

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2019
ANTENNA AND WAVE PROPAGATION

(Electronics and Communication Engineering)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
 2. Answer **ALL** the question in **Part-A**
 3. Answer any **FOUR** Questions from **Part-B**

PART –A

(14 Marks)

1. a) What is the difference between E-plane and H-plane pattern? [2M]
- b) Calculate the radiation resistance of half wave dipole. [2M]
- c) What are the advantages of Binomial arrays? [2M]
- d) Mention the properties of patch antennas. [3M]
- e) Give the applications of horn antenna. [3M]
- f) In which frequency range ground wave propagation is useful? [2M]

PART –B

(56 Marks)

2. An antenna with a radiation resistance of 48Ω , a loss resistance of 2Ω , and a reactance of 50Ω is connected to a generator with open circuit voltage of 10 V and internal impedance of 50Ω via $\lambda/4$ long transmission line with characteristic impedance of 100Ω . [14M]
 - i) Draw equivalent circuit.
 - ii) Determine power supplied by generator, and
 - iii) Determine power radiated by antenna.
3. a) A short antenna of height $h=l/2$ is mounted on a conducting plane. Show that its radiation resistance is one-half that of a short dipole antenna of length l and carrying the same current. [7M]
- b) Compare monopole antennas and dipole antennas. [7M]
4. a) Write short notes on Broadside arrays and End fire arrays. [7M]
- b) Draw the radiation pattern of 8 – isotropic elements fed in phase, spaced $\lambda/2$ apart with the principle of pattern multiplication. [7M]
5. a) Explain about salient features of Microstrip Antennas. [7M]
- b) What are the advantages and limitations of Microstrip antennas? Explain. [7M]
6. a) List out the differences between active and passive corner reflectors. [7M]
- b) With reference to paraboloids, explain the following: [7M]
 - i) f/D ratio
 - ii) Spill over and aperture efficiency
 - iii) Front to back ratio
 - iv) Types of feeds.
7. a) Describe briefly the salient features of ground wave propagation. [7M]
- b) Explain the “wave tilt of surface waves” in ground wave propagation. [7M]

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PART -A

(14 Marks)

1. a) Define the beam width of an antenna. [2M]
- b) Find the effective area of half wave dipole operating at 200 MHz which has a directivity of 1.644. [2M]
- c) What is the principle of pattern multiplication? [2M]
- d) What happens if length of the wire in travelling wave antenna increases? [3M]
- e) Explain why an antenna using a parabolic reflector is likely to be highly directive receiving antenna? [3M]
- f) In which frequency range Sky wave propagation is useful? [2M]

PART -B

(56 Marks)

2. a) With the help of neat diagrams, explain the principle of radiation mechanism in antennas. [7M]
- b) A source has a constant power pattern limited to top half of the hemisphere only. Find its directivity and effective area. [7M]
3. a) An infinitesimal electric dipole is centered at the origin and lies along z-axis. Find the far -zone electric and magnetic fields radiated. [7M]
- b) An infinitesimal electric dipole is centered at the origin and lies on the x-y plane along a line which is at an angle of 45° with respect to the x-axis. Find the far -zone electric and magnetic fields radiated. [7M]
4. a) Show that the directivity can be improved by using n elements in broadside or end fire array. [7M]
- b) Prove that the level of secondary lobe is -13.5 dB below that of major lobe in a uniform linear array. [7M]
5. a) Sketch the typical geometry of a helical antenna radiating in axial mode. List out all its parameters and basic characteristics. [7M]
- b) Explain the differences between travelling wave antenna and standing wave antennas. [7M]
6. a) Explain the principle of formation of images in an active corner reflector antenna. Hence sketch the image formation for a 90° corner reflector. Obtain array factor for 90° corner reflector. [7M]
- b) What is the principle of equality of path length? How is it applicable to Horn antennas? Obtain an expression for the directivity of a pyramidal horn in terms of its aperture dimensions. [7M]

7. a) List out the modes of propagation and their frequency ranges for radio waves. Show that an approximate estimate for the magnitude of electric field strength at VHF and above is given by $\left(\frac{240 * I * \pi * h_1 * h_2}{\lambda d^2}\right)$. [7M]
- where I - current in the $\lambda/2$ transmitting aerial;
h₁, h₂ - heights of Transmitting and Receiving antennas;
d - direct distance between aerials;
 λ - wavelength.
- Specify the assumptions made for the validity of the above expression.
- b) Write a short notes on [7M]
- i) MUF
 - ii) Virtual Height
 - iii) Wave tilt
 - iv) Multi hop Transmission.

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PART -A**(14 Marks)**

1. a) An antenna has directive gain of 50 dB. Find the effective aperture of the antenna. [2M]
- b) Calculate the radiation resistance of a quarter wave monopole. [2M]
- c) What is the use of antenna array? [2M]
- d) What is the advantage of terminating travelling wave antenna at one end other than feed? [3M]
- e) What is zoning for Lens antenna? [3M]
- f) In which frequency range space wave propagation is useful? [2M]

PART -B**(56 Marks)**

2. a) The normalized radiation intensity of an antenna is rotationally symmetric in ϕ and [7M]
 it is represented by
$$U = \begin{cases} 1 & 0 \leq \theta < 30^\circ \\ 0.5 & 30^\circ \leq \theta < 60^\circ \\ 0.1 & 60^\circ \leq \theta < 90^\circ \\ 0 & 90^\circ \leq \theta < 180^\circ \end{cases}$$
 What is the directivity (above isotropic) of antenna in dB?
- b) Derive the relationship between effective aperture area and gain of antenna. [7M]
3. a) Calculate effective length and effective aperture area of antenna whose radiation resistance is 73Ω . [7M]
- b) Derive the expression for power radiated and find the radiation resistance of a half wave dipole. [7M]
4. a) Find the radiation pattern of uniform linear array of four isotropic elements fed in phase, spaced $\lambda/2$. [7M]
- b) Find the radiation pattern of linear array of four isotropic elements fed in phase, spaced $\lambda/2$ and amplitude ratio of excitation sources is in the ratio 1:3:3:1. [7M]
5. a) Describe the characteristics of long wire travelling wave antennas; sketch their patterns for different lengths. [7M]
- b) Explain the design considerations for monofilar helical antennas in various modes. [7M]
6. a) With neat set up, explain the absolute method of measuring the gain of an antenna. [7M]
- b) Discuss Dielectric and metal Lens Antennas and their applications. [7M]
7. a) Derive the relationship between MUF and critical frequency. [7M]
- b) Determine the change in the electron density of E-layer when the critical frequency changes from 4 MHz to 1 MHz between mid-day and sun-set. [7M]



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PART –A

(14 Marks)

1. a) Draw the radiation pattern of omni-directional antenna. [2M]
- b) Why the effective length of linear antenna is less than physical length. [2M]
- c) Define array factor. [2M]
- d) What is the difference between resonant and non-resonant antenna. [3M]
- e) Explain how the efficiency of parabolic reflector affected by spillover. [3M]
- f) Define MUF? [2M]

PART –B

(56 Marks)

2. a) What is the difference between transmission line and dipole antenna. [3M]
- b) Sketch and comment on the current distributions and radiation patterns of vertical antennas of length $\lambda/2$, λ , $3\lambda/2$, 2λ . [7M]
- c) Write short notes on antenna field zones. [4M]
3. a) Compare far fields of small loop and short dipole. [7M]
- b) Prove that the radiation field of a half wave dipole is zero in the direction of its axis. Sketch the radiation diagram. Calculate HPBW. [7M]
4. a) What is Yagi-uda Antenna? Explain the construction and operation of Yagi-uda Antenna. Also explain its general characteristics? [7M]
- b) Explain the significance of folded dipole antenna. [7M]
5. a) Explain the principle of operation in V-antenna. [7M]
- b) What are the 3 independent parameters to be considered in design of Rhombic antenna? Write down the design equations. [7M]
6. a) How will you feed a parabolic reflector antenna? Explain aperture blockage and offset feed. [7M]
- b) Explain the principle and operation of Cassegrain antenna with a neat diagram. [7M]
7. a) Explain Duct propagation in detail. [7M]
- b) Find the range of LOS system when the receive antenna and transmit antenna heights are 10 m and 100 m respectively. Take the effective earth's radius into consideration. [7M]

