THIRD SEMESTER EXAMINATION 2015-16
EEC303
ELECTROMAGNETIC FIELD THEORY

14-04-2016

Time: 3 hours **Max Mark: 100**

Note

- Attempt all questions.
- Marks and number of question to attempt from the section is mentioned before each section.
- Assume missing data suitably .Illustrate the answer with suitable sketch.
- Use of smith chart is permitted.

1. Attempt any four parts of the following. [4x5]
   a. If the position vectors of points **T** and **S** are $3\mathbf{a}_x - 2\mathbf{a}_y + \mathbf{a}_z$ and $4\mathbf{a}_x + 6\mathbf{a}_y + 2\mathbf{a}_z$, respectively, find: (i) the coordinates of **T** and **S** (ii) the distance vector from **T** to **S**, (iii) the distance between **T** and **S**.
   b. If V = (x +y)z, evaluate $\oint V\,ds$, where S is the surface of the cylindrical wedge defined by $0 < \phi < \pi/2$, $0 < z < 2$ and dS is normal to that surface.
   c. Find the divergence of the following vectors:
      i) $\mathbf{A} = e^{xy}\,\mathbf{a}_x + \sin xy\,\mathbf{a}_y + \cos^2 xz\,\mathbf{a}_z$
      ii) $\mathbf{B} = \rho z^2 \cos\phi\,\mathbf{a}_\rho + z\sin^2\phi\,\mathbf{a}_z$
   d. State and explain stoke's theorem.
   e. Explain that the gradient of a scalar function at any point is directed normal to the surface passing through that point and on which the value of scalar function is constant.
   f. Two points are given as P (2, -1, -3) and Q (1, 3, 4). Give the vector that extends from P to Q in (i) Cartesian coordinates (ii) cylindrical coordinates.

2. Attempt any four parts of the following. [4x5]
   a. A point charge $Q_1 = 300\ \mu C$ located at (1, -1, -3) m experiences a force $F_1 = 8\,I_x - 8\,I_y + 4\,I_z$ N, due to a point charge Q_2 at (3, -3, -2) m. Determine Q_2.
   b. State and explain Gauss's law in differential form and explain what do you mean by $\nabla . D$.
   c. Derive an expression for continuity equation.
   d. Calculate the capacitance between concentric metal spheres of radius r_1 and r_2 with charge Q placed on the outer surface of inner shell.
   e. A coil is made of 150 turns of copper wire wound on a cylindrical core. If the mean radius of the turns is 6.5 mm and the diameter of the wire is 0.4 mm, calculate the resistance of the coil.

media.

3. Attempt any two parts of the following. [2x10]
   a. State and Explain Biot- Savart's law.
   b. Determine the magnetic field intensity, H at the centre of square current element. The length of each side is 2m and the current I = 1Amp.
   c. There exist a boundary between two magnetic material at z = 0 having permeability $\mu_1 = 4\mu_0$ H/m for region1, where z>0 and $\mu_2 = 7\mu_0$ H/m for region 2 where z<0. There exist a surface current of density $k = 60\,\mathbf{1}_x$ A/m at boundary z = 0. For a field $\mathbf{B}_1 = 2\,\mathbf{1}_x - 3\,\mathbf{1}_y + 2\,\mathbf{1}_z$ mT in region 1. Find the value of flux density $\mathbf{B}_2$ in region 2.

4. Attempt any two parts of the following. [2x10]
   a. State and explain the Maxwell's equation in differential and integral form. Also explain from which law they are derived.
   b. Derive an expression for the reflection coefficient of a uniform plane wave incident on a non-lossy medium.
   c. For uniform plane wave in sea water find the value of Attenuation Constant, Phase Constant, Intrinsic impedance and wavelength at 10^5 MHz. Given that $\sigma = 4$ mho/m and $\epsilon = 80\,\epsilon_0$ and $\mu = \mu_0$.

5. Attempt any two parts of the following. [2x10]
   a. (i) What is smith chart explain? How it is constructed?
      (ii) Using smith chart find the input impedance of 75 ohm lossless transmission line of length 0.1λ when the load is short.
   b. Why is it desirable to achieve an impedance match in a transmission line? Explain the different methods of impedance matching.
   c. A 60 ohm distortionless transmission line has a capacitance of 0.15nF/m. The attenuation of the line $1.15*10^{-3}$ Np/m. Calculate: (i) The line parameter resistance, inductance and conductance per meter of the line, (ii) Voltage at a distance of 1Km and 4Km with respect to sending voltage.

14-04-2016