Shree Sathyam
College of Engineering and Technology
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.
NH-544, Salem - Coimbatore Highways, Kuppanur, Sankari Taluk, Salem - 637301, TamilNadu, India.
Email : principal@shreesathyam.edu.in Web : www.shreesathyam.edu.in Phone : 04283 - 244080

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

PROGRAMME	:	B.E. - EEE
ACADEMIC YEAR	:	2024-2025
SEMESTER	:	III (ODD)
REGULATION	:	2021
COURSE CODE	:	EE3301
COURSE NAME	:	ELECTROMAGNETIC FIELDS
COURSE COMPONENT	:	CORE
NAME OF THE COURSE IN-CHARGE	:	Ms.ELAVARASI S

UNIT I ELECTROSTATICS – I

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

Assessment Questions for UNIT I

Bloom's Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6- Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 &L4, HOTS – L5 &L6

Sl. No.	Questions	Marks	CO	BL	PI Code
PART A					
1	Mention the sources of electromagnetic fields	2	CO1	L3	1.3.1
2	How are the unit vectors defined in cylindrical coordinate systems?	2	CO1	L1	1.4.1
3	Define Curl.	2	CO1	L1	1.2.1
4	State the physical significance of curl of a vector field	2	CO1	L1	1.3.1
5	What is the physical significance of divergence of a vector field?	2	CO1	L1	1.4.1
6	State the conditions for a vector A to be [a] solenoidal [b] irrotational.	2	CO1	L1	1.3.1
7	State Stoke's theorem	2	CO1	L1	2.1.2

8	Define Divergence	2	CO1	L1	4.1.2
9	State Coulomb's law of electrostatic charges.	2	CO1	L1	1.3.1
10	State the properties of electric flux lines.	2	CO1	L1	1.3.1
11	What is meant by equipotential surface?	2	CO1	L1	1.4.1
12	Electric field is conservative field. Justify	2	CO1	L1	1.2.1
13	What is the use of Gauss -law?	2	CO1	L1	1.3.1
14	Define vector and scalar field. Give an example.	2	CO1	L1	1.4.1
15	Why Gauss law cannot be applied to determine the electric field due to finite line charge?	2	CO1	L1	1.3.1
16	List the properties of gradient of a scalar.	2	CO1	L1	2.1.2
17	What is Electric field intensity?	2	CO1	L1	1.3.1
18	Obtain the Cartesian coordinate system the gradient of the function:f(r,Θ,z)=$5r^4z^3\sin\Theta$.	2	CO1	L6	1.4.1
19	What is gradient?	2	CO1	L1	1.2.1
PART B					
1	Determine curl of these vector fields. $P = x^2 yz\vec{a}_x + xz\vec{a}_z$ $Q = \rho \sin\phi \vec{a}_\rho + \rho^2 z\vec{a}_\phi + z \cos\phi \vec{a}_z$ $T = 1/r^2 \cos\theta\, a_r + r \sin\theta \cos\phi\, a_\theta + \cos\theta\, a_\phi$	13	CO1	L3	2.1.2
2	Find the gradient of scalar $V= e^{-z} \sin 2x \cosh y$ $U= \rho^2 z \cos 2\phi$ $W = 10r \sin^2 \theta \cos\phi$	13	CO1	L3	2.3.2
3	Determine the electric field intensity at P[-0.2, 0, - 2.3] due to a point charge of + 5nC at Q[0.2, 0.1, -2.5] in air. All dimensions are in meters	13	CO1	L13	2.1.2
4	Given point P [–1, 4, 3] and vector $A = ya_x + (x + z)a_y$ express P and A in cylindrical and spherical	13	CO1	L3	2.1.2

	coordinates. Evaluate A at P in the Cartesian and spherical systems				
5	Determine divergence and curl of the vector $A = x^2\ ax + y^2\ ay + z^2\ az$	13	CO1	L6	2.3.2
6	Write short notes on the following 1.Gradient 2.Divergence 3.Curl	13	CO1	L1	2.1.2
7	Transform the vector $A = 4ax - 2ay - 4az$ at P[x=+2,y=+3,z=4] to spherical coordinate	13	CO1	L3	2.1.2
8	Given point P(-2,6,3) and $A = yi + (x + z)\ j$ express P and A in cylindrical coordinates	13	CO1	L3	2.3.2
PART C					
1	Using Divergence theorem, evaluate $\iint F.nds$ where $F = 2xyi + y^2\ j + 4\ yzk$ and S is the surface of the cube bounded by x=0,x=1,y=0,y=1 and z=0,z=1	15	CO1	L3	2.1.2
2	Verify divergence theorem for the following case $A = xy^2\ a + y^3\ a + y^2\ za$ and the surface is cuboid defined by 0<x<1,0<y<1,0<z<1	15	CO1	L3	2.3.2
3	Derive Electric field intensity by applying Gauss‟s law to an [i] infinite line charge and [ii]infinite sheet of charge	15	CO1	L6	2.1.2
4	Three point charges in free space are located as follows: 50nC at (0,0) m: 40nC at(3,0) m; -60 nC at (0,4) m. Find the electric field intensity at (3,4) m	15	CO1	L3	2.1.2
5	with neat diagrams ,explain the spherical system with co-ordinates (R,ɵ,ɸ)	15	CO1	L3	2.3.2

UNIT II ELECTROSTATICS – II

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization –Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson’s and Laplace’s equations, Capacitance, Energy density, Applications..

Assessment Questions for UNIT II

Bloom’s Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6- Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 & L4, HOTS – L5 & L6

Sl. No.	Questions	Marks	CO	BL	PI Code
PART A					
1	Define Electric Potential	2	CO2	L1	1.3.1
2	What are the significant physical differences between Poisson’s and laplace’s equations	2	CO2	L1	1.4.1
3	Define electric field.	2	CO2	L1	1.2.1
4	Mention any two properties of electric field lines.	2	CO2	L3	1.3.1

5	Give the relationship between potential gradient and electric field.	2	CO2	L1	1.4.1
6	What is an equipotential surface?	2	CO2	L1	1.3.1
7	What is an electric flux and define electric flux density.	2	CO2	L1	2.1.2
8	State the applications of Poisson's equation and Laplace's equation.	2	CO2	L1	4.1.2
9	Define Polarization in dielectric material.	2	CO2	L1	1.3.1
10	Write the expression for the energy density in electrostatic field.	2	CO2	L1	1.3.1
11	What is dielectric polarization?	2	CO2	L1	1.4.1
12	Obtain Poisson's equation from Gauss's law.	2	CO2	L6	1.2.1
13	Define Dielectric strength.	2	CO2	L1	1.3.1
14	State expression the electric field intensity due to infinite line charge.	2	CO2	L1	1.4.1
15	Draw the equipotential lines and electric fields for a parallel plat capacitor?	2	CO2	L4	1.3.1
16	Define electric dipole and dipole moment.	2	CO2	L1	2.1.2
17	State Poisson's equation and Laplace equation for simple medium.	2	CO2	L6	1.3.1
18	What is capacitor and capacitance?	2	CO2	L1	1.4.1
19	Define electric potential and potential different difference	2	CO2	L1	1.3.1
PART B					
1	Determine the capacitance of concentric cylinders with mixed dielectrics	13	CO2	L3	4.2.1
2	State how the capacitance of a parallel plate capacitor is related to the plate area and plate separation. Determine the capacitance for plates of area 20 cm^2 and separation 8.854 mm. Calculate the electric potential between the plates, the electric field in the region between the plates and the energy stored when the charge of the capacitor is 44.27 nC.	13	CO2	L3	4.2.1
3	Derive expression for electric field intensity between two infinitely conducting plane	13	CO2	L6	2.4.1

4	Derive the boundary conditions at the interface of two dielectric media	13	CO2	L6	1.3.1
5	Determine the capacitance of concentric cylinders with mixed dielectrics	13	CO2	L3	2.1.2
6	Derive Poisson‟s and Laplace equation	13	CO2	L6	4.1.2
7	Derive expression for capacitance of a parallel plate capacitor having three dielectric media.	13	CO2	L6	1.3.1
8	Derive expression for electric field intensity and potential at any point due to a charged circular disc	13	CO2	L6	1.3.1
	PART C				
1	Using Gauss‟s law, obtain an expression for the electric field due to an infinitely long straightuniformly charged conductor	15	CO2	L3	4.2.1
2	Derive expression for electric field intensity between two infinitely conducting plane	15	CO2	L6	4.2.1
3	Using Gauss‟s law, obtain an expression for the electric field due to uniformly charged circular disc of σ col/m^2	15	CO2	L3	2.4.1
4	Conducting spherical shells with radii a = 10cm and b = 30 cm are maintained at a potential difference of 100V such that V[r = b] = 0 and V[r = a] =100. Determine V and E in the region between the shells	15	CO2	L3	2.4.1
5	Find the potential at r_A=5 m with respect to r_B=15 m due to point charge Q=500pC at the origin and zero reference at infinity	15	CO2	L3	4.1.1

UNIT III - MAGNETOSTATICS

Lorentz force, magnetic field intensity (H) – Biot–Savart’s Law - Ampere’s Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson’s Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

Assessment Questions for UNIT III

Bloom’s Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6- Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 & L4, HOTS – L5 & L6

Sl. No.	Questions	Marks	CO	BL	PI Code
	PART A				
1	What is the force on a charge, moving in a uniform magnetic field?	2	CO3	L1	1.3.1
2	What is the force experienced by a current carrying element in a uniform magnetic field?	2	CO3	L1	1.4.1
3	Give the relation between Magnetic flux and Flux density.	2	CO3	L5	1.2.1

4	State Lorentz’s law of force.	2	CO3	L1	1.3.1
5	Define Magnetic flux density.	2	CO3	L1	1.4.1
6	State Biot-Savart’s law.	2	CO3	L1	1.3.1
7	State Ampere’s law for a magnetic field	2	CO3	L1	2.1.2
8	What is the force between two current carrying conductors?	2	CO3	L1	4.1.2
9	What is the magnetic field at any point due to a infinitely long conductor carrying current?	2	CO3	L1	1.3.1
10	What is the magnetic field at the centre of the circular coil carrying current?	2	CO3	L1	1.3.1
11	Write down the equation for general form, integral form and point form of the ampere’slaw.	2	CO3	L1	1.4.1
12	Give the similarities between Electrostatic field and Magnetic field.	2	CO3	L3	1.4.1
13	State Ampere’s Circuital law. Must the path of integration be circular?	2	CO3	L1	1.4.1
14	State the expression for H due to infinite sheet of current	2	CO3	L1	1.4.1
15	State the expression for [i] energy stored in magnetic density and [ii] energy density inmagnetic field	2	CO3	L1	1.4.1
16	Define magnetic moment	2	CO3	L1	1.4.1
17	Write down the magnetic boundary condition.	2	CO3	L1	1.4.1
18	Compare magnetic scalar potential and vector potential.	2	CO3	L5	1.4.1
PART B					
1	State and Explain BiotSavart‟s law	13	CO3	L3	4.2.1
2	Obtain the expression for energy stored in magnetic field and also derive an expression formagnetic energy density	13	CO3	L6	4.2.1
3	Give the statement for Ampere‟s circuital law and give the expression for it.	13	CO3	L3	2.4.1
4	Two narrow circular coils A and B have the common axis and are placed 15cm apart coil has 10 turns of radius 5cm	13	CO3	L3	1.3.1

	with a current of 2A passing through it. Coil B has a single turn of radius 8cm. If the magnetic field at the centre of the coil A is to be zero what current must be passed through the coil B.				
5	Define Self Inductance and Mutual Inductance and show that $M = k\sqrt{L1\ L2}$.	13	CO3	L1	2.1.2
6	Find the maximum torque on 85 turn rectangular coil 0.2m by 0.3m carrying current of 2.0A in afield B=6.5T?	13	CO3	L4	4.1.2
7	Explain the classification and magnetization of magnetic materials.	13	CO3	L2	1.3.1
8	Determine H for a solid cylindrical conductor of radius a, where the current I is uniformly distributed over the cross section	13	CO3	L6	1.3.1
PARTB					
1	Derive the expression for the magnetic vector potential in the cases of an infinitely long, strainghtconductor in free space	15	CO3	L6	4.2.1
2	Derive the expression for magnetic field intensity at any point due to infinite straightconductor	15	CO3	L6	4.2.1
3	Consider the boundary between two media .show that the angles between the normal to theboundary and the magnetic flux densities on either side of the boundary satisfy the relation: $\tan\Theta 1 / \tan\Theta 2 = \mu 1 / \mu 2$. Where $\mu 1$ and $\mu 2$ are the permeabilities of the respective media and $\Theta 1$ and $\Theta 2$ are the angles	15	CO3	L3	2.4.1
4	State and prove magnetostatic boundry conditions.	15	CO3	L3	2.4.1

UNIT IV ELECTRODYNAMIC FIELDS

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications..

Assessment Questions for UNIT IV

Bloom's Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6- Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 & L4, HOTS – L5 & L6

Sl. No.	Questions	Marks	CO	BL	PI Code
PART A					
1	State Maxwell's equation I and II.	2	CO4	L1	1.4.1
2	State Faraday's law of electromagnetic induction.	2	CO4	L1	1.3.1
3	Mention the Maxwell's equation in phasor form.	2	CO4	L3	2.1.2
4	.Explain why $\nabla X B=0$?	2	CO4	L2	4.1.2
5	Explain why $\nabla X E=0$?	2	CO4	L2	1.3.1

6	Explain why ∇.D=0.?	2	CO4	L2	1.3.1
7	Mention the significance of displacement current. Write the Maxwell's equation in which it isused	2	CO4	L1	1.4.1
8	Differntiate transformer and motional emf.	2	CO4	L5	1.2.1
9	What is meant by displacement current?	2	CO4	L1	1.3.1
10	What is dissipation factor?	2	CO4	L1	1.4.1
11	How does displacement current differ form conventional current?	2	CO4	L1	1.3.1
12	Give the important equation that provide a connection b/w field and cicurit theory?	2	CO4	L3	2.1.2
13	What are the significant displacement current?	2	CO4	L1	1.4.1
14	Write the relation showing the energy required to establish a magnetic field by a quasi-stationary current system.	2	CO4	L1	1.3.1
15	Define 'dynamic emf' or 'motional emf'	2	CO4	L1	2.1.2
16	State any major difference between circuit theory and field theory	2	CO4	L4	1.4.1
	PART 6				
1	Derive Maxwell‟s Equation in Point form and Integral form	13	CO 4	L6	4.2.1
2	Derive Maxwell‟s equation for Time Varying Fields in Phasor form	13	CO 4	L6	4.2.1
3	Derive Maxwell‟s Equation for Free Space and for Conductor	13	CO 4	L6	2.4.1
4	Discuss the relation between Circuit Theory and Field Theory	13	CO 4	L1	1.3.1
5	Explain the concept of emf induction in static and time varying magnetic field	13	CO 4	L1	2.1.2
6	Derive the differential form of time harmonic Maxwell equation	13	CO 4	L6	4.1.2
7	An iron ring with a cross sectional area 3cm^2 and a mean circumfrance of 15cm^2 is wound with 250 turns of wire carrying a current of 0.3 A.the relative permeability of the	13	CO 4	L3	1.3.1

	ring is 1500. Calculate the flux established in the ring.				
PART C					
1	Derive Maxwell‟s equation from Ampere‟s law, Faraday‟s law and Gauss law	15	CO4	L6	4.2.1
2	Explain and detail about the difference between the conduction and displacement currents	15	CO4	L2	4.2.1
3	Describe the applications where circuit theory and field theory is used and applications,wherefield theory is used	15	CO4	L2	2.4.1
4	Explain briefly about transformer and motional EMFs	15	CO4	L2	2.4.1

UNIT V ELECTROMAGNETIC WAVES

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

Assessment Questions for UNIT V

Bloom's Taxonomy Levels: L1- Remember, L2- Understand, L3- Apply, L4 - Analyze, L5- Evaluate, L6- Create

Thinking Skills: LOTS – L1 &L2, IOTS – L3 & L4, HOTS – L5 & L6

Sl. No.	Questions	Marks	CO	BL	PI Code
PART A					
1	Define Wave.	2	CO5	L1	1.4.1
2	Mention the properties of uniform plane wave	2	CO5	L1	1.3.1
3	Define skin depth or depth of penetration	2	CO5	L1	2.1.2
4	Define linear polarization	2	CO5	L1	1.4.1
5	Define circular polarization	2	CO5	L1	1.3.1
6	Define elliptical polarization	2	CO5	L1	2.1.2
7	Define poynting vector	2	CO5	L1	4.1.2
8	Write down the expression for instantaneous power flow in electromagnetic field andinstantaneous pointing vector.	2	CO5	L1	1.3.1
9	What is complex poynting vector	2	CO5	L1	1.3.1
10	State Slepian vector.	2	CO5	L1	1.4.1
11	State poynting theorem.	2	CO5	L1	1.3.1
12	State snell's law	2	CO5	L1	1.4.1
13	Define Brewster angle.	2	CO5	L1	1.3.1

14	Define surface impedance.	2	CO5	L1	2.1.2
15	Mention the expression for plane electromagnetic waves propagating in a dielectric media in a direction x with respect to origin [0,0,0]	2	CO5	L3	4.1.2
16	Define skin depth	2	CO5	L1	1.4.1
17	Define standing wave ratio.	2	CO5	L1	1.3.1
18	What is loss tangent?	2	CO5	L1	2.1.2
PART B					
1	Derive the electromagnetic wave equation	13	CO5	L6	4.2.1
2	Derive the wave equation for magnetic field in phasor form	13	CO5	L6	1.4.1
3	Explain about the wave incidence obliquely on perfect conductor	13	CO5	L2	4.2.1
4	Briefly explain about the wave incidence normally on perfect conductor	13	CO5	L2	4.2.1
5	Derive Poynting vector and state its significance.	13	CO5	L6	2.4.1
6	Derive the relationship between electric field and magnetic field. Derive the wave equation for the magnetic field in phasor form	13	CO5	L6	2.4.1
7	Discuss phase velocity and propagation constant of electromagnetic waves	13	CO5	L1	4.1.1
PART C					
1	Derive the equation of propagation of the plane electromagnetic waves in free space, conductors and dielectrics	15	CO5	L6	4.2.1
2	Derive the Poynting theorem and give its significance	15	CO5	L6	4.2.1
3	Derive the expression for an intrinsic impedence, propagation constant and velocity of a plane Electromagnetic wave when propagated in a perfect medium conducting media and good conductor	15	CO5	L6	2.4.1
4	Describe the concept of electromagnetic wave propagation in a linear and lossy dielectric medium.	15	CO5	L2	2.4.1

Prepared by **Course in-Charge**	**Verified by** **HoD**	**Approved by** **PRINCIPAL**