ME (ETC), 1st Semester, Final Examination, 2013

Microwave Circuits and Applications (ETC 941)

Time: 3 hours **Full Marks: 70**

Answer any three questions from each group. Two marks are reserved for neatness

Group A

1. (a) Define *ABCD* parameters of a two-port network. Write down special properties of reciprocal network and symmetrical network (b) Derive the expression for *ABCD* parameters for a transmission line network in term of characteristic impedance, the complex propagation constant, and the length of the transmission line. (c) Find out the expression of the input impedances, when output port of the transmission line network is short circuited. (d) A 30 meter long lossless transmission line with Zo = 50Ω operating at 2 MHz is terminated with a load $Z_L = 60 + j40\ \Omega$ If phase velocity on the line is 0.6 times of velocity of light, find out standing wave ratio and input impedance without using Smith chart.

[3+3+ 3+2]

2. (a) How do electromagnetic emissions cause interference in electrical devices? Explain with suitable example. What is FCC regulation for electromagnetic emission for a digital device? (b) Write down the FCC radiated emission limits for Class A and Class B digital devices. (c) What is conducted emission? How is it measured by line impedance stabilization network (LISN). (d)Why quasi-peak detection is important than peak detection in conduction emission measurement?

[3+2+4+2]

3. (a) Derive the n^{th} order Butterworth lowpass approximate filter function. (b) What do you understand by quasi-lump elements of microstrip? How are inductances and capacitances realized by open and short stub? (c) Describe the design steps of a 5^{th} order microstrip lowpass filter using open stub.

[4+4+ 3]

4. (a) Explain the principle of operation of Branch line coupler. Draw the frequency response of such coupler for coupling, and isolation. (b)When is it called Hybrid coupler? (a) Write the principle of operation of Schiffman's phase shifter.

[5+2+ 4]

5. Write short notes (any two)
   (a) Reflection type phase shifter (b) Power-line Filter for EMC
   (c) Design of Wilkinson's Power divider (d) Bi-Conical antenna for EMI

[51/2 x 2]

Group-B

Answer any three questions.
(Two marks are reserved for neatness)

6. Furnish a block diagram of a microwave relay system showing both one way and two-way channel routes and discuss its various components.
In a satellite communication system, free-space conditions may be assumed. The satellite is at a height of 36,000 km above the earth, the frequency used is 4000 Mhz, the transmitting antenna gain is 15 dB, and the receiving antenna gain is 45 dB. Calculate a) the free-space transmission loss and b) the received power when the transmitted power is 200 W. 7+4 =11

7. What are the various modes of propagation of radio waves?
Suppose a reliable communication link has to be established between a transmitter and receiver within the frequency range of 1 MHz, which mode do you suggest and why?
Discuss the following useful terms with respect to radio wave propagation: Critical Angle, Critical Frequency, Maximum Usable Frequency and Skip Zone. What is Duct Propagation? 2+2+7

8. a) Explain wide area paging system along with suitable block diagrams. Why low data rates are required for the paging system?

b) What are the major distinctions between first generation (1G) cellular systems and second generation (2G) standards? Write down four different types of 2G standards, which are used for mobile communication. Mention three standards of 3G technology and discuss any one of the same.

c) Discuss IEEE 802.11 wireless LAN standard with suitable block diagram & illustrations. 2+6+3.

9. a) Explain the various ways by which coverage and channel capacity of a cellular system can be improved?

b) If a signal to interference ratio of 15db is required for satisfactory forward channel performance of a cellular system, what is the frequency reuse factor and cluster size that should be used for maximum capacity if the path loss exponent is n=4. Assume that there are six co channel cells in the first tier, and all of them are at the same distance from the mobile. Use suitable approximations. 8+3

10. Write short notes on the followings (**any two**): 11
a) TDMA Frame Structure in GSM. b) Active & Passive Repeaters. c) Okumara model for signal propagation in urban area. d) Small Scale Fading in wireless communication