Code No: 155SE **RA**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, August - 2022
ELECTROMAGNETIC FIELDS AND WAVES
(Electronics and Communication Engineering)

Time: 3 Hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1.a) Consider a line charge with uniform charge density ρ_L extending along the z-axis. Find the E field due to a line charge?
b) Given D=zρcos$^2\phi$ a_z C/m^2, calculate the charge density at (1,π/4,3) and total charge enclosed by the cylinder of radius 1m with $-2 \le z \le 2$m.
c) Derive the relation between Voltage and Electric field. [5+5+5]

2.a) Two point charges -4μC and 5μC are located at (2,-1,3) and (0,4,-2) respectively. Find the potential at (1,0,1) assuming zero potential at infinity?
b) Three point charges -1nC, 4nC and 3nC are located at (0,0,0), (0,0,1) and (1,0,0) respectively. Find the energy in the system?
c) Define convection and conduction currents. [5+6+4]

3.a) State and prove Biot-Savart's law.
b) A circular loop located on $x^2 + y^2 = 9. z = 0$ carries a direct current of 10A along $a_\emptyset$. Determine H at (0,0,4) and (0,0,-4). [8+7]

4.a) The magnetic vector potential of a current distribution in free space is given by $A = 15e^{-\rho}\, sin\emptyset\, a_z$ Wb/m. Find H at (3, π/4,-10). Calculate the flux through ρ=5, $0 \le \phi \le \pi/2$, $0 \le z \le 1$ 0.
b) An infinitely long filamentary wire carries a current of 2A in the +z-direction. Calculate B at (-3,4,7) and find the flux through the square loop described by $2 \le \rho \le 6$, $0 \le z \le 4$, $\phi = 90^0$? [7+8]

5.a) For a current distribution in free space
$A = (2x^2y + yz)a_x + (xy^2 - xz^3)a_y - (6xyz - 2x^2y^2)a_z$ Wb/m.
Show that $\nabla \cdot A = 0\ and\ \nabla \cdot B = 0$
b) Determine the boundary conditions for magnetic fields between conductor to dielectric. [8+7]

6.a) A medium is characterized by $\sigma = 0, \mu = \mu_0\ and\ \varepsilon = 5\varepsilon_0$.
If $H = 2\cos(wt - 3y)\, a_z A/m$, Calculate w and E.
b) Write Maxwell's equation in word form and integral form for time varying fields. [8+7]

7.a) In free space (z ≤ 0), a plane wave with $H = 10\cos(10^8 t - \beta z)\, a_x mA/m$ is incident normally on a lossless medium $(\varepsilon = 2\varepsilon_0, \mu = \mu_0)$ in region $z \geq 0$. Determine the reflected wave H_r, E_r and the transmitted wave H_t, E_t .

b) Explain the reflection of a plane wave at oblique incidence between conductor and dielectric. [8+7]

8.a) Derive the equation for input impedance of a transmission line in terms of load impedance.

b) A distortionless line has $Z_0 = 60\Omega, \alpha = 20mNp/m,$ u=0.6c, where c is the speed of light in a vacuum. Find R,L,G,C and λ at 100MHz. [7+8]

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