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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

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

Course Code : 20ECT302

Course Name: Electromagnetics

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

PART A

(Answer all questions. Each question carries 3 marks)

1. State Coulomb's law.
2. State divergence theorem and explain the physical significance of divergence.
3. Explain (i) scalar magnetic potential and (ii) vector magnetic potential.
4. Explain displacement current density.
5. State Snell's law of refraction.
6. Explain skin depth.
7. Derive the relation between standing wave ratio and reflection coefficient.
8. Differentiate between half wave transformer and quarter wave transformer.
9. Explain the terms phase velocity and group velocity.
10. Give the dominant modes for TE and TM modes in a rectangular waveguide, with reason derive the expressions for cut off frequency for dominant mode.

PART B

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

MODULE I

11. a) Define curl and also find the curl of vector field $A = x^2y\,a_x + y^2z\,a_y - 2xz\,a_z$. (7)

    b) Convert the point P (1,1,6) given in cartesian coordinate system to cylindrical and spherical coordinate system. (7)

OR

12. a) Point charges 5 nC and -2 nC are located at (2,0, 4) and (-3,0, 5) respectively. Calculate the electric force on a 1 nC point charge located at (1, -3, 7) and the electric field intensity at that point. (10)

    b) Give Poisson and Laplace equation for electrostatic field. (4)

MODULE II

13. a) Derive the capacitance of a two-wire transmission line. (7)

b) Derive an expression for electrostatic energy in terms of electric field intensity. (7)

OR

14. a) Derive the electrostatic boundary conditions at the interface between two perfect dielectrics. (7)
    b) From Faraday's Law, derive Maxwell's Equations in Differential and integral form. (7)

MODULE III

15. a) State and prove Poynting's theorem. (10)
    b) What is polarization. List different types of polarization. (4)

OR

16. a) From Maxwell's equations derive wave equations for a perfect dielectric medium. (10)

    b) Obtain wave equations in phasor form for a perfect dielectric medium. (4)

MODULE IV

17. a) Define transmission line equations and obtain an expression for characteristic impedance and propagation constant. (7)
    b) An air-line has a characteristic impedance of 70Ω and a phase constant of 3 rad/m at 100MHz. Calculate the inductance per meter and the capacitance per meter of the line. (7)

OR

18. a) A lossless line with Zo = 50Ω is 30m long and operates at 2MHz. The line is terminated with a load, Z_L = 60 + j40 Ω . If u = 0.6c on the line, where c is the velocity of light, then using Smith chart, Find (i) Reflection coefficient at load (ii) VSWR (iii) Input impedance (use Smith chart). (8)
    b) Derive the expression of input impedance due to a transmission line terminated by a load. (6)

MODULE V

19. a) Derive the expression for electric and magnetic field intensities for TE mode of propagation of rectangular waveguide. (10)
    b) Explain the following terms. i) Dominant mode (ii) Cut off frequency. (4)

OR

20. a) At 15GHz, an air-filled 5*2cm waveguide has (8)
$Ezx = 20\sin(40\pi x)\sin(50\pi y)\, e^{-j\beta z}$ V/m.
    (i) What mode is being propagated?
    (ii) Find β.
    (iii) Determine E_y/E_x.

    b) A standard air-filled rectangular waveguide with dimensions a=8.636cm, b= 4.318cm is fed by a 4GHz carrier from a coaxial cable. Determine whether a TE_{10} mode will be propagated. If so, calculate the phase velocity and group velocity. (6)

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