M.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING

FIRST YEAR SECOND SEMESTER EXAM 2018

EMI & EMC (MW)

Time: 3 hours Full Marks:100

Answer Question No. 1 and any FOUR questions from the rest

1. Answer ***any four*** from the following:

a) Find the wave velocity in Teflon ($\varepsilon_r = 2.1$). Determine the wavelength at 600 MHz in epoxy glass. Determine the following quantities in the indicated units: 20 mV (dBμV), 50 μV (dBmV). Determine the absolute values of 60 dBμV/m. [2+1+1+1]

b) What do you understand by "susceptible to electromagnetic emission" and "susceptible to conduction emission"? With regard to all types of EMI and ESD, suggest some techniques to protect an EVM which is actually a digital storage device. [2+3]

c) "FCC Conducted Emission Limits for Class B Digital Devices at 0.5 MHz is 'X' μV (QP) and 'Y' μV (AV)" - among X and Y which one is larger quantity and why? Why are both QP and AV required for setting these limits? Convert -37 dBm into dBμV (RMS) for 50 Ω system load using your expression. [2+1+2]

d) A 50 Ω signal generator is attached to a signal measurer whose input impedance is 25 Ω. The dial on the signal generator indicates that it is putting out a level of -20 dBm. Determine the voltage at the input to the signal measurer in dBμV. [5]

e) A 50 Ω source is attached to a 50 Ω signal measurer with 300 ft of RG58U cable. The source is tuned to a frequency of 100 MHz, and the dial indicates an output of -15 dBm. Determine the voltage at the input to the signal measurer in dBμV. [5]

2. a) Draw and explain different sub-circuits of the line impedance stabilization network (LISN). Illustrate the contributions of differential-mode and common-mode current components on the measured conducted emissions. How will you separate the Conducted Emissions into Common- and Differential-Mode Currents? [10+4]

b) What is the reason behind the arc during switching off an inductive load? Using circuit diagram explain different arc suppression techniques. [2+4]

3. a) For the 1-V, 10-MHz, 50% duty cycle trapezoidal waveform, determine the level at 10 MHz, 20 MHz and 130 MHz for the 20 ns rise/fall time. [6]

b) A transmission line with 100 Ω characteristic impedance with length corresponds to a time delay of 1 ns is connected with a source and a load as shown in Figure 1. The generated voltage can be defined using a piecewise linear function PWL(0 0 0.001n 20 1.999n 20 2n 0) which means initial 0 V at 0 s attains to 20 V after 0.001 ns and remains at 20 V till 1.999 ns then come down to 0 V at 2ns. The source is having a series resistance of 200 Ω and the load is a 500 Ω resistor. Plot output voltage across load vs time for 0 to 8 ns. [14]

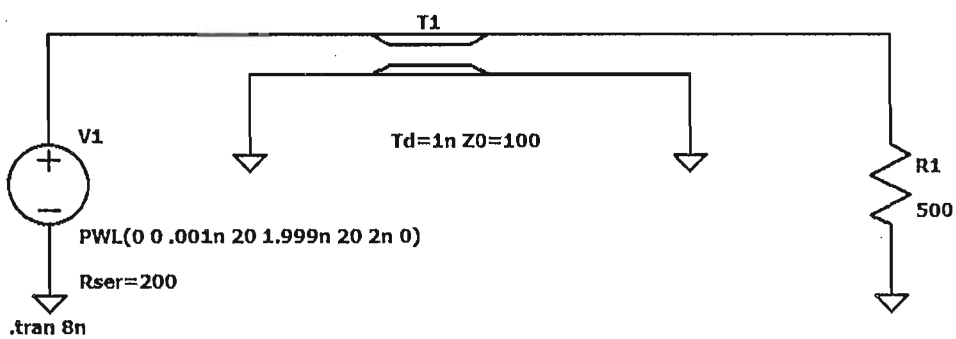

Figure1

4. a) "Actual resistors behave somewhat differently than this ideal at higher frequencies"- explain using mathematical expressions and show their behavior using Bode plots. [8]

b) A 1/8-W carbon resistor has the measured Bode plot of the impedance shown in Figure 2. Determine the lead inductance and parasitic capacitance. [12]

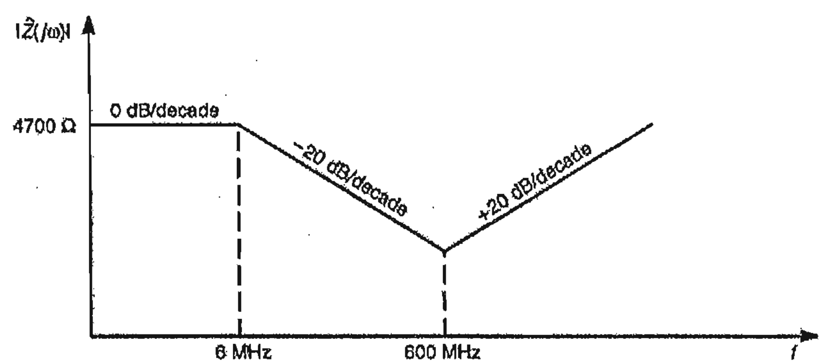

Figure 2

5. a) A half-wave dipole at 100 MHz carries a current whose magnitude (RMS) at the center of the dipole (the excitation point) is 100 mA.

Determine the total power radiated by the dipole and the power density at a distance of 1000 m away broadside to the antenna. [5]

b) Design a -6 dB attenuator for 75 Ω system. [5]

c) What is antenna factor? A known, incident, linearly polarized, uniform plane wave is incident on an antenna and the electric field at the position of the antenna in the absence of the antenna is 62 dBμV/m. A 30 ft length of RG58U coaxial cable is used to connect the antenna to a 50 Ω spectrum analyzer. The spectrum analyzer measures 40 dBμV. The coaxial cable has 4.5 dB/100 ft loss at the frequency of the incident wave, 100 MHz. Calculate the antenna factor. [2+5]

d) Determine the maximum effective aperture of a half-wave dipole that is operated at 150 MHz. [3]

6. a) Using different laws of physics, explain electric and magnetic shielding principle. Discuss regarding shielding effectiveness of an airplane. [3+2]

b) What is shielding effectiveness? How will you relate shielding effectiveness with absorption loss and reflection loss? Deduce reflection loss at the interface between two media. [10]

c) With proper explanation write your opinion on leakage from a microwave oven with linear array of see through holes with 40 cm × 25 cm door area with 4 circular holes (1 mm radius) per square cm? The operating frequency of the microwave oven is 2.45 GHz. [5]

7. Write short notes on: [4x5]

a) Matching Schemes for Signal Integrity
b) High-Speed digital interconnects and signal integrity
c) Common mode current reduction using Bazooka BALUN
d) Faraday shield