

B. Tech 5th Semester Examination

Electromagnetic Field Theory (NS)

EE-314

Time : 3 Hours

Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, selecting at least one question from each section A, B, C, and D. Section E is compulsory.

SECTION - A

1. (a) Give the physical interpretation of gradient and curl of a vector. (5)
- (b) Convert point P (1,3,5) from Cartesian to cylindrical and spherical co-ordinates. (5)
- (c) State and prove Laplace's equation for a simple medium in vector notation. (5)
- (d) Is Gauss's law useful in finding the electric field vector of a finite line charge? Explain. (5)
2. (a) Find E at P (1,5,2) m in free space if a point charge of $6\mu\text{C}$ is at (0,0,1), the uniform line charge density $\rho_L = 180 \text{ nC/m}$ along x-axis and uniform sheet of charge with $\rho_s = 25 \text{ nC/m}^2$ over the plane $z = -1$. (10)
- (b) State and explain Coulomb's law. (5)
- (c) Derive the expression for energy stored in a capacitor. (5)

SECTION - B

3. (a) Quote the expression for the magnetic field intensity inside and outside a co-axial conductor of inner radius 'a' and outer radius 'b' and carrying a current of I amperes in the inner and outer conductor. (10)
- (b) State Ampere's circuital law. Use it to find the magnetic field induction \vec{B} at a point within a current carrying (i) long solenoid, (ii) toroid. (10)
4. (a) An iron ring with a cross sectional area of 8 cm^2 and a mean circumference of 120 cm is wound with 480 turns of wire carrying a current of 2 A. The relative permeability of the ring is 1250. Calculate the flux established in the ring. (10)
- (b) State and prove Ampere's force law. (10)

SECTION - C

5. (a) A two dimensional electric field is given by $\vec{E} = x^2\vec{a}_x + x\vec{a}_y$ V/m. Show that this electric field cannot arise from a static distribution of charge. (8)
- (b) Derive the equation of continuity for time varying fields and point out the inconsistency of Ampere's law for time varying fields. (12)
6. (a) Write Maxwell's equation in free space for the time varying fields both in differential and integral form. Why these equations are not completely symmetrical? (7)
- (b) Uniform E and B fields are oriented right angles to each other. An electron with a speed of $8 \times 10^6 \text{ m/s}$ at right angles to both fields passes without being deflected through the field. If the magnitude of B is 0.5 mWb/m^2 , find the value of E. (7)

- (c) State Poynting theorem and define complex poynting vector and their applications. (6)

SECTION - D

7. (a) Write about Reflection by a perfect dielectric at Normal incidence. Also discuss about Conductors and Dielectrics in detail. (10)
- (b) A loss-less line of 100 ohms characteristic impedance connects a 100 KHz generator to a 140 ohms load. The load power is 100 mW. Calculate (i) Voltage reflection coefficient, (ii) Voltage standing wave ratio (VSWR), (iii) Position and values of voltage maxima and current maxima, (iv) Position and values of voltage minima and current minima. (10)
8. (a) Derive the transmission line equations in time domain and phasor domain. (10)
- (b) Find the input impedance of 75Ω lossless transmission line of length 0.1λ when the load is short by using Smith chart. (10)

SECTION - E

9. Attempt all questions.
- (a) Differentiate between scalar field and vector field. Give examples.
- (b) What do you mean by equipotential surfaces?
- (c) Obtain the unit vector in the direction from the origin towards the point
- (d) State the properties of electric flux lines.
- (e) State the Stokes' theorem. What do you infer from it?
- (f) What is impedance matching?

- (g) A parallel polarized wave propagates from air into dielectric at Brewster angle of 75° . Calculate the relative dielectric constant of the medium.
- (h) Give the physical interpretation of the gradient.
- (i) What is difference between scalar magnetic potential and vector magnetic potential?
- (j) What do you understand by polarized and unpolarized electromagnetic waves? (2×10=20)