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BTECH
(SEM III) THEORY EXAMINATION 2024-25
ELECTROMAGNETIC FIELD THEORY

TIME: 3 HRS

M.MARKS: 100

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt *all* questions in brief.

2 x 10 = 20

Q no.	Question	CO	Level
a.	Convert the point (2,6,3) into a spherical coordinate system.	CO1	K ₂
b.	Compute the gradient of the scalar field $f(x, y, z) = x^2 + y + z$ at point (2,0,1).	CO1	K ₂
c.	List the type of charge distribution with examples.	CO2	K ₂
d.	Describe how $\vec{E} = -\nabla V$, where E and V denote electric field and electric potential respectively.	CO2	K ₂
e.	Define Lorentz's law of force.	CO3	K ₁
f.	State that the $\oint B \cdot ds$ is zero in a static magnetic field	CO3	K ₁
g.	Describe magnetic moment.	CO4	K ₂
h.	State ampere's circuital law in a static magnetic field.	CO4	K ₁
i.	Explain the physical significance of the Poynting vector.	CO5	K ₂
j.	A conductor of 1m length is moved with a velocity of 100 m/sec perpendicular to a field of 1 Tesla. Compute the value of e.m.f induced.	CO5	K ₂

SECTION B

2. Attempt any *three* of the following:

10 x 3 = 30

Q no.	Question	CO	Level
a.	Given vector field $\vec{G} = 8\sin\phi a_r$ is in spherical coordinate, modify it into the cylindrical and rectangular coordinate system.	CO1	K ₃
b.	Determine the electric field in space due to charged finite length wire having uniform charge density.	CO2	K ₃
c.	Explain Biot-Savart's law for magnetic fields. How can this concept be used to determine the magnetic field in space due to a closed-loop current-carrying wire?	CO3	K ₄
d.	Verify that magnetostatic energy is given by $W_n = \frac{1}{2} \int \mu H^2 dv$	CO4	K ₅
e.	Determine the solution of the plain wave equation in a conducting medium. (lossy dielectric)	CO5	K ₃

SECTION C

3. Attempt any *one* part of the following:

10 x 1 = 10

Q no.	Question	CO	Level
a.	Derive the Gauss divergence theorem.	CO1	K ₃
b.	Examine the gradient of any scalar V and divergence and curl of any vector \vec{A} in different co-ordinate systems	CO1	K ₃



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4. Attempt any *one* part of the following:

10 x 1 = 10

Q no.	Question	CO	Level
a.	A potential field in free space is expressed as, $V = \frac{60 \sin \theta}{r^2}$ volt. Determine the electric flux density and hence the volume charge density at the point ($r=3\text{m}$, $\theta = 60^\circ$, $\phi = 25^\circ$) in spherical coordinates.	CO2	K ₃
b.	Explain the concept of energy stored and energy density in static electric field.	CO2	K ₄

5. Attempt any *one* part of the following:

10 x 1 = 10

Q no.	Question	CO	Level
a.	Derive the expression of magnetic field for an infinitely long coaxial transmission.	CO3	K ₃
b.	Determine the magnetic flux density B at a distance of d meter from an infinite straight wire carrying current I. Also, the flux density when the wire is semi-infinite.	CO3	K ₃

6. Attempt any *one* part of the following:

10 x 1 = 10

Q no.	Question	CO	Level
a.	Explain the concept of magnetization and susceptibility.	CO4	K ₄
b.	Derive an expression for the inductance of solenoid and toroid.	CO4	K ₃

7. Attempt any *one* part of the following:

10 x 1 = 10

Q no.	Question	CO	Level
a.	Derive and state the Poynting theorem for EM wave.	CO5	K ₃
b.	Derive an expression of characteristic impedance and propagation constant for a general and lossless transmission line.	CO5	K ₃