Community College of Skill Development

Lesson Plan: Fundamental of Electromagnetism

Program: B. Voc Electrical **Semester: I** **Course Code: ELV-103-V** **Credits: 3-0-0**

Course Objectives: The objective of this course is to provide students with a comprehensive understanding of the fundamental principles of electrostatics, magnetism, electromagnetism, and electromagnetic induction. This course aims to introduce the core concepts and laws governing electrostatics and magnetism and develop an understanding of the interaction between electric currents and magnetic fields.

Course Outcomes: After the successful completion of the course, students will be able to:
CO1: Describe and explain the fundamental principles of electrostatics and magnetism.
CO2: Utilize the laws of electromagnetism to solve practical problems involving electric and magnetic fields.
CO3: Analyse magnetic and electric circuits, comparing their properties and behaviour, and evaluate the effects of electromagnetic phenomena on various materials and systems.
CO4: Evaluate the impact of hysteresis and eddy current losses in magnetic materials and design strategies to minimize these losses in practical applications.

Equipment required in Classroom/ Laboratory/ Workshop

i. LCD/Projector
ii. Whiteboard/ Black Marker

Assessment Scheme

S.No.	Criteria	Marks
1	End Term Examination	75
2	Internal Evaluation Scheme	25
2a	Class Tests	15
2a (i)	Class Test-I	7.5
2a (ii)	Class Test-II	7.5
2(b)	Teacher Assessment (Continuous Evaluation)	10

2b (i)	Attendance	5
2b (ii)	Assignment / Presentation	5

Lecture No.	Topic Covered	Pedagogy	Date of Implementation	Course Outcomes Covered	Faculty Sign
1	Introduction to Electrostatics, Coulomb's Law – Statement & explanation	Lecture, discussion, Conceptual teaching	4/8/2025	Students define electrostatics and Coulomb's law.	
2	Superposition principle, Numerical applications of Coulomb's Law	Numerical problem solving session.	5/8/2025	Compute resultant forces on multiple charges.	
3	Electric Field, Electric Field Intensity due to point charges,	Lecture with board derivation and diagrams.	5/8/2025	Calculate electric field at a point due to single/multiple charges	
4	Numericals on Electric field, Electric Potential – Concept & relation with field intensity	Numerical problem solving Session, Lecture, board derivations.	12/8/2025	Compute net electric field on multiple charges	
5	Potential due to point charges, Numerical problems	Problem-solving examples.	12/8/2025	Solve numerical problems on electric potential on point charges.	
6	Electric Flux, Electric Flux Density, Relation with Electric Field Lines	Conceptual lecture, diagram illustration.	18/8/2025	Understand flux density and its relation to field lines.	
7	Gauss's Law – Statement, Derivation, Applications	Lecture with derivation, example applications.	19/8/2025	Apply Gauss's law to compute electric field of symmetric charge distributions.	
8	Problem-solving session + Tutorial on Electrostatics	Tutorial, interactive problem-solving	19/8/2025	Gain confidence in solving numerical electrostatics problem	

9	Basics of magnetism – Concept & Applications	Lecture, discussion of applications.	25/8/2025	Understand fundamental electromagnetic phenomena.	
10	Magnetic effect of Electric Current – Oersted's Experiment, Direction of magnetic lines of force (Right-Hand / Corkscrew rule),	Experiment Demonstration	26/8/2025	Understand magnet effect of current, Apply rules to determine field direction	
11	Typical electromagnetic fields, Electromagnets & its applications especially in Electrical Machines	Lecture, demonstration.	26/8/2025	Understand electromagnet uses	
12	Biot-Savart Law – Derivation & Concept	Lecture, derivation, examples.	2/9/2025	Understand concept of biot-savart law.	
13	Applications of Biot-Savart Law (straight conductor, circular loop)	Problem-solving session.	2/9/2025	Compute magnetic Field in the straight and circular current carrying wire using this law	
14	Numericals on Biot-Savart Law (straight conductor, circular loop)	Problem-solving session.	8/9/2025	Solving numericals problems on magnetic field in the straight and circular loop.	
15	Work law, Ampere-circuital law	Lecture with examples.	9/9/2025	Apply work-energy principles to magnetic systems.	
16	Applications of Ampere-circuital Law	Problem-solving session.	9/9/2025	Evaluate magnetic field in the straight wire and solenoid.	
17	Current-carrying conductor in magnetic field, Force between two parallel current-carrying conductors.	Lecture+PPT, demo.	15/9/2025	Compute force on conductor in magnetic field, Understand force between two conductors	

18	Numericals on force between two parallel current-carrying conductors.	Problem-solving session.	16/9/2025	Evaluate force in the rectangular loop with respect to other wire placed parallel to it.	
19	Magnetic circuits & comparison with Electric circuits	Lecture with diagrams.	16/9/2025	Draw analogy; compare magnetic parameters	
20	Ampere-turns calculation, Series & Parallel Magnetic circuits, Leakage flux	Lecture, derivations, numerical examples.	6/10/2025	Solve magnetic circuit problems with series/parallel configuration.	
21	Magnetization curve (B-H curve)	Lecture, diagram, Explanation.	13/10/2025	Analyze material properties from B-H curve;	
22	Hysteresis & Hysteresis Loss	Lecture, diagram explanation	14/10/2025	Understand hysteresis loss.	
23	Importance of Hysteresis Loss (Applications in electrical machines)	Numerical examples, Application discussion.	14/10/2025	Compute and interpret hysteresis loss in machines.	
24	Tutorial & Numerical session on Electromagnetism	Interactive tutorial.		Consolidate understanding of magnetism and electromagnetism.	
25	Introduction to Magnetism, Magnets, Poles, Magnetic lines of force	Lecture, demonstration with magnets.		Identify poles and magnetic field lines.	
26	Classification of Magnetic Materials (Dia, para, ferro)	Lecture with examples.		Classify materials an understand their magnetic behavior.	
27	Magnetic Polarity, Laws of magnetic force	Lecture +PPT.		Determine forces between poles and identify polarity.	

28	Magnetic Field, Magnetic Induction, Magnetic Flux & Flux Density	Lecture+PPT, diagrams		Compute magnetic flux, and density.	
29	Magnetic Intensity (H), Permeability, Relation between B & H	Lecture with derivation and examples.		Relate B and H; calculate magnetic intensity.	
30	Intensity of magnetization, Magnetic susceptibility	Lecture, problem solving examples.		Compute magnetization and susceptibility.	
31	Relations among B, H, I, K – Derivations & Numerical Problems	Board derivations, numerical practice.		Solve problems using H, I, K relations.	
32	Tutorial & Problem Solving on Magnetism	Tutorial, interactive problem-solving.		Solve magnetism problems.	
33	Introduction to Electromagnetic Induction, Faraday's Laws	Lecture, demo with coil.		Understand induction phenomenon and faraday's law of EMI	
34	Direction of Induced Current (Lenz's Law, Fleming's Rules)	Lecture and demo.		Determine the direction of induced current.	
35	Dynamically & Statically induced EMF	Board derivation, numerical examples.		Solve problems on dynamic and static inducted EMF.	
36	Self & Mutual Inductance, Coefficient of coupling, Series & Parallel inductance	Lecture + PPT with examples.		Compute self/mutual inductance and coupling coefficient	
37	Energy stored in magnetic field, Rise/Decay of current	Board derivations, examples.		Calculate energy stored and analyze current behavior in inductor.	
38	Eddy current loss, Applications	Lecture with examples and demo.		Understand eddy current loss and methods to reduce.	

Text/Reference Books:

1. Matthew N. O. Sadiku, “Elements of Electromagnetic”, Oxford University Press, 3rd Edition, 2001.
2. Nathan Ida, “Engineering Electromagnetics”, Springer (India) Pvt. Ltd., New Delhi, 2nd Edition, 2001.
3. Edward Mills Purcell, “Electricity and Magnetism”, Cambridge University Press, 2011.