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

Question Paper Code : 51449

B.E/B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fourth Semester

Electronics and Communication Engineering

EC 2253/EC 43/10144 EC 404/EC 1253/080290021 – ELECTROMAGNETIC FIELDS

(Regulations 2008/2010)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Determine the gradient of the scalar field $F = 5r^2 + r \sin \theta$.

2. What is an electric dipole ? Write down the potential due to an electric dipole.

3. If the magnetic field $B = 25x\hat{i} + 12y\hat{j} + \alpha z \hat{k}$ (T), find α.

4. Write Biot-Savart law.

5. Determine the capacitance of the parallel plate capacitor composed of tin foil sheets, 25 cm square for plates separated through a glass dielectric 0.5 cm thick with relative permittivity of 6.

6. State point form of Ohm's law.

7. State Faraday's Law.

8. Define dissipation factor.

9. What is Uniform Plane Wave ?

10. Define Brewster angle.

PART – B (5 × 16 = 80 Marks)

11. (a) (i) A point charge $Q_1 = 300\ \mu C$ located at (1, –1, –3) m experiences a force $F_1 = 8a_x - 8a_y + a_z$ (N) due to point charge Q_2 at (3, –3, –2) m. Find the charge Q_2. **(8)**

(ii) Given that $\vec{D} = \left(\frac{5r^2}{4}\right) \vec{a}_r$ (C / m^2) in spherical coordinates, evaluate both sides of divergence theorem for the volume enclosed by r = 4 m and $\theta = \frac{\pi}{4}$. **(8)**

OR

(b) (i) Derive the expression for potential due to an electric dipole at any point P. Also find electric field intensity at the same point. **(10)**

(ii) Two point charges, 1.5 nC at (0, 0, 0.1) and –1.5 nC at (0, 0, –0.1) are in free space. Treat the two charges as a dipole at the origin and find potential at P(0.3, 0, 0.4). **(6)**

12. (a) (i) Find the magnetic field at the centre of a square loop, which carries a steady current I, Let R be the distance from centre to side. Find the field at the centre of a n-sided polygon, carrying a steady current I. Again, let R be the distance from the centre to any side. Find the formula in the limit n (number of sides) tends to infinity. **(8)**

(ii) Find the magnetic field a distance h above the center of a circular loop of radius R, which carries a steady current I. **(8)**

OR

(b) (i) Derive the Ampere's law. **(8)**

(ii) Derive the expressions which mutually relate current density J, Magnetic field B and Magnetic vector potential A. **(8)**

13. (a) Derive the boundary relations for

(i) E-field **(8)**

(ii) H-field **(8)**

OR

(b) A composite conductor of cylindrical cross section used in overhead line is made of a steel inner wire of radius "a" and an annular outer conductor of radius "b", the two having electrical contact. Evaluate the H-field within the conductors and the internal self – inductance per unit length of the composite conductor. **(16)**

14. (a) With necessary explanation, derive the Maxwell's equation in differential and integral forms. **(16)**

OR

(b) (i) The conduction current flowing through a wire with conductivity $\sigma = 3 \times 10^7$ s/m and the relative permeability $\varepsilon_r = 1$ is given by $I_c = 3 \sin \omega t$(mA). $\omega = 10^8$ rad/sec, find the displacement current. **(8)**

(ii) An electric field in a medium which is source free is given by $E = 1.5 \cos (10^8 t - \beta z) \bar{a}_x$ V/m. Find B, H and D. Assume $\varepsilon_r = 1$, $\mu_r = 1$, $\sigma = 0$. **(8)**

15. (a) (i) Derive Wave Equation from Maxwell's Equations. **(8)**

(ii) Describe the concept of Plane Wave propagation in good conductors. **(8)**

OR

(b) Explain with relevant expressions, the concept of reflection of plane waves by a perfect dielectric at both normal and oblique incidence. **(16)**