Ex/PG/ETCE/T/128E/2017

M.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING

FIRST YEAR SECOND SEMESTER - 2017

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) What do you understand by "susceptible to electromagnetic emission"? How can an EVM be susceptible to electromagnetic emission? With regard to all types of EMI and ESD, suggest some techniques to protect an EVM. [1+2+2]

   b) "FCC Conducted Emission Limits for Class B Digital Devices at 0.5 MHz is 631 μV (QP) and 199.5 μV (AV)" - explain. Why are both QP and AV required for setting these limits? Express the limits in dBμV. [2+1+2]

   c) What type of anechoic chambers are used in radiation emission measurements? How these anechoic chambers are different from radiation pattern measurement chambers? Which type of antennas are suitable for radiated emission measurements? Illustrate the radiated emissions measurement method. [1+1+1+2]

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

   e) What is the reason behind the generation of arc during switching off an inductive load? Using circuit diagram explain different arc suppression techniques. [1+4]

2. How can a device connected in the power distribution network emits unwanted signals to disturb other devices connected in the same network? How will you measure this interference level using line impedance stabilization network (LISN). Draw and explain different sub-circuits of the line impedance stabilization network (LISN) circuit. [20]

3. A 50 Ω source is attached to a 50 Ω spectrum analyzer with 300 ft RG58U coaxial cable (4.5 dB/100 ft loss at 100 MHz). The source is tuned to 100 MHz and the spectrum analyzer indicates that the output is 56.5 dBμV. If the cable is removed and signal source is attached directly to 100 Ω then determine the voltage across the load in dBμV. Determine the reading on the meter of the source in dBm. [20]

4. A transmission line with 50 Ω characteristic impedance with length corresponds to a time delay of 2 μs 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 0.1u 10) which means initial 0 V at 0 s attains to 10 V after 0.1 μs and continues to generate constant 10 V. The source is having a series resistance of 10 Ω and the load is a 1 kΩ resistor. Plot input voltages at the transmission line vs time and load voltage vs time for 0 to 20 μs. [20]

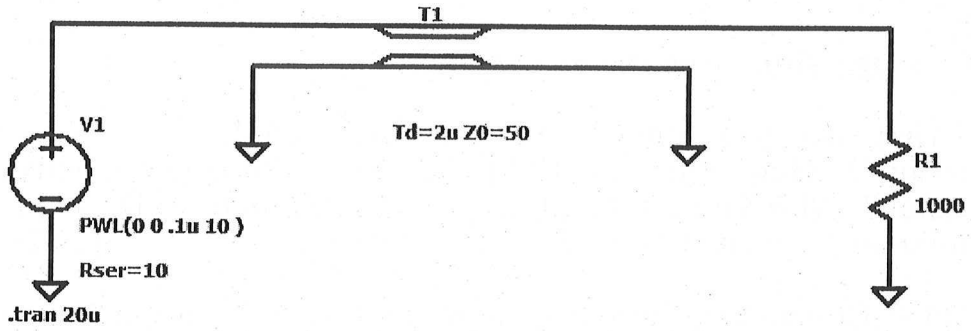

Figure1

5. a) Draw a periodic, trapezoidal pulse train representing clock and data signals of digital systems. Show that the key parameters that contribute to the high-frequency spectral content of the waveform are the rise and fall times of the pulse. [2+8]

   b) Plot the bounds on the one-sided magnitude spectrum of a 5-V, 100-MHz, 50% duty cycle trapezoidal waveform having rise/fall times of 1 ns. How does the spectral bound shift when the pulse train passes through a non ideal inductor? [4+6]

6. a) How much are the input impedances of the following antennas: i) half-wave dipole and ii) quarter wavelength monopole? How can a dipole or monopole antenna be designed with zero input reactance? [2+2]

   b) A half-wave dipole carries a 900 MHz current whose magnitude (RMS) at the center of the dipole (the excitation point) is 50 mA. Determine the total power radiated by the dipole and the power density at a distance of 100 m away broadside to the antenna. Determine the maximum effective aperture of a half-wave dipole that is operated at 900 MHz. [5+3]

   c) What is antenna factor? How will you design broadband antenna array for EMC measurement using narrow band dipole antennas? Which type of variation in antenna factor is required for EMC measurements? [2+4+2]

7. a) What is shielding effectiveness? How will you relate shielding effectiveness with absorption loss and reflection loss? Explain absorption loss and electric field reflection loss. [2+2+3+3]

   b) Explain the effects of a single aperture and linear aperture arrays on shielding effectiveness. With proper explanation write your opinion on leakage from a microwave oven with linear array of see through holes with A cm × B cm door area with N circular holes (radius = r mm) per square cm? The operating frequency of the microwave oven is f_o. [4+6]

8. Write short notes on (Any four) : [4x5]

   a) Matching Schemes for Signal Integrity
   b) Power supply filter
   d) Common EMC mistakes and their prevention techniques
   e) Near and far fields
   f) Common grounding myths
   g) Common ESD protection techniques