INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

Department of Electrical and Electronics Engineering

TUTORIAL QUESTION BANK

Course Name	**:**	**ELECTROMAGNETIC FIELDS THEORY**
Course Code	**:**	**AEE006**
Class	**:**	**B. Tech III Semester**
Branch	**:**	**Electrical and Electronics Engineering**
Year	**:**	**2018 – 2019**
Course Coordinator	**:**	**Mr. T Anil Kumar, Assistant Professor, EEE**
Course Instructors	**:**	**Mr. T. Anil Kumar, Assistant Professor, EEE** **Mr. B. Muralidhar Nayak, Assistant Professor, EEE**

COURSE OBJECTIVES:

The course should enable the students to:

I	Demonstrate the concept of electrostatic field intensity and electric potential.
II	Illustrate polarization of dielectrics and the behavior of conductors and dielectrics in an electric field.
III	Understand the concept of field intensity and flux density in magnetic fields.
IV	Discuss forces in magnetic fields and laws of electromagnetic induction.
V	Understand the concept of time varying field and apply numerical methods to electro-statics and magnetic fields.

COURSE LEARNING OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

CAEE006.01	Analyze the force and electric field intensity in the electrostatic field.
CAEE006.02	Identify the characteristics of electrostatic fields in terms of definitions.
CAEE006.03	State different laws which defines characteristics of electrostatic fields.
CAEE006.04	Illustrate polarization of dielectrics and the behavior of conductors and dielectrics in electric field.
CAEE006.05	Demonstrate the electric dipole and its effect on electric field.
CAEE006.06	Estimate the capacitance of parallel plates, spherical and coaxial capacitors with composite dielectrics.
CAEE006.07	Summarize the concept of magneto static and interrelate the terms of magnetic fields.
CAEE006.08	Interpret the magnetic field intensity due to circular, square and solenoid current carrying wire.
CAEE006.09	Use Ampere circuital law to determine magnetic field intensity due to an infinite sheet of current, a long current carrying filament and its applications.

CAEE006.10	Predict the force due to moving charge in the magnetic field for different configuration of current carrying conductor.
CAEE006.11	Demonstrate the magnetic dipole and its effect on magnetic field.
CAEE006.12	Calculate the self inductance and mutual inductance for different configurations of wires and applications of permanent magnet.
CAEE006.13	State the Faraday's laws of electromagnetic induction and nature of voltage induced in the coil.
CAEE006.14	Derive and explain the differential and integral form of Maxwell's equation in time varying fields and fields varying harmonically with time.
CAEE006.15	Discuss the different numerical methods to calculate the electrostatic and magneto-static fields.
CAEE006.16	Apply the concept of electromagnetic and electrostatic fields to solve real time world applications.
CAEE006.17	Process the knowledge and skills for employability and to succeed national and international level competitive examinations.

S. No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes
UNIT - I INTRODUCTION TO ELECTROSTATICS			
PART – A (SHORT ANSWER QUESTIONS)			
1	Write the mass of electron and proton.	Remember	CAEE006. 02
2	State coloumb's law.	Remember	CAEE006. 03
3	Define electric field.	Remember	CAEE0060.2
4	Explain force between two charges due to electric field.	Understand	CAEE006. 01
5	Define electric field intensity.	Remember	CAEE006. 01
6	Write the expression for electric field intensity on n charge.	Remember	CAEE006. 01
7	Write the expression for electric field intensity on line charge.	Remember	CAEE006. 01
8	Write the expression for electric field intensity on surface charge.	Remember	CAEE006. 01
9	State Guass law.	Remember	CAEE006. 03
10	Write any three applications of Guass law.	Understand	CAEE006. 03
11	Give the work done on point charge.	Remember	CAEE006. 01
12	Define potential difference.	Remember	CAEE006. 02
13	Write the Poisson's equation	Remember	CAEE006. 03
14	State Maxwell's curl equation.	Remember	CAEE006. 03
15	Define potential gradient.	Remember	CAEE006. 02
16	Write laplace's equation.	Remember	CAEE006. 03

17	Give the importance of elecro-statics.	Understand	CAEE006. 02
18	Define electric flux density.	Remember	CAEE006. 02
PART – B (LONG ANSWER QUESTIONS)			
1	Explain COLOUMB's law.	Understand	CAEE006. 03
2	Derive the expressions for electric field intensity due to line and surface charge distribution.	Understand	CAEE006. 01
3	Prove the divergence of flux density is equal to volume charge density.	Understand	CAEE006. 03
4	Derive the POISSON's and LAPLACE's equations.	Understand	CAEE006. 03
5	State and prove Guass law	Understand	CAEE006. 03
6	Explain the concept of electric field intensity and derive potential gradient.	Understand	CAEE006. 01
7	Derive the expressions for electric field intensity and work done on point charge.	Understand	CAEE006. 01
8	Explain the MAXWELL's curl equation for static electric field.	Understand	CAEE006. 03
9	Give the solution of laplace equation in spherical co-ordinates.	Understand	CAEE006. 03
10	Give the solution of laplace equation in cylindrical co-ordinates.	Understand	CAEE006. 03
11	Give the solution of laplace equation in rectangular co-ordinates.	Understand	CAEE006. 03
12	Explain electric field, electric field intensity and electric field due to incharge.	Understand	CAEE006. 01
PART – C (ANALYTICAL QUESTIONS)			
1	A charge Q2 = $121*10^{-9}$ C is located in vaccum at P2(-0.03,0.01,-0.04)m. Find force on Q2 due to Q1 = 100μC at P1(0.03,0.08,0.02)m	Understand	CAEE006. 01
2	Determine the potential at (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.	Understand	CAEE006. 01
3	Three equal point charges of 2μC are in free space at (0,0,0,), (2,0,0,) and (0,2,0) respectively. Find net force on Q4 = 5μC at (2,2,0).	Understand	CAEE006. 01
4	Calculate electric field E at point P(3,-4,2) in free space caused by A) a charge Q1 = 4μC at N1(0,0,0) . B) a charge Q2 = 2μC at N2(-1,2,4).	Understand	CAEE006. 01
5	Find the work done in moving a point charge 5μC from (4,π,0) to (6,π,0) in the field of Vector(E) = 10^6 /p ap + 10^4 /p az	Understand	CAEE006. 01
6	Given a field Vector(E) = $(-6y/x^2)$ax + (6/x)ay + 5 az v/m. calculate the potential difference VAB given A(-7,2,1) and B(4,1,2).	Understand	CAEE006. 01
UNIT – II CONDUCTORS AND DIELECTRICS			
PART – A (SHORT ANSWER QUESTIONS)			
1	Explain di-pole.	Understand	CAEE006. 05
2	Define dipole moment.	Remember	CAEE006. 05

3	Write the expression for electric potential due to dipole.	Remember	CAEE006. 05
4	Write the expression for electric field due to dipole.	Remember	CAEE006. 05
5	Write the expression for torque on electric dipole.	Remember	CAEE006. 05
6	Define capacitor and write its importance.	Remember	CAEE006. 06
7	What is the property of capacitor and write the expression for it?	Remember	CAEE006. 06
8	Write the capacitance of isolated sphere.	Remember	CAEE006. 06
9	Write the capacitance of spherical sphere.	Remember	CAEE006. 06
10	Write the capacitance of between parallel plates.	Remember	CAEE0060.6
11	Write the capacitance of between parallel plates with two dielectrics.	Remember	CAEE006. 06
12	Write the capacitance of co-axial cable.	Remember	CAEE006. 06
13	Write the expression for energy stored in capacitor.	Remember	CAEE006. 06
14	Write the expression for energy density in a static electric field.	Remember	CAEE006. 06
15	Define conductor.	Remember	CAEE006. 04
16	Define insulator.	Remember	CAEE006. 04
17	Give the importance of polarization.	Understand	CAEE006. 04
18	Expression for dielectric polarization.	Remember	CAEE006. 04
19	Define dielectric constant.	Remember	CAEE006. 04
20	Define current density.	Remember	CAEE006. 04
21	State conduction current density.	Remember	CAEE006. 04
22	Write point form of ohm's law.	Remember	CAEE006. 04
PART – B (LONG ANSWER QUESTIONS)			
1	Explain electric dipole and dipole moment.	Understand	CAEE006. 05
2	Derive the expression for electric potential due to dipole.	Understand	CAEE006. 05
3	Derive the expression for electric field due to dipole.	Understand	CAEE006. 05
4	Derive the expression for torque on an electric dipole in an electric field.	Understand	CAEE006. 05
5	Explain the element capacitor properties and its importance.	Understand	CAEE006. 06
6	Derive the expression for capacitance between parallel plate.	Understand	CAEE006. 06
7	Derive the expression for capacitance of the spherical condenser.	Understand	CAEE006. 06
8	Fine the capacitance of a two concentric spherical shells.	Understand	CAEE006. 06
9	Derive the expression for capacitance of the cylindrical condenser.	Understand	CAEE006. 06
10	Derive the expression for capacitance between parallel plate with two dielectrics.	Understand	CAEE006. 06

11	Derive the expression for energy stored in capacitor.	Understand	CAEE006. 06
12	Obtain the expression for energy density in a static electric field.	Understand	CAEE006. 06
13	Derive the expression for energy stored in parallel plate capacitor.	Understand	CAEE006. 06
14	Derive the expression for equation of continuity.	Understand	CAEE006. 04
15	Derive the point form of ohm's law.	Understand	CAEE006. 04
16	Explain polarization and charge density.	Understand	CAEE006. 04
17	Derive the expression for Guass law in dielectrics.	Understand	CAEE006. 04
PART – C (ANALYTICAL QUESTIONS)			
1	Calculate the capacitance of a parallel plate capacitor with the following details: Plate area = 150 cm^2, dielectric $€_{r1}$ = 5, d_1 = 3 mm, $€_{r2}$ = 4, d_2 = 4 mm. If 220V is applied across plates, what will be the voltage gradient across each dielectric?	Understand	CAEE006. 06
2	Predict the capacitance of a capacitor of two parallel plates 30cm by 30cm, separated by 5mm in air. Calculate the energy stored by the capacitor if it is charged to a potential difference of 500V?	Understand	CAEE006. 06
3	The capacitance of the capacitor formed by two parallel plates, each 100cm^2 in area separated by a dielectric 2mm thickness is $2*10^{-4}$. A potential difference of 20KV is applied. Determine Total dielectric flux in coloumbs The potential gradient in KV/m. The relative permeability of the material.	Understand	CAEE006. 06
4	The capacitance of the capacitor formed by two parallel plates, each 50cm^2 in area separated by a dielectric 1 mm thickness are. if 100 micro joules of energy required to increase the distance between the plates to 3 mm, calculate the initial and final voltage across the plates. Assume perfect insulation.	Understand	CAEE006. 06
5	The capacitance of the capacitor formed by two parallel plates, each 1.5m^2 in area separated by a dielectric 5 mm thickness. There are two dielectrics in between the plates. The first dielectric has a thickness of 3mm with a relative permeability of 6 and second dielectric has a thickness of 2mm with a relative permeability of 4. Calculate capacitance and derive formula used.	Understand	CAEE006. 06
UNIT – III MAGNETOSTATICS			
PART – A (SHORT ANSWER QUESTIONS)			
1	Explain the magnetic flux.	Understand	CAEE006. 07
2	Define magnetic flux density.	Remember	CAEE006. 07
3	Define magnetic flux intensity.	Remember	CAEE006. 07
4	Write the relation between magnetic flux density and intensity.	Remember	CAEE006. 07
5	What is the property of permeability in the magnetic circuit?	Understand	CAEE006. 07

6	Define intensity of magnetization.	Remember	CAEE006. 07
7	Define K.	Remember	CAEE006. 07
8	Write the relation between B, H, I and I.	Remember	CAEE006. 07
9	State Biot-savart's law	Remember	CAEE006. 07
10	Write the expression for magnetic field intensity of entire conductor.	Remember	CAEE006. 08
11	Write the expression for magnetic field intensity of solenoid.	Remember	CAEE006. 08
12	Write ampere's circuital law.	Remember	CAEE006.09
13	Write H and B of toroid.	Remember	CAEE006. 08
14	Write the expression for magnetic flux.	Remember	CAEE006.07
15	Write the expression for magnetic field intensity of a long current carrying conductor.	Remember	CAEE006. 08
16	Write the ampere's circuital law in differential form.	Remember	CAEE006.09
17	Write the ampere's circuital law in integral form.	Remember	CAEE006.09
18	Write the applications of ampere's circuital law	Understand	CAEE006.09
19	Write the MAXWELL's third equation.	Remember	CAEE006.09
20	Calculate the magnetic flux density at the center of a current carrying loop when the radius of loop is 2cm, loop current is 1mA and loop is placed in air.	Understand	CAEE006.07
PART – B (LONG ANSWER QUESTIONS)			
1	Define magnetic induction, magnetic field, magnetic flux ensity, magnetic field intensity, permeability and magnetic susceptibility.	Remember	CAEE006.07
2	State and explain Bio-Savart's law.	Understand	CAEE006.07
3	Using Bio-Savart's law, find the expression for magnetic field intensity due to a long current carrying conductor.	Understand	CAEE006.07
4	Using Bio-Savart's law, find the expression for magnetic field intensity at any point on the axis of a circular current carrying coil.	Understand	CAEE006.07
5	Using Bio-Savart's law, find the expression for magnetic field intensity due to a circular current loop.	Understand	CAEE006.07
6	Derive the expression for maxwell's second equation.	Understand	CAEE006. 08
7	Using Bio-Savart's law, find the expression for magnetic field intensity inside a long solenoid carrying current I.	Understand	CAEE006.07
8	Show that the magnetic field intensity at the end of solenoid is half of that in middle.	Understand	CAEE006. 08
9	Derive the expression for maxwell's third equation.	Understand	CAEE006. 08

10	State and explain ampere's circuital law.	Understand	CAEE006.09
11	Explain any two applications of ampere's circuital law.	Understand	CAEE006.09
12	Determine the magnetic field intensity using ampere's circuital law due to an infinite sheet of current.	Understand	CAEE006.09
13	Determine the magnetic field intensity using ampere's circuital law due to long current carrying conductor.	Understand	CAEE006.09
PART – C (ANALYTICAL QUESTIONS)			
1	A circular coil of radius 1of 1.5cm carries a current 1.5A, if the coil has 25 turns , find the field at the center.	Understand	CAEE006. 08
2	A steady current I amperes flows in a conductor bent in the form of circular. Find the magnetic field at the center of the loop.	Understand	CAEE006. 08
3	A steady current I amperes flows in a conductor bent in the form of square loop of side a. Find the magnetic field at the center of the loop.	Understand	CAEE006. 08
4	A uniform solenoid 100mmbin diameter and 400mm long has 100 turns of wire and a current of I = 3A . fid the magnetic field on the axis of the solenoid a) at the center b) at on end c) half the way.	Understand	CAEE006. 08
5	A current of 1A is flowing in a circular coil of radius 10cm and 20 turns. Calculate the intensity of magnetic field at a distance 10cm on the axis of the coil and at the centre.	Understand	CAEE006. 08
5	The magnitude of H at a radius of 1m from a long linear conductor is 1A/m. Determine current in the wire.	Understand	CAEE006. 08
6	Calculate the magnetic flux density at the center of a current carrying loop when the radius of loop is 2cm, loop current in 1mA and loop is paced in air.	Understand	CAEE006. 08
7	A current of 1A is flowing in a circular coil of radius 10cm and 20 turns. Calculate the intensity of magnetic field at a distance 10cm on the axis of the coil and at the centre.	Understand	CAEE006. 08
UNIT – IV FORCE IN MAGNETIC FIELD AND MAGNETIC POTENTIAL			
PART – A (SHORT ANSWER QUESTIONS)			
1	Write the Lorentz force equation.	Remember	CAEE006.10
2	Write the expression for force on straight current carrying conductor in an magnetic field.	Remember	CAEE006.10
3	Write the expression for force between two straight long and parallel current carrying conductors.	Remember	CAEE006.10
4	Write the expression for force on infintely long current carrying conductor in an magnetic field.	Remember	CAEE006.10
5	Write the expression for induced emf.	Remember	CAEE006.12
6	Write the transformer induction equation.	Remember	CAEE006.12
7	Write the expression for motional induced emf.	Remember	CAEE006.12
8	Write the expression for torque on a current loop placed in a magnetic field.	Remember	CAEE006.10

9	Write the field form of Ampere's law.	Remember	CAEE006.11
10	Express the magnetic field intensity in terms of scalar magnetic potential.	Remember	CAEE006.11
11	Where the concept of scalar magnetic potential is valid?	Understand	CAEE006.11
12	Express magnetic flux density in terms of magnetic potential.	Remember	CAEE006.11
13	Express poisson's equation in magnetic.	Remember	CAEE006.11
14	Write scalar poisson's equations.	Remember	CAEE006.11
15	Give the self inductance of a solenoid.	Remember	CAEE006.12
16	Give the self inductance of a toroid.	Remember	CAEE006.12
17	Write the Neumann's formula for mutual inductance.	Remember	CAEE006.12
18	Write the expression for energy stored in magnetic field.	Remember	CAEE006.12
19	Write the expression for energy density in a magnetic field.	Remember	CAEE006.12
PART – B (LONG ANSWER QUESTIONS)			
1	Explain the motion of charged particle in magnetic field.	Understand	CAEE006.10
2	Derive the expression for Lorentz force equation.	Understand	CAEE006.10
3	Derive the expression for force on straight current carrying conductor in an magnetic field.	Understand	CAEE006.10
4	Derive the expression for force between two current carrying conductors in an magnetic field.	Understand	CAEE006.10
5	Derive the expression for the torque on a current loop placed in a magnetic field.	Understand	CAEE006.10
6	Explain the concept of scalar and vector magnetic potential.	Understand	CAEE006.11
7	Derive the expression for vector magnetic potential, A which satisfies the vector poisson's equation.	Understand	CAEE006.11
8	Define and explain self and mutual inductance.	Understand	CAEE006.12
9	Derive the expression of self-inductance of solenoid.	Understand	CAEE006.12
10	Derive the expression of self-inductance of toroid.	Understand	CAEE006.12
11	Derive the expression for mutual inductance M.	Understand	CAEE006.12
12	Derive the expression for energy stored and energy density in a magnetic field.	Understand	CAEE006.12
PART – C (ANALYTICAL QUESTIONS)			
1	Derive an expression for H at the centre of a circular wire carrying a current I in the anti-clockwise direction. The radius of the circle is a and the wire is in xy plane.	Understand	CAEE006.11
2	A circular coil of radius 1of 1.5cm carries a current 1.5A, if the coil has 25 turns, find the field at the center.	Understand	CAEE006.10

3	Two long parallel conduction carrying 100A. If the conductors are separated by 200mm. Find the force per meter of each conductor if the current flow direction is in opposite direction.	Understand	CAEE006.12
4	Two coils A and B with 800 turns and 1200 turns respectively, have a common magnetic circuit. A current of 0.5A in A will produce a flux of 3mwb and 80% of the flux links with coil B. calculate self inductance of each coil and mutual inductance.	Understand	CAEE006.12
5	What is the maximum torque on a square loop of 100 turns in a field of uniform flux density B = 1wb/mt2. The loop has 10cm side and carries a current of 3A. What is the magnetic moment of the loop?	Understand	CAEE006.12
6	A toroidal coil of 500 turns is wound on a steel ring of 0.5m. Mean diameter and $2*10^{-2}$ m^2 cross sectional area. An excitation of 4000A/m produces a flux density of 1 tesla. Compute the inductance of the coil. If a 10mm long gap is cut in the ring, determine the current required to maintain the flux density at 1 tesla. Also find the inductance under these new conditions.	Understand	CAEE006.12
7	Two mutually coupled coils are connected in series with L1 = 0.5H, L2 = 0.6H and M = 0.1H. , current flowing through it is increasing at rate of 1A/sec. Derive the expression for voltage induced in coils i) When they in series aiding connection. ii) When they in series opposite connection.	Understand	CAEE006.12
8	A solenoid with 300 turns is 300 mm long and 30mm in diameter. If the current is 500mA. Calculate i) Inductance ii) Energy stored in solenoid. Assume μr = 1.	Understand	CAEE006.12

UNIT – V
TIME VARYING FIELDS AND FINITE ELEMENT METHOD

PART – A (SHORT ANSWER QUESTIONS)

1	State faraday's law of electro-magnetic induction.	Remember	CAEE006.13
2	Write the expression for emf induced.	Remember	CAEE006.13
3	Write the MAXWELL's equations for static fields.	Remember	CAEE006.14
4	Write the MAXWELL's equations for static fields in integral form.	Remember	CAEE006.14
5	Write the MAXWELL's equations for time varying fields.	Remember	CAEE006.14
6	Write the MAXWELL's equations for time varying fields in integral form.	Remember	CAEE006.14
7	Write the MAXWELL's equations for hormonically varying fields.	Remember	CAEE006.14
8	Write the MAXWELL's equations for time hormonically fields in integral form.	Remember	CAEE006.14
9	Write the expression for statically induced emf.	Remember	CAEE006.13
10	Write the expression for dynamically induced emf.	Remember	CAEE006.13
11	Write the expression for displacement current density.	Remember	CAEE006.13
12	Write the expression for induced emf from Faraday's disc generator.	Remember	CAEE006.13
13	Give the importance of finite difference method.	Remember	CAEE006.15

14	Give the importance of finite element method.	Remember	CAEE006.15
15	Give the importance of charge simulation method.	Remember	CAEE006.15
16	Give the importance of boundary element method.	Remember	CAEE006.15
PART – B (LONG ANSWER QUESTIONS)			
1	Explain the Faraday's law of electro-magnetic induction and derive the expression for induced emf.	Understand	CAEE006.13
2	Derive the expression for one of the Maxwell's equation.	Understand	CAEE006.14
3	Explain about induced emf and derive the expression for statically and dynamically induced emf.	Understand	CAEE006.13
4	Derive the expression from modified Ampere law.	Understand	CAEE006.14
5	Explain Faraday's Disc Generator with neat sketch and derive the expression for induced emf.	Understand	CAEE006.13
6	Explain the complete concept of displacement currents.	Understand	CAEE006.14
7	Write and explain differential and integral form of Maxwell's equation.	Understand	CAEE006.14
8	Write and explain differential and integral form of Maxwell's equation for fields varying harmonically with time	Understand	CAEE006.14
9	Explain and Give the importance of finite difference method.	Understand	CAEE006.15
10	Explain and Give the importance of finite element method.	Understand	CAEE006.15
11	Explain and Give the importance of charge simulation method.	Understand	CAEE006.15
12	Explain and Give the importance of boundary element method.	Understand	CAEE006.15
PART – C (ANALYTICAL QUESTIONS)			
1	A square loop of wire 25cm * 25cm is placed in an alternating field with the maximum intensity of 1A/m. If the plane of the loop is perpendicular to the magnetic field and varying at a frequency of 10MHz. Find induced enf in the loop.	Understand	CAEE006.14
2.	Determine the conduction and displacement current densities in a material having conductivity of 10^{-3} s/m and €r = 2.5 if the electric field in material is , E = $5.8*10^{-6}$ sin($9.0*10^{9}$t) V/m.	Understand	CAEE006.14
3	A conductor of length 100cm moves at right angles to a uniform field of strength 10000 lines per cm^2 , with a velocity of 50 meters/sec. Calculate the emf induced in it. Compute also the value of the induced emf when the conductor moves at an angle of 30 degrees to the direction of the field.	Understand	CAEE006.14
4	In a material for which σ = 5.0$(\Omega m)^{-1}$ and σr = 1 the electric field intensity is E = 250sin (10^{10}t) V/m. Calculate the conduction and displacement current densities and the frequency at which they have equal magnitudes.	Understand	CAEE006.14

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