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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Second/Third Semester

Electrical and Electronics Engineering

EE 6302 — ELECTROMAGNETIC THEORY

(Regulations 2013)

(Also Common to PTEE 6302 – Electromagnetic Theory B.E. (Part-Time) Second Semester – Electrical and Electronics Engineering – Regulations 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Coulomb's law.

2. Define Divergence and state its physical meaning.

3. State Poisson's equations.

4. State the electrostatic boundary conditions.

5. State Biot-Savart's law.

6. Distinguish between scalar and vector potential.

7. What is displacement current? What is the need for using that current?

8. What are the major differences between field theory and circuit theory?

9. What is Poynting vector? What does it denote?

10. Find out skin depth in copper, whose conductivity is 5.8×10^7 S/m and relative permeability is 1 at 10 GHz

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive the Electric field intensity due to discrete and continuous charges. (8)

(ii) A charge $Q_A = -20\,\mu C$ is located at A (–6,4,7) and a charge $Q_B = 50\,\mu C$ is at B (5,8,–2) in free space. (Distances are given in metres). Determine the vector force exerted on Q_A by Q_B. (5)

Or

(b) (i) Find electric field E at P(1,1,1) caused by four identical 3 nC (nanoCoulomb) charges located at P1(1,1,0), P2(–1,1,0), P3(–1,–1,0) and P4(1,–1,0). (7)

(ii) State Gauss's law. List out the applications of this law. (6)

12. (a) (i) Derive the relation for energy density of Capacitance. (7)

(ii) State and prove the boundary conditions for electrostatics. (6)

Or

(b) (i) Derive both Poisson's and Laplace's equations. (6)

(ii) What are dielectrics? Describe about dielectric polarization and dielectric strength. (7)

13. (a) (i) Derive the relation for magnetic field intensity (H) due to straight conductors. (7)

(ii) State and prove the boundary conditions for magnetostatics. (6)

Or

(b) (i) Derive the relation for energy density of inductance. (6)

(ii) Derive the relation for torque. (7)

14. (a) (i) Derive the Maxwell's equations in both integral and differential form. (7)

(ii) Using a circuit diagram, describe how a transformer functions. (6)

Or

(b) (i) Discuss how magneto-dynamics differ from magneto-statics. Discuss how Faraday's law finds application in a emf generation scenario. (6)

(ii) Compare and contrast field theory with circuit theory. Consider an antenna. How are its input signal and output signal measured (as a circuit quantity or field quantity)? Why? (7)

15. (a) (i) Derive wave equation from Maxwell's equations. (6)

(ii) Derive Poynting vector. (7)

Or

(b) Describe with related figures and expressions, plane wave reflection and refraction. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A 9375 MHz uniform plane wave is propagating in a material medium of $\varepsilon_r = 2.56$. If the amplitude of the electric field intensity of loss less medium is 500 V/m. Calculate phase constant, propagation constant, velocity, wavelength and intrinsic impedance.

Or

(b) A parallel plate capacitor with plate area of 5 cm^2 and plate seperation of 3 mm has a voltage $50 \sin 10^3 t$ V applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_0$.