Kurukshetra University Kurukshetra
Undergraduate Programs
Course: CC-2/MCC-3

Session: 2023-24	
Part A - Introduction	
Subject	Physics
Semester	2nd
Name of the Course	**Electricity, Magnetism and EM Theory**
Course Code	B23-PHY-201
Course Type: (CC/MCC/MDC/CC-M/ DSEC /VOC/DSE/PC/AEC/VAC)	CC/MCC
Level of the course (As per Annexure-I	100-199
Pre-requisite for the course (if any)	Appeared or passed the 1st sem (B.Sc. Physical Science/ equivalent)
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Explain and differentiate the vector and scalar formalisms of electrostatics. Also be able to apply Gauss's Divergence & Stokes theorem to solve various problems in electrostatics 2. Describe the magnetic materials & important properties of magnetic field. Understand the properties and theories of dia-, para- & ferromagnetic materials. 3. Derive Maxwell equations and their physical significance and familiar about the propagation of electromagnetic waves i.e. boundary conditions at the interface between different media. The students will also be able to have basic idea about the propagation of electromagnetic waves in free space and in medium. 4. Understand D.C. and A.C. circuits, able to apply and analyse using networks. Analyze DC/AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor. 5. Learn to present observations, results, analysis and

	different concepts related to experiments of Electricity and Magnetism.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks: 70**		**Time:3hrs**	

Part B- Contents of the Course

Instructions for Paper- Setter

1.Nine questions will be set in total.

2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.

4. 20% numerical problems are to be set.

5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Vector Background and Electric Field** : Gradient of a scalar and its physical significance, Line, Surface and Volume integrals of a vector and their physical significance, Flux of a vector field, Divergence and curl of a vector and their physical significance, Gauss's divergence theorem, Stoke's theorem. Conservative nature of Electrostatic Field, Electrostatic Potential, Potential as line integral of field, potential difference Derivation of electric field E from potential as gradient. Derivation of Laplace and Poisson equations. Electric flux, Gauss's Law, Differential form of Gauss's law and applications of Gauss's law. Mechanical force of charged surface, Energy per unit volume.	11
II	**Magnetic Field:** Biot-Savart law and its simple applications: straight wire and circular loop, Current Loop as a Magnetic Dipole and its Dipole Moment, Ampere's Circuital Law and its applications to (1) Solenoid and (2) Toroid, properties of B: curl and divergence, **Magnetic Properties of Matter:** Force on a dipole in an external field, Electric currents in Atoms, Electron spin and Magnetic moment, types of magnetic materials, Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H and M, Electronic theory of dia and paramagnetism, Domain theory of ferromagnetism (Langevin's theory), Cycle of Magnetization- B-H curve and hysteresis loop: Energy dissipation, Hysteresis loss and importance of Hysteresis Curve	12
III	**Time varying electromagnetic fields:** Electromagnetic induction,	11

	Faraday's laws of induction and Lenz's Law, Self-inductance, Mutual inductance, Energy stored in a Magnetic field, Derivation of Maxwell's equations, Displacement current, Maxwell's equations in differential and integral form and their physical significance. **Electromagnetic Waves:** Electromagnetic waves, Transverse nature of electromagnetic wave, energy transported by electromagnetic waves, Poynting vector, Poynting's theorem. Propagation of Plane electromagnetic waves in free space & Dielectrics	
IV	**DC current Circuits:** Electric current and current density, Electrical conductivity and Ohm's law (Review), Kirchhoff's laws for D.C. networks, Network theorems: Thevenin's theorem, Norton theorem, Superposition theorem. **Alternating Current Circuits:** A resonance circuit, Phasor, Complex Reactance and Impedance, Analysis for RL, RC and LC Circuits, Series LCR Circuit: (1) Resonance, (2) Power Dissipation (3) Quality Factor and (4) Band Width, Parallel LCR Circuit.	11
	Practicum 1. Use of Multimeter for measuring Resistance, A.C. and D.C. Voltage and Current, checking of electrical fuses. 2. Low resistance by Carey Foster's bridge with calibration. 3. Determination of Impedance of an A.C. circuit and its verification. 4. Frequency of A.C. mains using an electromagnet. 5. Frequency of A.C. mains Electrical vibrator. 6. High resistance by substitution method. 7. To compare capacitances using De'Sauty bridge. 8. To study the Characteristics of a Series RC Circuit. 9. To study a series LCR circuit and determine its (a) Resonant frequency, (b) Quality factor. 10. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor. 11. To verify the Thevenin and Norton theorems. 12. To verify the Superposition and Maximum Power Transfer Theorems. 13. Self-inductance by Anderson's bridge. 14. Verification of laws of electromagnetic induction. 15. Study of B-H curves of various materials using C.R.O, and determination of various parameters. **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30
Suggested Evaluation Methods		

Internal Assessment: ➢ **Theory (20 Marks)** • Class Participation: **05 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **05 Marks** • Mid-Term Exam: **10 Marks** ➢ **Practicum (10 Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10 Marks** • Mid-Term Exam: **Nil**	**End Term Examination : 50 Marks** **20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Electricity and Magnetism (Berkley, Phys. Course 2), Edward M. Purcell, 1986 McGraw-Hill Education
2. Electricity and Magnetism: A.S. Mahajan & A.A. Rangwala (Tata- McGraw Hill), 1988.
3. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
4. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
5. Feynman Lectures Vol.2, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education
6. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
7. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
8. Field and Wave Electromagnetics (2nd Edn.), David K. Cheng , Addison-Wesley Publishing Company.
9. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
10. Advanced Level Practical Physics, M. Nelkon and Ogborn, Henemann Education Books Ltd., New Delhi
11. Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi
12. Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
13. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
14. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House