ELECTROMAGNETIC FIELD THEORY (SEMESTER - 4)

CS/B.TECH (EE-N)/SEM-4/EE-402/09

1. .....
Signature of Invigilator

2. ..... **Reg. No.**
Signature of the Officer-in-Charge

Roll No. of the Candidate

CS/B.TECH (EE-N)/SEM-4/EE-402/09

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

ELECTROMAGNETIC FIELD THEORY (SEMESTER - 4)

Time : 3 Hours] [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

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Marks Obtained

	Group – A										Group – B			Group – C				
Question Number																	***Total Marks***	***Examiner's Signature***
Marks Obtained																		

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Head-Examiner/Co-Ordinator/Scrutineer

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GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) The electric field on equipotential surface is

a) unity

b) always parallel to the surface

c) always perpendicular to the surface

d) zero. ☐

ii) Electric field in a region containing space charges can be found using

a) Laplace's equation

b) Poisson's equation

c) Coulomb's law

d) Helmholtz equation. ☐

iii) Electrostatic field is

a) solenoidal

b) conservative

c) both solenoidal & conservative

d) sometimes solenoidal, sometimes conservative. ☐

iv) The integral $\oint \vec{E} \cdot \vec{d}\rho = 0$, if the electric field $\vec{E}$ is caused by

a) a static change

b) a time varying magnetic field

c) both (a) and (b)

d) none of these. ☐

v) In good conductors, the phases of $\vec{E}$ and $\vec{H}$ differ by

a) 0° b) 45°

c) 90° d) 180°. ☐

vi) One weber is equal to

a) 10^{6} lines b) 44×10^{-7} lines

c) 10^{12} lines d) 10^{8} lines. ☐

vii) Two thin parallel wires carry currents along the same direction. The force experienced by one due to the other is

a) parallel to the lines

b) perpendicular to the lines and attractive

c) perpendicular to the lines & repulsive

d) zero. ☐

viii) The magnetic field at any point on the axis of a current carrying circular coil will be

a) perpendicular to the axis

b) parallel to the axis

c) at an angle 45° with axis

d) zero. ☐

ix) To apply Gauss's law, the Gaussian surface should be chosen in such a way that field is

a) perpendicular

b) tangential

c) either perpendicular or tangential

d) parallel to the surface.

x) Gradient of a scalar function results in a

a) vector function b) scalar function

c) peak function d) periodic function.

xi) At the boundary of two media of permeability μ_1 and μ_2, the boundary condition satisfied is

a) the normal component of the magnetic field strength $\vec{H}$ is continuous

b) the normal component of the flux density $\vec{B}$ is continuous

c) the tangential component of flux density $\vec{B}$ is continuous

d) the tangential component of the magnetic field strength $\vec{H}$ is continuous.

xii) The continuity equation for steady current is

a) $\nabla \cdot \vec{J} + \frac{\partial Q_V}{dt} = 0$ b) $\nabla \cdot \vec{J} = 0$

c) $\frac{\partial Q_V}{dt} = 0$ d) $\nabla \times \vec{J} = 0$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following questions. $3 \times 5 = 15$

2. Derive an expression for electric field $\vec{E}$ due to surface (sheet) charge uniformly distributed over an infinite plane having density ζ_s c/m^V .

3. State and explain the following :

   a) Strokes theorem

   b) Helmholtz's theorem.

4. Deduce boundary condition of electric field for Dielectric-Dielectric boundary.

5. Deduce an expression for magnetic field intensity $\vec{H}$ due to an infinitely long current carrying conductor carrying current *I*. Use Biot-Savart law.

6. Derive an expression for Lorentz force on a moving charge in an electromagnetic field.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following questions. 3 × 15 = 45

7. a) What are conduction and displacement currents ?

   b) From the concept of displacement current derive an expression for modified Ampere's law.

   c) Write and explain differential and integral forms of Maxwell's equations.

   3 + 5 + 7

8. a) A plane polarized wave is travelling along *Z*-axis. Show graphically the variation of $\vec{E}$ and $\vec{H}$ with *Z*. Show that $\frac{E_y}{H_z}$ = 377 Ω for the wave.

   b) Develop the analogy between the uniform plane EM waves and the electric transmission line.

   c) A uniform transmission line has constants *R* = 12 m Ω, *G* = 0·8 $\mu\ \Omega^{-1}$ /m, *L* = 1·3 μH/m and *C* = 0·7 nF/m. At 5 kHz, find (i) impedance, (ii) dB attenuation in 2 km. 6 + 5 + 4

9. a) Establish the relation $\nabla \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$. The symbol used has usual meaning.

   b) What do you mean by linearly polarized plane E.M. waves in free space ?

   c) What do you mean by depth of penetration in such medium ? If the penetration depth is 1·35 m at 50 Hz, what will this be at 10 kHz ? 6 + 4 + 5

10. a) Write down general procedure for solving Poisson's and Laplace's equation.

b) Deduce an expression of energy density in electrostatic field.

c) What is meant by the following :

i) Transformer and motional *e.m.f.*

ii) Electric potential and potential gradient. 5 + 5 + (3 + 2)

11. a) Find *curl H* at the origin, where $H = 2Y\ \vec{i}_x - (x^2 + z^2)\ \vec{i}_y + 3y\ \vec{i}_z$.

b) Show that

i) $\nabla \times (f G) = \nabla f \times G + f \nabla \times G$

ii) $\nabla \times (\nabla \times F) = \nabla (\nabla . F) - \nabla^2 F$.

c) It is required to hold four equal point charges + q each in equalibrium at the corners of a square. Find the point charge which will do this if placed at the centres of the square.

dia

5 + 5 + 5

END