



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

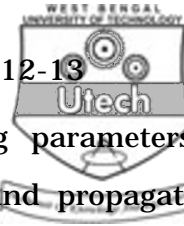
The figures in the margin indicate full marks.

*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 : $2 \times 5 = 10$

- 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 load.
- 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
 constant 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 $\lambda/4$ and impedance of a transformer that will match a 100Ω load to a 50Ω air filled line at 10 GHz ? Consider both rectangular wave guide ($2.286 \text{ cm} \times 1.016 \text{ cm}$) 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 n th section $Z_n = \sqrt{Z_{n-1} Z_{n+1}}$. 6

- b) Explain how multiple-reflection at a junction 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
- EMC in health care unit
 - Significantce of S_{11} and S_{21} of two-port transmission line ?
 - Stub matching
 - Quarter wave transformer
 - Radiated susceptibility.
