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**Question Paper Code : P 1279**

B.E/B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Third Semester

Electrical and Electronics Engineering

EE 1201 — ELECTROMAGNETIC THEORY

(Common to B.E.(Part-Time) Second Semester – Regulation 2005)

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List out the sources of electromagnetic fields.

2. When a vector field is solenoidal and irrotational?

3. Calculate the capacitance of a parallel plate capacitor having an electrode area of 100 cm². The distance between the electrodes is 3 mm and the dielectric used has a permittivity of 3.5 the applied potential is 80 V. Also compute the charge on the plates.

4. Define polarization.

5. State Ampere's circuital Law.

6. What is the inductance per unit length of a long solenoid of N turns and having a length "l" meters? Assume that its carries a current of "I" amps.

7. A parallel plate capacitor with plate area of 5 $cm^2$ and plate separation of 3 mm has a voltage $(50 \sin 10^3 t)$V applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_0$.

8. State Faraday's law of Electromagnetic induction

9. Compute the reflection and transmission coefficients of an electric field wave travelling in air and incident normally on a boundary between air and a dielectric having permittivity of 4.

10. Calculate the depth of penetration in copper at 10 MHz, given the conductivity of copper is $5.8 \times 10^7$ S/m and its permeability = 1.26 mH/m.

PART B — (5 × 16 = 80 marks)

11. (a) Given point P(–2,6,3) and vector $A = ya_x + (x+z)a_y$. Evaluate A and at P in the Cartesian, cylindrical and spherical systems.

Or

(b) (i) State Divergence theorem and prove it.

(ii) For a vector field A, show explicitly that $\nabla \cdot \nabla \times \vec{A} = 0$; that is the divergence of the curl of any vector field is zero.

12. (a) (i) Using Laplace's equation, find the potential V between two concentric circular cylinders, if the potential on the inner cylinder of radius 0.1 cm is 0 V and that on the outer cylinder of radius 1 cm is 100 V.

(ii) A point charge of 5nC is located at (–3, 4, 0) while line y = 1 ,z = 1 carries uniform charge 2 nC/m. If V = 0V at O(0,0,0),find V at A( 5, 0,1).

Or

(b) (i) State and prove Gauss's Law. (8)

(ii) Derive an expression for energy density in an electric field. (8)

13. (a) (i) Obtain the expression for the magnetic field around a long straight wire using the magnetic vector potential.

(ii) Derive the expression for the magnetic vector potential in the cases of an infinitely long, straight, conductor in free space.

Or

(b) (i) Determine the self inductance of a coaxial cable of inner radius "a" and outer radius "b".

(ii) A circular loop located on $x^2 + y^2 = 9, z = 0$ carries a direct current of 10 A along $a_\phi$. Determine H at (0,0,4) and (0,0,–4).

14. (a) Derive the Maxwell's equation from Faradays law, Ampere's Law, and Gauss law in the integral and point forms.

Or

(b) (i) Compare the field theory and circuit theory.

(ii) Distinguish between Transformer emf and motional emf.

15. (a) (i) A co-axial line has an inner conductor of radius 0.1 cm and an inductance of $0.35\mu H$. Find the values of the characteristic impedance, capacitance and the radius of the outer conductor of the line at 10 MHz if the dielectric constant of the sponge material used as insulation in between the inner and outer conductors is 4. Calculate the velocity of propagation and wavelength and phase constant in this case.

(ii) Derive the general electromagnetic wave equation.

Or

(b) (i) A lossy material has $\mu_r = 5, \varepsilon_r = 2$. If at 5 MHz, the phase constant is 10 rad/m. Calculate the loss tangent the conductivity of the material, the permittivity, the attenuation constant and the intrinsic impedance.

(ii) An electric field in free space is given by $E = 50\cos(10^8 t + \beta x)a_y V/m$ find the direction of the wave propagation, calculate $\beta$ and the time taken to travel a distance of $\lambda/2$.

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