Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous Institute Affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EXC503	Electromagnetic Engineering	4	--	--	4	--	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		Knowledge of Vector Calculus, Cylindrical and Spherical coordinate systems
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Apply basic laws of electromagnetic and Maxwell's equations
	CO2	Illustrate the behavior of EM waves and travelling of waves in free space as well as media.
	CO3	Solve problems related to the propagation of electromagnetic waves
	CO4	Discuss the types of antennas and their parameters
	CO5	Discuss types of radio wave propagation

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Basic Laws of Electromagnetic and Maxwell's Equations**		10
	1.1	Coulomb‟ s law, Gauss‟ s law, Bio-Savart‟ s law, Ampere‟ s law, Poisson‟ s and Laplace equations	2	
	1.2	Boundary conditions for static electric and magnetic fields	2	
	1.3	**Maxwell's Equations:** Integral and differential form for static and time varying fields and its interpretations	2	
2		**Uniform Plane Wave Equation and Power Balance**		10
	2.1	**Wave equation:** Derivation and its solution in cartesian co-ordinates	2	
	2.2	**Solution of wave equations:** Partially conducting media, perfect dielectrics and good conductors, concept of skin depth	2	
	2.3	**Electromagnetic Power:** Poynting Vector and power flow in free space and in dielectric, conducting media	2	
	2.4	**Polarization of wave:** Linear, Circular and Elliptical	2	
	2.5	**Propagation in different media:** Behavior of waves for normal and oblique incidence in dielectrics and conducting media, propagation in dispersive media	2	
3		**Radiation Field and Computation**		12
	3.1	Concept of vector potential, fields associated with Hertzian dipole	3	
	3.2	Radiation resistance of elementary dipole with linear current distribution, radiation from half-wave dipole and quarter-wave monopole	4	
	3.3	**Finite Difference Method (FDM):** Neumann type and mixed boundary conditions, Iterative solution of finite difference equations, solutions using band matrix method	4	

	3.4	**Finite Element Method (FEM)**: triangular mesh configuration, finite element discretization, element governing equations, assembling all equations and solving resulting equations	4	
	3.5	**Method of Moment (MOM):**Field calculations of conducting wire, parallel conducting wires	4	
4		**Fundamentals of Antenna**		**10**
	4.1	**Antenna Parameters:** Radiation intensity, directive gain, directivity, power gain, beam width, band width, gain and radiation resistance of current element	3	
	4.2	**Half-wave dipole and folded dipole:** Reciprocity principle, effective length and effective area	3	
	4.3	Radiation from small loop and its radiation resistance, Helical antenna	3	
5		**Radio Wave Propagation**		**10**
	5.1	**Types of wave propagation:** Ground, space, and surface wave propagation, tilt and surface waves, impact of imperfect earth and earth‟ s behavior at different frequencies	1,2	
	5.2	**Space wave propagation:** Effect of imperfection of earth, curvature of earth, effect of interference zone, shadowing effect of hills and building, atmospheric absorption, Super-refraction, scattering phenomena, troposphere propagation and fading	1,2	
	5.3	**Sky Wave Propagation:** Reflection and refraction of waves, ionosphere and earth magnetic field effect	1,2	
	5.4	**Measures of ionosphere propagation:** Critical frequency, angle of incidence, maximum unstable frequency, skip distance, virtual height, variations in ionosphere	1,2	
			Total	**52**

References:

[1] W.H. Hayt, and J.A. Buck, "Engineering Electromagnetics", McGraw Hill Publications, Seventh Edition.

[2] R.K. Shevgaonkar, "Electromagnetic Waves", TATA McGraw Hill Companies, Third Edition.

[3] Edward C. Jordan and Keth G. Balmin, "Electromagnetic Waves and Radiating Systems", Pearson Publications, Second Edition.

[4] Matthew N.D. Sadiku, "Principles of Electromagnetics", Oxford International Student Forth Edition.

[5] J.D. Kraus, R.J. Marhefka, and A.S. Khan, "Antennas & Wave Propagation", McGraw Hill Publications, Forth Edition.