

PHYSICS 242

PHY 242 - General Physics II is the second course in the calculus-based PHY 241/242 sequence. It provides an introduction to electricity, magnetism, optics and selected topics in Modern Physics. It is designed for majors in physics, chemistry, mathematics and engineering. There are four 1-hour lectures, one 1-hour tutorial and one 3-hour lab each week. Prerequisite: MAT 241. Co-requisite: MAT 242.

Week 1

Electric Charge, Conductors, Insulators, and Induced Charges, Coulomb's Law, Electric Field and Electric Forces, Electric Dipoles

Week 2

Charge and Electric Flux, Gauss's Law, Charges on Conductors, Electric Potential, Electric Potential Energy, Equipotential Surfaces, Potential Gradient

Week 3

Capacitance, Capacitors in Series and Parallel, Energy Storage, Electric-Field Energy, Dielectrics, Current, Resistivity, Resistance, Electromotive Force, Circuits, Energy and Power in Electric Circuits

Week 4

Resistors in Series and Parallel, Kirchhoff's Rules, R-C Circuits, Power Distribution, Magnetic Field and Magnetic Forces, Magnetic Flux, Motion of Charged Particles in a Magnetic Field, Magnetic Force on a Current, Force and Torque on a Current Loop, The Direct-Current Motor

Week 5

Magnetic Field of a Moving Charge, Current Element and Straight Current-Carrying Conductors, Force Between Parallel Conductors, Magnetic Field of a Circular Current Loop, Biot-Savarte and Ampere's Law

Week 6

Faraday's Law, Lenz's Law, Motional Electromotive Force, Induced Electric Fields, Displacement Current and Maxwell's Equations, Mutual Inductance and Self-Inductance, Magnetic-Field Energy, The R-L Circuit, L-C Circuit, and L-R-C Series Circuits

Week 7

Phasors and Alternating Currents, Resistance and Reactance, The L-R-C Series Circuit, Power and Resonance in AC Circuits, Transformers

Week 8

Maxwell's Equations and Electromagnetic Waves, Plane Electromagnetic Waves and the Speed of Light, Sinusoidal Electromagnetic Waves, Energy and Momentum in Electromagnetic Waves, Standing Electromagnetic Waves

Week 9

Reflection and Refraction, Snell's Law, Total Internal Reflection, Polarization, Reflection and Refraction at a Plane Surface

Week 10

Reflection at a Spherical Surface, Refraction at a Spherical Surface, Thin Lenses, Cameras, The Eye, The Magnifier, Microscopes and Telescopes

Week 11

Interference and Coherent Sources, Two-Source Interference of Light, Intensity in Interference Patterns, Interference in Thin Films

Week 12

Fresnel and Fraunhofer Diffraction, Diffraction from a Single Slit, Intensity in the Single-Slit Pattern, Multiple Slits, The Diffraction Grating, Circular Apertures and Resolving Power

Week 13

Invariance of Physical Laws, Relativity of Simultaneity, Relativity of Time Intervals and Length, Lorentz Transformation, The Doppler Effect for Electromagnetic Waves, Relativistic Momentum, Relativistic Work and Energy

Week 14

Emission and Absorption of Light, The Photoelectric Effect, Atomic Line Spectra and Energy Levels, The Nuclear Atom, The Bohr Model, The Laser, X-Ray Production and Scattering, Continuous Spectra, Wave-Particle Duality

Week 15

Selected topics in The Wave Nature of Particles, De Broglie Waves, Electron Diffraction, Probability and Uncertainty, The Electron Microscope, Wave Functions and the Schrödinger Equation, Quantum Mechanics, Particle in a Box, Potential Wells, Potential Barriers and Tunneling, The Hydrogen Atom, The Zeeman Effect, Electron Spin, Many-Electron Atoms and the Exclusion Principle, Properties of Nuclei, Nuclear Binding and Nuclear Structure, Nuclear Stability and Radioactivity, Activities and Half-Lives, Fundamental Particles, Particle Accelerators and Detectors, Particles and Interactions