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Question Paper Code	XXXXX
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M.E. / M.Tech. / B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

3rd Semester

Electrical and Electronics Engineering

24EEPC301– Electromagnetic Fields

Regulation - 2024

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

	Marks	K- Level	CO
1. Which theorem would you apply to evaluate the integral of a vector field around a closed loop? a) Gauss's theorem b) Green's theorem c) Stokes' theorem d) Fourier's theorem	1	K1	CO1
2. Which of the following are the Human-made sources of electromagnetic fields? a) vacuum cleaners b) hair-dryers c) refrigerators d) All of the mentioned	1	K1	CO1
3. What is the value of total electric flux coming out of a closed surface? a) Equal to the total charge enclosed by the surface. b) Equal to the surface charge density. c) Equal to volume charge density. d) Zero	1	K1	CO2
4. An infinite sheet of charge has a uniform surface charge density σ . What is the direction of the electric field above the sheet? a) Radially inward b) Radially outward c) Parallel to the surface d) Zero electric field	1	K1	CO2
5. What is the direction of the magnetic field at the center of a circular current-carrying loop? a) Tangential to the loop. b) Radial to the loop. c) Perpendicular to the plane of the loop. d) Parallel to the plane of the loop.	1	K1	CO3
6. What does Biot-Savart's Law enable one to calculate? a) The magnetic field created by a moving charged particle. b) The force between two parallel conductors. c) The inductance of a closed circuit. d) The capacitance between two plates	1	K1	CO3
7. Maxwell's equations unified which of the following aspects of physics? a) Electricity and Magnetism b) Gravity and Motion c) Thermodynamics and Optics d) Kinetics and Potential Energy	1	K1	CO4
8. Which component is essential for the functioning of magnetic circuits but not electrical circuits? a) Resistor b) Capacitor c) Core material d) Inductor	1	K1	CO4
9. In which medium do electromagnetic waves travel the fastest? a) Vacuum b) Water c) Glass d) Air	1	K1	CO5
10. The human body model (HBM) is used for a) Measuring inductance b) Simulating ESD Event c) Measuring capacitance of IC's d) Testing Battery performance	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11. State the conditions for a vector A to be (a) solenoidal (b) irrotational.	2	K2	CO1
12. Infer the two vectors $A=3\vec{ax}+\vec{ay} - 5\vec{az}$ and $B= \vec{ax} + \vec{ay} - \vec{az}$ are perpendicular to each other.	2	K2	CO1
13. Choose relation between electric field intensity and potential?	2	K3	CO2

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| 14. Identify the force of interaction between two charges 4×10^{-8} and 8×10^{-5} spaced 10cm apart in kerosene($\epsilon_r = 2$). | 2 | K3 | CO2 |
| 15. State Faraday's law of electromagnetic induction. | 2 | K2 | CO3 |
| 16. Find the value of magnetic field intensity at the centre of a circular loop of radius 1m carrying a current of 10 A. | 2 | K1 | CO3 |
| 17. Compare between the conduction current and displacement current. | 2 | K2 | CO4 |
| 18. Write the point form of continuity equation and explain its significance. | 2 | K1 | CO4 |
| 19. State Snell's law. | 2 | K2 | CO5 |
| 20. Write the wave equation in a conducting medium. | 2 | K1 | CO5 |
| 21. What is magnetic levitation? | 2 | K1 | CO6 |
| 22. List out application of RF MEMS. | 2 | K1 | CO6 |

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

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| 23. a) Make use of the divergence theorem, Solve where $F=2xy a_x + y^2 a_y + 4yz a_z$ and S is the surface of the cube bounded by $x=0, x=1; y=0, y=1; \text{ and } z=0, z=1$. | 11 | K3 | CO1 |
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| b) Identify and Transform a rectangular coordinate vector $A=4a_x - 2a_y + 3 a_z$ into a cylindrical and spherical coordinate system at point P (1,-3,2) | 11 | K3 | CO1 |
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| 24. a) Analyze the electric field intensity at a point P distant 'h' m from an infinite line of uniform charge ρ_1 C/m using gauss's law. | 11 | K4 | CO2 |
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| b) A circular disc of 10 cm radius is charged uniformly with a total charge $10\mu\text{C}$. Analyze the electric field at a point 30 cm away from the disc along the axis | 11 | K4 | CO2 |
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| 25. a) Apply the Bio- Savart's law to derive the expression for magnetic field intensity on the axis of solenoid at a) entering point of the solenoid b) center of the solenoid. | 11 | K3 | CO3 |
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| b) Develop an expression for boundary conditions in magnetic fields B and H at the plane interface between two media. | 11 | K3 | CO3 |
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| 26. a) Compare electrical circuit theory and magnetic field theory. | 11 | K4 | CO4 |
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| b) Analyze and develop the Maxwell's equations in point form and integral form using Ampere's circuital law and electric gauss's law. | 11 | K4 | CO4 |
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| 27. a) Simplify the electromagnetic wave equation for free space in terms of electric field and magnetic field | 11 | K4 | CO5 |
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| b) Analyze from Maxwell equation, derive the integral form of poynting theorem for an arbitrary volume bounded by surface. | 11 | K4 | CO5 |
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| 28. a) Apply the working principle of RF MEMS switches and RF based communication systems. | 11 | K3 | CO6 |
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| b) Demonstrate how wireless power transfer can be applied to charge electric vehicles. | 11 | K3 | CO6 |
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Knowledge Level:

K - Level	K1	K2	K3	K4	K5	K6	Total
Marks	20	10	70	66	-	-	166
Marks %	12.04	6.02	42.17	39.76	-	-	100

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create