

**P. E. Society's  
Modern College of Arts, Science and  
Commerce Ganeshkhind, Pune-16  
(Autonomous)**

**B.Sc.(Physics)**

**Choice Based Credit System Syllabus**

**To be implemented from Academic Year 2022-2023**

**Structure of the Course:****F. Y. B.Sc.**

Semester	Course Type	Course Code	CourseName	Credit
I	Compulsory Course	22-PHY-111	Mechanics and Properties of Matter	2
		22-PHY-112	Physics Principles and Applications	2
		22-PHY-113	Physics Laboratory-IA	1.5
II	Compulsory Course	22-PHY-121	Heat and Thermodynamics	2
		22-PHY-122	Electricity and Magnetism	2
		22-PHY-123	Physics Laboratory-IB	1.5

Number of Lectures: 36 for each theory course

Number of Practical: 10 for each Practical course

Marks: Total 50 for each course (35 External + 15 Internal)

**Course code and title: 22-PHY-111: Mechanics and Properties of Matter**

**Lectures: 36**

**(Credits-02)**

**Learning Outcomes:**

- 1) Application of Newton's laws of motion to solve various problems related to day-to-day life.
- 2) Concepts like zero work done, conservative forces, mass energy equivalence ( $E=mc^2$ ).
- 3) Effect of force on various types of materials is described and physical properties like elasticity, different moduli etc. along with their relation.
- 4) Examples of surface tension in nature and its applications in our day-to-day life.
- 5) Concept of viscosity of fluids, Bernoulli's Equation and its applications.

**1. Motion:**

**(8 Lectures)**

- 1.1 Newton's laws of motion (Revision) and its applications
- 1.2 Various types of forces in nature
- 1.3 Frames of reference (Inertial and Non-inertial frames)
- 1.4 Impulse, momentum, Law of conservation of Momentum and coefficient of restitution
- 1.5 Mechanics and Evolution of transportation system- Wheel, steam engine, automobile engines, Electric vehicle, Hydrogen fuel-based car, Hyper loop, bullet train
  - Problems
  - Activity

**2. Work and Energy:**

**(5 Lectures)**

- 2.1 Kinetic energy, Potential energy, Work Energy Theorem
- 2.2 Work done with constant force and varying force (spring force)
- 2.3 Conservative and Non conservative forces, inverse square law
- 2.4 Law of energy conservation, Gravitational potential energy
  - Problems
  - Activity

**3. Fluid Dynamics**

**(8 Lectures)**

- 3.1 Concept of viscous force and viscosity
- 3.2 Coefficient of viscosity
- 3.3 Steady and Turbulent flow
- 3.4 Reynolds number, Equation of continuity
- 3.5 Bernoulli's Principle with proof
- 3.6 Applications of Bernoulli's Principle (Venturi Meter, Pitot Tube, Aspirator Pump)
- 3.7 Water Hammer Effect
- 3.8 Osmosis and Vapour Pressure of a solution
- 3.9 Laws of Osmotic Pressure
  - Problems
  - Activity

**4. Surface Tension**

**(4 Lectures)**

- 4.1 Surface tension
- 4.2 Angle of contact
- 4.3 Factors affecting surface tension,
- 4.4 Jaeger's method for determination of surface tension
- 4.5 Applications of surface tension
- 4.6 Hydrophilic and Hydrophobic Materials
- 4.7 Applications of Hydrophobic materials

- Problems
- Activity

## 5. Elasticity

(5 Lectures)

- 5.1 Stress and Strain
- 5.2 Hook's law and Coefficient of elasticity
- 5.3 Young's modulus, Bulk modulus, Modulus of rigidity
- 5.4 Work done during longitudinal strain, Volume strain and Shearing strain
- 5.5 Poisson's ratio
- 5.6 Relation between three elastic moduli ( $Y$ ,  $\eta$ ,  $K$ )
- 5.7 Applications of Elasticity in Medical field
- 5.8 Universal testing machine
  - Problems

## 6. Applications of Elasticity in Construction

(6 Lectures)

- 6.1 Bending of beams
- 6.2 Bending moments
- 6.3 Stiffness of beams
- 6.4 Cantilevers
- 6.5 Columns or Pillars
- 6.6 Critical load for a column
- 6.7 Calculation of critical load
  - Problems

### Reference Books

1. Physics: Resnick, Halliday & Walker 9/e, Wiley.
2. University Physics: Sears and Zeeman sky, XI th /XII th Edition, Pearson Education.
3. Mechanics: D.S. Mathur, S. Chand and Company, New Delhi.
4. Elements of Properties of Matter: D.S. Mathur, S. Chand, New Delhi.
5. Concepts of Physics: H.C. Verma, Bharati Bhavan Publisher.
6. Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd.
7. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir VI Edition. Pearson Education/Prentice Hall International, New Delhi.
8. Fundamentals of Mechanics: J C Upadhyaya, Himalaya Publishing House.
9. Mechanics: D. S. Mathur, Revised by P. S. Hemne, S. Chand and Company, New Delhi.

**Coursecodeandtitle:22-PHY-112: Physics Principles and Applications**

**Lectures: 36**

**(Credits-02)**

**LearningOutcomes:**

1. To understand the general structure of atom, spectrum of hydrogen atom.
2. To understand the atomic excitation and LASER principles.
3. To understand the bonding mechanism and its different types.
4. To demonstrate an understanding of electromagnetic waves and its spectrum.
5. Understand the types and sources of electromagnetic waves and applications.
6. To demonstrate quantitative problem solving skills in all the topics covered.

**1. Physics of Atoms**

**(07-Lectures)**

- 1.1 Introduction to Atom
- 1.2 Bohr's Atomic Model
- 1.3 The Bohr Theory of the Hydrogen Atom
- 1.4 The Hydrogen Spectrum
- 1.5 Atomic Spectra:
  - 1.5.1 Emission line Spectrum
  - 1.5.2 Absorption line spectrum
  - 1.5.3 Uses of Atomic Spectra
- 1.6 Frank-Hertz experiment
  - Problems
  - Activity

**2. Physics of Molecules**

**(06-Lectures)**

- 2.1 Introduction to Bonding Mechanisms
- 2.2 Forces between Atoms
- 2.3 Types of Bonding: Ionic, Covalent, van der Waal's, Hydrogen, Metallic
- 2.4 Rotation energy levels of a diatomic molecule
- 2.5 Vibration energy levels of a diatomic molecule
  - Problems
  - Activity

**3. LASERS and Its Applications**

**(06-Lectures)**

- 3.1 Introduction to LASERS
- 3.2 Characteristics of Lasers: brief explanation
- 3.3 Basic Principle of Lasers: Three Processes
- 3.4 Boltzmann Distribution Law
- 3.5 Population Inversion and Pumping
- 3.6 TypesofLasers:
  - 2.5.1 He-NeLaser
  - 2.5.2 RubyLaser
- 3.7 Applications of Lasers in medicine, industry and defense
  - Problems
  - Activity

**4. Sources of Electromagnetic Waves (08-Lectures)**

- 4.1 Introduction to Electromagnetic Waves: Historical Perspective
- 4.2 General properties of Electromagnetic radiations
- 4.3 Electromagnetic spectrum and its sources
- 4.4 Production of electromagnetic waves: Hertz experiment
- 4.5 Plank's hypothesis is of Photons
- 4.6 Applications of electromagnetic waves: Microwave oven, RADAR, X-ray radiography, CT scan, Different generations in wireless telephony (3G,4G,5G)
- 4.7 Solar cell, construction and working
  - Problems
  - Activity

**5. Introduction to Telecommunication (09-Lectures)**

- 5.1 Basics of communication systems, Block diagram of general communication system
- 5.2 Modulation and demodulation
  - Need of modulation, Types of modulation AM and FM, Basic Circuits and its working, Waveforms and Modulation Index
- 5.3 Noise in Communication
- 5.4 Applications of communications
- 5.5 Principles of Fiber Optic Communication
- 5.6 Types of cables: Twisted Pair, Coaxial Cable and Fiber Optic Cable
  - Problems
  - Activity

**Books/References**

1. Concepts of Modern Physics: A Beiser (6<sup>th</sup> ed., McGrawHill, 2003)
2. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer
3. Sears and Zemansky's University Physics: H. D. Young R. A. Freedman, Sandin (11th Ed. Pearson Education)
4. LASERS: M. N. Avdhanulu, S. Chand Publications.
5. Basic Communication by Kennedy
6. Communication Electronics by, 3<sup>rd</sup> Edition by Dennis Roddy, John Coolen

**Course code and title: PHY-113 Physics Laboratory 1A****Practical: 10****(Credits-1.5)****Section I- Mechanics and Properties of Matter**

Sr. No	Title of the experiment
1	Study and use of various measuring Instruments. 1. Vernier caliper 2. Micrometer Screw Gauge 3. Travelling Microscope
2	Study of Modulus of Rigidity of wire using Torsional Oscillations
3	Determination of coefficient of Viscosity by Poiseuille's method
4	Determination of "Y" and " $\eta$ " by flat spiral spring
5	Determination of "Y" by bending method.
6	Study of surface tension by Jaeger's method
7	Study of Poisson's ratio of rubber using rubber tube /rubber chord
8	Study of surface tension of liquid using Fergusson Method
9	Determination of coefficient of restitution

**Section II-Physics Principles and Applications**

Sr. No	Title of the experiment
1	Study of Spectrometer and determination of angle of prism
2	Study of Spectrometer calibration and determination of refractive indices of different colors
3	Study of divergence of LASER beam
4	Study of total internal reflection using LASER
5	Determination of Plank's constant
6	Determination of wavelength of LASER light by plane diffraction grating
7	Study of I-V characteristics of solar cell

Note: Any four experiments from each section be conducted during the semester, with a total of 10 experiments.

**SEMISTER-II**

**Course code and title: PHY-121 Heat and Thermodynamics**

**Lectures: 36**

**(Credits-02)**

**Learning Outcomes**

- 1) To understand various thermodynamic processes like isothermal, isobaric, isochoric processes and laws of thermodynamics.
- 2) To understand the concept of entropy.
- 3) To understand Carnot's cycle, Heat engines and Refrigerators.
- 4) To understand Principle of thermometry and various types of thermometers like Liquid filled thermometers, Gas filled thermometers, Bimetallic thermometers, Platinum resistance thermometer

**1. Fundamentals of Thermodynamics**

**(8 Lectures)**

- 1.1 Concept of thermodynamic state
- 1.2 Equation of state
- 1.3 Van der Waal's equation of state (without proof)
- 1.4 Thermal equilibrium
- 1.5 Zeroth law of thermodynamics
- 1.6 Thermodynamic processes: Adiabatic, Isothermal, Isobaric and Isochoric changes
- 1.7 Indicator diagram
- 1.8 Work done during isothermal change
- 1.9 Adiabatic relations
- 1.10 Work done during adiabatic change, Internal energy
- 1.11 Internal energy as state function
- 1.12 First law of thermodynamics
- 1.13 Reversible and Irreversible changes
  - Problems

**2. Applied Thermodynamics:**

**(9 Lectures)**

- 2.1 Conversion of heat into work and its converse Second law of thermodynamics
- 2.2 Concept of entropy
- 2.3 Temperature - entropy diagram
- 2.4 T-ds equations
- 2.5 Clausius - Clapeyron latent heat equations
  - Problems

**3. Heat Transfer Mechanisms**

**(9 Lectures)**

- 3.1 Carnot's cycle and Carnot's heat engine and its efficiency
- 3.2 Heat Engines: Otto cycle & its efficiency, Diesel cycle & its efficiency
- 3.3 Refrigerators: General principle and coefficient of performance of refrigerator
- 3.4 Simple structure of Vapour compression refrigerator
- 3.5 Air Conditioning: Principle and its applications
  - Problems



**4. Thermometry:**

**(6 Lectures)**

4.1 Concept of heat & temperature

4.2 Principle of thermometry

4.3 Temperature scales & inter- conversions

4.4 Principle, Construction and Working: (Liquid thermometers, Liquid filled thermometers, Gas filled thermometers, Bimetallic thermometers, Platinum resistance thermometer, Thermocouple)

- Problems

**5. Temperature sensors:**

**(4 Lectures)**

5.1 Large appliances: Washing Machine, Oven, Geyser

5.2 Small appliances: Iron, Induction cooktop

Reference Books:

1. Concept of Physics: H. C. Verma, Bharati Bhavan Publisher.
2. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand and Company Ltd.
3. Heat and Thermodynamics: Mark W. Zemansky, Richard H. Dittman, 7<sup>th</sup> Edition, Mc-Graw Hill International Edition.
4. Thermodynamics and Statistical Physics: J. K. Sharma, K. K. Sarkar, Himalaya Publishing House.
5. Thermal Physics (Heat and Thermodynamics): A. B. Gupta, H. P. Roy books and Allied (P) Ltd. Calcutta.
6. Instrumentation: Devices & Systems, Rangan, Mani and Sarma.
7. Handbook of repair and maintenance of domestic electronic appliances: Shashi Bhushan Sinha (BPB publications)

**Course code and title: PHY-122 Electricity and Magnetism**

**Lectures: 36**

**(Credits-02)**

**Learning Outcomes:**

- 1) To understand the concept of the electric force, electric field and electric potential for stationary charges.
- 2) Able to calculate electrostatic field and potential of charge distributions using Coulomb's law and Gauss's law.
- 3) To understand the dielectric phenomenon and effect of electric field on dielectric.
- 4) To Study magnetic field for steady currents using Biot-Savart and Ampere's Circuital laws.
- 5) To study magnetic materials and its properties.
- 6) Demonstrate quantitative problem-solving skills in all the topics covered.

**1. Electrostatics**

**(08-Lectures)**

- 1.1 Revision of Coulomb's law:
  - 1.1.1 Statement
  - 1.1.2 Variation of forces with distances
- 1.2 Superposition principle:
  - 1.2.1 Statement
  - 1.2.2 Explanation with illustration
- 1.3 Concept of electric field
  - 1.3.1 Electric intensity at any point due to point charge
  - 1.3.2 Electric Intensity at any point due to group charges
- 1.4 Electric Potential
  - 1.4.1 Electric potential at any point due to point charge
  - 1.4.2 Electric potential at any point due to group of charges
- 1.5 Electric potential energy of system
- 1.6 Concept of electric flux and Gauss's law in electrostatics
- 1.7 Application of Gauss's Law
  - Problems

**2. Dielectrics**

**(08-Lectures)**

- 2.1 Introduction to dielectric materials
- 2.2 Electric Dipole
  - 2.2.1 Electric dipole
  - 2.2.2 Dipole moment
- 2.3 Electric potential and intensity at any point due to dipole
- 2.4 Torque on a dipole placed in an electric field
- 2.5 Polar and non-polar molecules
- 2.6 Electric polarization of dielectric material
- 2.7 Gauss' law in dielectric
- 2.8 Electric vectors E, D, P and its relation
  - Problems

**3. Magnetization and Magnetic Properties of Materials**

**(07-Lectures)**

- 3.1 Introduction to Magnetization
- 3.2 Magnetic materials
- 3.3 Types of Magnetic Materials
  - 3.3.1 Diamagnetic materials
  - 3.3.2 Paramagnetic materials
  - 3.3.3 Ferromagnetic materials
  - 3.3.4 Antiferromagnetic materials
- 3.4 Magnetic Properties of Materials: Magnetization(M), Magnetic Intensity(H), Magnetic Induction(B), Magnetic Susceptibility, Magnetic Permeability
- 3.5 Relation between B, M and H
- 3.6 Hysteresis and Hysteresis Curve
- 3.7 Bohr Magneton
  - Problems

#### 4. Magnetostatics

(07-Lectures)

- 4.1 Introduction to magnetization,
- 4.2 Magnetic Induction and Intensity of magnetization
- 4.3 Biot-Savart's law:
  - 4.3.1 Statement
  - 4.3.2 Long straight conductor
  - 4.3.3 Circular Coil
- 4.4 Ampere's circuital law:
  - 4.4.1 Statement
  - 4.4.2 Field of Solenoid
  - 4.4.3 Field of Toroid
- 4.5 Gauss law for magnetics
  - Problems

#### 5. Basic electrical wiring and use of different electrical devices

(06-Lectures)

- 5.1 AC DC signals
- 5.2 Electrical supply frequency
- 5.3 Concept of neutral/ground
- 5.4 Basic Electric wiring (layout of electrical board), Fuse, Lamp holder, socket and plug
- 5.5 Single phase, two phase, three phase connections
- 5.6 Transformers
- 5.7 Battery and its types
- 5.8 Tools
- 5.9 Earthing & its importance in electrical wiring
  - Problems
  - Activity

#### References:

1. Fundamentals of Physics: Halliday Resnik and Walker, 8<sup>th</sup> Edition.
2. Electromagnetics: B. B. Laud.
3. Foundations of Electromagnetic theory: Reitz, Milford, Christey.
4. Electricity and Electronics: D.C.Tayal, Himalaya Publishing House, Mumbai.
5. Introduction to Electrodynamics: D.G. Griffith.
6. Electricity and Magnetism: BrijLal, Subramanyan, Ratan Prakashan (Revised edition, 1997).

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7. Electricity and Magnetism: Khare, Shrivastav (Revised edition, 1997).
8. ITI electrician theory I and II: Priti Agarwal and Rahul Garg (Neelkanth publication)
9. A textbook of electrical technology (Vol-I): B.L.Thareja, A.K.Thareja (S.Chand Publication)

**Course code and title: PHY-123 Physics Laboratory 1B****Practical: 08****(Credits-1.5)****Section I- Heat and Thermodynamics**

Sr No	Title of the experiment
1	Interpretation of Isothermal and Adiabatic curve on P-V diagram and theoretical study of Carnot's cycle by drawing graphs of Isothermal and Adiabatic curves
2	Study of temperature coefficient of Thermistor.
3	Study of Thermocouple and determination of inversion temperature
4	Study of thermal conductivity by Lee's method
5	Study of specific heat of Graphite
6	Study of Solar constant
7	Determination of calorific values of different fuels

**Section II- Electricity and Magnetism**

Sr No	Title of the experiment
1	Study of charging and discharging of capacitor
2	Study of LR circuit
3	Study of LCR circuit
4	Study of Kirchhoff's Laws
5	Study of Diode characteristics
6	Study of Voltmeter, Ammeter and Multimeter ( AC, DC, ranges and least count)
7	Determination of frequency of AC mains
8	Comparison of capacitor using DeSauty's method

**Note: Any four experiments from each section be conducted during the semester.**