STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI
COURSE PLAN June - November 2024

Department : Physics
Name/s of the Faculty : Ms. Panimaya Peshija. A
Course Title : Electromagnetic theory
Course Code : 23PH/PC/ET34
Shift II

COURSE OUTCOMES (COs)

COs	Description	CL
CO1	Remember the basic concepts of divergence and curl, Biot-Savart law, Amperes law, Electric and magnetic potential, maxwell's equation, Poynting's theorem, Polarization, wave equation, Lorentz's transformation and energy-momentum correlation	K1
CO2	Understand the idea on electric dipole, magnetic dipole, multipole, gauge transformation, frequency dependence of permittivity, and covariance of electrodynamics.	K2
CO3	Apply the concept of multipole to assess field at different distances, Poynting's theorem in linear dissipative media, wave propagation in a rectangular wave guide, Lorentz transformation to show invariance of Maxwell's equation.	K3
CO4	Analyse the effect of magnetic field on atomic orbits, electric field in a dielectric medium, reflection and transmission at normal incidence and oblique incidence, fields on the surface and inside rectangular wave guide, transformation of electromagnetic fields.	K4
CO5	Evaluate and develop boundary value problems in electrostatics and magnetostatics, deduct the field of a moving point charge, predict energy flow and attenuation in wave guides, evaluate Lagrangian and Hamiltonian for a relativistic charged particle.	K5

Week	Unit No.	Content	Cognitive Level	Teaching Hours	COs	Teaching Learning Methodology	Assessment Methods
Jun 19 – 26, 2024 (Day Order 1 - 6)	I	Electrostatics 1.1 Divergence and curl of E – Electric potential - Poisson's equations - Laplace's equations in 1D, 2D and 3D – Boundary's conditions and uniqueness theorems	K1-K5	5	CO1-CO5	Lecture, Blackboard	Discussion and questioning
Jun 27 – July 4, 2024 (Day Order 1 - 6)	I	1.2 Potential of a localized charge distribution - Energy of a point and continuous charge distributions - Multipole expansion: approximate potentials at large distances – monopole and dipole - Electric field of a dipole 1.3 Dielectrics – Field of a polarized object – Boundary value problems with dielectrics	K1-K5	5	CO1-CO5	Lecture, PPT, demonstration video	Discussion and questioning

July 5 – 12, 2024 (Day Order 1 - 6)	I,II	Field inside a dielectric – Energy in dielectric systems – Forces on dielectric. Magnetostatics 2.1 Bio-Savart law - Divergence and curl of B – Ampere's law – Calculation of magnetic fields due to current carrying elements – Long straight wire, long solenoid - Magnetic vector potential – Magnetic potential at any point due to current carrying elements	K1-K5	1 5	CO1-CO5	Lecture, Blackboard, game	Discussion and questioning,quiz
July 15 – 23, 2024 (Day Order 1 - 6)	II	2.2 Macroscopic equations, boundary conditions on B and H - Methods of solving boundary value problems in magnetostatics - Multipole expansion of the vector potential.	K1-K5	6	CO1-CO5	Lecture, demonstration video	Discussion and questioning
July 24 – 31, 2024 (Day Order 1 - 6)	II	2.3 Magnetization Torque and forces on magnetic dipole – Energy in the magnetic field - Effect of a magnetic field on atomic orbits.	K1-K5	5	CO1-CO5	PPT, Demonstration video	Problem Solving Test-K5

Aug 1 – 5, 2024 (Day Order 1 - 3)	III	Maxwell's equations, Conservation laws and Radiation 3.1 Maxwell's equations – Maxwell's equation in matter – Polarization current – Displacement current - Boundary conditions – Vector and Scalar potentials – Gauge transformations – Lorentz and Coulomb Gauge	K1-K5	3	CO1-CO5	Lecture, Blackboard	Quiz, Discussion
Aug 6 – 10, 2024	**C.A. Test - I**						
Aug 12 – 14, 2024 (Day Order 4-6)	III	3.2. Poynting's theorem and conservation of energy and momentum for a system of charged particles and electromagnetic fields – Retarded scalar and vector potentials for continuous distributions - Jefimenko's equations - Point charges – Lienard-Wiechert potential	K1-K5	3	CO1-CO5	Lecture, Blackboard	Discussion and questioning

Aug 16 – 23, 2024 (Day Order 1-6)	III	Fields of a moving point charge - Electric and magnetic fields of a moving point charge - Velocity and acceleration fields. 3.3 Electric dipole radiation - Magnetic dipole radiation - Radiation from an arbitrary source - Power radiated by a point charge -Larmor formula.	K1-K5	6	CO1-CO5	PPT, Lecture	Discussion and questioning
Aug 27 – Sep 3, 2024 (Day Order 1-6)	IV	Plane Electromagnetic Waves and Wave guides 4.1. Wave equation – Boundary conditions: Reflection and Transmission – Polarization – Electromagnetic waves in vacuum - Wave equation for E and B - Monochromatic plane waves - Energy and momentum in electromagnetic waves - Propagation in linear media	K1-K5	6	CO1-CO5	Demonstration video, Lecture, Blackboard	Discussion and questioning

Sep 4 – 11, 2024 (Day Order 1-6)	IV	Reflection and transmission at normal incidence and oblique incidence 4.2. Guided waves – Wave guides – TE and TM waves - TE waves in a rectangular wave guide - Cut-off frequency, wave velocity and wavelength	K1-K5	5	CO1-CO5	Lecture, PPT,Blackboard	Discussion and questioning
Sep 12 - 20, 2024 (Day Order 1-6)	IV,V	Group velocity - Coaxial transmission line - Cylindrical waveguides - Energy flow and attenuation in wave guides – Cavity resonators Relativistic Electrodynamics: 5.1 Lorentz transformation – Structure of space time	K1-K5	4 1	CO1-CO5	Lecture, Blackboard	Quiz-K3
Sep 23 - 26, 2024 (Day Order 1-4)	V	Relativistic mechanics - Relativistic energy and momentum - Relativistic kinematics – Relativistic dynamics	K1-K5	4	CO1-CO5	Lecture, PPT	Seminar-K4
Sep 27 – Oct 3, 2024	**C.A. Test - II**						
Oct 4 – 5, 2024 (Day 5 & 6)		5.2 Invariance of Maxwell's equations under Lorentz transformation	K1-K5	2	CO1-CO5	Lecture, Blackboard	Discussion and questioning

Oct 7 - 15, 2024 (Day Order 1 to 6)		Invariance of electric charge; covariance of electrodynamics – Transformation of electromagnetic fields - Lagrangian for a relativistic free particle	K1-K5	5	CO1-CO5	Lecture, Blackboard	Model Making-K2
Oct 16 - 22, 2024 (Day Order 1 to 6)		Lagrangian and Hamiltonian for a relativistic charged particle in an external electromagnetic field	K1-K5	2	CO1-CO5	Lecture, Blackboard	Discussion and questioning
Oct 23 - 24, 2024 (Day Order 1 to 2)	**REVISION**						