Wave theory & propagation. (EXTC).
S.E. Sem-IV (CBGS) June 2014.

QP Code : NP-19806

(3 Hours) **[Total Marks : 100**

N. B. : (1) Question **No. 1** is **compulsory**.
(2) Attempt any **three** out of remaining **five.**
(3) Assume suitable data, whenever **necessary** and **justify** the same.
(4) **Figures** to the **right** indicates marks.

1. Attempt any **four** out of **five** :–
   (a) Identify the type of polarization of the Electromagnetic wave with the following Electric fields and justify the same 5

   (i) $\vec{E} = \sin(\omega t - \beta z)\,\mathbf{a}_x + \sin(\omega t - \beta z + \frac{\pi}{2})\mathbf{a}_y$

   (ii) $\vec{E} = [E_1 \cos(\omega t)\,\mathbf{a}_x - E_2 \sin(\omega t)\mathbf{a}_y]e^{-j\beta z}$

   (b) With regards to the ionosphere discuss the following 5
   (i) E Layer
   (ii) Sporadic E Layer

   (c) Derive the boundary condition for electric and magnetic fields 5

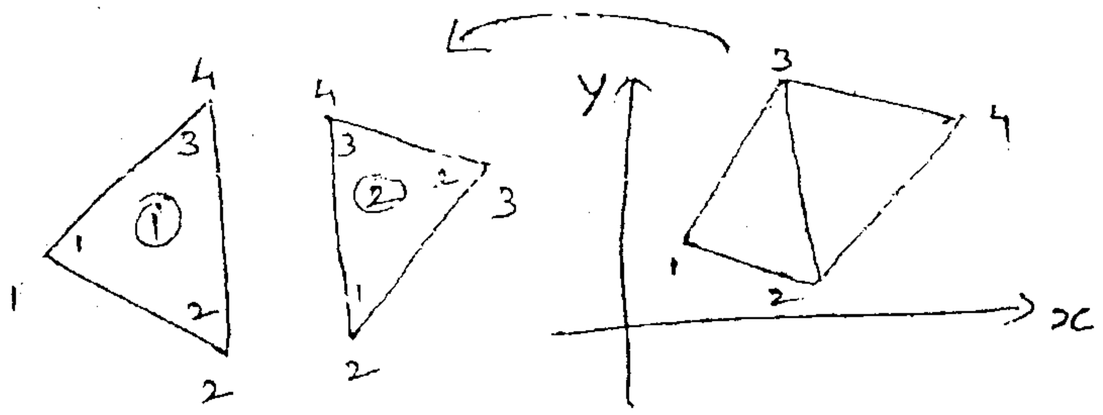
   (d) With the help of a neat schematic, Explain the working of an electromagnetic pump. 5

   (e) What do you mean by depth of penetration? 5

2. (a) State and Explain Faraday's Law in both the integral and differential form? Explain the shortcomings of each of the form? 3+2

   (b) Four 40 nC charges are located at A(1,0,0), B(-1,0,0), C(O,1,0) and D(0,-1,0). Determine the total force on the charge at A 5

   (c) The coefficient matrix for two elements as shown below are given by 5



$$C^{(1)} = \begin{bmatrix} 1.2357 & -0.7786 & -0.4571 \\ -0.7786 & 0.6929 & 0.0857 \\ -0.4571 & 0.0857 & 0.3714 \end{bmatrix} \text{ and}$$

$$C^{(2)} = \begin{bmatrix} 0.5571 & -0.4571 & -0.1 \\ -0.4571 & 0.8238 & -0.3667 \\ -0.1 & -0.3667 & 0.4667 \end{bmatrix}$$

Determine the global coefficient matrix

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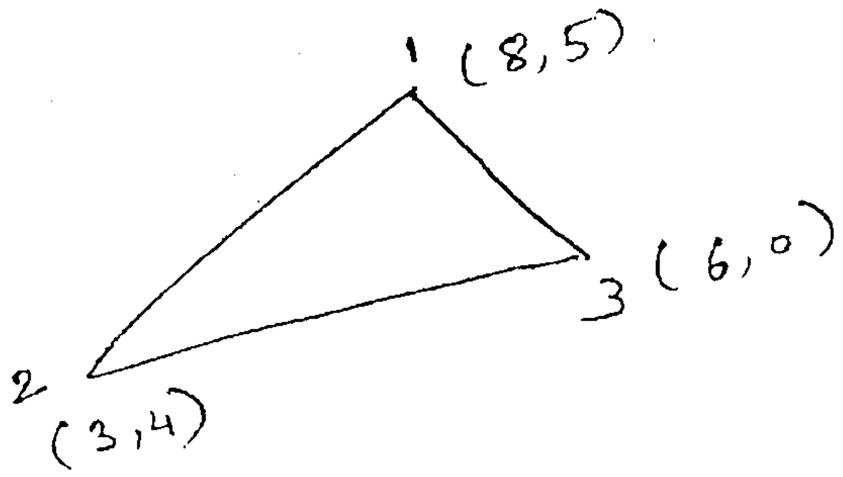
(d) Determine the shape functions a_1, a_2, a_3 for the following element 5



3. (a) State and explain Maxwell's equation in free space in integral and differential form .Hence explain the difference between conduction and displncement current. 8+2

(b) A media has the following properties $\mu_r = 8$, $\varepsilon_r = 2$, $\sigma = 10^{-4}$ mho/m at 2 Ghz. Determine 10

(i) attenuation constant
(ii) attenuation constant in dB
(iii) phase constant
(iv) propagation constant
(v) wavelength
(vi) phase velocity
(vii) intrinsic impedance viii)refractive index
(ix) loss tangent
(x) is the media behaving like a conductor or dielectric

4. (a) Derive Wave equation in free space 5

(b) State the Poynting theorem. Write its final expression hence explain the mennino of each term. 5

(c) Solve Laplace's Equation $\nabla^2 V = 0$; $0 \le x \le 1$; $0 \le y \le 1$ 10
With $V(x,1) = 45x(1-x)$; $V(x, 0) = V(0,y) = V(1,y) = 0$. Assume mesh size as 0.5

5. (a) Obtain the reflection and transmission coefficient of a parallel polarized wave incident between a dielectric-dielectric boundary with an oblique incidence 10

(b) An electromagnetic wave is incident from air to a medium with dielectric constant 5 and relative permeability 80. If the angle of incidence is 58° determine the angle of reflection and refraction. 5

(c) What polarization is transmitted in ground wave propagation and why? Hence state typically till what distance is ground wave propagation effective 4+1

6. (a) Explain Super refraction and tropospheric fading 6+4

(b) What is virtual height of a layer? Why is it called so? Is it more or less than the actual height of the layer 5

(c) What is ionosphere? Which layers are present during day and night time? Where does maximum attenuation of an electromagnetic wave take place inside the ionosphere? Hence define critical frequency. 2+1+1+1
