Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2023
ELECTRICAL AND ELECTRONICS ENGINEERING
(2020 SCHEME)

Course Code : 20EET204

Course Name: Electromagnetic Theory

Max. Marks : 100 **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Explain the physical significance of curl of vector field.
2. Transform the vector field $\vec{A}$ = 10 $\overrightarrow{a_x}$ - 8 $\overrightarrow{a_y}$ +6 $\overrightarrow{a_z}$ to cylindrical coordinate system at point P (10, -8, 6).
3. Derive the differential form of Gauss's law.
4. Obtain Laplace's equation from Poisson's equation.
5. Distinguish between scalar and vector magnetic potential.
6. Calculate the capacitance of a parallel plate capacitor having an electrode area of 100 cm^2. The distance between the electrodes is 4mm and the dielectric has a permittivity of 3.5. The applied potential is 100 V. Also compute the charges on the plates.
7. State the wave equations for E and H in a conducting medium.
8. Show that the intrinsic impedance for free space is 120π.
9. Explain about electromagnetic interference in transmission line.
10. Explain about impedance matching in transmission line.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Calculate the constants a, b and c so that the vector $\bar{E}$ is irrotational. $\bar{E} = (x + 2y + az)\widehat{a_x} + (bx - 3y - z)\widehat{a_y} + (4x + cy + 2z)\widehat{a_z}$. (5)

    b) Convert the vector $\bar{A} = \frac{10}{r}\,\widehat{a_r} + r\,cos\theta\,\widehat{a_\theta} + \widehat{a_\emptyset}$ to cartesian coordinate system. Also evaluate $\bar{A}$ at (-3, 4, 0). (9)

OR

12. a) Explain about spherical coordinate system. (5)

    b) Verify the divergence theorem for vector field $\bar{D} = xy^2\widehat{a_x} + y^3\widehat{a_y} + y^2z\widehat{a_z}$ taken over the cube bounded by x=0, x=1, y=0, y=1, z=0, z=1. (9)

MODULE II

13. a) Explain about electric dipole. Derive an expression for the electric field intensity at any point due to dipole. (9)

b) A charge q_2 experiences a force of 1N at a distance of 1m from another charge. Calculate the distance at which the force on q_2 is reduced to 0.5N. (5)

OR

14. a) With neat diagram derive an expression for capacitance of co axial cable. (5)

b) A charge Q_1=-10 nC is at origin in free space. What charge Q_t should be kept at (2,0,0) to make x-component of electric field intensity as zero at the point (3,1,1). (9)

MODULE III

15. a) Derive the Maxwell's equation from i) Ampere's circuital law, ii) Gauss's law, iii) Faraday's law. (10)

b) If the magnetic flux density in a medium is given by $B = \frac{1}{\rho} cos\emptyset \, \widehat{a_\rho}$, calculate the flux crossing the surface defined by $-\frac{\pi}{4} < \emptyset < \frac{\pi}{4}$, $0 \leq z \leq 2\ m$. (4)

OR

16. a) Derive the boundary conditions for electric field at an interface separating conductor and dielectric. (7)

b) Derive the expression for magnetic field intensity on the axis of a circular loop. (7)

MODULE IV

17. a) Calculate the attenuation constant and phase constant for a uniform plane wave with frequency of 10 GHz in a medium for which $\mu = \mu_0$, $\varepsilon_r = 2.3$ and $\sigma = 2.56x10^{-4} mho/m$. (4)

b) State and prove Poynting's theorem. (10)

OR

18. a) Derive the wave equation in a lossy dielectric medium. (7)

b) A 9375 MHz uniform plane wave is propagating in polystyrene ($\mu_r = 1, \varepsilon_r = 2.56$). If the amplitude of the electric field intensity is 20 V/m & the material is lossless, calculate (i) wavelength in polystyrene, (ii) velocity of propagation, (iii) intrinsic impedance (iv) propagation constant. (7)

MODULE V

19. a) Explain about standing wave ratio and derive the expression for voltage SWR. (8)

b) An air-line has a characteristic impedance of 70Ω and a phase constant of 3rad/m at 100MHz. calculate the inductance/m and capacitance/m of the line. (6)

OR

20. a) A transmission line operating at 500 M rad/s has L=0.5 μH/m, C= 32 pF/m, G=100 $\mu\Omega^{-1}$/m and R=25 Ω/m. Calculate propagation constant, velocity of propagation, wavelength and characteristic impedance. (7)

b) Derive the expression for characteristic impedance in transmission line. (7)

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