

B.Tech II Year II Semester (R20) Regular & Supplementary Examinations April/May 2024

ELECTROMAGNETIC FIELD THEORY

(Electrical & Electronics Engineering)

Time: 3 hours

Max. Marks: 70

PART – A
(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- (a) State Gauss law and its applications. 2M
 - (b) A point charge Q of 0.4 nC is located at the origin. Obtain the absolute potential at A (2, 2, 3). 2M
 - (c) List boundary conditions between two dielectric medium. 2M
 - (d) Determine the value of capacitance between two square plates cross sectional area 1 sq.cm separated by 1 cm placed in a liquid whose dielectric constant is 6. 2M
 - (e) State Ampere Circuital law. 2M
 - (f) Write the expression for the force on a moving charge. 2M
 - (g) What is Magnetic Scalar Potential? 2M
 - (h) Differentiate Self and Mutual Inductance. 2M
 - (i) State Faraday's law of Electromagnetic Induction. 2M
 - (j) State the formula for velocity of uniform plane wave and what is the velocity of uniform plane wave in free space? 2M

PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

- 2 A line $y = 1, z = 1$ carries a uniform charge of 2 nC/m, find potential at A (5, 0, 1) if $V = 0$ volts at (0, 0, 0). 10M

OR

- 3 (a) Derive Poisson's and Laplace equations. 6M
 (b) Determine electric field intensity at P (-0.2, 0, -2.3) m due to a point charge of +5 nC at Q (0.2, 0.1, -2.5) m in air. 4M

- 4 What is Capacitance? Derive the expression for the Capacitance of Parallel Plate Capacitor? 10M

OR

- 5 A pair of 200 mm long concentric cylindrical conductors of radii 50 mm and 10 mm, is filled with a dielectric with permittivity $\epsilon = 10\epsilon_0$. A voltage is applied between the conductors which establishes $E = \frac{10^6}{r} a_r$. Calculate Capacitance, Voltage applied and Energy stored? 10M

- 6 Find the magnetic flux density at the centre of a square sides equal to 5 cm carrying 10 amperes of current. 10M

OR

- 7 Derive an expression for the torque on a current loop placed in Magnetic Field. 10M

- 8 A coil with 5000 turns, $r_1 = 1.25$ cm, and $l_1 = 1$ m has a core with $\mu_r = 50$. A second coil of 500 turns, $r_2 = 2$ cm and $l_2 = 10$ cm is concentric with the first coil and the space between the coils is free space. Find the Mutual Inductance. 10M

OR

- 9 Derive the expression for energy stored and energy density in Static Magnetic Field. 10M

- 10 A lossy dielectric is characterised by $\epsilon_r = 2.5$, $\mu_r = 4$ and $\sigma = 10^{-3}$ at frequency of 10 MHz. Find attenuation constant, phase constant, velocity of propagation, wave length and intrinsic impedance. 10M

OR

- 11 State Pointing Theorem? Derive pointing vector from Pointing Theorem. 10M

B.Tech II Year II Semester (R20) Regular & Supplementary Examinations August/September 2023

ELECTROMAGNETIC FIELD THEORY

(Electrical & Electronics Engineering)

Time: 3 hours

Max. Marks: 70

PART – A

(Compulsory Question)

1 Answer the following: (10 X 02 = 20 Marks)

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| (a) Verify whether the potential field $V = \rho \cos \phi + 5z$ satisfies Laplace's equation? | 2M |
| (b) What is Potential Gradient? | |
| (c) Define Non-Polar molecules with an example. | 2M |
| (d) Describe about Energy Density in a Static Electric field. | 2M |
| (e) Write the statement of Stoke's theorem. | 2M |
| (f) What is Magnetic Dipole and Dipole Moment? | 2M |
| (g) Describe about Mutual Inductance. | 2M |
| (h) Define Scalar Magnetic potential. | 2M |
| (i) What is Statically Induced EMF? | 2M |
| (j) Write short notes on Intrinsic Impedance. | 2M |

PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

- | | |
|---|----|
| 2 (a) Discuss about the Force between two point charges according to Charles Augustus French physicist. | 5M |
| (b) Let $\rho_v = (3x + 4y + 2z) \text{ C/m}^3$ in the cubical region described by $0 \leq x, y, z \leq 3$ and the $\rho_v = 0$ outside the cube. Determine the total charge contained within the cube. | 5M |

OR

- | | |
|--|----|
| 3 (a) Explain and derive the Torque on an Electric Dipole in an Electric field. | 5M |
| (b) Discuss and derive the Capacitance of a Coaxial cable based on Laplace's equation. | 5M |
| 4 (a) State the boundary conditions for E and D at the boundary between two media of different permittivity. | 5M |
| (b) Describe briefly about the conduction current density and also derive $J = \sigma E$. | 5M |

OR

- | | |
|---|----|
| 5 (a) Derive the expression for the capacitance of a parallel plate capacitor. | 5M |
| (b) An Electric field from a medium whose relative permittivity is 7 passes into a medium of relative permittivity 2. If E makes an angle of 60° with the boundary normal, what angle does the field makes with normal in the second dielectric? | 5M |

- | | |
|---|----|
| 6 (a) State and discuss about Biot-Savart's law. | 5M |
| (b) Discuss and derive Force between two Straight and Parallel Current Carrying Conductors. | 5M |

OR

- | | |
|---|----|
| 7 (a) Derive Maxwell's equation $\text{Div}(\mathbf{B}) = 0$. | 5M |
| (b) Determine and discuss Magnetic Field Intensity and Magnetic Flux Density at a point on the axis of a solenoid of finite length. | 5M |

Contd. In Page 2

- 8 (a) Explain and determine the Self Inductance of a Long Solenoid. 5M
(b) Discuss and derive about Energy Stored in a Magnetic Field. 5M

OR

- 9 (a) Explain and determine the Self Inductance of a Toroid. 5M
(b) A toroidal coil of 500 turns is wound on a steel ring of 0.5 m mean diameter and $2 \times 10^{-3} \text{ m}^2$ cross sectional area. An excitation of 4000 Am^{-1} produces a flux density of 1T. Find the inductance of the coil. 5M

- 10 (a) Derive and explain about the Modified form of Maxwell's equation. 5M
(b) Deduce the equation of the propagation of the plane Electromagnetic Waves in free space. 5M

OR

- 11 (a) Derive and discuss about Maxwell's equation $\nabla \times E = -\frac{\partial B}{\partial t}$. 5M
(b) Write short notes on Wave Length, Skin Effect and Impedance of media. 5M
