SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: EM Waves and Transmission Lines (23EC0407) **Course & Branch**: B.Tech. – ECE

Year &Sem: II-B.Tech & II-Sem **Regulation:** R23

UNIT –I
ELECTROSTATIC FIELDS

1	**a**	What are the co-ordinate systems? and write their co-ordinates.	**[L2] [CO1]**	**[2M]**
	b	Define position and displacement vectors?	**[L2] [CO1]**	**[2M]**
	c	Define convection current and current density.	**[L2] [CO1]**	**[2M]**
	d	Define conduction current and current density.	**[L2] [CO1]**	**[2M]**
	e	Define dielectric constant.	**[L2] [CO1]**	**[2M]**
2	**a)**	Convert the following Cartesian points to cylindrical and spherical coordinates: i. P(2, 5, 1) ii. R(6, 2, -4)	**[L2] [CO1]**	**[6M]**
	b)	Express the following points in Cartesian coordinates: i. P(2, 30^0, 5) ii. Q(4, 30^0, 60^0)	**[L2] [CO1]**	**[4M]**
3	**a)**	Define Coulomb's law and derive the force F that exists between two unlike charges.	**[L3][CO1]**	**[5M]**
	b)	Point charges 1mC and -2mC are located at (3,2,1) and (-1,-1,4) respectively. Calculate the electric force on 10nC charge located at (0,3,1).	**[L3][CO1]**	**[5M]**
4	**a)**	Define Electric field intensity and write its expression for N point charges.	**[L1][CO2]**	**[5M]**
	b)	A Point charge of 20nC is located at the origin. Determine the magnitude and direction of the electric field intensity at point (1,3,-4).	**[L3][CO1]**	**[5M]**
5	**a)**	Explain the following i. Electric Flux density ii. Gauss Law.	**[L2][CO3]**	**[6M]**
	b)	What are the applications of Gauss law?	**[L1][CO3]**	**[4M]**
6	**a)**	A point charges 5nC and -2nC are located at (2,0,4) and (-3,0,5) respectively. Determine the electric flux density **D** at (1,3,-4).	**[L3] [CO1]**	**[5M]**
	b)	Apply Gauss Law to evaluate the electric flux density at a point P due to the point charge located at the origin.	**[L3][CO3]**	**[5M]**
7	**a)**	Determine the Electric flux density at a point P due to infinite line charge of uniform Charge density ρL C/m using Gauss law.	**[L3][CO3]**	**[5M]**
	b)	Determine the Electric flux density at a point P due to infinite sheet of Charge using Gauss law.	**[L3][CO3]**	**[5M]**
8	**a)**	Define Electric Potential. Find the electric potential for a point charge is located at origin and Write Maxwell's second equation for electrostatic field.	**[L3][CO3]**	**[5M]**
	b)	Explain the maxwell's two equations for electrostatic fields.	**[L2] [CO1]**	**[5M]**
9		Derive the energy density of electrostatic field.	**[L2] [CO1]**	**[10M]**
10	**a)**	Derive the expression for poisson's and laplace's equations.	**[L4] [CO1]**	**[4M]**
	b)	Deduce the capacitance value of the parallel plate capacitor, and calculate the capacitance of parallel plate capacitor having a mica dielectric of ξr = 6, plate area of 10 in^2, and a separation of 0.01 in.	**[L4] [CO1]**	**[6M]**
11	**a)**	Derive the expression for capacitance of co-axial cable.	**[L4] [CO1]**	**[6M]**
	b)	Find the capacitance for a 10 km long coaxial cable of ξr = 4 with inner and outer radius of 1 cm and 1.6 cm respectively.	**[L3] [CO1]**	**[4M]**

UNIT –II
MAGNETOSTATIC FIELDS

1	**a)**	Define Biot-Savat's Law.	**[L2][CO2]**	**[2M]**
	b)	Define Ampere's circuital Law.	**[L2][CO2]**	**[2M]**
	c)	Write the expression for Ampere's Force Law.	**[L2][CO2]**	**[2M]**
	d)	Define inductance.	**[L2][CO2]**	**[2M]**
	e)	An antenna radiates in free space and H= 50 Cos(1000t-5y)ax A/m. Calculate ω and β.	**[L2][CO2]**	**[2M]**
2	**a)**	Explain Ampere's Circuital Law.	**[L3][CO2]**	**[5M]**
	b)	Determine the Magnetic Field intensity due to Infinite line Current by applying Ampere's Circuital law.	**[L3][CO3]**	**[5M]**
3	**a)**	An infinitely filamentary wire carries a current of 2A in the +z direction. Calculate B at (-3,4,7).	**[L3][CO1]**	**[5M]**
	b)	Determine the Magnetic Field Intensity due to a infinite sheet current.	**[L3][CO2]**	**[5M]**
4	**a)**	Define magnetic flux density and state Maxwell's Equations for static EM Fields.	**[L2][CO2]**	**[5M]**
	b)	Discuss about Magnetic Vector and Scalar Potentials.	**[L2][CO2]**	**[5M]**
5	**a)**	Given Magnetic Vector Potential A= $-\rho^2/4\ a_z$ wb/m, Calculate the total magnetic flux crossing the $\Phi=\pi/2, 1\leq\rho\leq 2$m, $0\leq z\leq 5$m.	**[L3][CO1]**	**[5M]**
	b)	Derive the expression to find the force due to a moving charged particle in the B field.	**[L3][CO2]**	**[5M]**
6	**a)**	Determine the force on the current element due to the magnetic field.	**[L3][CO2]**	**[5M]**
	b)	Derive the energy density of magnetostatic field.	**[L3][CO2]**	**[5M]**
7	**a)**	Define Faraday's law. Determine the Transformer EMF for the time varying fields.	**[L3][CO2]**	**[6M]**
	b)	Why ampere's Law is In-consistent?	**[L2][CO2]**	**[4M]**
8	**a)**	Define Displacement Current with expression.	**[L2][CO4]**	**[5M]**
	b)	A parallel-plate capacitor with plate area of 5 cm² and plate separation of 3mm has a voltage $\mathbf{50sin(10^3}\boldsymbol{t})$ V applied to its plates. Calculate the displacement current assuming $\boldsymbol{\varepsilon = 2\varepsilon_0}$.	**[L3][CO2]**	**[5M]**
9	**a)**	Express maxwell's equations in integral and differential forms.	**[L2][CO3]**	**[6M]**
	b)	In free space, H= 10 sin(ωt-100x)ay A/m. Calculate E	**[L3][CO4]**	**[4M]**
10		Explain maxwell's equation in word statements.	**[L2][CO3]**	**[10M]**
11	**a)**	In free space, E= 20 cos(ωt-50x)ay V/m. Calculate J_d, H.	**[L3][CO2]**	**[6M]**
	b)	State different conditions of fields on different boundary surfaces.	**[L2][CO3]**	**[4M]**

Course Code: 23EC0407 **R23**

UNIT –III

EM WAVE CHARACTERISTICS

1	**a)**	Define skin depth.	**[L1][CO4]**	**[2M]**
	b)	What is Brewster angle?	**[L1][CO4]**	**[2M]**
	c)	What is the difference between normal incidence and oblique incidence?	**[L1][CO4]**	**[2M]**
	d)	Define critical angle.	**[L1][CO4]**	**[2M]**
	e)	What is total internal reflection?	**[L1][CO4]**	**[2M]**
2	**a)**	Derive the wave equations for conducting medium.	**[L3][CO6]**	**[5M]**
	b)	Derive the wave equations for perfect dielectric medium.	**[L3][CO6]**	**[5M]**
3	**a)**	Explain briefly about uniform plane wave.	**[L2][CO4]**	**[5M]**
	b)	What is the relation between **E** and **H** in uniform plane wave?	**[L1][CO4]**	**[5M]**
4	**a)**	Evaluate the wave equation in lossy dielectric medium for sinusoidal time variations.	**[L4][CO6]**	**[5M]**
	b)	In a Nonmagnetic medium **E**=$\mathbf{4\sin(2\pi X10^7 t - 0.8x)\ a_z v/m}$, find $\boldsymbol{\varepsilon_r}$, η.	**[L3][CO4]**	**[5M]**
5	**a)**	Evaluate the wave characteristics of plane wave in lossless dielectric medium.	**[L4][CO6]**	**[5M]**
	b)	In lossless medium η $= \mathbf{40\pi, \mu_r = 1}$, **H**=2 cos (ωt - z) $\hat{\boldsymbol{a}}_x$+5sin (ωt - z) $\hat{\boldsymbol{a}}_y$. Find $\boldsymbol{\varepsilon_r}$, ω, **E** for the medium.	**[L3][CO4]**	**[5M]**
6	**a)**	Derive the characteristics of plane wave in free space.	**[L3][CO6]**	**[5M]**
	b)	Given that **E**=$\mathbf{40\cos(10^8 t - 3x)\ a_y v/m}$, Determine the direction of wave propagation, velocity of the wave, wave length.	**[L3][CO4]**	**[5M]**
7	**a)**	Derive the expression for intrinsic impendence and propagation constant in a good conductor.	**[L3][CO6]**	**[5M]**
	b)	In a medium, **E** = 14$e^{-0.05x}$sin (2 X 10^8 t - 2x) $\hat{a}_z$ V/m. Determine the followings: i) The propagation constant ii) The wavelength iii) The speed of the wave	**[L3][CO4]**	**[5M]**
8		Define polarization. Explain various types of polarization.	**[L2][CO4]**	**[10M]**
9		Evaluate the expressions for reflection coefficient and transmission coefficient by a normal incident wave for a dielectric medium.	**[L4][CO4]**	**[10M]**
10		Derive the expressions for reflection coefficient and transmission coefficient for reflection of plane wave at oblique in parallel polarization.	**[L3][CO4]**	**[10M]**
11	**a)**	Explain about surface impedance.	**[L2][CO4]**	**[5M]**
	b)	Discuss about power and Poynting vector.	**[L2][CO6]**	**[5M]**

UNIT –IV
TRANSMISSION LINES - I

1	**a)**	Define Transmission line	**[L1][CO5]**	**[2M]**
	b)	List different types of transmission line	**[L1][CO5]**	**[2M]**
	c)	What is meant by loss less transmission line?	**[L1][CO5]**	**[2M]**
	d)	Write Distortion less condition.	**[L1][CO5]**	**[2M]**
	e)	What are the primary and secondary constants of transmission line?	**[L1][CO5]**	**[2M]**
2	**a)**	Define and explain the different types of transmission lines used in communication systems	**[L2][CO5]**	**[5M]**
	b)	A transmission line with R = 0.1 Ω/m, L = 0.3 μH/m, C = 50 pF/m, and G = 0.01 S/m is operating at 1MHz. Calculate the characteristic impedance and propagation constant.	**[L4][CO5]**	**[5M]**
3	**a)**	With neat sketch explain about Primary and Secondary constants of transmission line.	**[L2][CO5]**	**[6M]**
	b)	Discuss about Transmission line Parameters.	**[L2][CO5]**	**[4M]**
4	**a)**	Derive and explain the T- and π-equivalent circuits for a transmission line.	**[L3][CO5]**	**[6M]**
	b)	A lossy cable which has R = 25 Ω/m, L =0.1 μH/m, C =1 pF/m, and G = 0 operates at f = 0.5 GHz. Find the attenuation constant of the line	**[L4][CO5]**	**[4M]**
5		Deduce the equation for voltage and current at any point in a transmission line.	**[L4][CO5]**	**[10M]**
6	**a)**	Determine the equation for Characteristic Impedance of a Transmission line.	**[L3][CO5]**	**[6M]**
	b)	Explain the concept of infinite line transmission line?	**[L2][CO5]**	**[4M]**
7	**a)**	A telephone line has the following parameters: R =30 Ω/km,G =0 L = 100mH/km, C = 20μF/m. At 1KHz, Find the characteristic impedance, propagation constant and velocity of the signal.	**[L3][CO5]**	**[6M]**
	b)	Explain the applications of transmission lines	**[L2][CO5]**	**[4M]**
8		A distortion less line has Z_0=60 Ω Attenuation constant = 20 mNp/m and u=0.6c (c is velocity of light) Find the primary parameters of the transmission line (R,L,C,G, and λ) at 100MHz.	**[L3][CO5]**	**[10M]**
9	**a)**	Explain briefly about phase velocity and group velocity.	**[L2][CO5]**	**[4M]**
	b)	Find the phase velocity and group velocity for a transmission line where L = 0.5 μH/m and C = 25 pF/m	**[L1][CO5]**	**[6M]**
10	**a)**	Define a lossless transmission line. Derive the characteristics of a lossless transmission line.	**[L3][CO5]**	**[6M]**
	b)	Determine the characteristic impedance and velocity for the loss less line from the following parameters. L=1μH/m ,C =0.25 μF/m	**[L3][CO5]**	**[4M]**
11	**a)**	What is distortion less transmission line? Derive the characteristics of a distortion less line.	**[L2][CO5]**	**[5M]**
	b)	Determine the propagation constant and velocity for the distortion less line from the following parameters at 2 GHz. R=20 Ω/km, L=4 mH/km, C=0.02μF/km, G=0.1m ℧/km	**[L3][CO5]**	**[5M]**

UNIT –V
TRANSMISSION LINES-II

1	**a)**	Define input impedance of a transmission line	**[L1] [CO5]**	**[2M]**
	b)	Define VSWR.	**[L1] [CO5]**	**[2M]**
	c)	State the average power of a transmission line.	**[L1] [CO5]**	**[2M]**
	d)	Define open-circuited transmission line	**[L1] [CO5]**	**[2M]**
	e)	What is a matched line?	**[L1] [CO5]**	**[2M]**
2	**a)**	Derive the expression for the input impedance of a lossless transmission line.	**[L3] [CO5]**	**[6M]**
	b)	A transmission line of characteristic impedance 50 Ω is terminated with a load of 100 Ω. Calculate the reflection coefficient at the load.	**[L3] [CO5]**	**[4M]**
3	**a)**	What is VSWR? How is it related to the reflection coefficient?	**[L2] [CO5]**	**[5M]**
	b)	Differentiate between short-circuited and open-circuited transmission lines.	**[L4] [CO5]**	**[5M]**
4	**a)**	Explain the concept of matched lines.	**[L2] [CO5]**	**[4M]**
	b)	A Certain transmission line 2m long operating at $\omega = 10^6$ rad/s has α=8dB/m, β=1 rad/m, and Z_0=60+j40Ω. If the line is connected to a source of 10 $\angle 0^0$ V, Zg = 40Ω and terminated by a load of 20+j50Ω, determine the input impedance.	**[L4] [CO5]**	**[6M]**
5	**a)**	Describe the concept of low-loss RF transmission lines.	**[L2] [CO5]**	**[5M]**
	b)	A 20 m long lossless transmission line with Z0 = 30Ω operating at 2 MHz is terminated with a load Z_L = 30 + j 30Ω. If u = 0.6 C on the line, find the reflection coefficient, the standing wave ratio S and the input impedance.	**[L3] [CO5]**	**[5M]**
6	**a)**	What are the criteria that make a line a low-loss transmission line?	**[L2] [CO5]**	**[5M]**
	b)	How can UHF transmission lines be modelled as circuit elements?	**[L4] [CO5]**	**[5M]**
7		Explain the Smith Chart and its use in transmission line problems.	**[L2] [CO5]**	**[10M]**
8		A 50Ω lossless transmission line is terminated on a load impedance of Z_L = (25 + j 50) Ω. Use the smith chart to find. i) Voltage reflection coefficient. ii) VSWR. iii) input impedance of the line, given that the line is 0.3λ long.	**[L3] [CO5]**	**[10M]**
9		A 30 m long lossless transmission line with Z_0 = 50Ω operating at 2 MHz is terminated with a load Z_L = 60 + j 40Ω. If u = 0.6 C on the line, find the reflection coefficient, the standing wave ratio S and the input impedance. (i) without using smith chart (ii) Using smith chart	**[L4] [CO5]**	**[10M]**
10	**a)**	Describe the working principle of a quarter-wave transformer.	**[L2] [CO5]**	**[5M]**
	b)	A 75 Ω line is to be matched to a 25 Ω load. Design a quarter-wave transformer and calculate its characteristic impedance.	**[L5] [CO5]**	**[5M]**
11	**a)**	A lossless transmission line with Z_0=50 Ω is 30m long and operates at 3MHz. The line is terminated with a load Z_L= 70 +j50Ω, If u=0.6c on the line. Compute reflection coefficient, standing wave ratio and Input impedance, load impedance, using smith chart.	**[L5] [CO5]**	**[6M]**
	b)	Discuss the method of single stub matching.	**[L2] [CO5]**	**[4M]**