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BMS College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January 2018 Semester End Make Up Examinations

Course: Fields and Waves **Duration: 3 hrs**
Course Code: 15ES3GCFAW **Max Marks: 100**
Date:12.01.2018

Instructions: **Answer FIVE FULL questions, choosing one from each unit.**

UNIT 1

1	a	Define Electric field intensity. Derive the expression for field at a point due to many charges.	**10**
	b	Calculate the divergence of vector D at the points specified if, i) $\mathbf{D} = 1/z^2[10xyz\ \mathbf{a}_x + 5x^2z\ \mathbf{a}_y + (2z^3 - 5x^2y)\ \mathbf{a}_z]$ at P (-2,3,5). ii) $\mathbf{D} = 5z^2\ \mathbf{a}_r + 10rz\ \mathbf{a}_z$ at P $(3, -45^0, 5)$.	**10**

OR

2	a	Derive the expression for energy Density in an electric field	**10**
	b	Find E and J corresponding to a drift velocity of 6.0×10^{-4} m/s in the case of silver conductor using the data: $\boldsymbol{\sigma}_{silver} = 61.7 \times 10^6$ S/m and mobility $\boldsymbol{\mu}_{silver} = 5.6 \times 10^{-3}$ H/m	**5**
	c	At the boundary between glass ($\boldsymbol{\epsilon}_r = 4$) and air, the lines of electric field make an angle of 40^0 with normal to the boundary. If electric flux density in air is $0.25\mu C/m^2$, determine the orientation and magnitude of electric flux density in glass.	**5**

UNIT 2

3	a	State and prove Biot-Savart's Law.	**6**
	b	Given vector magnetic potential $\mathbf{A} = x^2\ \mathbf{a}_x + 2yz\ \mathbf{a}_y + (-x^2)\ \mathbf{a}_z$, find the magnetic flux Density.	**7**
	c	Derive the boundary condition for tangential component of H in a steady magnetic field.	**7**

UNIT 3

4	a	State and explain Faraday's law in integral and point form.	**8**
	b	List the Maxwell's equations in point and integral form for time varying fields.	**8**
	c	Given $\mathbf{E} = E_m \sin(\boldsymbol{\omega} t - \boldsymbol{\beta} z)\ \mathbf{a}_y$ in free space, calculate B.	**4**

UNIT 4

5	a	Starting from Maxwell's equations obtain the general wave equation in electric and magnetic fields.	**6**
	b	State and prove Poynting theorem	**8**
	c	Determine i) attenuation constant ii) wavelength and iii) intrinsic impedance for a	**6**

good conductor at a frequency of 1MHz given that $\epsilon_r = 12$, $\mu_r = 1$ and conductivity $\sigma = 20 \times 10^{-3}$ s/m.

UNIT 5

6	a	Define the terms i) Reflection coefficient and ii) Transmission coefficient. Also derive the relation between them.	**8**
	b	Write a short note on SWR.	**6**
	c	Given $\Gamma = 0.5$, $\eta_1 = 100\Omega$, $\eta_2 = 300\Omega$, $E_i = 100$ V/m. Calculate values of average power for the incident, reflected and transmitted wave.	**6**

OR

7	a	Derive the general expression for plane wave propagation in any arbitrary directions.	**8**
	b	Write a short note on Brewster angle.	**6**
	c	An electromagnetic wave traveling in free space is incident on a dielectric medium with relative dielectric constant equal to 2 at an angle of 45^0. Find the angle by which E tilts as the wave crosses the boundary.	**6**

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