Department of Science Education
Institute of Education & Research
University of the Punjab, Lahore

Course Outline

Programme	BS Science Education (1-8)	**Course Code**	**SE-312A**	**Credit Hours**	3
Course Title	**Physics – IV: Electricity and Magnetism**				

Course Introduction

This course provides a fundamental understanding of electricity and magnetism, essential components of classical physics. It covers the principles and applications of electric and magnetic fields, electrostatics, circuits, and electromagnetism.

Learning Outcomes

By the end of this course, students will be able to:

1. Explain fundamental principles of electricity and magnetism, including electrostatics, electric fields, and magnetic forces.
2. Analyze and solve problems related to electric and magnetic fields using mathematical methods.
3. Apply concepts of capacitance, resistance, and inductance to real-world electrical systems and circuits.
4. Connect theoretical principles to practical technologies such as electromagnetic waves and devices.

	Course Content	**Assignments/Readings**
Week 1	**Unit-I Electrostatics** 1.1 Electric charge 1.2 Conductors and insulators 1.3 Coulomb's law,	Resnick & Halliday, Ch. 21
	1.4 Electric Field due to 1.4.1 A point Charge 1.4.2 An electric dipole	Resnick & Halliday, Ch. 22
Week 2	1.4.3 Continuous charge distributions (cases of uniform line, ring and disk of charge),	Resnick & Halliday, Ch. 22
	1.5 Electric dipole in an electric field	Resnick & Halliday, Ch. 22
Week 3	1.6 Electric flux, Gauss' law 1.6.1 Applications in planar, cylindrical, and spherical symmetry	Resnick & Halliday, Ch. 23
	Unit-II Electric Potential 2.1 Equipotential surfaces 2.2 Potential due to 2.2.1 A point charge and a group of point charges 2.2.2 An electric dipole	Resnick & Halliday, Ch. 24
Week 4	2.3 Electric potential of continuous charge distributions	Resnick & Halliday, Ch. 24
	2.4 Relation between electric field and electric potential energy.	Resnick & Halliday, Ch. 24
Week 5	**Unit-III Capacitance and Dielectrics** 3.1 Calculating the capacitance 3.2 Capacitors in series and parallel	Resnick & Halliday, Ch. 25

	3.3 Energy stored in an electric field	Resnick & Halliday, Ch. 25
Week 6	3.4 dielectrics and Gauss' law	Resnick & Halliday, Ch. 25
	Unit-IV Electric Current and Resistance 4.1 Ohm's law 4.2 Electric current and current density	Resnick & Halliday, Ch. 26
Week 7	4.3 Resistance and resistivity 4.4 Resistors in series and parallel	Resnick & Halliday, Ch. 26
	4.5 Microscopic view of Ohm's law 4.6 Semiconductors and superconductors	Resnick & Halliday, Ch. 26
Week 8	4.7 Microscopic view of Ohm's law	Resnick & Halliday, Ch. 26
	4.8 Semiconductors and superconductors	Resnick & Halliday, Ch. 26
Week 9	**Unit-V Magnetic Forces and Fields** 5.1 Magnetic force on: 5.1.1 A moving charge 5.1.2 A current-carrying wire	Resnick & Halliday, Ch. 28 & 29
	5.2 Torque on a current loop Magnetic dipole moment	Resnick & Halliday, Ch. 28 & 29
Week 10	5.4 Magnetic field due to a current	Resnick & Halliday, Ch. 28 & 29
	5.5 Force between two parallel currents	Resnick & Halliday, Ch. 28 & 29
Week 11	5.6 Ampere's law	Resnick & Halliday, Ch. 28 & 29
	5.7 Biot-Savart law	Resnick & Halliday, Ch. 28 & 29
Week 12	5.8 Magnetic field due to a current carrying 5.8.1 Solenoid 5.8.2 Toroid	Resnick & Halliday, Ch. 28 & 29
	5.9 Current carrying coil as a magnetic dipole	Resnick & Halliday, Ch. 28 & 29
Week 13	**Unit-VI Electromagnetic Induction** 6.1 Faraday's law of induction	Resnick & Halliday, Ch. 30
	6.2 Lenz's law 6.3 Motional EMF	Resnick & Halliday, Ch. 30
Week 14	6.4 Induced electric fields 6.5 Energy stored in a magnetic field	Resnick & Halliday, Ch. 30
	Unit-VII Magnetic Properties of Materials 7.1 Gauss' law for magnetism 7.2 Spin and orbital magnetic dipole moments	Resnick & Halliday, Ch. 32
Week 15	7.3 Magnetization, magnetic materials 7.3.1 Diamagnetism 7.3.2 Paramagnetism 7.3.3 Ferromagnetism	Resnick & Halliday, Ch. 32
	7.4 Hysteresis	Resnick & Halliday, Ch. 32
Week 16	**Unit-VIII Maxwell's Equations and Displacement Current** 8.1 Induced magnetic fields 8.2 Displacement Currents	Resnick & Halliday, Ch. 32
	8.3 Electromagnetism 8.4 Maxwell's equations.	Resnick & Halliday, Ch. 32

Textbooks and Reading Material

1. **Fundamentals of Physics** (Extended), by D. Halliday, R. Resnick, and J. Walker, Wiley, 10th Edition, 2013.
2. **Physics Vol. II** (Extended), by R. Resnick, D. Halliday, and K. Krane, 5th Edition, Wiley, 2001.
3. **Electricity and Magnetism**, by E. M. Purcell and D. J. Morin, Cambridge, 3rd Edition, 2013.
4. **University Physics with Modern Physics**, by R. A. Freedman, H. D. Young, and A. L. Ford (Sears and Zeemansky), Addison-Wesley, 13th Edition, 2010.
5. **Physics for Scientists and Engineers**, by R. A. Serway and J. W. Jewett, 8th Edition, Golden Sunburst Series, 2010.
6. **Physics for Scientists and Engineers with Modern Physics**, by D. C. Giancoli, Addison-Wesley, 4th Edition, 2008.

Teaching Learning Strategies

1. Lectures, interactive discussions, and problem-solving sessions.
2. Laboratory experiments for practical understanding.

Assignments: Types and Number with Calendar

1. **Problem Set 1**: Solve problems related to electrostatics, electric fields, and Coulomb's law (End of Week 3).
2. **Conceptual Questions**: Short-answer questions on electric potential, capacitance, and energy storage (Start of Week 5).
3. **Numerical Problems**: Analyze resistance, current density, and applications of Ohm's law (End of Week 7).
4. **Problem Set 2**: Problems on magnetic forces, torque, and Biot-Savart law (End of Week 10).
5. **Group Assignment/Presentation**: Research and present findings on the applications of Maxwell's equations in modern technology (End of Week 14).