Pokhara University
Faculty of Science and Technology

Course No.: 3 credit (3-1-2)
Course title: **Applied Physics**
Nature of the course: Theory and Practical
Year: First
Level: Bachelor

Full marks: 100
Pass marks: 45
Time per period: 1 hour
Total periods: 45
Program: BE

1. Course Description

This course is designed to develop the knowledge of basic concepts of physics which are essential in understanding and solving engineering related problems.

2. General Objectives

The general objectives of this course are:

1. To introduce oscillation in different systems.
2. To familiarize about characteristics and applications of different types of wave.
3. To provides the fundamentals of laser and optical fiber with their importance in various fields.
4. To enhance the importance of capacitor and dielectrics in energy storage.
5. To familiarize the fundamental concepts and laws in electromagnetism.
6. To enlighten the basics of quantum mechanics and its future prospects.
7. To provide the knowledge of applications of thermodynamics laws.

3. Methods of Instruction

3.1.General instructional Techniques: Lecture, discussion, readings.
3.2.Specific instructional Techniques: Lab works, Project works.

4. Contents in Detail

Specific Objectives	Contents

Students will get knowledge on importance of mechanical oscillations and their scope in various engineering fields.	**Unit 1: Mechanical Oscillation (6 hrs)** **1.1** Free oscillation, Damped oscillation and Forced oscillation (Physical meaning and equations). **1.2** Compound pendulum, Minimum and maximum time period in compound pendulum, Interchangeability of point of suspension and point of oscillation in compound pendulum, Torsion pendulum, Determination of modulus of elasticity of material using torsion pendulum.
Students will be familiar with properties, types of wave and their importance in different fields.	**Unit 2: Wave motion (4 hrs)** Introduction of wave, wave velocity and particle velocity, types of waves and their applications, Speed wave in stretched string, energy, power and intensity of plane progressive wave, standing wave and resonance, sonometer,.
First goal of acoustic standard is to reduce excessive reverberation and loudness. Further the students will understand the sound waves, their productions and uses.	**Unit 3: Acoustics (4 hrs.)** **3.1** Classification of sound waves, Acoustics of building, Reverberation of sound, absorption coefficient, Noise pollution and its control, Sound insulation, Sabine equation. **3.2** Introduction, production and applications of ultrasonic wave. Ultrasonic method in non-destructive testing.
Understand the use of lasers in engineering sciences and apply the concept of optical fibers in communication system and sensors.	**Unit 4: Photonics (6 hrs.)** **4.1** Laser: Introduction of laser, Principles of generation of laser light (induced absorption, spontaneous emission, stimulated emission, population inversion, pumping, metastable state), He–Ne laser, Semiconductor laser, Applications of laser. **4.2** Fiber optics: Introduction, Types of optical fiber, Principle of propagation of light wave through optical fiber (Acceptance angle), Numerical aperture, Applications of optical fiber in communications, Optical fiber sensors.

By the end of this section students will able to explain the concept of capacitor, its capacitance and will be able to evaluate the capacity of capacitors to store energy with and without dielectrics.	**Unit 5: Capacitor and Dielectric (6 hrs.)** **5.1** Capacitor: Introduction, Types of capacitor, Charging and discharging of capacitor. **5.2** Dielectric: Introduction, Dielectric constant, electric flux density, Polarization, Polarization in free space, Gauss law in dielectric, Electronic and Ionic polarization (Clausius-Mossotti equation).
Students will able to deal with interaction between electric field and magnetic field on matter. Further they will familiar with behavior of electromagnetic waves and origin of optics.	**Unit 6. Electromagnetism (6 hrs.)** **6.1**. EM Oscillation: LC oscillation, Damped LCR oscillation, Forced em oscillation, resonance and quality factor **(**2hrs). **6.2**. EM waves: Maxwell equations in integral form, Conversion of Maxwell's equations in differential form, Continuity equation, Relation between electric field, magnetic field and speed of light, wave equations in free space, verification of light wave as an electromagnetic wave, Wave equation in dielectric medium (4hrs).
Students will able to apply principles of quantum mechanics to investigate the observables on known wave functions.	**7. Quantum Mechanics (5 hrs.)** Inadequacy of classical mechanics, Importance of quantum mechanics, Matter wave (de-Broglie equation), Wave function and its significance, Energy and momentum operator, Time independent and time dependent Schrodinger wave equations, Application of Schrodinger wave equation for the electron in metal, Normalized wave function describing the motion of an electron inside in an infinite potential well.

Students will able to understand the laws of thermodynamics and its applications.	**8 . Fundamentals of thermodynamics and heat transfer (8 hrs.)** **8.1** Concepts and definition: applications of thermodynamics, properties and state of substance, thermodynamics properties and types, processes (definition, characteristics and examples): reversible and irreversible process. **8.2** Laws of thermodynamics: first law of thermodynamics, first law for closed system, internal and stored energy, joules law, enthalpy, specific heat, application of first law for closed system, Related problems on closed system, second law of thermodynamics, heat engine (four components of refrigerator and heat pump, COP of refrigerator and heat pumps), Kelvin-Planck and Clausius statement of second law. **8.3** Heat transfer: modes of heat transfer (conduction, convection and radiation), statement and assumption of Fourier's law of thermal conductivity, one dimensional steady state heat conduction through plane wall, basic laws of radiation (Emissive power and emissivity, Stefan-Boltzmann's law), Concept of black bodies.

Laboratories (Any Eight):

1. To determine the acceleration due to gravity and radius of gyration of bar pendulum.
2. To determine the value of modulus of elasticity of the material given and moment of inertia of circular disc using torsion pendulum.
3. To determine the acceptance angle of an optical fiber using laser source.
4. To determine the frequency of AC mains by using sonometer apparatus.
5. To determine the wavelength of laser light by using diffraction grating
6. To determine the capacitance of given capacitor by charging and discharging through resistor.
7. To plot a graph between current and frequency in an LRC series circuit and to find: i) the resonance frequency ii) the quality factor.

8. To determine the dielectric constant of a given material
9. To determine the Planck's constant and photoelectric work functions of the material.
10. To measure the pressure, specific volume and temperature.
11. To find out the efficiency of a compressor.
12. To measure the rate of heat, transfer by conduction
13. To measure the performance of a Refrigeration/ Heat pump

Evaluation system and Students' Responsibilities

1. Evaluation System

In addition to the formal exam(s), the internal evaluation of a student may consist of quizzes, assignments, lab reports, projects, class participation, etc. The tabular presentation of the internal evaluation is as follows.

<table>
<tr><th>External Evaluation</th><th>Marks</th><th>Internal Evaluation</th><th>Weight</th><th>Marks</th></tr>
<tr><td rowspan="12">Semester-End examination</td><td rowspan="12">50</td><td colspan="2">Theory</td><td rowspan="5">30</td></tr>
<tr><td>Attendance</td><td>10%</td></tr>
<tr><td>Assignments</td><td>20%</td></tr>
<tr><td>Presentations/Viva/Quizzes</td><td>10%</td></tr>
<tr><td>Term exam</td><td>60%</td></tr>
<tr><td colspan="2">Practical</td><td rowspan="5">20</td></tr>
<tr><td>Attendance</td><td>10%</td></tr>
<tr><td>Report</td><td>10%</td></tr>
<tr><td>Viva</td><td>20%</td></tr>
<tr><td>Exam</td><td>60%</td></tr>
<tr><td>Total Internal</td><td></td><td>50</td></tr>
<tr><td colspan="4">Full Marks</td><td>100</td></tr>
</table>

Student Responsibilities:

Each student must secure at least 45% marks in internal evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear the End-Term examinations.

Students are advised to attend all the classes and complete all the assignments within the specified time period. If a student does not attend the class(es), it is his/her sole responsibility to cover the topic(s) taught during the period. If a student fails to attend a formal exam, quiz, test, etc. there won't be any provision for re-exam.

Prescribed Books and References

Text Books

Halliday, D., Resnick, R., Walker. J., Fundamental of Physics, John wiley and Sons. Inc. 2005.

Young, H. D., Freedman. R. A., Sears and Zemansky's University Physics, 2009.

Howel, J. R. and Buckius, R. O., Fundamentals of Engineering Thermodynamics, McGraw-Hill Publishers, 1994

Vasudeva, A. S., Modern Engineering Physics, S. Chand and Company Ltd., 2004.

Course in Physics for IIT–JEE, Tata McGraw Hill Publishing Company Ltd., 2007.

Singh, H., & Hemne, P. S. (2000). *B. Sc. Practical Physics*. S. Chand Publishing.

Arora, C. L. (2020). *B. Sc. Practical Physics*. S. Chand Publishing.

Reference Books

Bhandari, I. B. et. al. Engineering Physics. KEC Publication. (2022).

Malik, H. K., Singh, A. K., Engineering Physics, Tata McGraw Hill Education Private Ltd., 2010.

Mathur, D. S., Mechanics, S. Chand and Company Ltd., 2003.

Van Wylen, G. J. and Sonntag, R. E., Fundamentals of Classical Thermodynamics, Wiley Eastern Limited, New Delhi, 1989

Sapkota, B., Pokharel, B., Bhattarai, B., Fundamentals of Engineering Physics, Benchmark Education Support (P) Ltd., 2012

Shrestha, V. K., Problems in Physics B. Sc. Level, Ratna Pustak Bhadar, 2000.

Bhandari, I. B. et. al. (2000). B. E. Practical Physics. KEC Publications (2022)

Subrahmanyam, N., Lal, B, Waves and Oscillation, 2009

Subrahmanyam, N., Lal, B., A text book of Optics, S. Chand and Company Ltd., 2005.

Lamichhane, T. R., Bhatta, M. D., A Text Book of Engineering Physics, Sunlight Publication, 2011

Tiwari, K. K., Electricity and Magnetism, S. Chand and Company Ltd., 2001

Murugeshan, R., Sivaprasath, K., Modern Physics, S. Chand and Company Ltd., 2009.

Reitz, J., Milford, F.J., Christy, R.W., Foundations of Electromagnetic Theory, 1996.