Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech(ECE-M.Comm)/SEM-3/MCE-302A/2012-13

2012

EMI/EMC

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer Question No. 1 and any *four* from the remaining.

1. Explain any *two* of the following : 2 × 5 = 10

   a) Explain why microstrip line is supported by quasi-TEM mode.

   b) Why are electronic equipment required for the compatibility to EMC and EMI ?

   c) How frequency and phase distortion affect the EM wave ?

   d) Draw the E & H-fields of a microstrip line.

2. a) A transmission line has the following parameters : $Z_0 = 300\ \Omega$, $Z_1 = 300\ (1 - j)\ \Omega$ and propagation constant $\gamma = 0.054 + j3.53$ per m.

Determine —

i) The reflection co-efficient at the load.

ii) The transmission co-efficient at the laod.

iii) Reflection co-efficient at any point 2 m away from the load. 9

b) Find out the expression of $Z_{in}{}^{s}$ in terms of phase consant of a lossless short circuited line of length *l*. 6

3. a) Show with graphical representation that short circuited Z_{in} of a line is inductive when $n\pi < 1 < (2n + 1)\,\pi/2$ and capacitive when $(2n + 1)\,\pi/2 < 1 < (n + 1)\,\pi$. Also find out the expression of equivalent induction and capacitance. 6 + 3

b) Explain the phase and frequency distortion of a transmission line. 6

4. a) Prove that the fractional B.W. of a quarter wave transformer is

$$\frac{\Delta f}{f_0} = 2 - \frac{4}{\pi} \cos^{-1} \left| \frac{2 |\Gamma_m| \sqrt{Z_I Z_L}}{(Z_L - Z_I) \sqrt{1 - |\Gamma_m|^2}} \right|$$

Where Γ_m = Maximum reflection co-efficient of the line.

Z_I = Line impedance

Z_L = Load impedance. 8

b) What are the required length $\lambda g/4$ and impedance of a transformer that will match a 100 Ω load to a 50 Ω air filled line at 10 GHz ? Consider both rectangular wave guide (2.286 cm × 1.016 cm) and coaxial line cases. What is the frequency band of operation for a coaxial line over which the reflection co-efficient remains less than 0.1 ? 7

5. a) In a multi-section $\lambda/4$ transformer prove that the impedance of the nth section $Z_n = \sqrt{Z_{n-1} Z_{n+1}}$. 6

b) Explane how multiple-reflection at a juction effect the wave propagation. Prove that the total reflection co-efficient of a multiple section is $\Gamma = \Gamma_1 + \Gamma_{3\theta} - j2\theta$, just that obtained by taking only 1st order reflection into account. 9

6. a) An empty rectangular wave guide is matched to a dielectric filled wave guide (k = 2.56) in TE_{10} mode at 10 GHz by means of a $\lambda/4$ transformer. Find the length and dielectric constant of the matching section. The broader dimension of the wave guide is a = 2.5 cm. 7

   b) Explain with suitable expression the binomial transformation of a multi-section line. What advantage do you get from Chebyshev transformer ? 4 + 4

7. a) What are the limitations of microstrip line at microwave frequencies ? Find out the expression of dielectric loss tangent of a microstrip line. 3 + 4

   b) In a microstrip line find out the following parameters : (a) Line width (W) (b) effective length L_{eff} (c) Line extension due to fringing field.

   (Given = 4.4, t/w = 0.4, operating frequency = 5.25 GHz).

   8

8. Write shorts notes on any *three* of the following : 3 × 5

   a) EMC in health care unit

   b) Significantce of S11 and S21 of two-port transmission line ?

   c) Stub matching

   d) Quarter wave transformer

   e) Radiated susceptibility.