Ref. No.: Ex/ET/T/415C/2019

B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
FOURTH YEAR
FIRST SEMESTER EXAM 2019

PRINCIPLES OF EMC

Time: Three hours | Full Marks:100

Section A [Answer *any two*]

1. a) With regard to EMI, discuss different ways of electromagnetic energy transfer with examples. [5]

   b) FCC defines a digital device as - "Any unintentional radiator (device or system) that generates and uses timing pulses at a rate in excess of 9000 pulses (cycles) per second and uses digital techniques...". Write your opinion regarding aforesaid definition. [5]

   c)What do you understand by - "FCC emission limits for class B digital device (measured at 3m) is 40 dBμV/m for 30-88 MHz"? Also explain the significance of each underlined parts. [5]

   d) 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]

2. a) Derive an expression to convert power in dBm to voltage (RMS) in dBmV for 75 Ω load impedance. [5]

   c) RG58U coaxial cable is specified as having 4.5 dB/100 ft loss at 100 MHz. A 50 Ohm source is attached to a 150 Ohm 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 -25 dBm. Calculate the voltage at the input to the signal measurer in dBmV. [15]

3. a) Using diagrams discuss the use of a line impedance stabilization network (LISN) in the measurement of conducted emissions of a product. [8]

   b) Discuss various important sub-circuits used in LISN. Draw the equivalent circuits of a LISN for even mode and odd mode currents. [4+8]

[Turn over

Section B [Answer *any two*]

4. a) Draw a periodic, trapezoidal pulse train representing clock and data signals of digital systems and show that the frequency spectral content of the waveform may depend on the duty cycle and rise and fall times of the pulse. [10]

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

5. a) Draw equivalent circuits for non-ideal capacitor taking care of their losses, lead inductance and package capacitance. Using suitable plots and mathematical expressions explain how the impedance magnitude and phase of a non ideal capacitor vary with frequency. [15]

   b) How does the spectral bound of a trapezoidal pulse train shift, when it passes through the non-ideal capacitor? [5]

6. a) Plot the bounds on the one-sided magnitude spectrum of a trapezoidal pulse train. How does the spectral bound shift when the pulse train passes through a non ideal inductor? [2+8]

   b) A 5-V, 10-MHz oscillator having a rise/fall time of 10 ns and a 50% duty cycle is applied to a gate as shown in Fig.1. Determine the value of the capacitance such that the fifth harmonic is reduced by 20 dB in the gate voltage $V_G(t)$. [10]

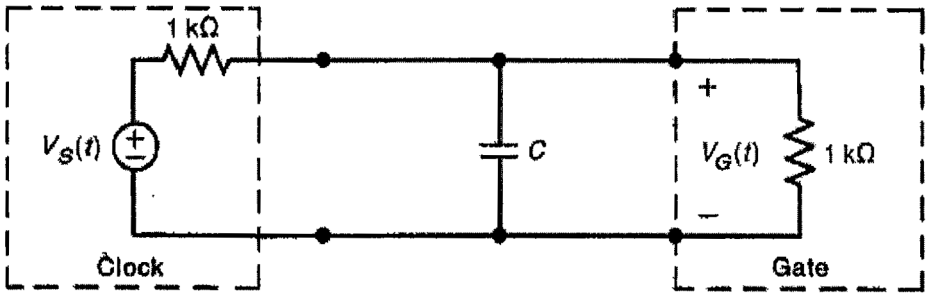

Fig. 1

Section C [Answer *any* one]

7. a) 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]

   b) Explain the effects of a single aperture and linear aperture arrays on shielding effectiveness. [5]

   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 9 circular holes (1mm radius) per square cm? The operating frequency of the microwave oven is 2.45 GHz. [5]

8. Write short notes on (any two): [2x10]
   a) Human body model for ESD
   b) ESD protection techniques
   c) Arc suppression techniques