

**III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2016**  
**ANTENNAS 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. Answering the question in **Part-A** is compulsory  
 3. Answer any **THREE** Questions from **Part-B**

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**PART -A**

- |      |                                                                                                                                                                                          |      |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1 a) | Define the terms radiation intensity and directivity.                                                                                                                                    | [4M] |
| b)   | Compare the different types of wire antenna.                                                                                                                                             | [4M] |
| c)   | Given a linear broadside uniform array of isotropic elements, ( $N=\infty$ ) with a separation of $\lambda/4$ ( $d= \lambda/4$ ) between the elements. Find the directivity of an array. | [3M] |
| d)   | What are the advantages of Microstrip antennas?                                                                                                                                          | [3M] |
| e)   | Describe the cassegrain method of feeding a parabolic reflector.                                                                                                                         | [4M] |
| f)   | Define the terms MUF and Skip Distance                                                                                                                                                   | [4M] |

**PART -B**

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|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 2 a) | Explain the current distribution on a thin-wire antenna.                                                                                                                                                                                                  | [10M] |
| b)   | For an infinitesimal dipole excited by a constant RF current I, determine radiation intensity U, maximum value of U and directivity.                                                                                                                      | [6M]  |
| 3 a) | Explain the concept of Retarded Potentials.                                                                                                                                                                                                               | [10M] |
| b)   | A thin dipole is $\lambda/15$ long. If it has loss resistances of $1.5\Omega$ , calculate its directivity and gain                                                                                                                                        | [6M]  |
| 4 a) | With a neat sketch explain the operation of Yagi-Uda array.                                                                                                                                                                                               | [8M]  |
| b)   | Deduce an expression for the radiation pattern of an end-fire array with N vertical dipoles.                                                                                                                                                              | [8M]  |
| 5 a) | Find the directivity of 10 turn helix antenna having pitch angle $10^\circ$ , circumference C equal to $\lambda$ .                                                                                                                                        | [4M]  |
| b)   | Explain the radiation mechanism of microstrip antenna.                                                                                                                                                                                                    | [8M]  |
| c)   | Describe the different types of microstrip antennas                                                                                                                                                                                                       | [4M]  |
| 6 a) | Briefly explain about Flat Sheet Reflectors.                                                                                                                                                                                                              | [10M] |
| b)   | A paraboloid reflector of circular cross-sectional area 8000 sq.cm is uniformly excited at 5GHz. Calculate the HPBW and the gain.                                                                                                                         | [6M]  |
| 7 a) | Explain in detail about Ground wave propagation.                                                                                                                                                                                                          | [10M] |
| b)   | A television transmitter antenna has a height of 169 metres and the receiving antenna has a height of 16 metres. What is the maximum distance through which the TV signal could be received by space propagation? What is the radio horizon in this case. | [6M]  |

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**PART -A**

- 1 a) Define the terms beam efficiency and half-power beam width of an antenna. [4M]
- b) Find the radiation resistance of a 20 turn, 1m diameter small loop antenna operating at 10 MHz. If the loss resistance of 1-turn loop is  $1\Omega$ , find its radiation efficiency? [3M]
- c) Discuss the characteristics of folded dipoles. [4M]
- d) Describe the significance of Helical antennas. [4M]
- e) List the features of Lens antennas. [3M]
- f) Write a brief note on Radio Horizon. [4M]

**PART -B**

- 2 a) Explain the radiation mechanism in a single wire. [6M]
- b) The radiation intensity of an antenna is given by  $U(\theta) = \cos^4\theta$ ; ( $0 \leq \theta \leq 90^\circ$ ,  $0 \leq \phi \leq 360^\circ$ ). Find the half-power beam width (HPBW). [4M]
- c) Discuss the different field regions of an antenna. [6M]
- 3 a) Derive an expression for the radiation resistance of a short electric dipole element. [8M]
- b) What is meant by the effective area of an antenna? How is it related to the gain? [4M]
- c) Calculate the radiation resistance of a single-turn small circular loop having mean radius of  $\lambda/20$  and radiating in free space. [4M]
- 4 a) Explain in detail about Broadside and End-fire arrays. [12M]
- b) A broadside array operating at 100 cm wavelength consists of four half wave dipoles spaced 50 cm. Each element carries radio frequency current in the same phase and magnitude 0.5 Amp. Calculate the radiated power. [4M]
- 5 a) Describe the construction and operation of helical antenna under normal mode [8M]
- b) Explain the features and radiation properties of rectangular patch antennas. [8M]
- 6 a) Briefly explain about Corner Reflectors. [10M]
- b) The diameter of a parabolic reflector is 2m. For operation at 6 GHz, find the beam width between first nulls and the gain [6M]
- 7 a) Explain the following terms: (i) Critical frequency (ii) MUF [12M]  
 (iii) Skip Distance (iv) Virtual height
- b) Find the range of LOS system when the receive and transmit antenna heights are 10m and 100m respectively. Take the effective earth's radius into consideration [4M]

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**PART -A**

- 1 a) What are the factors that contribute to the efficiency of antenna? [3M]
- b) Find the radiation resistance and directivity of long wire resonant antenna of length  $l=\lambda$ ? [4M]
- c) Describe the concept of Scanning Arrays. [4M]
- d) Give the comparison between axial mode and normal mode of helical antenna. [3M]
- e) Write a brief note on Zoning. [4M]
- f) List the characteristics of Sky wave propagation. [4M]

**PART -B**

- 2 a) Explain the radiation mechanism in dipole. [6M]
- b) An antenna has a radiation resistance of  $72 \Omega$ , a loss resistance of  $8\Omega$  and a power gain of 12 dB. Determine the antenna efficiency [4M]
- c) Explain the isotropic, directional and omnidirectional patterns. [6M]
- 3 a) A half-wave dipole antenna is radiating 1KW and has a gain of 2.15dBi. Find the input power to the isotropic antenna which will radiate same field strength of the dipole [8M]
- b) Explain the concept of short magnetic dipole [8M]
- 4 a) Explain in detail about Binomial arrays. [10M]
- b) Discuss the radiation pattern of a linear array of the three isotropic sources spaced  $\lambda/2$  apart. The excitation of the sources is in-phase and have amplitude ratio 1:2:1. [6M]
- 5 a) Describe the construction and operation of helical antenna under axial mode. [8M]
- b) Explain the radiation mechanism in travelling wave radiator. [8M]
- 6 a) Explain the important design parameters of parabolic reflector antenna [10M]
- b) Give the comparison between horn antenna and paraboloidal reflector antenna. [6M]
- 7 a) A HF radio link has to be established between two points at a distance of 2500 Km on earth's surface considering the ionospheric height to be 200 Km and its critical frequency 5 MHz. Calculate the MUF for the given path. [6M]
- b) Explain in detail about sky wave propagation. [10M]

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**PART -A**

- |      |                                                                   |      |
|------|-------------------------------------------------------------------|------|
| 1 a) | Define the terms gain and resolution of an antenna.               | [4M] |
| b)   | Give the comparison of far fields of small loop and short dipole. | [3M] |
| c)   | Explain the principle of Pattern multiplication.                  | [4M] |
| d)   | What are the limitations of Microstrip antennas?                  | [3M] |
| e)   | Write a brief note on F/D ratio.                                  | [4M] |
| f)   | Explain the mechanism of reflection and refraction.               | [4M] |

**PART -B**

- |      |                                                                                                                                                                                                                                                               |       |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 2 a) | Briefly explain about principal pattern.                                                                                                                                                                                                                      | [6M]  |
| b)   | A lossless antenna has input impedance of $73\Omega$ . It is fed by a $50\Omega$ transmission line. If the radiation power pattern of the antenna is given by $U=4 \sin^3\theta$ , find the maximum absolute gain of the antenna and its overall efficiency . | [8M]  |
| c)   | Give the classification of polarization                                                                                                                                                                                                                       | [2M]  |
| 3 a) | Derive expressions for the components of the radiated field of a short dipole element.                                                                                                                                                                        | [8M]  |
| b)   | The mean radius of a small circular loop of constant current is $\lambda/10$ . Find the physical area of the loop                                                                                                                                             | [4M]  |
| c)   | Explain how a loop antenna is used for determining the field strength in a medium.                                                                                                                                                                            | [4M]  |
| 4 a) | For a 6-element Yagi array for operation of 500 MHz with a folded dipole, find the length of reflector element and driven element.                                                                                                                            | [4M]  |
| b)   | For an N-element uniform linear array, derive an expression for the array factor.                                                                                                                                                                             | [6M]  |
| c)   | Write a brief note on Parasitic elements.                                                                                                                                                                                                                     | [6M]  |
| 5 a) | Explain the design considerations for monofilar helical antennas in different modes.                                                                                                                                                                          | [10M] |
| b)   | Discuss the basic properties of helical antennas.                                                                                                                                                                                                             | [6M]  |
| 6 a) | Find the BWFN and power gain of a 2m paraboloid reflector operating at 6000 MHz.                                                                                                                                                                              | [4M]  |
| b)   | Describe the directivity and gain measurements of an antenna.                                                                                                                                                                                                 | [12M] |
| 7 a) | What is the critical frequency for reflection at vertical incidence, if the maximum value of electron density is $1.24 \times 10^6$ per $\text{cm}^3$ .                                                                                                       | [6M]  |
| b)   | Explain in detail about Tropospheric wave propagation..                                                                                                                                                                                                       | [10M] |

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