Hall Ticket No | | | | | | | | | | | Question Paper Code: AECC18

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech V SEMESTER END EXAMINATIONS (REGULAR/ SUPPLEMENTARY) - FEBRUARY 2024
Regulation: UG20

ANTENNAS AND WAVE PROPAGATION

Time: 3 Hours **(ELECTRONICS AND COMMUNICATION ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Explain the fundamental concepts in antenna engineering, focusing on the introductory aspects and basic parameters such as patterns, beam area, and beam efficiency. Provide a comprehensive overview of how these parameters influence the performance of antennas in communication systems [BL: Understand| CO: 4|Marks: 7]

   (b) (b) Consider a parabolic dish antenna with a diameter D=2 operating at a frequency of 5 GHz. The antenna is fed with a transmitter power of 20 watts, and the radiation pattern characteristics are such that the main lobe power is 15 watts, and the total radiated power is 18 watts. Calculate the gain, directivity, and efficiency of the antenna. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Investigate the realm of horn antennas, delineating the various types and elucidating the fundamental design equations governing their construction. Provide a detailed examination of the design equations, encompassing aspects like flare angle, aperture size, and length.
   [BL: Understand| CO: 2|Marks: 7]

   (b) Consider a Yagi Uda antenna operating at 900 MHz with the following specifications. i) The driven element has a length of 0.5 and is positioned at the center. ii) There are five directors with lengths decreasing from 0.45λ to 0.35λ iii) The reflector has a length of 0.55λ. Calculate the total length of the Yagi-Uda antenna, wavelength and element length.
   [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Given the basic characteristics of microstrip antennas, how do their compact size, frequency agility, and ease of integration influence their suitability for applications in modern wireless communication systems? Provide examples of specific scenarios where these characteristics make microstrip antennas advantageous compared to other antenna types.
   [BL: Understand| CO: 3|Marks: 7]

   (b) Elucidate the fundamental concepts underlying their operation of smart antennas. What key technologies and principles contribute to the ”smart” capabilities of these antennas in enhancing wireless communication systems? [BL: Apply| CO: 3|Marks: 7]

4. (a) Elaborate on the design and operating principles of paraboloidal reflectors. How does the parabolic shape of the reflector contribute to focusing incoming electromagnetic waves, and what role do feed antennas play in these systems [BL: Understand| CO: 4|Marks: 7]

   (b) Explore the applications of Babinet's Principle in the context of slot antennas. How does Babinet's Principle aid in the analysis, design, or understanding of slot antennas, and what insights can be gained by considering the complementary relationship between a conducting screen and its aperture? [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Illustrate the principle behind the broadside radiation pattern. How does the arrangement of individual antenna elements contribute to achieving a broadside radiation pattern, and what are the typical applications for antennas with this configuration? [BL: Understand| CO: 5|Marks: 7]

   (b) Describe in detail the concept of pattern multiplication in the context of these antennas. If each antenna has its own way of sending signals (its radiation pattern), how does pattern multiplication affect the combined signal's radiation pattern? [BL: Apply| CO: 5|Marks: 7].

6. (a) Describe the essential components and parameters involved in setting up a measurement for antenna directivity. What are the key instruments and techniques used to accurately measure the directivity of an antenna in a controlled laboratory environment?
   [BL: Understand| CO: 5|Marks: 7]

   (b) Demonstrate how the choice of binomial coefficients in the array factor influences the directivity of the antenna array. What role do the coefficients play in determining the beamwidth of the antenna? [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) highlight the key differences between mechanical waves and electromagnetic waves, mentioning the characteristics that distinguish them in terms of their propagation through various mediums.
   [BL: Understand| CO: 6|Marks: 7]

   (b) Elaborate on the differences between slow fading and fast fading, providing examples of situations where each type is likely to occur in wireless communication systems. Also explain path loss in the context of radio wave propagation and outline the factors that contribute to it.
   [BL: Apply| CO: 6|Marks: 7]

8. (a) Outline the concept of wave tilt in ground wave propagation and how it influences the coverage area. Additionally, provide insights into the factors that contribute to curved earth reflections in this mode. [BL: Understand| CO: 6|Marks: 7]

   (b) Explain the concept of Critical Frequency (fo), Maximum Usable Frequency (MUF), and Lowest Usable Frequency (LUF) in the context of ionospheric propagation. What are the fundamental characteristics and units associated with each of these parameters? [BL: Apply| CO: 6|Marks: 7]