

Code No: 154AV

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech II Year II Semester Examinations, March - 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) Obtain the expression for capacitance of a spherical capacitor.
- b) Two-point charges $Q_1=3 \text{ nC}$ and $Q_2=-2 \text{ nC}$ are placed at $(0, 0, 0)$ and $(0, 0, -1)$ respectively. Assuming zero potential at infinity, find the potential at $(2, 2, 2)$. [7+8]
- 2.a) Obtain the electric field intensity E at a point when an infinite line charge is placed along z -axis by applying Gauss's Law.
- b) Find the flux density D at point A $(8,4,-1)$ caused by a point charge of 40 mC at the origin. [8+7]
- 3.a) State Ampere's Circuit law and explain its application for an infinite current sheet.
- b) Given the magnetic flux density $B=9 \cos 10^6 t \sin 0.01x a_z \text{ mT}$. Find the value of the closed line integral of E around the perimeter specified by $0 < x < 20 \text{ m}$, $0 < y < 3 \text{ m}$ at $t=1 \mu\text{sec}$. [8+7]
- 4.a) Derive the expression for the force between two finite current carrying loops.
- b) Given the vector current density $J = 10\rho^2 z a_\rho - 4\rho \cos^2 \theta a_\theta \text{ A/m}^2$, determine the total current flowing outward through the circular band $\rho = 3, 0 < \theta < 2\pi, 2 < z < 2.8$. [8+7]
- 5.a) Obtain the Conditions at the boundary conductor- freespace interface.
- b) Find the conduction and displacement current densities in a material having conductivity of 10^{-3} S/m and $\epsilon_r = 2.5$ if the electric field in the material is $E = 5.0 \times 10^{-6} \sin(9.0 \times 10^9 t) \text{ V/m}$ [8+7]
6. In free space $E = 20 \cos(\omega t - 50x) a_y \text{ V/m}$. Calculate: a) Displacement current density and b) Magnetic field intensity H . [15]
- 7.a) Discuss the electromagnetic wave propagation in a lossless dielectric medium.
- b) A 30 GHz radar signal may be represented as a uniform plane wave in a sufficiently small region. Calculate the wavelength in cm and the attenuation in dB per foot if the wave is propagating in a nonmagnetic material for which $\epsilon_R=1$ and $\sigma = 0$. [8+7]
- 8.a) Develop the relationship between group velocity and phase velocity for a rectangular wave guide?
- b) A rectangular wave guide measures $3 \text{ cm} \times 4.5 \text{ cm}$. Determine the cutoff wave length, cut off frequency for the dominant TM mode? [8+7]