Reg. No. : | E | N | G | G | T | R | E | E | . | C | O | M |

Question Paper Code : 70089

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Third Semester

Electrical and Electronics Engineering

EE 3301 – ELECTROMAGNETIC FIELDS

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Given point $P(-2,6,3)$ find P in cylindrical and spherical coordinates.

2. Given vectors $A = 3a_x + 4a_y + a_z$ and $B = 2a_y - 5a_z$, find the angle between A and B.

3. State Poisson's equations and Laplace equations.

4. If the electric field intensity is given by $E = (Xu_x + Yu_y + Zu_z)$ volt/m, Find the potential difference between $X(2,0,0)$ and $Y(1,2,3)$.

5. State the boundary conditions between two magnetic material.

6. Given that the magnetic vector potential $A = (\sin 2\varphi)a_\varphi$ in cylindrical co-ordinates. Find the flux density at $(2, \pi/4, 0)$.

7. Determine the maximum torque on 80 turn rectangular coil of $0.25\,m \times 0.4\,m$, carrying a current of 10 A in a field of 0.8 Tesla.

8. State Faradays law.

9. State Pointing vector and write its significance.

10. Define intrinsic impedance and estimate its value for free space.

PART B — (5 × 13 = 65 marks)

11. (a) A positive charge of $3\times10^{-3}C$ located at $P_1(3,-2,-4)$m and negative charge of $5\times10^{-6}C$ is located at $P_2(1,-4,3)$m. find (i) vector force on negative charge (ii) Magnitude of force on charge at P_1.

Or

(b) Find the electric field intensity at a point P located at (0,0,h)m due to charge of surface charge density σ C/m² uniformly distributed over the circular disc $r \le a, z = 0$ m and correlate your result by applying gauss's law.

12. (a) A total charge of 25nC is distributed around a circular ring of radius 2.5 m with its center located at the origin and lying in xy plane. Find the potential at $(0,0,5)m$.

Or

(b) Four equal point charges, $100\,\mu C$ each are located at the corners of a square of 10 cm side in XY plane. Determine the value of fifth charge, which when placed at Centre of the square. Keep all the four equal charges at their respective equilibrium position. The medium is free space.

13. (a) Two long straight parallel wires in air 2m apart carry currents I_1 and I_2 in the same direction. The magnetic field intensity at midway is 7.5 AT/m. If the force on each wire per unit length is 2.5×10^{-4} N, estimate the currents I_1 and I_2.

Or

(b) State Biot-Savart Law. Deduce the expression for the magnetic field at a point on the axis of a current carrying circular loop of radii is 'R' distant 'X' from the center.

14. (a) Develop Maxwell's equations in Integral and Differential forms time varying fields.

Or

(b) Examine whether the following fields satisfy Maxwell's equations or not. $E = \left[E_m \sin x \, Sin\, t\, a_y\right]$ and $H = \left[(E_m / \mu 0) Cos\, x \cos t\, a_z\right]$.

15. (a) Develop the wave equations from Maxwell's equations for lossy dielectric materials.

Or

(b) Derive the propagation constant for waves in lossless dielectric materials.

PART C — (1 × 15 = 15 marks)

16. (a) Convert the points $P(1,3,5), T(0,-4,3)$ and $S=(-4,-3,-10)$ from Cartesian to cylindrical and spherical coordinate systems. Then transform the vector $\bar{Q}=\frac{\sqrt{x^2+y^2}}{x^2+y^2+z^2}\bar{a}_x-\frac{yz}{x^2+y^2+z^2}\bar{a}_y$ and Evaluate $\bar{Q}$ at T in all the coordinates.

Or

(b) Deduce the expression for the capacitance of parallel plate capacitor having two dielectric media and the capacitor of type specified about as the following details A = 1 t_1 = 0.008, t_2 = 0.003, $\varepsilon_1 = 6\ \varepsilon_0, \varepsilon_2 = \varepsilon_0$. Calculate capacitance at the system. If voltage of 6000 volt is applied across the capacitor determine the potential gradient in two dielectrics.