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

Question Paper Code : 60449

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Fourth Semester

Electronics and Communication Engineering

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

(Regulations 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. In XY plane, $Q_1 = 100\ \mu C$ at (2,3)m, experiences a repulsive force of 7.5N because of Q_2 at (10.6)m. Find Q_2.
2. What is Gradient?
3. A current filament carrying 15 A in the a_z direction lies along the entire z axis. Find H in rectangular coordinates at $P_A(2,-4,4)$.
4. What is Magnetic vector potential?
5. Express Laplace equation in spherical coordinates.
6. Write the expression for energy stored in an inductor.
7. Distinguish between conduction current and displacement current.
8. Write down the expressions for instantaneous and complex Poynting vector.
9. Write the constitutive relations concerning the characteristics of the medium in which the fields exist.
10. Write the equation for Brewster angle.

PART B — (5 × 16 = 80 marks)

11. (a) Derive an expression for the electric field due to a straight and infinite uniformly charged wire of length 'L' meters and with a charge density of $+\rho c/m$ at a point P which lies along the perpendicular bisector of wire. (16)

Or

(b) (i) A uniform line charge $\rho_L = 25Nc/m$ lies on the $x = 3m$ and $y = 4m$ in free space. Find the electric field intensity at a point (2, 3 and 15) m. (8)

(ii) Given that potential $V = 10\sin\theta\cos\Phi/r^2$ find the electric flux density D at $(2,\pi/2,0)$. (8)

12. (a) Derive the expression for Biot-Savart law. Derive the equation for torque on a current carrying loop. (16)

Or

(b) Find H-field on the axis of a ring carrying a constant current. Highlight the similarities between Biot-Savart law and Coulomb's law. (16)

13. (a) (i) State and prove the boundary conditions for static magnetic field and static electric field. (10)

(ii) Derive the expression for electrostatic energy density. (6)

Or

(b) (i) Derive the Capacitance of a parallel plate capacitor. (4)

(ii) Calculate the self-inductances of and the mutual inductances between two coaxial solenoids R_1 and R_2, $R_2 > R_1$, carrying currents I_1 and I_2 with n_1 and n_2 turns/m respectively. (6)

(iii) Derive the expression for energy density in magnetic fields. (6)

14. (a) (i) Explain the Ampere's circuit law. (8)

(ii) Derive the Poynting's Theorem. (8)

Or

(b) (i) Describe the Maxwell's equations in differential and Integral forms. (8)

(ii) Write Faraday's law in differential and integral forms and explain Faraday's experiments. (8)

15. (a) A uniform plane wave in a medium having $\sigma = 10^{-3} S/m, \varepsilon = 80\varepsilon_0$ and $\mu - \mu_0$ is having a frequency of 10 kHz.

(i) Verify whether the medium is good conductor. (3)

(ii) Calculate the following :

(1) Attenuation constant. (2)

(2) Phase constant. (2)

(3) Propagation constant. (2)

(4) Intrinsic impedance. (3)

(5) Wavelength. (2)

(6) Velocity of Propagation. (2)

Or

(b) A uniform plane wave in free space is normally incident on a dielectric having relative permittivity 4 and relative permeability 1. The electric field of incident wave is given by $\overline{E} = E_0 e^{-jz} \overline{a}_x$ to $z < 0$, where E_0 is a real constant. Calculate

(i) Frequency and wave length of incident and transmitted waves. (4)

(ii) Magnetic field of incident wave. (3)

(iii) Transmission coefficient and the expression for the electric field of the transmitted wave. (6)

(iv) Expression for the magnetic field of the transmitted wave. (3)
