Course content

This course provides a deep exploration of fundamental principles in physics and their applications to complex engineering problems in computer science. It focuses on the use of mathematical, natural science, engineering, and computer science tools to solve real-world challenges. Topics include oscillations, waves, electrostatics, electromagnetism, and more, with an emphasis on understanding and solving problems in the context of engineering.

Key topics covered include:

1. **Vibrations**: Simple harmonic motion, energy in harmonic oscillators, damped and forced vibrations, resonance, and synthesis of harmonic motions.
2. **Waves**: Formation of harmonic waves, wave function, elasticity, wave velocity in elastic media, Huygens' principle, wave reflection and refraction, sound waves, and Doppler effect.
3. **Interference of Light**: Young's double-slit interference, coherent light, thin-film interference, and Michelson interferometer.
4. **Diffraction of Light**: Diffraction phenomena, Huygens-Fresnel principle, diffraction patterns, and single-slit, wire, and grating diffraction.
5. **Polarization of Light**: Natural and polarized light, polarization through absorption, reflection, and birefringence, scattering and polarization effects.
6. **Electrostatics**: Charge, electric field strength, Coulomb's law, electric field lines, electric flux, and electrostatic equilibrium in conductors.
7. **Electric Potential**: Conservative nature of electric fields, potential superposition principle, potential gradient, and energy in electrostatic fields.
8. **Capacitors and Dielectrics**: Capacitance, capacitor configurations, effects of dielectric materials on electric fields, dielectric polarization, displacement vector, and energy in dielectric fields.
9. **Electric Current and Magnetic Fields**: Electric current, current density, Ohm’s law, magnetic forces and charged particle motion, magnetic fields, and Ampere's law.
10. **Magnetic Forces**: Motion of charged particles in magnetic fields, Hall effect, magnetic forces on current-carrying conductors, and interactions between parallel conductors.
11. **Magnetic Properties of Matter**: Atomic magnetic moments, magnetization of materials, magnetic field strength, and the analysis of ferromagnetic materials.
12. **Electromagnetic Induction and Waves**: Faraday's law of electromagnetic induction, induced electromotive force (EMF), self and mutual inductance, energy in magnetic fields, Maxwell’s equations, and the properties of electromagnetic waves.

Course objectives

Knowledge

1. Master the fundamental principles of mathematics, natural sciences, engineering, and computer science necessary for solving complex engineering problems in computer science.
2. Understand and apply the principles of wave dynamics, electromagnetism, and optics to analyze and solve engineering challenges.
3. Learn the physical theories and models related to electric and magnetic fields, and their interaction with matter and energy.

4. Gain proficiency in using scientific methods, literature research, and experimental techniques for solving engineering problems.

Skills

1. Use mathematical and physical tools to express and solve complex problems in computer science and engineering.
2. Analyze the dynamics of physical systems such as oscillations, wave propagation, and electromagnetic fields in the context of real-world applications.
3. Apply computational techniques to simulate and solve problems involving waves, light, electricity, and magnetism.
4. Design and conduct experiments to test theories and principles in the fields of mechanics, optics, and electromagnetism.

Competencies

1. Apply interdisciplinary knowledge to identify critical components of complex engineering problems in the computer science field.
2. Demonstrate the ability to conduct research, synthesize findings, and propose solutions to intricate engineering challenges.
3. Collaborate with peers to solve problems, share insights, and develop innovative solutions in the field of computer science engineering.
4. Communicate technical concepts effectively, both in written and verbal forms, to diverse audiences.