Course Schedule and Weekly Learning Goals

The provided schedule is subject to changes. The outlined learning objectives are the concepts that should be mastered on a weekly basis. Examinations will evaluate the content covered until the week before each exam.

It is important to note that the 2nd half of the semester frequently requires concepts that stem from the 1st half of the term. Therefore, it is essential to consistently review these foundational concepts throughout the semester.

Week 01 Electric Charge, Force, Field

Class 01

- Review of Vector Algebra/Calculus
- Intuition behind Electric Charges
- Conservation of Electric Charge
- Quantization of Charge
- Conductors and Insulators
- Coulomb's Law

Class 02

- Electric Field & Electric Field Lines
- Applying Coulomb's law to calculate Electric Field Intensity of charge distributions
- Introduction to Electric Flux
- Intuition for Surface Integral and the Divergence Theorem

Week 02 Gauss's Law for Electricity

Class 03

- (Contd.) Applying Coulomb's law to calculate the Electric Field Intensity of charge distributions
- Introduction to Gauss's law for Electricity

Class 04

- Applying Gauss's law to calculate the Electric Field Intensity of charge distributions

Week 03 Electric Potential Energy

Class 05

- (Contd.) Applying Gauss's law to calculate the Electric Field Intensity of charge distributions

Class 06

- Introduction to Electric Potential Energy
- Work done by Electric Field
- Work done by a collection of point charges and **Quiz, Assignment #1**

Week 04 Electric Potential

Class 07

- Introduction to Electric Potential
- Equipotential Surfaces

Class 08

- Relating Electric Potential to Electric Field
- Calculation of Electric Potential of various charge distribution source

Week 05 Capacitors and Capacitance

Class 09

- (Contd.) Calculation of Electric Potential of various charge distribution source
- Introduction to Capacitors
- Working principle of Capacitors

Class 10

- Energy storage of a Capacitor
- Capacitors with Dielectric material
- Electric field energy storage in a capacitor with/without a dielectric

Week 06 Electric Circuit Analysis

Class 11

- Introduction to Electric Circuits
- Working principle of Electric Circuits
- Primary Electric Components
- Ohm's Law and **Quiz, Assignment #2**

Class 12

- Electromotive Force
- Joule-heating law
- Introduction to Kirchhoff's laws
- Review of the syllabus till Mid-term and Interlude

Week 07 Mid-Term Examination

Week 08 Solving DC Circuits and Transient Circuits

Class 13

- Applying Kirchhoff's laws
- Power dissipation in the circuits
- Theory of Metallic Conduction

Class 14

- Introduction to Transient Circuits

- *RC* circuits $\sim$ Charge, Current, Voltage equation

Week 09 Magnetic Force, Field

Class 15

- Introduction to Magnetism
- Magnetic force calculation
- Gauss's law for Magnetism
- Charged Particles in Magnetic Fields

Class 16

- Cyclotron
- Synchrotron
- Cathode-Ray Tube experiment
- Hall effect and **Quiz, Assignment #3**

Week 10 Bio-Savart Law

Class 17

- Defining the Biot-Savart Law
- Intuition for the Current Element
- Magnetic force in a coil conducting current
- Applying the Biot-Savart law to calculate the magnetic field of a current distribution

Class 18

- (Contd.) Applying the Biot-Savart law to calculate the magnetic field of a current distribution
- Intuition for Line Integral and the Stoke's Theorem

Week 11 Ampere's Law

Class 19

- Introduction to Ampere's law
- Applying Ampere's law to calculate the magnetic field of a current distribution

Class 20

- Introduction to Electromagnetic Induction
- Induced EMF and Faraday's law of Induction
- Lenz's Law
- Motional EMF

Week 12 Electromagnetic Induction and Oscillation

Class 21

- Self and Mutual Induction

- *RL* circuits $\sim$ Current, Voltage equation
- *RLC* Circuits $\sim$ Charge, Current, Voltage equation

Class 22

- Introduction to Alternating Current
- Phasor diagrams and Complex reactances
- *RLC* components in AC circuits

Week 13 Electromagnetic Waves and Modern Physics I: Smallest

Class 23

- Lissajous figures and their significance
- Displacement current and corrected Ampere's law
- Maxwell's equations in differential and integral version
- Introduction to EM waves and their propagation and **Quiz, Assignment #4**

Class 24

- Introduction to Quantum Physics: The Ultraviolet Catastrophe
- Wave-Particle duality
- The Schrödinger Equation
- Heisenberg's Uncertainty Principle
- The Photoelectric Effect and Quantization of Photons
- Atomic Properties, Rutherford Model, Bohr's Model, Orbits and Energies.
- Nuclear Properties, Binding Energy, Nuclear Decays, Half and Mean Lives.
- Alpha, Beta, and Gamma radiation, Fission, and Fusion.

Week 14 Modern Physics II: Fastest

Class 25

- Introduction to Special Relativity: Postulates and Intuition for Spacetime
- Lorentz transformation: Length contraction, Time dilation
- Review of the entire course and Epilogue

Week 15 Final Examination

May the Force be with You.