Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 52443

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017

Fourth Semester

Electronics and Communication Engineering

EC 2253 – ELECTROMAGNETIC FIELDS

(Regulations 2008)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Check if the following field is compressible or incompressible :
   $\vec{F} = -x^2y\vec{i} + y^2x\vec{j}$.
2. Determine the electric flux density at a distance of 20 cm due to an infinite sheet of uniform charge 20 $\mu C/m^2$ lying on the z = 0 plane.
3. State Ampere's circuital law.
4. Find the force per meter length between two long parallel wires A and B separated by 5 cm in air and carrying currents of 40 A in the same direction.
5. Write the equation of continuity of current. What does it mean ?
6. State any two properties of ferromagnetic materials.
7. State Lenz's law.
8. A plane travelling wave in free space has an average Poynting vector of 1.5 watts/m^2. Calculate the average energy density.
9. Write the one dimensional wave equation for a wave travelling in z-direction.
10. Define 'Brewster angle'.

PART – B (5×16=80 Marks)

11. a) i) Given point P(–2, 6, 3) and $\vec{A} = y\vec{i} + (x+z)\vec{j}$, express P and $\vec{A}$ in spherical coordinates. (10)

ii) By means of Gauss's law, determine the electric field intensity at a point P distant 'h' m from an infinite line of uniform charge $\rho_l C/m$. (6)

(OR)

b) i) A circular disc of radius 'a' m is charged uniformly with a charge density of $\rho_s C/m^2$. Find the electric field intensity at a point 'h' m from the disc along its axis. (10)

ii) Find the expression for the potential due to a dipole at a point P not in the line connecting the two poles of the dipole. (6)

12. a) i) By means of Biot-Savart's law, derive an expression for the flux density produced by an infinitely long straight wire carrying a current 'I', at any point P distant 'a' normal to the wire. (10)

ii) If the vector potential is given by $\vec{A} = \vec{i}5(x^2+y^2+z^2)^{-1}$ Wb/m, find the magnetic flux density $\vec{B}$. (6)

(OR)

b) i) Two narrow circular coils A and B have a common axis and are placed 10 cm apart. Coil A has turns of radius 5 cm with a current of 1 A passing through it. Coil B has a single turn of radius 7.5 cm. If the magnetic field at the centre of coil A is to be zero, what current should be passed through coil B ? (8)

ii) Derive an expression for torque in a rectangular loop which is carrying a current of 'I' amperes and is situated in a uniform magnetic field 'B' Wb/m^2. (8)

13. a) i) The relative permittivity ε_r of a linear, homogeneous, isotropic dielectric material is 3.6 and the material is covering the space between z = 0 and z = 1. If V = –6000z volts in the material, find (i) $\vec{E}$ ii) $\vec{P}$. (6)

ii) Obtain the expression for energy stored in the magnetic field and also derive the expression for magnetic energy density. (10)

(OR)

b) i) Derive the electrostatic boundary conditions at the interface between two dielectrics. (10)

ii) Calculate the self-inductance per unit length of an infinitely long solenoid. (6)

14. a) i) A parallel plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage of 50 sin 10^3 t V applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_0$. (6)

ii) Derive the Maxwell's equations in both point and integral forms from Ampere's law and Faraday's law of electromagnetic induction. (10)

(OR)

b) Show that the total power flow along a coaxial cable is given by the surface integration of the Poynting vector over any closed surface. (16)

15. a) Describe the electromagnetic wave propagation in lossy dielectrics. (16)

(OR)

b) i) Derive the phasor form of EM wave equations for a uniform plane wave. (10)

ii) What are Linear, Elliptical and Circular polarizations ? (6)