Code: R7211003 **R07**

B.Tech II Year I Semester (R07) Supplementary Examinations December 2015

ELECTROMAGNETIC WAVES & TRANSMISSION LINES

(Electronics & Instrumentation Engineering)

(For 2008 Regular admitted batch only)

Time: 3 hours Max. Marks: 80

Answer any FIVE questions

All questions carry equal marks

(Use of Smith chart is provided in the examination hall)

*****

1 (a) Derive the expression for a capacitance of coaxial capacitor with neat schematic.

(b) A point charge 100 pC is located at (4, 1, -3) while the x-axis carries charge 2 nC/m. If the plane z = 3 also carries 5 nC/m^2. Find E at (1, 1, 1). (represent graphically with relevant coordinate system)

2 (a) Derive expression of H for line current distribution using Biot-Savart's law along with graphical representation.

(b) A steady state current of I amps flow in a conductor bent in the form of square loop of side 'a'. Find the 'H' at the centre of the loop.

3 (a) Explain about the inconsistency of Ampere's law and derive a Maxwell's expression of $\nabla \times \mathrm{H}$ for time varying EM fields.

(b) In air, $\mathrm{E} = \frac{\sin\theta}{\mathrm{r}}\cos(6\times10^7\mathrm{t} - \beta\mathrm{r})\,\mathrm{a}_\emptyset\ \mathrm{V/m}$. Find β and H.

4 (a) Derive expressions for α, β, η, E & H in lossy dielectric medium.

(b) For the $\mathrm{E} = \left(50/\rho\right)\cos(10^8\mathrm{t} + \beta\mathrm{z})\,\mathrm{a}_\emptyset\ \mathrm{V/m}$ and $\mathrm{H} = \left(\mathrm{H}_0/\rho\right)\cos(10^8\mathrm{t} + \beta\mathrm{z})\,\mathrm{a}_\rho\ \mathrm{A/m}$ in free space, determine H_0 and β such that the fields satisfy Maxwell's equations.

5 (a) Derive the relation between reflection coefficient and transmission coefficient due to reflection of plane waves at normal incidence.

(b) In free space $\mathrm{H} = 0.2\cos(\mathrm{t} - \mathrm{x})\,\mathrm{az\ A/m}$. Find total power through (i) a square plate of side 10 cm on plane x + z = 1 (ii) a circular disc of radius 5 cm on plane x = 1.

6 (a) Derive the expressions for TM waves in rectangular waveguide using Maxwell's equations.

(b) A rectangular waveguide with dimensions a = 2.5 cm, b = 1 cm is to operate below 15.1 GHz. How many TE and TM modes can the waveguide transmit if guide is filled with a medium characterized by $\sigma = 0, \varepsilon = 4\varepsilon0, \mu r = 1$? Calculate cut-off frequencies of the modes.

7 (a) Prove that a line of finite length and terminated by its Z_0 is equivalent to a line of an infinite length with neat sketches.

(b) A telephone line has the following parameters: $\mathrm{R} = 40\ \Omega/\mathrm{m}$, $\mathrm{L} = 0.2\ \mu\mathrm{H/m}$, $\mathrm{G} = 400\ \mu\mathrm{S/m}$, and $\mathrm{C} = 0.5\ \mathrm{nF/m}$. (i) If the line operates at 10 MHz, calculate the characteristic impedance and velocity u. (ii) After how many meters will the voltage drop by 30 dB in the line.

8 (a) Derive and obtain the relation between Z_{oc}, Z_{sc}, and Z_0.

(b) A $100 + j150\Omega$ load is connected to a 75 Ω lossless line. Find (using the smith chart only) (i) The reflection coefficient. (ii) The standing wave ratio. (iii) The load admittance. (iv) $Z_{in}\ at\ 0.4\lambda$ from the load. (v) The locations of V_{max} and V_{min} w.r.t the load if the line is 0.6λ long.