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Question Paper Code : 21392

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Third Semester

Electrical and Electronics Engineering

EE 2202/EE 34/EE 1201 A/10133 EE 303/080280017 – ELECTROMAGNETIC THEORY

(Regulation 2008/2010)

(Common to PTEE 2202 – Electromagnetic theory for B.E. (Part-Time) Second Semester Electrical and Electronics Engineering)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mention the sources of electromagnetic fields.

2. State the physical significance of curl of a vector field.

3. State the properties of electric flux lines.

4. A dielectric slab of flat surface with relative permittivity 4 is disposed with its surface normal to a uniform filed with flux density 1.5 C/m^2. The slab is uniformly polarized. Determine polarization in the slab.

5. Find the value of magnetic filed intensity at the centre of a circular loop of radius 1 m carrying a current of 10 A.

6. Write the expression for the magnetic force between an electromagnet and an armature to be attracted.

7. What type of voltage is induced in a loop which is rotating about the y-axis in a magnetic field of flux density $\vec{B}=B_0 \sin\omega t \vec{i}$ Tesla?

8. Write the relation showing the energy required to establish a magnetic field by a quasi-stationary current system.

9. What is 'Voltage reflection coefficient' at the load end of a transmission line?

10. Define 'Standing Wave Ratio'.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Describe the classification of vector fields. (6)

(ii) If $\vec{B}=y\vec{a}_x+(x+z)\vec{a}_y$ and a point Q is located at $(-2,6,3)$, express (1) the point Q in cylindrical and spherical coordinates, (2) $\vec{B}$ in spherical coordinates. (10)

Or

(b) Determine the divergence and curl of the following vector fields: (4 + 4 + 8)

(i) $\vec{P}=x^2yz\vec{a}_x+xz\vec{a}_2$

(ii) $\vec{Q}=\rho\sin\phi\vec{a}_\rho+\rho^2z\vec{a}_\phi+z\cos\phi\vec{a}_z$

(iii) $\vec{T}=\frac{1}{r^2}\cos\theta\vec{a}_r+r\sin\theta\cos\phi\vec{a}_\theta+\cos\theta\vec{a}_\phi$.

12. (a) (i) State and explain Coulomb's law and deduce the vector form of force equation between two point charges. (6)

(ii) At an interface separating dielectric $1(\varepsilon_{r1})$ and dielectric $2(\varepsilon_{r2})$, show that the tangential component of $\vec{E}$ is continuous across the boundary, whereas the normal component of $\vec{E}$ is discontinuous at the boundary. (10)

Or

(b) (i) A circular disc of radius 'a' m is charged uniformly with a charge density of ρ_s C/m^2. Find the electric potential at a point P distant 'h' m from the disc surface along its axis. (8)

(ii) Find the value of capacitance of a capacitor consisting of two parallel metal plates 30 cm × 30 cm surface area, separated by 5 mm in air. What is the total energy stored by the capacitor if the capacitor is charged to a potential difference of 1000V? What is the energy density? (8)

13. (a) Derive a general expression for the magnetic flux density B at any point along the axis of a long Solenoid. Sketch the variation of B from point to point along the axis. (16)

Or

(b) (i) For an infinite current sheet of uniform current density 'K' A/m, derive the expression for the magnetic field intensity. (6)

(ii) A coil has 1000 turns and carries a magnetic flux of 10 mWb. The resistance of the coil is 4Ω. If it is connected to a 40 V DC supply, estimate the energy stored in the magnetic field when the current has attained its final study value. Derive the formula used. (5 + 5)

14. (a) (i) A rectangular T-turn coil with mean length 'l' and width 'w' is wound on a cylindrical drum. If the drum rotates in a uniform field with a flux density B everywhere in the positive X-direction at a constant speed of N rpm, the axis being in alignment with Z-axis, develop an expression for induced emf in the coil. (6)

(ii) If the flux density varies harmonically with time as given by $B = B_0 \sin\omega t$, establish an expression for the induced emf in the above case. (10)

Or

(b) (i) Derive the differential form of time-harmonic Maxwell's equations. (10)

(ii) Show that the total displacement current between the condenser plates connected to an alternating current voltage source is exactly same as the value of charging current (conduction current) flowing in the leads. (6)

15. (a) Derive the EM wave equations in frequency domain and obtain the expressions for intrinsic impedance and propagation constants for free space, conductor and dielectric medium. (16)

Or

(b) (i) Explain how the rate of energy transportation by means of EM waves from one point to another point can be obtained from Maxwell's equations. (10)

(ii) A lossless transmission line has characteristic impedance of 70 Ω and phase constant of 3 rad/m at 100 MHz. Calculate the inductance / metre and the capacitance / metre length of the line. (6)
