Reg. No. :

Question Paper Code : X 20445

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020

Fourth Semester

Electronics and Communication Engineering

EC 6403 – ELECTROMAGNETIC FIELDS

(Regulations 2013)

(Common to PTEC 6403 – Electromagnetic Fields for B.E. Part-Time Third Semester – Electronics and Communication Engineering Regulations 2014)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Define line charge density.
2. Write the equation for Gauss law.
3. What are the boundary conditions for electric field at the perfect dielectric-conductor interface ?
4. Find the energy stored in the 20pF parallel plate capacitor with plate.
5. Define magnetic vector and scalar potential.
6. A current of 3A flowing through an inductor of 100 mH. What is the energy stored in inductor ?
7. Define skin depth.
8. Define dielectric strength.
9. Define phase velocity.
10. Find the displacement current density for field $E = 300 \sin 10^9 t$ V/m.

PART – B **(5×13=65 Marks)**

11. a) i) State and explain divergence theorem. **(6)**

ii) Determine the electric flux density D at (1,0,2) if there is a point charge 10 mC at (1,0,0) and a line charge of 50 mC/m along y axis. **(7)**

(OR)

b) i) Derive the expression for energy stored in an electrostatic field, in terms of field quantities. **(8)**

ii) The two point charges 10 μC and 2 μC are located at (1,0,5) and (1,1,0) respectively. Find the potential at (1,0,1), assuming zero potential at infinity. **(5)**

12. a) i) Derive the relationship between polarization and electric field intensity. **(7)**

ii) Derive the capacitance of a spherical capacitor. **(6)**

(OR)

b) i) Derive the boundary conditions of the tangential and normal components of electric field at the interface of two mediums with dielectrics. **(8)**

ii) If two parallel plates of area $4m^2$ are separated by a distance 6 mm, find the capacitance between these 2 plates. If a rubber sheet of 4 mm thick with $\varepsilon_r = 2.4$ is introduced in between the plates leaving a gap of 1 mm on both sides, determine the capacitance. **(5)**

13. a) i) Magnetic vector potential $\vec{A} = \frac{-\rho^2}{4}\vec{a}_z$ Wb/m, calculate the total magnetic flux crossing the surface $\phi = \frac{\pi}{2}, 1 \le \rho \le 2m, 0 \le z \le 5m.$ **(7)**

ii) $\vec{H} = 3\cos x\,\vec{a}_x + z\cos x\,\vec{a}_y$, A / m for $z \ge 0$ and $\vec{H} = 0$ for $z < 0$. This magnetic field is applied to a perfectly conducting surface in xy plane. Find current density on conductor surface. **(6)**

(OR)

b) i) Obtain the expression for magnetic field intensity at the centre of a circular wire. **(7)**

ii) At a point P(x,y,z) the components of vector magnetic potential $\vec{A}$ are given as Ax = 4x + 3y + 2z; Ay = 5x + 6y + 3z; Az = 2x + 3y + 5z. Find $\vec{B}$ at point P. **(3)**

iii) Explain the magnetic field intensity due to a straight wire. **(3)**

14. a) From the basic laws derive the time varying Maxwell's equation and explain the significance of each equation in detail. **(13)**

(OR)

b) i) State and derive poynting theorem. **(8)**

ii) Explain the transformer emf using Faraday's law. **(5)**

15. a) i) State and prove Poynting's theorem and give its physical interpretation. **(7)**

ii) Derive Maxwell's equations for time varying fields. **(6)**

(OR)

b) Derive the wave equation starting from Maxwell's equation for free. **(13)**

PART – C **(1×15=15 Marks)**

16. a) Summarize the concept of transformer and motional emf.

(OR)

b) Derive an expression of self-inductance and mutual inductance.