MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

UG Model question paper-I

ELECTROMAGNETIC FIELDS

II YEAR I SEMESTER

EEE

Time: 3 hours **Max Marks: 60**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 10 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A (10 Marks)

1.a) What are the properties of potential function? [1]
b) What are the limitations of Coulomb's law? [1]
c) Define dipole and dipole moment. [1]
d) What is the capacitance of a parallel plate capacitor when the stored energy is 5 μJ and the voltage across the plates is 5 V? [1]
e) What are the limitations of Ampere's circuital law? [1]
f) State Boit-Savart's law. [1]
g) What is the significance of Lorentz force equation in magnetic fields? [1]
h) A solenoid with air core has 2000 turns and a length of 500 mm. Core radius is 40 mm. Find its inductance. [1]
i) Write the Maxwell's equations in integral form for time varying fields. [1]
j) What is meant by statically induced e.m.f? [1]

PART- B (50 Marks)

SECTION-I

2.a) Derive the expression for electric field intensity due to line charge.
b) Four concentrated charges $Q_1 = 0.3\ \mu C$, $Q_2 = 0.2\ \mu C$, $Q_3 = -0.3\ \mu C$, $Q_4 = 0.2\ \mu C$ are located at the vertices of a plane rectangle. The length of rectangle is 5 cm and breadth of the rectangle is 2 cm. Find the magnitude and direction of resultant force on Q_1. [5+5]

(OR)

3.a) Explain the Laplace and Poisson's equations for electrostatic fields.
b) Using Gauss law, derive an expression for electric field intensity at any point inside and outside of a sphere of radius 'a' due to a uniform spherical charge distribution of volume charge density of 'ρ'. [5+5]

SECTION-II

4.a) Derive the expression for energy stored and energy density in static electric field.
b) A parallel plate capacitor consists of two square metal plates of side 500 mm and separated by a 10 mm slab of Teflon with $\epsilon_r = 2$ and 6 mm thickness is placed on the lower plate leaving an air gap of 4mm thick between it and upper plate. If 100 V is applied across the capacitor, find D, in Teflon and air. [5+5]

OR

5.a) State and prove the conditions on the tangential and normal components of electric flux density and electric field intensity, at the boundary between the dielectrics.
b) A square parallel plate capacitor 200 mm on side with a plate spacing of 25 mm is filled with a dielectric slap (ε_r =240 of the same dimensions if 100 V is applied to the capacitor) Find: (i) the polarization P in the dielectric and (ii) the energy stored by the capacitor.

[5+5]

SECTION-III

6.a) State Biot-Savart's law for magnetic field B due to a steady line current in free space.

b) Derive an expression for magnetic field intensity due to infinite sheet of current. [5+5]

OR

7.a) A steady current of 10 A is established in a long straight hollow aluminum conductor having inner and outer radius of 1.5 cm and 3 cm respectively. Find the value of B as function of radius

b) Derive an expression for the magnetic field strength at the center of a square loop of side 'a' meters and N turns. [5+5]

SECTION-IV

8.a) Derive point form of Ampere's circuital law.

b) Two infinitely long parallel conductors are separated by a distance '*d*'. Find the force per unit length exerted by one of the conductor on the other if the currents in the two conductors are I_1 and I_2. [7+7]

OR

9.a) Derive the expression for inductance of a solenoid.

b) A single-phase circuit comprises two parallel conductors A and B, each 1 cm diameter and spaced 1 meter apart. The conductors carry currents of +100 and -100 amperes respectively. Determine the magnetic field intensity at the surface of each conductor and also exactly midway between A and B. [7+7]

SECTION-V

10.a) A conductor with cross sectional area of 10 cm^2 carries a conduction current of $0.2 \sin(109t)$ mA. Given that $\sigma = 2.5 \times 10^6$ S/m and $\varepsilon_r = 6$, calculate the magnitude of the displacement current density.

b) Derive the Maxwell's equations in point and integral form for time varying fields. [7+7]

OR

11.a) Explain the concept of displacement current and obtain an expression for the displacement current density.

b) Derive Maxwell's fourth equation, $\nabla \times E = -\frac{\partial B}{\partial t}$. [7+7]

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UG Model question paper-II
ELECTROMAGNETIC FIELDS
II YEAR I SEMESTER EEE

Time: 3 hours **Max Marks:60**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 10 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A (10 Marks)

1.a) State the expression for the force between one charge point to an array of a charge points? [1]
b) State and explain Gauss's law. [1]
c) Give ohms law in point form. [1]
d) Brief about the concept of Polarization in materials. [1]
e) Define Ampere's circuital law and its applications. [1]
f) Obtain Maxwell's second equation. [1]
g) Derive Expression for Vector Magnetic Potential. [1]
h) Write the applications of Permanent Magnets. [1]
i) State Faraday's law of Electromagnetic induction. [1]
j) What is displacement current? Explain. [1]

PART- B (50 Marks)

SECTION-I

2.a) Three equal positive charges of 4×10^{-9} coulomb each are located at three corners of a square, side 20cm. determine the electric field intensity at the vacant corner point of the square.
b) State and explain Maxwell's first law. [5+5]

OR

3.a) What is an electric dipole? Obtain expression for torque experienced by an electric dipole in a uniform electric field.
b) Derive the expression for Potential gradient. [5+5]

SECTION-II

4.a) Derive the expression for the energy stored in the charged condenser.
b) The capacitance of a parallel plate condenser is 0.2μF. Potential difference between the plates is 2V. Calculate the energy stored by the charged condenser. [5+5]

OR

5.a) Differentiate static electric and magnetic fields.
b) Derive Equation of continuity. What is its significance? [5+5]

SECTION-III

6.a) Find the Magnetic Field Intensity due to a straight current carrying filament.
b) Find the magnetic field intensity at the centre O of a square loop of sides equal to 5M and carrying 10A of current. [5+5]

OR

7.a) State Ampere's circuital law and prove the same.
b) In the region 0 < r < 0.5m, in cylindrical co-ordinates, the current density is $J = 4.5e^{-2r}\hat{a}_z\left(A/m^2\right)$ and J = 0 elsewhere. Use Amperes law to find H [5+5]

SECTION-IV

8.a) Derive an expression for magnetic field strength H, due to a current carrying conductor of finite length placed along the y-axis, at a point P in x-z plane and r distant from the origin.

b) What is scalar magnetic potential? Give its limitations. [5+5]

OR

9.a) A toroid with cross section of radius 2cm has a silicon steel core of mean length 28cm and an air gap of length 1mm. Assume the air-gap area is 10% greater than the adjacent core and find the mmf required to establish an air-gap flux of 1.5 mwb.

b) Explain the concept self and mutual inductances. [5+5]

SECTION-V

10. Write Maxwell's equation for static fields. Explain how they are modified for time varying electric and magnetic fields. [10]

OR

11.a) Generalize Ampere's law for time varying fields.

b) In a material for which $\sigma = 5.0$ s/m and $\in r = 1$, the electric field intensity is E = 250 Sin1010t (V/m). Find the conduction and displacement current densities and the frequency at which they have equal magnitudes. [5+5]

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UG Model question paper-III

ELECTROMAGNETIC FIELDS

II YEAR I SEMESTER

EEE

Time: 3 hours **Max Marks: 60**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 10 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A (10 Marks)

1.a) What is Maxwell's First Law? [1]
b) Derive the relationship between potential and electric field intensity. [1]
c) Justify that electric field is conservative. [1]
d) Define current density. Write the relation between current and current density. [1]
e) What is the fundamental difference between static electric and magnetic field lines?
f) A long straight wire carries a current I = 1 amp. At what distance is the magnetic field
H= 1A/m. [1]
g) Mention the limitations of scalar magnetic potential. [1]
h) A solenoid has an inductance of 20 mH. If the length of the solenoid is increased by two times and the radius is decreased to half of its original value, find the new inductance. [1]
i) What is the significance of displacement current? [1]
j) Derive Maxwell's equation derived from Ampere's law. [1]

PART- B (50 Marks)

SECTION-I

2.a) Determine the potential a (0,0,4) m caused by a total charge 10^{-8} C distributed uniformly along a disc of radius 4m lying in the z=0 plane and centered at origin.
b) Define work done and electric potential. Show that the electric field intensity is negative gradient of potential. [5+5]

OR

3.a) Find the value of electric field intensity at any point along the axis of a uniformly charged disc.
b) State Gauss law and mention few applications of it. [5+5]

SECTION-II

4.a) What is an electric dipole and dipole moment? Derive an expression for torque experienced by an electric dipole.
b) A parallel plate capacitor has conducting plates of area equal to $0.04m^2$. The plates are separated by a dielectric material whose $\epsilon_r = 2$ with the plate separation of 1cm. Find its capacitance value. [5+5]

OR

5.a) Derive the boundary conditions of two dielectric media.
b) Explain about equation of continuity in electrostatic fields. [5+5]

SECTION-III

6.a) Using ampere's circuital law, find MFI due to an infinite sheet of current.
b) What is the magnetic field, H in Cartesian coordinates due to z- directed current element? Find **J** if I=2A.

OR

7.a) What is meant by Curl? Give its significance.
b)A steady current of I amperes flow in a circular bent in the form of square loop of side 'a'. Find the MFI (H) at the center of the loop. [5+5]

SECTION-IV

8.a) Find the force between two straight long and parallel current carrying conductors in the same and opposite directions.

b) Explain the concept of scalar and vector magnetic potentials. [5+5]

OR

9.a) Find the inductance of Solenoid.

b) Derive the expression for energy stored and energy density in a magnetic field. [5+5].

SECTION-V

10.Write Maxwell's equations in point form and explain physical significance of the equations. [10]

OR

11.a) State and explain the Faraday's laws in electromagnetic induction.

b)Explain statically and dynamically induced e.m.fs. . [5+5]

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UG Model question paper-IV

ELECTROMAGNETIC FIELDS

II YEAR I SEMESTER EEE

Time: 3 hours **Max Marks: 60**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 10 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A (10 Marks)

1.a) Write the properties of potential function. [1]

b) What is Maxwell's first law? [1]

c) Define electric dipole. [1]

d) Define Convection and conduction current densities. [1]

e) Define Magnetic field intensity. [1]

f) Write the applications of Ampere's circuital law. [1]

g) Write the vector Poisson's equation. [1]

h) What are the applications of permanent magnets? [1]

i) Define time varying fields. [1]

j) How dynamically induced EMF is produced? [1]

PART- B (50 Marks)

SECTION-I

2.a) If V=2x2y+20z-(4/(x2+y2)) Volts, Find ***E*** and ***D*** at P (6,-2.5,3)
b) Derive Laplace and Poisson equation. [5+5]

OR

3.a) A circular disc of radius 'a' m is charged uniformly with a charge density of σ c/ m^2. Find the electric field at a point 'h' m from the disc along its axis.
b) What is an electric dipole? Obtain expression for torque experienced by an electric dipole in a uniform electric field. [5+5]

SECTION-II

4.a) Show the expression of the capacitance for a spherical capacitor consists of 2 concentric spheres of radius 'a'&'b' also obtain the capacitance for an isolated sphere.
b) Find the capacitance of a conducting sphere of 2 cm in diameter, covered with a layer of polyethelene with $\in r = 2.26$ and 3 cm thick. [5+5]

OR

5.a) Derive an expression for capacitance of co-axial cable.
b) In a material for which σ = 5.0 s/m and $\in$ r = 1, the electric field intensity is E = 250 Sin1010t (V/m). Find the conduction and displacement current densities.

SECTION-III

6.a) Using Biot-Savart's law, find the magnetic field intensity on the axis of a circular loop with radius R and carrying a steady current I.

b) Find the magnetic field intensity at the centre of square loop of side 5m carrying 10A of current. [5+5]

OR

7.a) State Ampere's circuital law and explain any two applications of Ampere's circuital law.

b) Derive the equation to show that curl of magnetic field intensity in equal to current density. [5+5]

SECTION-IV

8.a) Show that the force between two parallel conductors carrying current in the same direction is attractive.

b) A magnetic field, $B = 3.5 \times 10^{-2}$along the x-axis. If the conductor current is 5 A in the $-A_x$ direction, what force must be applied to hold the conductor in position. [5+5]

OR

9.a) Derive the expression for self inductance of a coaxial cable of inner radius 'a' and outer radius 'b'.

b) Determine the inductance of a solenoid of 2500 turns wound uniformly over a length of 0.25m on a cylindrical paper tube, 4 cm in diameter and the medium is air. [5+5]

SECTION-V

10.a) Write Maxwell's equations in integral form for time varying Fields.

b) Generalize Ampere's law for time varying fields. [5+5]

OR

11.a) State and explain Faraday's laws of electromagnetic induction.

b) In a material for which $\sigma = 5.0$ s/m and $\in r = 1$, the electric field intensity is E = 250 Sin1010t (V/m). Find the conduction and displacement current densities, and the frequency at which they have equal magnitudes. [5+5]