiring by Black & Decker
- 4. The Concept Of Wires & Cables by Tapan Kumar Ghosh

## Second Semester B.Sc. (Physics)

Paper Title: Electricity & Magnetism

**Teaching Hours:** 4 Hrs / Week **Total hours:60** 

Marks: Th-80+IA-20 Credits :3

### Unit I

### **Vector Analysis**

Scalar and Vector Products. Gradient of scalar and its physical significance. Divergence of vector and its physical significance. Curl of vector and its physical significance. Vector integration; line, surface & volume integrals of a vector field (Qualitative). Gauss Divergence theorem & Stokes theorem (statement).

### **Maxwell's Electromagnetic Theory**

Derivation of Maxwell's equations in differential form. Mention of Maxwell's equations in integral form and their physical significances. Derivation for general plane wave equation in free space. Transverse nature of radiation. Derivation of Poynting's theorem.

**15 Hours** 

### Unit II

### DC Circuit Analysis

Voltage and current sources. Kirchoff's current and voltage laws. Derivation of Thevenin's Theorem. Derivation of Norton's Theorem. Derivation of Superposition Theorem. Derivation of Maximum Power Transfer Theorem.

### **Transient Circuits**

Theory of growth and decay of current in RL circuit. Theory of charging and discharging of capacitor in RC circuit. Time constants of RL and RC circuits. Measurement of high resistance by leakage method.

### **15 Hours**

### Unit III

### Magnetostatics

Statement of Biot-Savart's law. Mention of expressions for Magnetic field at a point (i) due to a straight conductor carrying current (ii) along the axis of the circular coil carrying current (iii) along the axis of solenoid. Principle, construction and theory of Helmholtz Galvanometer.

### Magnetic Properties

Magnetic intensity, Magnetic induction, Magnetic potential. Derivation of Magnetic intensity and magnetic potential due to dipole (magnet) at general point. Mention of expressions for magnetic intensity at axial and equatorial point. Permeability and magnetic susceptibility. Distinction between dia, para, and ferromagnetic materials. Ampere Circuital Law (statement).

### Dielectrics

Types of dielectrics (polar and non-polar molecules). Electric field (E), Electric displacement (D), Electric

dipole moment (p), electric polarization (P). Gauss law in dielectrics. Derivation for Relation between D, E and P. Derivation for relation between dielectric constant and electric susceptibility. Boundary conditions for E & D.

### **Electromagnetic induction**

Faraday's law of electromagnetic induction. Lenz's law. Self and mutual inductance (Qualitative).

15 Hours

### Unit IV

### **Alternating Current**

Definitions of average, peak and rms values of AC. AC circuits containing LR, CR and their responses (using j operator). Expressions for impedance, current & phase angle in series LCR circuit using j operator. Expressions for admittance and condition for resonance in parallel LCR circuit using j operator. Concept of Series resonance & parallel resonance (sharpness, half power frequency, quality factor, voltage magnification). Comparison between Series resonance & parallel resonance. De Sauty's Bridge (Qualitative).

### **Electrical Instrument**

Ballistic Galvanometer; Theory of Ballistic Galvanometer (Derivation for current and Charge). Constants of Ballistic Galvanometer and their relationship. Condition for moving coil galvanometer to be ballistic. Determination of self-inductance (L) by Rayleigh's method.

**15 Hours** 

### **REFERENCE BOOKS :**

- 1) Electricity and magnetism by Brij Lal and N Subrahmanyam, Rathan Prakashan Mandir, Nineteenth Edition, 1993.
- 2) Principles of Electronics by V K Mehta and Rohit Mehta, S Chand & Company, Eleventh Edition, **2008.**
- 3) Fundamentals of Magnetism & Electricity : d. N. Vasudeva, S Chand Publication, (2011).
- 4) Fundamentals of Electricity and Magnetism Basudev Ghosh (Books & Allied New Central Book Agency, Calcutta, 2009).
- 5) Electricity & Magnetism : B. S. Agarwal, Kedarnath Ramnath Publication(2017).
- 6) Electricity & Magnetism : A. N. Matveev, Mir Publishers Moscow, (1987).
- 7) Electricity and Magnetism with Electronics : Dr. K.K.Tewari, S.Chand Publications(1995).
- Fundamentals of electric circuit theory : Dr. D. Chattopashyay & Dr. P. C. Rakshit, S. Chand Publications, 7<sup>th</sup> Rev. Edn. (2006).
- 9) Electricity and Magnetism : John Yarwood, University Tutorial Press, (1973).
- 10) Feynman Lecture series, VolII, R P Feynnman et al, Narosa Publishing House, New Delhi
- 11) Electricity & Magnetism, N S Khare & S S Srivastava, AtmaRam & Sons, New Delhi.
- 12) Electricity & Magnetism, D L Sehgal, K L Chopra, N K Sehgal, S Chand & Co, Sixth Edition, (1988).
- 13) Electricity & Electronics, D C Tayal, Himalaya Publishing House, Sixth Edition(1988).
- 14) Basic Electronics & Linear Circuits, N N Bhargava, D C Kulshrestha & SC Gupta, TMH Publishing Company Limited, 28<sup>th</sup> Reprint, (1999).
- 15) Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books Private Limited, New Delhi, 5<sup>th</sup> Edition, (**1994**).
- 16) Introduction to Electrodynamics by D J Griffiths Pearson Education (2015).
- 17) Classical Electrodynamics : John David Jackson, John Wiley & Sons, (2007).

18) Electromagnetism by B B Laud 2ed.

19) An Introduction to vector analysis : B. Hague, Springer Science & Bussiness Media, (2012).

20) Electrical Networks, Theraja 3rd revised edition

21) Circuit Theory ( Analysis & Synthesis) : A. Chankrabarti, Dhanpat Rai Publications, (1951).

22) Electricity and Magnetism, S P Taneja, R Chand & Co. New Delhi.

23) Introduction to Electromagnetic Theory, S P Taneja, R Chand & Co. New Delhi.

# Practical

### Paper Title: Practical II

Teaching Hours: 4 Hrs / Week

Marks: Th-40+IA-10

Credits : 1

### Bridge Course: (02 Hours)

- Study of some important terms regularly used in Physics (like, 1 coulomb, 1 volt, 1 ampere, 1 tesla, 1 ohm, emf and pd, 1 farad, etc..)
- ii) Study of Bread Board Connections. Working of rheostat/potentiometer.
- iii) Resistance, Decade Inductance, Decade capacitors, AC/DC Sources and measuring devices.

### **Practicals:**

- 1 Thevenin's & Norton's theorem
- 2 High resistance by leakage method
- 3 Time constant of RC circuit by charging and discharging method.
- 4 Calibration of Ammeter using Helmholtz Galvanometer
- 5 LCR series and parallel resonance circuit
- 6 De Sauty's AC bridge
- 7 L & C by Equal Voltage Method
- 8 Use of CRO to find voltage, frequency and phase.
- 9 Measurement of power consumption by various bulbs, domestic electrical instruments and estimation (self-study/demonstration)
- 10 Constants of Ballistic Galvanometer (self-study/demonstration)
- 11 One Physics experiment of student's choice (self-study/demonstration).

### Note :

- 1. Experiments are of four hours duration.
- 2. Minimum of eight experiments to be performed.

### **References:**

1. Physics through experiments. B Saraf etc,- Vikas Publications (2013)

2. D P Khandelwal - A Laboratory Manual of Physics for Undergraduate Classes, Vikas

Publications First ed (1985)

3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London.

4. An Advanced Course in Practical Physics, D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, (**2002**)

- 5. BSC, Practical Physics, CL Arora, S Chand & Co, New Delhi, (**2007**) Revised Edition.
- 6. B.Sc. Practical Physics, Geeta Sanon R. Chand & Co. New Delhi

### **Question Paper pattern**

# First and Second Semester B.Sc. Degree Examination PHYSICS

Time	e: 3 hc	urs	Max. Marks: 80
		I	1
1.		Answer any 10 sub question	10 x 2 = 20
	i.		
	ii.		
	iii.		
	iv.		
	v.		
	vi.		
	vii.		
	viii.		
	ix.		
	X.		
	xi.		
	xii.		
2.			
	(a)		5 marks
	(b)		10 marks
		OR	
3.	(a)		5 marks
	(b)		10 marks
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4	(d) (h)		5 MdrKs 10 marks
		OR	10 11/11/13
5	(a)		5 marks
	(b)		10 marks

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6.	(a)	5 marks
	(b)	10 marks
		OR
7.	(a)	5 marks
	(b)	10 marks
8.	(a)	5 marks
	(b)	10 marks
		OR
9.	(a)	5 marks
	(b)	10 marks

#### \*\*\*\*\*\*

#### Instruction to set the question paper.

- 1. Question number 1 has 12 sub questions consisting of 3 questions from each unit. Each question carries two marks. A student must answer any ten questions.
- 2. Question number 2 and 3 are from unit I.
- 3. Question number 4 and 5 are from unit II.
- 4. Question number 6 and 7 are from unit III
- 5. Question number 8 and 9 are from unit IV.
- 6. Student has to answer question numbers 2 or 3, 4 or 5, 6 or 7 and 8 or 9 (four questions of (5+10=15) marks each)

Note: In case a student answers both the questions from the same unit in full or part, the highest marks from any one choice must be considered.