Course Title: Mechanics and Electrodynamics **Credit: 3+1**
Course No.: CSIT.124
Nature of the Course: Theory+Lab **Total hours: 48**
Year: First, Semester: Second
Level: B.Sc.CSIT

1. Course Description

The course intends to enable the students to be acquainted with the basic concepts and principles of Mechanics and Electrodynamics. Students will be familiarized with the fundamentals of Newton's laws of motion, conservation Laws, motion of charged particles electric and magnetic fields, harmonic oscillators, LCR circuits, electrostatics, magnetostatics and Maxwell's equations.

2. Course Objectives

At the end of this course the students should be able:

- to acquire sufficient basic knowledge in mechanics and electrodynamics.
- to apply this knowledge base for studying major courses in CSIT.
- to introduce the concepts and methods of mechanics and electrodynamics needed for application in various branch of CSIT

3. Specific Objectives and Contents

Specific Objectives	**Contents**
• Understand Newton's laws of motion • Explain and use conservation Laws • Learn the concept of Gravitational fields and potential energy • Explain the collisions phenomena	Unit I: Review of Basic Concepts of Mechanics (5) Newton's laws of motion, Conservation Laws (momentum and energy), potential energy, Gravitational fields, Collisions
• Write and explain the equation of motion of uncharged and charged particles • Explain the motion of charged particles in different electric and magnetic fields • Discuss the examples of cyclotron,	Unit II: Particle Dynamics (6) Equation of motion of uncharged and charged particles, Charged particles in constant and alternating electric field, Charged particles in a magnetic field - cyclotron, magnetic focusing, Charge particles in combined electric and magnetic field

magnetic focusing

- Understand the motion of harmonic oscillator and explain the examples of a diatomic molecule, pendulum with large oscillation
- Concept of damped oscillations, driven oscillations and resonance
- Understand LCR resonance circuits
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Unit III: Harmonic Oscillator (8)

Harmonic oscillator, example of a diatomic molecule, pendulum with large oscillation, Damped oscillations, power factor, Q – factor, Driven oscillations, resonance, LCR and parallel resonance circuits

- Understand the concept of electric field and electric potential
- Use Gauss's law to symmetric problems
- Explain the Poisson's and Laplace's equations and their solutions
- Express Laplace's equations in spherical cylindrical coordinates and rectangular coordinates
- Application for calculating the electric field due to conducting sphere in a uniform E field
- Explain the concept of method of images and its applications
- Concept of electrostatic energy and its derivation for various cases

Unit IV: Electrostatics (9)

Electric field and electric potential, Gauss's law and its applications, Solution of electrostatic problems, Poisson's and Laplace's equations, Solution of Laplace's equations in spherical cylindrical coordinates and rectangular coordinates, Examples conducting sphere in a uniform E field, method of images, point charge and a conducting sphere, line charge and line images, systems of conductors, Solution of Poisson's equation, Electrostatic Energy - Potential energy of a group of charges and charge distributions, energy density, energy of a system of charged conductors

- Understand the effect and working of dielectrics
- Explain the modification of electric field in a dielectric media and polarization
- Use Gauss's law in a dielectric medium
- Understand the concept of displacement vector, electric susceptibility
- Concept of boundary conditions on boundary value problems
- Explain the molecular theory of dielectrics and induced dipoles

Unit V: Dielectrics (6)

Electric field in a dielectric media, Polarization, field inside and outside a dielectric Gauss's law in a dielectric medium, displacement vector, electric susceptibility and dielectric constant, Boundary conditions on field vectors, boundary value problems in a dielectric medium, dielectric sphere in a uniform electric field, Molecular theory of dielectrics, induced dipoles

- Explain vector potential and magnetic field
- Understand the magnetic forces between currents and its effects on charged particles
- Understand and use Biot-Savart law to solve for the field
- Expalin and derive the energy density in the magnetic field
- Explain the magnetic energy of coupled circuits

Unit VI: Magnetostatics (6)

Vector potential and magnetic field, Magnetic forces between currents, Magnetic effects on charged particles, Biot-Savart law and its applications, Energy density in the magnetic field, magnetic energy of coupled circuits

- Explain the physical meaning of the Maxwell's Equations
- Understand the concept of displacement current
- Calculate the electromagnetic energy
- Formulate the electromagnetic wave equations without and with source

Unit VII: Maxwell's Equation (8)

Maxwell's equations - displacement current, Electromagnetic energy, Wave equations without and with source, boundary conditions

. Prescribed Text

- *Mechanics*: D. S. Mathur, S. Chand and Company Ltd
- *Introduction to Electrodynamics*: David J. Griffith, Prentice Hall of India

7. Reference

- *Foundations of Electromagnetic Theory:* John R. Ritz, Frederick J. Milford and Robert W. Christy, Narosa Publishing House
- *Berkeley Physics Course, Vol. 1, Mechanics*, McGraw-Hill / Dev Publishers, New Delhi
- *Newtonian Mechanics*, P. French, MIT Introductory Physics Series, Viva Bools Pvt Ltd
- *Fundamentals of Physics*, D. Halliday, R. Resnick, J. R. Christman and J. Walker, Wiley