Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (S), SEPT 2022
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. Convert a point P (-1,5,3) to cylindrical and spherical coordinate system.
2. Explain divergence of a vector field with its physical significance.
3. State and explain Coulomb's law.
4. Derive Poisson's and Laplace equation.
5. State and prove Ampere's circuital law.
6. Divergence of magnetic field is always zero. Explain.
7. What is meant by Poynting vector? Explain.
8. What is skin depth? Explain.
9. Define propagation constant and characteristic impedance of a transmission line.
10. Define voltage standing wave ratio (VSWR).

PART B

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

MODULE I

11. a) Prove the divergence theorem for the vector $\overline{D} = (x^2 - yz)\hat{a}_x + (z^2 - xz)\hat{a}_y + ((y^2 - xy)\hat{a}_z$, defined for a rectangular parallel piped bounded by the region $0 \le x \le a,\ 0 \le y \le b,\ 0 \le z \le c$. (10)

b) Find the gradient of the following scalar field $W = 10r\sin^2\theta\cos\phi$. (4)

OR

12. a) Given point P (-2, 6, 3) and vector $A = y\hat{a}_x + (x+z)\hat{a}_y$ express P and A in cylindrical and spherical coordinates. Evaluate A at P in the cartesian, cylindrical and spherical systems. (10)

b) For a vector field A, show that $\nabla.(\nabla XA) = 0$; that is, the divergence of the curl of any vector field is zero. (4)

MODULE II

13. a) Four identical charges are placed at the corners of a square of side 'a'. Find the resultant force and electric field intensity developed on a charge. (7)

b) Derive the expression for capacitance of a two-wire line. (7)

OR

14. a) Define electric dipole. What is the electric field intensity due to an electric dipole. (7)
    b) State and prove Gauss's law and using Gauss's law, determine the electric field intensity due to infinite line charge. (7)

MODULE III

15. a) Obtain the expression for magnetic field intensity on the axis of a rectangular loop carrying current. (7)
    b) Derive the electrostatic boundary condition at the interface between two dielectric mediums. (7)

OR

16. a) Derive Maxwell's equation in integral form and differential form from basics. (10)
    b) Derive continuity equation for current. (4)

MODULE IV

17. a) Derive wave equation from Maxwell's equations for a conducting media. (7)
    b) A 10 GHz plane wave travelling in free space has an amplitude 15V/m find i) Velocity of propagation ii) Wave length iii) Characteristic impedance of the medium iv) Amplitude of H and v) Propagation constant. (7)

OR

18. a) State and explain Poynting theorem. (10)
    b) Determine the depth of penetration for copper at 3 MHz. The conductivity for Copper is 58 $\mu\mho m^{-1}$and permeability is 1.26 μHm^{-1}. (4)

MODULE V

19. a) Obtain the transmission line equations and its solution. (7)
    b) A transmission line with a characteristic impedance of 300 Ω is terminated in a purely resistive load. It is found by measurement that the minimum line voltage upon it is 5 mV and maximum 7.5 mV. What is the value of load impedance? (7)

OR

20. a) At a frequency of 100 MHz, the following values are appropriate for certain transmission line: L=0.25 μH/m, C=80 pF/m, R=0.15Ω/m and G=8μ℧/m. Calculate values for i) attenuation constant ii) propagation constant iii) velocity of propagation and iv) characteristic impedance. (8)
    b) Explain various impedance matching techniques in detail. (6)

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