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BMS College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October / November 2021 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: EE/EC/TCE/EI/ML **Duration: 3 hrs.**
Course Code: 15ES3GCFAW **Max Marks: 100**
Course: Fields and Waves **Date: 24.10.2021**

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

UNIT 1

1 a Derive the expression for the capacitance of a co-axial cable. **8**

b Two concentric cylindrical conductors, r_a=0.01m and r_b = 0.08m, have surface charge densities ρ_{sa} =4 0pC/m^2 and ρ_{sb}, such that D and E fields exist only between the two cylinders but are zero elsewhere. Find ρ_{sb} and write expressions for D and E between the cylinders. **12**

OR

2 a Derive the relationship between V and E. **8**

c Find the force on a point charge of 50μC at (0, 0, 5) m due to a charge of 500πμC that is uniformly distributed over the circular disc r ≤ 5m, z = 0m. **12**

UNIT 2

3 a Explain the concept of scalar and vector magnetic potentials. **8**

b A current sheet, $\mathbf{K} = 6.5\mathbf{a}_z$ A/m, at x = 0 separates region1, x < 0, where $\mathbf{H}_1$=10a_y A/m and region2, x > 0.Find $\mathbf{H}_2$ at x = +0. **6**

c A 'z' directed current distribution is given by J = r^2 $\mathbf{a}_r$ for r ≤ a. Find **B** at any point r ≥ a using Ampere's circuital law. **6**

UNIT 3

4 a Write and explain point and integral form of Maxwell's equation for free space **8**

b Find the amplitude of the displacement current density in air near car antenna where the field strength of FM signal is $\mathbf{E}$ = 80cos (6.277 x 10^{8}t – 2.092y) $\mathbf{a}_z$ V/m; **6**

c A circular loop conductor lies in plane z = 0 and has a radius of 0.1m and resistance of 5Ω.Given $\mathbf{B}$ = 0.2sin10^{3}t $\mathbf{a}_z$ T. Determine the current in the loop. **6**

UNIT 4

5 a Derive the wave equations starting from Maxwell's equation for free space. **8**

b Determine the propagation constant γ for a material having μ_r=1,ε_r=8 and σ=0.25pS/m, if the wave frequency is 1.6MHz. **4**

c A wave propagating in a lossless dielectric has $\mathbf{E}$ = 500cos (10^{7}t – βz) $\mathbf{a}_x$ V/m; and $\mathbf{H}$ = 1.1cos (10^{7}t – βz) $\mathbf{a}_y$ A/m. If the wave is travelling at a velocity 0.5 times the velocity in free space, find i)μ_r, ii) ε_r, iii)β, iv)λ, v)η. **8**

UNIT 5

6	a	Derive expression for phase velocity for wave propagating in dispersive medium.	**7**
	b	Define transmission coefficient and reflection coefficient.What is the relationship between them?	**7**
	c	A plane wave travelling in +z direction in free space ($z < 0$) is normally incident at $z = 0$ on a conductor ($z > 0$) for which $\sigma = 61.7$ MS/m, $\mu_r = 1$. The free space E wave has a frequency f=1.5 MHz and an amplitude of 1V/m; at the interface it is given by $E(0,t)=1.0 \sin 2\pi ft\ a_y$ (V/m). Find H (z, t) for $z > 0$.	**6**

OR

7	a	What is a standing wave? Define standing wave ratio. What is its relationship with reflection coefficient? Also derive an equation for standing wave.	**8**
	b	A wave is incident at an angle of 30^0 from air to Teflon, $\varepsilon_r=2.1$.Calculate the angle of transmission.	**4**
	c	A uniform plane wave in free space is incident normally on a copper surface ($\sigma=5.8\times10^7$) at z=0.What percentage of the incident power density is transmitted into the copper, if the incident electric field is $E_0 \cos(10^{10}t-\beta z)$ V/m.	**8**

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