INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNIACTION ENGINEERING

ASSIGNMENT

Course Name	:	**Electromagnetic Theory and Transmission Lines (EMTL)**
Course Code	:	A40411
Class	:	II - B. Tech
Branch	:	ECE
Year	:	2016 – 17
Course Coordinator	:	Ms. A. Usha Rani, Associate Professor.
Course Faculty	:	Ms. A. Usha Rani, Associate Professor. Mr.G.Nagendra Prasad, Associate Professor.

OBJECTIVES

This course has the basics of electric and magnetic fields such as different charge densities, flux (electric and magnetic), scalar and vector potentials, emf, mmf, and capacitance induced and propagation of EM waves through

- To introduce the concept of co-ordinate systems and types to analyze the motion of object and their applications in free space to student.
- To impart the knowledge of electric and magnetic fields in real time applications.
- To introduce the fundamental theory of electromagnetic waves in transmission lines and their practical applications.
- To study the propagation characteristics of electromagnetic wave in bounded and unbounded media.
- To calculate various line parameters by conventional and graphical methods

S.No	QUESTIONS	Blooms taxonomy level	Course Outcome
	UNIT-I **ELECTROSTATICS**		
	DESCRIPTIVE QUESTIONS		
1	State Gauss's law. Using divergence theorem and Gauss's law, relate the displacement density D to the volume charge density ρ_v.		
2	State and Prove Gauss's law. List the limitations of Gauss's law.		
3	Explain the following terms: i. Homogeneous and isotropic medium and ii. Line, surface and volume charge distributions.		
4	Derive the boundary conditions for the tangential and normal components of Electrostatic fields at the boundary between two perfect dielectrics..		
5	Using Gauss's law derive expressions for electric field intensity and electric flux density due to an infinite sheet of conductor of charge density ρ_s C/cm		
6	State coulomb's law and write the equation for F that exist between two unlike charges**?**		
7	Derive the expression for potential difference between two points in an electric field.		

8	Explain and derive continuity equation?		
9	Explain convection current density and derive expression for it?		
10	State Gauss's law and obtain first Maxwell's equation for electrostatic fields?		
11	Obtain the expression for the capacitance of a coaxial capacitor?		
12	Derive poisons and Laplace's equations and mention their applications?		
13	Explain the terms conduction current, convection current and relaxation time.		
14	Define amperes circuit law and give the expression?		
15	List the applications of amperes circuit law?		
	ANALYTICAL QUESTIONS		
1	Point charges Q1 and Q2 are respectively located at (4, 0, -3) and (2, 0, 1). If Q2 = 4 nC, find Q1 such that. i. The E at (5, 0, 6) has no Z-component. ii. The force on a test charge at (5, 0, 6) has no X-component.		
2	Derive the boundary conditions for the tangential and normal components of Electrostatic fields at the boundary between two perfect dielectrics.		
3	A parallel plate capacitance has 500mm side plates of square shape separated by 10mm distance. A sulphur slab of 6mm thickness with $\in r = 4$ is kept on the lower plate find the capacitance of the setup. If a voltage of 100 volts is applied across the capacitor, calculate the voltages at both the regions of the capacitor between the plates.		
4	If point charge 3 μC is located at the origin. Also there are two more charges -4 μC and 5 μC are located at (2, -1, 3) and (0, 4, -2) respectively. Find potential at (-1, 5, 2) Assume zero potential at infinity.		
5	A point charge of 5 nC is located at the origin. If V = 2v at (0, 6, -8), find i. The potential at A (-3, 2, 6) ii. The potential at B (1, 5, 7) iii. The potential difference V_{AB}		
6	Three point charges 2μc,4 μc,8 μc are located at(0,0,0)(0,0,1) and (1,0,0) respectively. Find energy in the system.		
7	A parallel-plate capacitor has plates located at z = 0 and z = d. The region between platesis filled with a material containing volume charge of uniform density ρ_0 C/m_3, and which haspermittivity. Both plates are held at ground potential. a) Determine the potential field between plates b) Determine the electric field intensity, E between plates.		
8	Concentric conducting spheres are located at r = 5 mm and r = 20 mm. The region between the spheres is filled with a perfect dielectric. If the inner sphere is at 100 V and the outer sphere at 0 V:a) Find the location of the 20 V equipotential surface, b) Find $E_{r,max}$ c) Find ε_r if the surface charge density on the inner sphere is 1.0 μC/m_2		
	UNIT -2 **MAGNETOSTATICS**		
	DESCRIPTIVE QUESTIONS		
1	Derive Ampere's circuital law in differential form?		
2	State and explain Biot- Savart's law?		
3	Derive the boundary conditions between conductor and free		

	space?		
4	Derive the boundary conditions between two dielectrics?		
5	Derive the boundary conditions between conductor and dielectric?		
6	What is the inconsistency in Ampere's Law? How it is rectified by Maxwell?		
7	Describe in detail the Faraday's law of induction. Write down the mathematical statement of this law?		
8	Derive Maxwell's equations in integral form and differential form for time varying fields.		
9	Define and explain the terms scalar and vector magnetic potential? How to determine these quantities for a magnetic field?		
10	Prove the Maxwell's equation $\nabla . B = 0$.		
11	Derive Lorentz force equation?		
12	Derive the equation of force on a differential current element?		
13	Write short notes on energy stored in a magnetic field?		
14	Derive the inductance of Solenoid?		
15	Obtain Maxwell's equations in phasor form?		
	ANALYTICAL QUESTIONS		
1	A steady current element 10^{-3} a_z Am is located at the origin in free space. What is the magnetic field B due to this element at the point (1,0,0)m?		
2	A H due to a current source is given by H = [ycos(αx)] a_x + (y+e^x)a_z. Describe the current density over the yz plane?		
3	A radial field $H = \frac{2.39X\ 10^6}{r} cos\phi a_r\ A/m$ exists in free space. Find the magnetic flux crossing the surface defined by $0 \leq \phi \leq \frac{\pi}{4}\ and\ 0 \leq z \leq 1\ m.$		
4	If the vector magnetic potential within a cylindrical conductor of radius 'a' is $A = \frac{\mu_0 I r^2}{4\pi a^2}\ a_z, find\ H.$		
5	Calculate the force on al straight conductor of length 30cm carrying a current of 5 A in a_z direction and the magnetic field B = 3.5x10^{-3}(a_x-a_y)Tesla where a_x and a_y are unit vectors.		
	UNIT -3 **EM WAVE CHARACTERISTICS**		
	DESCRIPTIVE QUESTIONS		
1	Obtain wave equations for good conductors?		
2	Explain the characteristics of wave in perfect dielectric?		
3	What is the meant by polarization of wave? When the wave is linearly polarized and circularly polarized?		
4	Derive expression for intrinsic impedance in a uniform plane wave in a lossy dielectric?		
5	Explain skin depth and derive expression for depth of penetration for good conductor?		
6	Derive the expression for reflection of a wave when incident on dielectric with oblique incidence with perpendicular polarization?		
7	Define Brewster angle and derive an expression for Brewster angle when a		

	wave is parallely polarized?		
8	State and Prove Poynting theorem?		
9	Explain the power loss in a plane conductor?		
10	Derive the expression for power flow in a concentric cable?		
	ANALYTICAL QUESTIONS		
1	Find the skin depth and surface resistance of an aluminium at 100MHz having conductivity $\sigma = 5.8x10^7$ mho/m, $\mu_r = 100$.		
2	The electric field in the free space is given by, $E = 50\cos(10^8t+\beta x)\mathbf{a}_y$ V/m. i. Find the direction of propagation ii. Calculate β and time it takes to travel a distance of $\lambda/2$.		
3	A 10 GHz plane wave travelling in a free space has an amplitude of **E** as E_x = 10 V/m. Find β, η, v, λ?		
4	A plane wave travelling in free space has an average Poynting vector of 5 watts/m^2. Find magnitude of electric field intensity?		
5	A uniform plane wave of 200 MHz travelling in a free space impinges normally on a large block of material having ϵ_r=4, μ_r=9, $\sigma = 0$. Calculate transmission and reflection coefficients at the interface.		
	UNIT-IV **TRANSMISSION LINES - I**		
	DESCRIPTIVE QUESTIONS		
1	Starting from the equivalent circuit, derive the transmission line equations for V and I, in terms of the source parameters.		
2	From the fundamental voltage & current equations of transmission line, derive Expression for input impedance Z_{in} of the line. Modify the expression for lossy & lossless cases.		
3	What are the different distortions on a line and derive the conditions for distortion less transmission.		
4	What is loading? Explain the different types of loading in transmission lines?		
5	What are the different distortions on a line and derive the conditions for minimum attenuation?		
6	Derive the characteristic impedance Z_o from the initial equation of transmission line?		
7	Derive the Propagation constant P from the general equations of Voltage and current?		
8	Derive the expressions for α and β in terms of primary constants?		
9	Define wave length, velocity of propagation and group velocity and write the respective equations?		
10	Derive the expression for loss less transmission line?		
11	Draw the equivalent circuit of infinite line and show that its input impedance is equal to the characteristic impedance?		
12	Express constants A and B in terms of voltage and current from the general line equations?		
	ANALYTICAL QUESTIONS		
1	At 8 MHz the characteristic impedance of transmission line is (40- j2) Ω and the propagation constant is (0.01+j0.18) per meter. Find the primary constants.		
2	A loss less transmission line has 75 Ω characteristic impedance. The line is terminated in a load impedance of 50-j100 Ω. The maximum voltage measured on the line is 100V. Find the maximum current and minimum voltage on the line.		

3	A transmission line in which no distortion present has the following parameters. Z_o=50 ohm, α = 20mN/m, V=0.7V_o . Determine primary constants and wave length at 0.1 GHz.		
4	Calculate the characteristic impedance, the attenuation constant and phase constant of a transmission line if the following measurements have been made on the line Z_{OC}=550Ω and Z_{SC} = 500Ω.		
5	A generator of 1V, 1 KHz supplies power to a 100 km long line terminated in Z_o and having the following constants, R = 10.4Ω/km, L = 0.00367 H/km, G = 0.8x10^{-6} mho/km and C = 0.00835x10^{-6} F/km. Calculate Z_o , attenuation constant α , phase constant β, wavelength λ and velocity V.		
UNIT-V **TRANSMISSION LINES - II**			
DESCRIPTIVE QUESTIONS			
1	Explain the principle of impedance matching with quarter wave transformer?		
2	Explain the significance and utility of $\lambda/8$,$\lambda/4$ and $\lambda/2$ line?		
3	Explain the significance and design of single stub impedance matching. Discuss the factors on which length depends?		
4	Describe the construction of smith chart and give its applications?		
5	Explain with neat sketches how the input impedance of a lossless line varies with frequency?		
6	Derive the relation between reflection coefficient and standing wave ratio?		
7	Derive the expression for the input impedance of an uniform transmission line terminated with load Z_L. Hence discuss the properties of a quarter wave length and half wave length lines assuming the line to be loss less?		
8	Explain the significance of V_{max} and V_{min} positions along the transmission line, for a complex load Z_R. Hence obtain expression for impedances at these positions?		
9	Explain the method of determining the input impedance of line using smith chart for a lossless of length L at any frequency f for a complex load of Z_R.		
10	Derive expression for the input impedance of a lossless line. Hence evaluate Z_{OC} and Z_{SC}, also sketch their variation with line length?		
ANALYTICAL QUESTIONS			
1	Find the characteristic impedance of a line at 1600Hz if the following measurements have made on the line at 1600 Hz, Zoc =750Ω and Zsc= 500Ω.		
2	A transmission line of length 0.4λ has a characteristic impedance of 100 and is terminated by a load impedance of 200+j180 ohm , by using smith chart find i. voltage reflection coefficient ii. VSWR iii. Input impedance of the line		
3	Calculate the characteristic impedance of a quarter wave transformer if a 120 ohm load is to be matched to a 75ohm line?		
4	A transmission line having 50 ohm impedance is terminated in a load of (40+j30) ohm. What is the voltage standing wave ratio?		
5	A lossless line having an air dielectric has a characteristic impedance of 400 Ω. The line is operating at 200 MHz and Zin = 200 − j200 Ω. Use the Smith chart , find: (a) S; (b) Z_L if the line is 1 m long; (c) the distance from the load to the nearest voltage maximum		

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