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

Question Paper Code : 71449

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

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.

2. What is the relationship between electric scalar potential and electric field intensity?

3. What is magnetic vector potential?

4. State Lorentz force equation for a moving charge.

5. State Poisson's and Laplace's equations.

6. What is mutual inductance?

7. What is displacement current?

8. Define Poynting Vector.

9. What is skin effect?

10. What is Brewster angle?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A charge $Q_1 = 3 \times 10^{-4}$ C is at a point M(1,2,4) and a second charge $Q_2 = -10^{-4}$ C located at a point N(2,0,10) in vacuum. Find the force exerted on Q_2 by Q_1. (4)

(ii) Infinite uniform line charges of 5 nC/m lie along the x and y axes in free space. Find E at P_A (0, 0, 4) and at P_B(0, 3, 4). (4)

(iii) Derive an expression for Electric field on the axis of a uniformly charged circular disc. (8)

Or

(b) (i) Define divergence and curl. (4)

(ii) Derive an expression for potential due to electric dipole. (6)

(iii) State Gauss law and prove it. (6)

12. (a) (i) Find H in rectangular co-ordinates at P(2,3,4) if there is a current filament on the z axis carrying 8 mA in the a_z direction. (4)

(ii) Express Biot-Savart Law in vector form and describe it. (4)

(iii) State Ampere's circuital law and discuss about any two simple applications of it. (8)

Or

(b) (i) Derive an expression for Torque on a loop carrying a current I. (12)

(ii) Define magnetic flux density and magnetic moment. (4)

13. (a) (i) Derive the boundary conditions for electric fields. (8)

(ii) Derive the expressions for electrostatic energy and energy density. (8)

Or

(b) (i) State continuity equation for current and point form of ohm's law. (4)

(ii) Discuss in detail the nature of magnetic materials. (6)

(iii) A solenoid is 50cm long, 2 cm in diameter and contains 1500 turns. The cylindrical core has a diameter of 2 cm and a relative permeability of 75.This coil is coaxial with a second solenoid 50cm long, 3 cm in diameter and having 1200 turns. Calculate the inductance for the inner solenoid; find inductance of the outer solenoid; determine mutual inductance between the two solenoids. (6)

14. (a) (i) From basic principles, derive Maxwell's four equations in integral form and differential form. (12)

(ii) State the modified form of Ampere's circuital law. Why was it modified? Justify. (4)

Or

(b) (i) Derive expressions for Instantaneous, Average and Complex Poynting Vector. (12)

(ii) Interpret E × H. (4)

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

(ii) What is a Uniform Plane Wave? Derive the relation between E and H in a Uniform Plane Wave. (10)

Or

(b) (i) Discuss in detail with relevant expressions and figures, the concepts involved in reflection of plane waves by a perfect conductor at normal incidence. (10)

(ii) A uniform plane electromagnetic wave is inddent normally upon a sheet of dielectric material, which has the following constants: $\varepsilon=4\varepsilon_v, \mu=\mu_v, \sigma=0$. If the sheet is 2cm thick and the amplitude of the electric field strength of the incident wave is 100mv/m, determine the electric field strength of the wave after passing through the sheet, if the frequency is 3000 MHz; if the frequency is 30 Hz. Comment on the results. (6)