Sub Code:NEC508

Paper Id: 130522 Roll No: | | | | | | | | | | | | |

B.TECH
(SEM V) THEORY EXAMINATION 2019-20
FUNDAMENTALS OF E.M. THEORY

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If you require any missing data, choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a) Explain the significance of displacement current.
b) Write and explain differential form of Faraday's law.
c) Explain electric susceptibility.
d) Define Polarization.
e) What happens when a solid conductor is placed in an electric field?
f) Find the stored energy in the system for four identical charges Q = 2nc, at the corners 1 m on a side.
g) A charge $Q_2 = 121 \times 10^{-9}$ c is located in vacuum at P_2 (-0.03, 0.01, -0.04). Find force on Q_2 due to Q_1= 100μc at P_1 (0.03, 0.08, 0.02). All distances in meters.
h) Transform the vector $4f_x - 2f_y - 4f_z$ into spherical co-ordinates at point P(x=-2, y=-3, z=4).
i) Given $\vec{A} = 5f_x - 2f_y - f_z$ find the expression of a unit vector f_B such that f_B is parallel to $\vec{A}$.
j) Given two vectors $\vec{A} = 4f_y + 10f_z$ and $\vec{B} = 2f_x + 3f_y$. Find the projection of $\vec{A}$ and $\vec{B}$.

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a) What do you understand by skin depth? Show that in case of a semi-infinite solid conductor the skin depth S is given by $S = \sqrt{\frac{2}{\omega\mu\sigma}}$.
b) Obtain the equation of continuity in integral and differential form.
c) State and prove integral and differential form of Maxwell's equation.
d) What do you mean by displacement current? Derive an expression for displacement current density.
e) Find the Laplacian of the following scalar fields:-
   1) $V = e^{-z} \sin 2x \cosh y$
   2) $W = 10r \sin^2\theta \cos\phi$

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SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

a) State and explain the Gauss's law of electromagnetic in integral form.

b) Prove that the net power flowing out of a given volume V is equal to the time rate of decrease in energy stored within volume V minus the conduction losses.

4. Attempt any *one* part of the following: 10 x 1 = 10

a) Derive the expression for electric field intensity due to infinitely long charged wire (surface charge).

b) Show that for uniform plane wave in perfect medium, $\vec{E}$ and $\vec{H}$ are normal to each other and the ratio of their magnitude is constant of the medium.

5. Attempt any *one* part of the following: 10 x 1 = 10

a) Derive an expression for magnetic field intensity due to infinitely long straight conductor using Ampere's circuital law.

b) Find the electric field intensity due to finite line of charge using cylindrical system.

6. Attempt any *one* part of the following: 10 x 1 = 10

a) What is transmission line? Discuss various types of transmission lines.

b) Derive Poisson's and Laplace's equations from fundamentals.

7. Attempt any *one* part of the following: 10 x 1 = 10

a) Can a static magnetic field exist in the interior of perfect conductor? Explain.

b) Derive expression or the potential at a point outside a hollow sphere having a uniform charge density.