# M.TECH/ECE/1ST SEM/ECEN 5101/2018
## ANTENNA & 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) A simple dipole at 5.8 GHz placed along x-axis is used as a transmitter. Which among the following would be the best receiver? A dipole placed along
(a) xz-plane (b) z- axis (c) xy- plane (d) yz-plane.

(ii) The radiation efficiency can have the maximum value as:
(a) 100% (b) 90% (c) 95% (d) ∞.

(iii) An ideal binomial array has
(a) infinite gain (b) no side lobes
(c) infinite sidelobes (d) no gain.

(iv) A magnetic current source placed normally on a perfect electric conductor produces
(a) a positive image (b) a negative image
(c) does not produce an image (d) cannot comment.

(v) For a travelling wave antenna, if the length of the antenna is increased, the major beam of radiation pattern
(a) moves away from the axis
(b) comes closer to the axis
(c) does not depend on antenna length
(d) cannot be predicted.

(vi) Field equivalence principle is used to
(a) replace a current source with a voltage source
(b) replace fictitious sources with actual sources
(c) replace a voltage source with a current source
(d) replace actual sources with fictitious sources.





(vii) -10 dB return loss of an antenna corresponds to
(a) 1:1 VSWR (b) 2:1 VSWR (c) 3:1 VSWR (d) 4:1 VSWR.

(viii) Directivity of a parabolic reflector antenna whose aperture diameter is d can be given as:
(a) $D=1.5(d/\lambda)^2$ (b) $D=9.87(d/\lambda)^2$
(c) $D=4.5(d/\lambda)^2$ (d) $D=6.4(d/\lambda)^2$.

(ix) The length of a microstrip patch printed on substrate of relative dielectric constant $\varepsilon_r$ is given as:
(a) $L=0.56(\lambda_0/(\varepsilon_r)^{1/2})$ (b) $L=0.59(\lambda_0/(\varepsilon_r)^{1/2})$
(c) $L=0.49(\lambda_0/(\varepsilon_r)^{1/2})$ (d) $L=0.46(\lambda_0/(\varepsilon_r)^{1/2})$.

(x) The ratio of the ERP of N element and the ERP of single element when both are fed by power P and having gain G is defined as:
(a) N (b) 2N (c) $N^2$ (d) $4N^2$

### Group – B

2. (a) How would you derive the electric and magnetic field of an arbitrary antenna, given the source current?

(b) The radial component of the radiated power density of an infinitesimal linear dipole is given by $W = A_0 \frac{\sin^2\theta}{r^2} a_r$. Determine its directivity.

(c) With appropriate diagram and explanation, show why doesn't a two wire conductor radiate in the far field.

**4 + 4 + 4 = 12**

3.(a) What is sky wave propagation? Explain with suitable diagram.

(b) What do you mean by impedance bandwidth of an antenna? Based on impedance bandwidth, explain the classification of antennas.

(c) If the power transmitted from a transmitter is 10 kW and gains of transmitting and receiving antennas are 30 dB and 20 dB respectively then calculate the maximum power received at a distance of 10 km over free space for 2 GHz transmission frequency.

**2 + 5 + 5 = 12**

### Group – C

4.(a) Highlight the characteristic of travelling wave antennas which are not evident in resonant type antennas. What is the disadvantage of using these antennas?

(b) Describe the operating principle of a log periodic dipole array.

(c) What is a balun used for in antenna designs?

**4 + 6 + 2 = 12**

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

(b) Write short note on feed systems of parabolic reflectors.

**5 + 7 = 12**

## Group – D

6. (a) Explain the concept of edge element controlled null placement in uniformly excited linear array.

(b) Derive the expression for maxima, minima, FNBW and directivity of N elements uniform broadside array. Plot the radiation pattern of an array in broadside which consists of four isotropic elements fed with equal magnitude of currents and in same phase and inter-element spacing of half wavelength.

**5 + 7 = 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) Derive an expression for maximum useable frequency (MUF) for the flat earth.

(b) Derive an expression to convert radio horizon in to optical horizon.

**5 + 7 = 12**

9.(a) A transmitter operating at 2 MHz provides ground wave electric field strength of 1 mV/m at a distance of 8 km. A short vertical transmitting antenna with efficiency 60% is used for transmission. The ground conductivity is given as $5.3 \times 10^{-5}$ mho/cm and relative permittivity is 10. Find the transmitted power.

(b) Explain the physical principle of RF shielding. Discuss how RF shielding is realized in the design of microwave oven.

**5 + 7 = 12**