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Question Paper Code : 91402

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Fourth Semester

Electronics and Communication Engineering

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

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Stokes theorem and give its meaning.

2. A 15 nC point charge is at the origin in free space. Calculate V_1 if point P_1 is located at $P_1(-2,3,-1)$ and V = 0 at (6,5,4).

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. State point form of Ohm's law.

6. Find the magnetization in a magnetic material where $\mu = 1.8 \times 10^{-5}$ H/m and H=120 A/m.

7. State Poynting vector.

8. Maxwell's Second Equation is based on a famous law. What is it? Substantiate.

9. What is Uniform Plane Wave?

10. Define Brewster angle.

PART B — (5 × 16 = 80 marks)

11. (a) (i) State Gauss law and explain its applications. (6)

(ii) Three infinite uniform sheets of charge are located in free space as follows: 3 nC/m^2 at z = –4, 6 nC/m^2 at z = 1 and –8 nC/m^2 at z = 4. Find E at the points P_A(2,5,–5), P_B(4,2,–3), Pc(–1,–5,2) and P_D(–2,4,5). (6)

(iii) Point charges of 50 nC each are located at A(1,0,0) , B(–1,0,0), C(0,1,0) and D(0,–1,0) in free space. Find the total force on the charge at A. (4)

Or

(b) (i) Define Curl, Divergence and Gradient and state their meanings. (6)

(ii) Find the potential due to an electric dipole. (6)

(iii) Two uniform line charges, 8 nC/m each, are located at $x = 1$, $z = 2$ and at $x = -1$, $y = 2$ in free space. If the potential at the origin is 100 V, find V at P(4,1,3). (4)

12. (a) (i) Find H in rectangular components at P(2,3,4) if there is a current filament on the z axis carrying 8 mA in the a_z direction. Repeat if the filament is located at $x = -1$ and $y = 2$. Find H if both filaments are present. (6)

(ii) State Ampere's Circuital law and explain its applications. (6)

(iii) A filamentary conductor is formed into an equilateral triangle with sides of length / carrying current I. Find the magnetic field intensity at the center of the triangle. (4)

Or

(b) (i) State Lorentz force equation for a moving charge and explain its applications. (6)

(ii) Derive the expression for Torque on a loop carrying a current I. (10)

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) Derive Maxwell's equations from basic principles. (10)

(ii) Derive the expression for power flow in a co-axial cable. (6)

Or

(b) (i) Derive the expression for Poynting vector. (10)

(ii) Why is Ampere's circuital law modified? How is it modified? Substantiate. (6)

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.
