TE - Sem V (R2007)(E&TRx) 18/11/15 -

(old) EME

QP Code : 1613

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

N.B. (1) Question No. 1 is compulsory
(2) Attempt any four from remaining six questions.
(3) Assume suitable data wherever necessary.

1 a) A uniform plane wave at a frequency of 500MHz travels in vacuum along the +x direction. The electric field of the wave at some instant is given as $\vec{E} = \overline{5a_y} + \overline{4a_z}\ V/m$. Find the phase constant of the wave and also the vector magnetic field. 5

b) A uniform volume charge density of 0.2 $\mu C/m^3$ is present throughout the spherical shell extending from r=3cm to r=5cm. if $\rho_v = 0$ elsewhere, find the total charge present throughout the shell. 5

c) Derive Poisson's and Laplace's equations. 5

d) For the transmission line in +x direction with characteristic impedance, Z_0, terminated with the load impedance, Z_L, derive the expression for the voltage reflection coefficient. 5

2 a) Derive the boundary conditions for normal and tangential components of electric field at the boundary of two dielectric media. 10

b) The magnetic field in some region is given by $\bar{H} = \left[\frac{x+2y}{z^2}\overline{a_y} + \frac{2}{z}\overline{a_z}\right]$ [illegible] A/m. If the region has a dielectric constant of 3 and zero conductivity, find the electric field in the region. 10

3. a) Derive an expression for the characteristic impedance of the transmission line. A transmission line has Z_0=65+j5Ω and y=1+j20 per meter. Find the primary constants of the line at 900MHz. 10

b) A high frequency 50Ω lossless line is 141.6cm long with a relative dielectric constant $\varepsilon_r = 2.49$ at 500MHz. It is terminated with the load impedance of (100+j150)Ω. Calculate: 10

i) The VSWR
ii) The complex reflection coefficient
iii) The input impedance of the transmission line
iv) The impedance at a distance of 100m from the load.

DO NOT USE SMITH CHART.

[TURN OVER

4 a) Explain electromagnetic interference and its effects. 10

b) State Poynting theorem. Derive the Poynting vector. 10

5. a) What is polarization of electromagnetic waves? Explain linear, circular and elliptical polarization in detail. 10

b) Derive the reflection and transmission coefficient for a wave obliquely incident at a perfect dielectric with parallel polarization. 10

6. a) A 25m transmission line with characteristic impedance of 50Ω is terminated in a load of 40+j30Ω at a frequency of 10MHz. Use Smith chart to find the minimum length of the short circuited stub used for matching the load to the transmission line, and the minimum distance of the stub from the load. 10

b) Derive the wave equation for an electromagnetic wave propagating in a source free region. 5

c) Derive the reflection and transmission coefficient for a wave normally incident at a perfect dielectric. 5

7. Derive the expression for the power radiated by a Hertzian dipole. 20
