310608/310508

Roll No.

Total No. of Pages: 3

310608/310508

B. Tech. III - Sem. (Main) Exam., (Academic Session 2021- 2022)

Electrical Engineering

3EE4 – 08 Electromagnetic Field

Common EE/EEE

Time: 2 Hours

Maximum Marks: 80

Min. Passing Marks:

Instructions to Candidates:

Part – A: *Short answer questions (up to 25 words) 2 × 3 marks = 6 marks. Candidates have to answer* ***two*** *questions out of* ***five****.*

Part – B: *Analytical/Problem solving questions 3 × 15 marks = 45 marks. Candidates have to answer* ***three*** *questions out of* ***six****.*

Part – C: *Descriptive/Analytical/Problem Solving questions 1 ×29 marks = 29 marks. Candidates have to answer* ***one*** *questions out of* ***three****.*

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL

2. NIL

PART – A

Q.1 Convert the point A (8, 45°, 4) into Cartesian coordinates.

Q.2 Express Poisson's and Laplace equation in Cartesian coordinates.

Q.3 What is the difference between electric flux and magnetic flux?

Q.4 What is Lorentz force?

Q.5 Define uniform plane wave.

PART – B

Q.1 Prove the divergence theorem for $\oint_S \bar{A}.d\bar{s} = \int_v \nabla.\bar{A}dv$ Find the divergence of the vector $\bar{A} = x^2\hat{i} + (xy)^2\hat{j} + 24x^2y^2z^2\hat{k}$ at (1, 2, 3).

Q.2 State and explain Gauss's law. Derive the expression of electric field intensity of a uniform plane sheet with charge density. σ_s. Find the electric field at the Gaussian surface of the plane sheet in air with $\sigma_s = \frac{10^{-9}}{9\pi}\frac{e}{m^2}$

Q.3 Describe the Biot Savart's law. Establish the expression of magnetic field intensity using this law for infinitely long current carrying conductor at a distance R from the conductor.

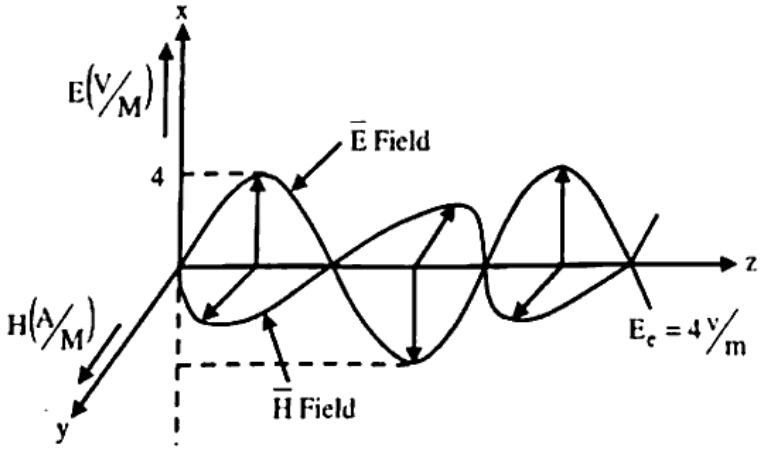
Q.4 Explain Ampere's circuit law. Find the expression of magnetic field, $\bar{H}$ for a coaxial cable from the centre of the inner conductor with radius a to the inner radius b of the outer conductor. Also, plot the $\bar{H}$ field.

Q.5 Write down the Maxwell's equations for static and time varying field in –

(a) Point form

(b) Integral form

Q.6 Define the Poynting vector. How the total time average power flow by an EM wave is calculated? Consider the EM wave travels along z direction as shown below in a medium of intrinsic impedance with 100Ω.



Find the average power density and the total power crossing 10 cm^2 of the plane normal to the direction of propagation.

PART – C

Q.1 Find the expressions for electrostatic boundary condition in the interface of two dielectric media with relative permittivities, $\in r_1$ & $\in r_2$. What will happen to the boundary condition for –

(a) Conductor-dielectric interface?

(b) Conductor-free space interface?

Q.2 Define magnetic polarization density, $\bar{M}$ of an iron bar. Establish the relation between relative permeability and magnetic susceptibility of the iron bar. Also, find the permeability and susceptibility values for a magnetic field intensity of 100A/m that induces magnetic flux density of $4\pi \times 10^{-2} Wb/m^2$.

Q.3 Derive the expression for plane wave propagation formula using time harmonic Maxwell's equations. Discuss and establish the relation from the above formula for –

(a) Skin depth of a conductor

(b) Tangent loss of a dielectric
