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Question Paper Code : 80367

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Electrical and Electronics Engineering

EE 6302 — ELECTROMAGNETIC THEORY

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine the angle between $A = 2\vec{a}_x + 4\vec{a}_y$ and $B = 6\vec{a}_y - 4\vec{a}_z$.
2. State Stoke's Theorem.
3. Find the capacitance of an isolated spherical shell of radius a.
4. Find the magnitude of D for a dielectric material in which E = 0.15 MV/m and $\varepsilon_r = 5.25$.
5. State Ampere's Circuital Law.
6. A conductor 4 m long lies along the y-axis with the current of 10 A in a_y direction, if the field is $B = 0.05\,a_x$ Tesla calculate the force on the conductor.
7. Moist soil has conductivity of 10^{-3} S/m and $\varepsilon_r = 2.5$, determine the displacement current density if $E = 6.0 \times 10^{-6}\ sin\ 9.0 \times 10^9$ t (V/m).
8. State Faraday's Law.
9. Define standing wave ratio.
10. State the properties of uniform plane wave.

PART B — (5 × 13 = 65 marks)

11. (a) (i) State and Prove Divergence theorem (8)

(ii) Transform $4\vec{a}_x - 2\vec{a}_y - 4\vec{a}_z$ at (2, 3, 5) to cylindrical coordinates. (5)

Or

(b) (i) Derive the expression for electric field intensity due to uniformly charged circular disc of σ c/m^2. (8)

(ii) Find the force on a charge Q_1 of 20 μC at (0, 1, 2)m due to Q_2 of 300 μC at (2, 0, 0)m. (5)

12. (a) (i) Find the potential at $r_A = 5$ m with respect to $r_B = 15$ m due to point charge $Q = 500$ pC at the origin and zero reference at infinity. (6)

(ii) Find the capacitance of a parallel plate capacitor with dielectric $\varepsilon_{r1} = 1.5$ and $\varepsilon_{r2} = 3.5$ each occupy one half of the space between the plates of area 2 m^2 and $d = 10^{-3}$ m. (7)

Or

(b) (i) In spherical coordinates $V = -25$ V on a conductor at $r = 2$ cm and $V = 150$ V at $r = 35$ cm. The Space between the conductor is a dielectric of $\varepsilon_r = 3.12$. Find the surface charge densities on the conductor. (10)

(ii) Define Laplace and Poisson's equation. (3)

13. (a) Derive the expression for magnetic field intensity due to infinitely long straight conductor carrying a current of I amps along Z-axis. (13)

Or

(b) (i) Determine H for a solid cylindrical conductor of radius a, where the current I is uniformly distributed over the cross section. (5)

(ii) Calculate the inductance of a ring shaped coil of mean diameter 20 cm, wound on a wooden core of 2 cm diameter containing 200 turns. (8)

14. (a) Derive Maxwell's equation in both point and integral form for conducting medium and free Space. (13)

Or

(b) (i) Explain the concept of emf induction in static and time varying magnetic field. (8)

(ii) In a material for which $\sigma = 5.0$ S/m and $\varepsilon_r = 1$ with $E = 250 \sin 10^{10}$ t (V/m). Find J_c and J_D and also the frequency at which they equal magnitudes. (5)

15. (a) Derive the expression for electromagnetic wave equation for conducting and perfect dielectric medium. (13)

Or

(b) A 6580 MHz uniform plane wave is propagating in a material medium of $\varepsilon_r = 2.25$. If the amplitude of the electric field intensity of lossless medium is 500 V/m. Calculate the phase constant, propagation constant, velocity, wavelength and intrinsic impedance. (13)

PART C — ($1 \times 15 = 15$ marks)

16. (a) 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 1.0 V/m at the interface it is given by $E(0, t) = 1.0 \sin 2\pi ft\, a_y$ (V/m). Analyse the wave and predict magnetic wave $H(z, t)$ at $z > 0$. (15)

Or

(b) Given that $A = 30e^{-r}\vec{a}_r - 2z\vec{a}_z$ in cylindrical coordinates, evaluate both sides of divergence theorem for the volume enclosed by $r = 2$, $z = 0$ and $z = 5$. (15)