(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3081 Roll No. | | | | | | | | | | |

# B.Tech.

## (SEM. IV ) THEORY EXAMINATION 2010-11

## ELECTROMAGNETIC FIELD THEORY

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

**Note :** (1) All question carry equal marks.

(2) Attempt **all** questions.

1. Attempt any **four** parts of the following : **(5×4=20)**

(a) State Coulomb's law of forces. A charge of 10–3 Coulomb is located at P (30, –10, 15) in vacuum. What force is exerted on this charges by a second charge $6 \times 10^{-4}$C at Q(20, 10, 25) ?

(b) Find the divergence of a vector $A = 3x^2 i_x + 5x^2y^2 i_y + xyz^3 i_z$ and del $\nabla$ of a scalar function $x^2yz$.

(c) Establish the following vector identity :

(i) $A \times (B + C) = (A \cdot C)B - (A \cdot B)C$

(ii) $\nabla \cdot (\nabla \times A) = 0$

(iii) $\nabla \times \nabla \phi = 0$

(d) Two particles having charges $3 \times 10^{-9}$C and $6 \times 10^{-9}$C are spaced by 1.1 meter part. Determine the electric field at the point A situated at a distance of 0.5 meter from each of the particles.

(e) Verify Stokes theorem by considering relevant example. Discuss its salient features.

(f) A charge distribution with spherical symmetry has density $\rho_v = \rho_0 r/R$, $0 \leq r \leq R$ and 0 for $r > R$. Determine E everywhere.

2. Attempt any **four** parts of the following : **(5×4=20)**

(a) A parallel plate capacitor consists of two square metal plates with 500 mm side and separated by 10 mm. A slab of sulphur ($\epsilon = 4$) 5 mm thick is placed on the lower plate. This leaves an air gap 4 mm thick between the sulphur slab and the upper plate. Find the capacitance of the capacitor.

(b) What are the boundary condition for dielectric-dielectric boundary. An electric field in medium 1 whose relative permittivity is 7 passes into a medium of relative permittivity 2. If E makes an angle of 60 with the normal in the first medium, what angle does the field makes with normal in the second dielectric medium ?

(c) State and derive Ohm's law in point form.

(d) Derive an expression for the potential difference at any point between spherical shells in terms of applied potential using Laplace equation.

(e) Write short notes on Duality and equation of continuity.

(f) Given the total current in a circular conductor of radius 4 mm if the current density varies according to $J = \frac{10^4}{r} A/m^2$.

3. Attempt any **two** parts of the following : **(10×2=20)**

(a) Determine the magnetic flux density B at a distance d metre from an infinite straight wire carrying current I. Also find out when the length of the wire is semi infinite.

(b) State and derive Ampere circuital law. A single turns circle coil of 50 metres in diameter carries current $28 \times 10^4$ Amp. Determine the magnetic field intensity H at a point on the axis of coil and 100 metres from the coil. The relative permeability of free space surrounding the coil is unity.

(c) Find the vector potential due to long straight wire of length L and carrying a current I. Also determine the self inductance per unit length of the long solenoid.

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) State and explain the Maxwell's equation in differential and integral form. Derive the expression for $\alpha$ and $\beta$ in a Dielectric medium.

(b) Define phase velocity, group velocity, propagation constant and phase-shift constant. For a lossy dielectric material having $\mu_r = 1$, $\varepsilon_r = 40$, $\sigma = 20$ S/m, calculate the attenuation constant, phase shift and intrinsic impedance at a frequency of 9 GHz.

(c) Derive the wave equation for conducting medium.

5. Attempt any **two** parts of the following : **(10×2=20)**

(a) Using the general current and voltage equations for a transmission line. Obtain an expression for the input impedance of an lossless transmission line when the line is terminated by load impedance $Z_L$.

(b) A cable pair has the following primary coefficient at an angular velocity of 5000 rad/sec

R = 30 ohm/km, G = 1 μ v/km

L = 1.1 mH/km, C = 0.2 μp /km

Calculate (i) The characteristic impedance (ii) The attenuation coefficient (iii) the phase shift coefficient (iv) The attenuation in decibels over a length of 15 Km.

(c) Explain the term standing wave ration related to transmission line. What will be the value of input impedance when output impedances are (i) short ckted (ii) open ckted (iii) characteristic impedance.