Bengal Engineering and Science University, Shibpur

ME (ETC), 2nd Semester, Final Examination, 2013

Advanced Microwave Circuits, Systems and Measurements (ETC-1033)

Time: 3 hours Full marks: 100

Answer any FIVE questions. Questions are equal valued.

1. (a) Explain various types of planer transmission lines with appropriate diagrams. Describe the low-frequency characteristics of microstrip line. How we can calculate the distributed capacitance of a microstrip line. (b) How to evaluate different losses and attenuation constant of a microstrip line. (c) Calculate the width and length of a microstrip line for a 50 Ω Characteristic impedance and a 90° phase shift at 2.5 GHz. The substrate thickness is h=0.127 cm, with ε_{eff} =2.20. (d) What do you understand by Surface-Wave Propagation in microstrip.

2. (a) Draw the electrical field distribution of a coupled microstrip lines and describes their parallel plate and fringing capacitances. What do you understand by even mode and odd mode propagation? Find out the expression for characteristic impedance and effective dielectric constant for even mode and odd mode excitation. (b) What is Immittance Inverter. Realize generalized bandpass filters (including distributed elements) using immittance inverters. (c) Write down the design steps of 5th order parallel coupled microstrip bandpass filter

3. (a) Design broadband microwave biasing circuit using shunt stub (b) Design a planar transmission line baluns using coupled gap line.

4. (a)Write the principle of operation of Switched- delay line phase shifter. Design such a phase shifter using microstrip line with a 30 degree phase shift at 2.4GHz, on a substrate with a dielectric constant of 3.2 and thickness 0.79 mm. (b) What do you understand by loaded-line phase shifter? (c) Construct a variable reactance, reflection type phase shifter using hybrid coupler and PIN diode. (d) Write down different applications of phase shifter.

5. (a) Describe the principle of operation of Wilkinson's Power divider and derive the formulas for equal and unequal power division. (b) One wishes to realize a power divider with a power ratio of 2.5:1 between the two outputs. Determine the charecteristics impedence of the two output lines, with a 50 ohm input and evaluate all the terms of the scattering matrix.

6. (a)Design a single-section TEM directional coupler by uniformly coupled symmetric lines. Show the variation of coupling (k) with respect to frequency. How the frequency bandwidth ratio relates the fractional bandwidth. (b) Design a modified Branch-line coupler using shorted coupled-line pair in microstrip form.

7. (a) What do you understand by electromagnetic compatibility (EMC) of a system? Define four basic EMC problems. (b) Write down the FCC radiated emission limits for Class A and Class B digital devices. The radiated emissions from a product are measured at 50 MHz at 15 m away and are found to be 21mV/m. Does the product complies with FCC Class B limit? (c) Explain the principle of operation of biconical antenna with a schematic diagram. Determine the half-angle of an infinite biconical antenna to give an input impedance of 50 V. Which frequency range is used for radiation emission measurement by biconical antenna?

8. Write short note (any TWO) on followings
   (a) RF Mixer
   (b) Equivalent circuit of CPW discontinuities
   (c) Schiffman's Differential Phase shifter
   (d) Butler Matrix
   (e) Low noise Amplifier