Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC 503	Electromagnetic Engineering	4	--	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXC 503	Electromagnetic Engineering	20	20	20	80	--	--	--	100

Prerequisites: Knowledge of Vector Calculus, Cylindrical and Spherical coordinate systems

Course Objective:

1. To study relationship between electrostatics, steady magnetic field and time varying fields using Maxwell's equations for different media
2. To understand the propagation of wave in different media like dielectric and conducting media by solving wave equation and find parameters of media
3. To calculate energy transported by means of electromagnetic waves from one point to another and to study polarization of waves
4. To solve electromagnetic problems using different numerical methods
5. To extend students' understanding about wave propagation by different techniques such as ground waves and space waves
6. To study radiation from a current element

Course Outcomes:

1. Ability to find nature of electric or magnetic fields produced due to different charge distributions
2. Ability to understand working of different equipment based on electromagnetic effects used in day to day life
3. Knowledge of behavior of EM waves and travelling of waves in free space as well as media
4. Ability to identify and solve problems related to the propagation of waves
5. Ability to understand the basics of wave propagation required for the study of antennas

Module No.	Unit No.	Topics	Hrs.
1.0		**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	
	1.2	Boundary conditions for static electric and magnetic fields	
	1.3	**Maxwell's Equations:** Integral and differential form for static and time varying fields and its interpretations	
2.0		**Uniform Plane Wave Equation and Power Balance**	10
	2.1	**Wave equation:** Derivation and its solution in cartesian co-ordinates	
	2.2	**Solution of wave equations:** Partially conducting media, perfect dielectrics and good conductors, concept of skin depth	
	2.3	**Electromagnetic Power:** Poynting Vector and power flow in free space and in dielectric, conducting media	
	2.4	**Polarization of wave:** Linear, Circular and Elliptical	
	2.5	**Propagation in different media:** Behavior of waves for normal and oblique incidence in dielectrics and conducting media, propagation in dispersive media	
3.0		**Radiation Field and Computation**	12
	3.1	Concept of vector potential, fields associated with Hertzian dipole	
	3.2	Radiation resistance of elementary dipole with linear current distribution, radiation from half-wave dipole and quarter-wave monopole	
	3.3	**Finite Difference Method (FDM):** Neumann type and mixed boundary conditions, Iterative solution of finite difference equations, solutions using band matrix method	
	3.4	**Finite Element Method (FEM)**: triangular mesh configuration, finite element discretization, element governing equations, assembling all equations and solving resulting equations	
	3.5	**Method of Moment (MOM):**Field calculations of conducting wire, parallel conducting wires	
4.0		**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	
	4.2	**Half-wave dipole and folded dipole:** Reciprocity principle, effective length and effective area	
	4.3	Radiation from small loop and its radiation resistance, Helical antenna	
5.0		**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	
	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	
	5.3	**Sky Wave Propagation:** Reflection and refraction of waves, ionosphere and earth magnetic field effect	
	5.4	**Measures of ionosphere propagation:** Critical frequency, angle of incidence, maximum unstable frequency, skip distance, virtual height, variations in ionosphere	
Total			**52**

Recommended Books:

1. W.H. Hayt, and J.A. Buck, "*Engineering Electromagnetics*", McGraw Hill Publications, 7th Edition, 2006
2. R.K. Shevgaonkar, "*Electromagnetic Waves*", TATA McGraw Hill Companies, 3rd Edition, 2009
3. Edward C. Jordan and Keth G. Balmin, "*Electromagnetic Waves and Radiating Systems*", Pearson Publications, 2nd Edition, 2006
4. Matthew N.D. Sadiku, "*Principles of Electromagnetics*", Oxford International Student 4th Edition, 2007
5. J.D. Kraus, R.J. Marhefka, and A.S. Khan, "*Antennas & Wave Propagation*", McGraw Hill Publications, 4th Edition, 2011

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

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