

# PHYSICS

*Teaching Hours: 150T + 50P*

*Full Marks: 100(75T + 25P)*

*Nature of course: Theory + Practical*

*Pass Marks: 27T + 8P*

## **1. Introduction**

The curriculum in Physics is designed to provide students with an understanding of the scientific laws and principles of the physical world. As expected this curriculum will provide an opportunity to the students to see physics as a contribution to life in modern society.

The course demands emphasis on conceptual understanding of the physics phenomena. This will involve the proper utilization of suitable mathematical and environmental aspects need to be emphasized whenever possible. The students are expected to actively participate in the learning process through experimentation supplemented by demonstration, discussions and problem solving.

## **2. Objectives**

### **2.1 General objectives**

The general objectives of this course are:

- a) To provide students with sufficient understanding and knowledge of the fundamental principles of physics and their applications;
- b) To develop the skills of experimenting, observing, interpreting data evaluating evidence and formulating generalizations and other implications of the physics and appreciate the advancement of physics and its applications as essential for the growth of national economy.

### **2.2 Specific objective**

*Upon completion of this course, the students will be able to:*

1. Describe physics as a coherent and developing framework of knowledge based on fundamental theories of the structure and process of the physical world;
2. Explain phenomena in terms of theories and models;
3. Apply quantitatively and qualitatively the knowledge and understanding of physical principles and theories;

4. Translate information from one from to another;
5. Present information in the language of physics or other appropriate form; and
6. Design simple experiment to develop relations among physical quantities and draw conclusions.

### 3. Course content

#### Unit 1 Waves and optics

**40 teaching hours**

#### Waves

**(23 hrs)**

1. Wave motion , Wave motion; Longitudinal and transverse waves; Progressive and stationary waves; Mathematical description of a wave. ( 4 hrs)
2. Mechanical waves – Speed of wave motion; Velocity of sound in solid and liquid; Velocity of sound in gas; Laplace’s correction; Effect of temperature , pressure, humidity on velocity of sound. (5 hrs)
3. Wave in pipes and strings – Stationery waves in closed and open pipes; Harmonics and overtones in closed and open organ pipes; End correction in pipes; Resonance Tube experiment ; Velocity of transverse waves along a stretched string; Vibration of string and overtones; Laws of vibration of fixed string. ( 6hrs)
4. Acoustic phenomena – Sound waves: Pressure amplitude; Characteristics of sound: Intensity; loudness, quality and pitch ; Beats; Doppler’s effect; Infrasonic and ultrasonic waves; Noise pollution : Sources, health hazard and control. (8 hrs)

#### Physical Optics

**(17 hrs)**

1. Nature and propagation of light – nature and sources of light; Electromagnetic spectrum; Huygen’s principle, Reflection and Refraction according to wave theory; Velocity of light: Foucault’s method; Michelson’s method. (6 hrs)
2. Interference – Phenomenon of interferences; Coherent sources; Young’s two slit experiment; Newton’s ring. (4 hrs)
3. Diffraction from a single slit; Diffraction pattern of image; Diffraction grating; Resolving power of optical instruments. ( 4 hrs)
4. Polarization- Phenomenon of polarization; Brewster’s law; transverse nature of light; Polaroid. ( 3 hrs)

## Unit – 2 Electricity and Magnetism

### Current Electricity

(20hrs)

1. D.C. circuit – Electric currents; Drift velocity and its relation with current; Ohm's law; Electrical Resistance; Resistivity; Conductivity; Super conductors; Perfect Conductors; Perfect Conductors; Current – Voltage relations; Ohmic and Non-Ohmic resistance; Resistances in series and parallel, Potential Divider Conversion of galvanometer into voltmeter and ammeter, Ohmmeter; Electromotive force: Emf of a source, internal resistance; work and power in electrical circuits- Joule's law and its verification. (9 hrs)
2. Electrical circuits – Kirchhoffs laws; Wheatstone bridge circuit; P.O Box, Meter Bridge; Potentiometer; Comparison of emf's , measurement of internal resistance of a cell. (7 hrs)
3. Thermoelectric effect- Seebeck effect; Thermocouples, Peltier effect: Variation of thermoelectric emf with temperature , Thermopile, Thomson effects. (2 hrs)
4. Chemical effect of current – Faraday's laws of electrolysis; Faraday's constant, Verification of Faraday laws of electrolysis. (2 hrs)

### Magnetic Field of current

(35 hrs)

1. Magnetic Field-Magnet field lines and magnetic flux; Oersted's experiment; Force on moving charge, Force on Conductor; Force and Torque on rectangular coil, Moving coil galvanometer; Hall effect; Magnetic field of a moving charge; Biot and Savart law and its application to (i) a circular coil (ii) a long straight conductor (iii) a long solenoid; Forces between two parallel conductors carrying current – definition of ampere. (14 hrs)
2. Magnetic properties of materials elements of earth magnetism and their variation; Dip and Dip circle; Flux density in magnetic material; Relative permeability; Susceptibility; Hysteresis, Dia, Para and Ferromagnetic materials. (5 hrs)
3. Electromagnetic induction- Faraday's laws; Induced electric fields; Lenz's law, Motional electromotive force; AC generators; eddy fields; Self inductance and mutual inductance; Energy stored in an inductor; Transformer. (8 hrs)
4. Alternating currents peak and RMS value of AC current and Voltages, Ac through resistor , capacitor and inductor; Phasor diagram, Series circuits containing combination of resistor, capacitor and inductor; Series Resonance, Quality factor; Power in AC circuits: Power factor; Choke coil. (8 hrs)

### Unit-3 Modern Physics

1. Electrons and Photons-Electrons: Milikan's oil drop experiment, Gaseous discharge at various pressure; Cathode rays, Motion of electron beam in electric and magnetic fields; Thomson's experiment to determine specific charge of electrons. (10 hrs)
2. Solids and Semiconductor devices- Structure of solids; Energy bands in solids (qualitative ideas only); Difference between metals, insulators and semi-conductors using band theory; Intrinsic and extrinsic semi-conductors; P-N junction; Semiconductor diode: Characteristics in forward and reverse bias; Full wave rectification; Filter circuit; Zenar diode; Transistor: Common emitter characteristics, Logic gates; NOT, OR, AND, NAND and NOR., Nanotechnology (introductory idea) (11 hrs)
3. Quantization of energy-Bohr's theory of hydrogen atom; Spectral series; Excitation and ionization potentials; Energy level; Emission and absorption spectra, De Broglie Theory; Duality; Uncertainly principle.  
Lasers: He- Ne laser, Nature and production, properties and uses.  
X-rays: Nature and production; uses: X-rays, X-rays diffraction, Bragg's law.
4. Nuclear physics- Nucleus: Discovery of nucleus; Nuclear density ; Mass number; Atomic number; Atomic mass; Isotopes; Einstein's mass-energy relation, Mass Defect; Binding energy; Fission and fusion.
5. Radioactivity- Alpha-particles; Beta-particles, Gamma rays; Laws of radioactive disintegration; Half life and decay constant; Geiger-Muller Tube; Radio carbon dating; Medical use of nuclear radiation; Health hazards and safety precautions.
6. Nuclear energy and other sources of energy – Sources of energy; Conservation and degradation of energy; Transformation of energy. Nuclear energy: Energy released from fission and fusion; Thermal and Hydroelectric power; Wind energy consumption pattern and demands; Energy use in Nepal.  
*Fuels and pollution: Global Warming; Acid Rain.*
7. Particle physics and cosmology particles and antiparticles, Quarks and Leptons, baryons, mesons.
8. *Universe:* Hubble law; Big Bang; Critical density; Dark matter,

## Practical

A student will perform at least 24 experiments from the given list:

## Introduction

General instruction: Students are expected to learn general ideas of errors, order of accuracy and graphical analysis. Students are also expected to learn the physical principles and theory of experiments on magnetism not covered in the theory curriculum.

## List of Experiments

### A. Wave and Optics

1. Determination of the wavelength of sodium light by measuring the diameter of Newton's rings.
2. Determination of the wavelength of a given monochromatic source of light by passing a plane diffraction grating.
3. Determination of the refractive index of a given transparent medium and calculation of the speed of the light in the medium.
4. Uses of laser beams:
  - I. Determination of the wavelength of He-Ne laser light
  - II. Determination of the diameter of a given hair
5. Use of Sonometer:
  - I. Determination of the frequency of a given tuning fork
  - II. Comparison of frequencies of two tuning forks.
6. Determination of the frequency of A.C. Mains
7. Use of resonance tube:
  - I. Determination of velocity of sound in air at NTP
  - II. Comparison of frequencies of two tuning forks.
8. Determination of the end correction of the resonance tube apparatus.

## **B. Electricity**

9. Verification of Ohm's Law
10. Use of P.O. Box:
  - I. Determination of the resistivity of the material of a given wire
  - II. Verification of the laws of series and parallel resistances
11. Use of meter bridge:
  - I. Comparison of resistances of two given wires
  - II. Determination of the resistivity of the material of a given wire
  - III. Verification of the laws of series and parallel resistances
12. Determination of high resistance by substitution method.
13. Determination of the capacitance of the capacitor by charging and discharging a capacitor.
14. Use of potentiometer:
  - I. Comparison of emf's of two cells
  - II. Comparison Of resistances of two given wires
  - III. Determination of the internal resistance of a cell
15. Conversion of given galvanometer into an ammeter and a voltmeter of desired range.
16. Calibration of a given ammeter and voltmeter.
17. Determination of the half-life of a circuit containing a pure capacitor in series with a resistance in a D.C. circuit.
18. Uses of a series LCR circuit:
  - I. Determination of the resonant frequency of a series LCR circuit
  - II. Determination of the quality factor of a series LCR circuit

## **C. Magnetism**

19. Determination of the pole strength and magnetic moment of a bar magnet by locating the neutral points keeping:
  - I. North pole pointing towards the geographical south
  - II. North pole pointing towards the geographical north
20. Use of deflection magnetometer:
  - I. Determination of the pole strength and magnetic moment of a bar magnet
  - II. Comparison of the magnetic moments of two bar magnets
21. Use of oscillation magnetometer:
  - I. Determination of the pole strength and magnetic moment of a bar magnet
  - II. Comparison of the magnetic moments of two bar magnets
22. Use of dip circle:

Determination of the angle of dip in the laboratory

### C. Modern Physics

23. Study the characteristics of a junction diode.
24. Study the characteristics of a transistor.
25. Study the characteristics of a Zener diode.
26. Determination of Planck's constant using a photocell

### List of Activities

1. To assemble a household circuit comprising three bulbs, three switches, a fuse and a power source. Measure current and voltage across each component and then interpret the data.
2. To use multimeter to (a) identify base of transistor and terminal of IC (b) Check whether a given electronic component (e.g diode, transistor, and IC) is in working order.
3. To study the relation between frequency and length of a given wire under constant tension using sonometer.
4. To study AND, OR, and NOT gates.
5. To identify the difference between e.m.f and p.d. of a cell.

*Note:* The above are only the specimens of activities. In order to arouse creativity, the students must be encouraged to take up new activities ( other than mentioned above) in consultation with the teacher concerned.

### Laboratory Manual

- I. Certificate Level Physics Practical Guide, U.P Shrestha, Ratna Pustak Bhandar, Kathmandu
- II. Elementary Practical Physics, Dr. Narayan Hari Joshi , Taleju Prakashan

### 4. Teaching Strategies:

- Lecturing
- Group Interaction
- Problem solving
- Demonstration
- Evaluation

### 5. Instructional materials

OHP, LCD demonstration kits, writing boards etc.

## 6.Evaluation Scheme

Unit	Teaching hours	LAQ	SAQ	NP	Mark Distribution			Total
					LAQ	SAQ	NP	
Electricity And magnetism	55	3\4	2\3	2\3	4x3	2x4	4x2	28
Modern Physics	55	3\4	2\3	2\3	4x3	2x4	4x2	28
Waves And sound	21	1\2	1\1	1\1	4x1	2x1	4	10
Physical Optics	19	1\2	1\1	1\1	4x1	2x1	3	9
<b>Total</b>	<b>150</b>	<b>8\12</b>	<b>10\14</b>	<b>6\8</b>	<b>32</b>	<b>20</b>	<b>23</b>	<b>75</b>

### Note:

**LAQ:** long answer Question

**SAQ:** Short answer Question

**NP:** Numerical problems

- In the table numerator denotes the number of questions to be attempted and denominator denotes the number of question asked. For example, 3\4 means 3 questions are to be answered out of 4 questions.
- There will be three groups A,B and C. Group A contains short-answer questions(SAQ),group B long answer Questions(LAQ) and Group C Numerical Problems(NP)
- Each of SAQs carries 2 marks, each of LAQs carries 4 marks and each of numerical problems carries 4 marks except in Physics Optics for which it carries only 3 marks.
- Short answer questions should cover the entire course as far as possible. These questions should be of conceptual type.

### Practical

Every student will perform at least 20 experiments and 4 activities during the academic year.

### 7.Evaluation Scheme for Practical examination:

One Experiment	12 Marks
One activity	3 Marks
Practical record of experiments and activities	5 Marks
Viva on experiment and activity	5 Marks

**Reference books:**

1. University Physics, Sears F. W., M.W. Zemansky, H.D. Young and R. A. Freedman, 11<sup>th</sup> edition, Pearson Education Singapore, 2004.
2. Advanced Level Physics, Nelkon and Parker, Heimesmann Education book Ltd., 2000
3. Advanced Level Physics Tom Duncan, John Murray Ltd, 2000.