9. (a) What do you mean by EMI? Why rf shielding is desirable? Design one technique to achieve rf shielding.

   (b) Why EMC is needed in present day electromagnetic environment? Discuss method/s to achieve EMC standards.

5 + 7 = 12

ANTENNA AND RADIATING SYSTEMS
(ECEN 5101)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) The current distribution along a short dipole ($l<<\lambda$) may be assumed to be
   (a) sinusoidal (b) constant
   (c) triangular (d) sawtooth.

   (ii) A ground wave gradually disappears as one moves away from the transmitter because of
   (a) interference from sky wave
   (b) finite conductivity of the earth's surface
   (c) loss of LOS communication
   (d) maximum single hop distance limitation.

   (iii) The skip distance is
   (a) same for each layer
   (b) independent of the state of ionization
   (c) independent of frequency
   (d) independent of transmitted power.

   (iv) Maximum usable frequency is given as
   (a) $f_c \cos\theta_i$ (b) $f_c \sin\theta_i$
   (c) $f_c \sec\theta_i$ (d) $f_c \cos\theta_r$.

   (v) Optimum working frequency generally taken as
   (a) 15% above MUF (b) 15% below MUF
   (c) 10% above MUF (d) 10% below MUF.

   (vi) The FNBW of an antenna
   (a) is less than its HPBW (b) is greater than its HPBW
   (c) may be equal to its HPBW (d) any one of (a), (b) and (c).

(vii) The input impedance of a folded dipole antenna is __ times that of a regular dipole antenna.
(a) 1 (b) 2
(c) 4 (d) 8

(viii) In a broad side array, the antenna radiates
(a) parallel to the line of the array
(b) perpendicular to the line of the array
(c) at an angle of 45° with respect to the array axis
(d) isotropically.

(ix) Which one of the following antennas will be useful to measure radiated emission over a frequency range of 1 – 12 GHz?
(a) dipole antenna (b) microstrip antenna
(c) yagi-uda (d) ridged horn antenna.

(x) The effects of EMI can be reduced by
(a) suppressing emission
(b) reducing the efficiency of the coupling path
(c) reducing the susceptibility of the radiator
(d) all of (a), (b) and (c).

Group – B

2. (a) Explain the relevance of complex poynting vector in electromagnetic field analysis with suitable expressions.

(b) Derive general wave equations for defining electromagnetic radiation of an antenna.

(c) Derive radiation resistance expression for Hertzain Dipole antenna.

2 + 5 + 5 = 12

3. (a) Derive the phasor representation of an infinitesimal dipole for the electric field when the dipole is placed at the origin along the z axis.

(b) A lossless resonant half wave dipole antenna with input impedance 73Ω is connected to a transmission line whose characteristic impedance is 50Ω. Find the efficiency if the antenna.

8 + 4 = 12

Group – C

4. (a) Explain the concept of resonant and non resonant V-antenna. Point out respective advantages and disadvantages. Design a V-antenna for f = 10 MHz with directivity as 6 dB.

(b) Find out the operating frequency of a short dipole and short monopole antenna if the radiation resistance is 0.05 Ω and (i) dipole length 70 mm (ii) monopole height 120 mm.

7 + 5 = 12

5. (a) What do you mean by antenna array? Classify antenna array based on (i) geometrical configuration (ii) associated radiation pattern.

(b) Why null placement in array system is desired? Develop a method to achieve such objective and point out limitations of the method if any.

4 + 8 = 12

Group – D

6. (a) Derive an expression of flare angle for a pyramidal horn antenna. Write the applications and advantages of horn antenna.

(b) Calculate the beamwidth, directivity and gain of a 12 cm × 8 cm pyramidal horn antenna which is operating at 8 GHz with aperture efficiency of 60 %.

7 + 5 = 12

7. (a) Explain the concept of effective dielectric constant as applied to general microstrip architecture.

(b) Explain the radiation mechanism of a rectangular microstrip patch antenna.

4 + 8 = 12

Group – E

8. (a) Differentiate between actual height and virtual height related to ionosphere wave propagation with suitable diagram.

(b) A pulse of a given frequency is transmitted upwards and it is received back after a period of 2 ms. Find the virtual height of the reflecting layer.

(c) Explain multipath fading with relevant diagram. Calculate the critical frequency for a medium at which the wave reflects if the maximum electron density is 1.24×10^6 electrons/cc.

(d) A transmitter radiates 100 Wof power at a frequency of 50 MHz, so that space wave propagation takes place. The transmitting antenna has a gain of 5 and its height is 50 m. The receiving antenna height is 2 m. It is estimated that field strength of 100 V/m is required to give a satisfactory result. Calculate the distance between transmitter and receiver.

3 + 2 + (2 + 2) + 3 = 12