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**Presidency University**

**Bengaluru**

**SCHOOL OF ENGINEERING**

**Summer Term End-Term Examinations, August 2024**

**Date**: 06/08/2024

**Time**: 09:30am – 12:30pm

**Max Marks**: 100

**Weightage**: 50%

**Odd Semester**: Summer Term End-Term 2024

**Course Code**: ECE3112

**Course Name**: Antenna and Microwave Engineering

**Department:** ECE

**Instructions:**

1. *Read the all questions carefully and answer accordingly.*
2. *Do not write any matter on the question paper other than roll number.*

**PART A**

**Answer any SIX Questions. Each question carries 10 marks. (6Qx 10M= 60M)**

1. An antenna is a metallic device capable of transmitting electromagnetic waves efficiently. How many types of antennas are there? Explain each in brief with diagram. (CO:1 BL: Knowledge)
2. Assume a broadcasting system operating at 100MHz, employing a halfwave dipole antenna having a gain of 2.15 dB. The power supplied to the transmitting antenna is 1 kW. The minimum power to be delivered to the receiving antenna is 10^-9 W. If the distance between two antennas is 500 km. Find the minimum gain of receiving antenna. (CO:1 BL: Knowledge)
3. A directional coupler is a 4-port passive device generally used to design important circuit elements such as phase shifters, variable impedance, and balanced duplexers. Consider the case of an ideal directional coupler where all the ports are perfectly matched. Using the properties of S−parameters, arrive at the final S-matrix configuration for such a device. (CO:2 BL: Knowledge)

1. An antenna has 3 major elements namely: driven element, reflector, and director. It is designed to operate in very high and ultra-high frequency bands (30MHz - 3GHz) and is famous for its high gain and directivity. Identify the antenna and explain their construction very briefly.

(CO:1BL: Comprehension)

1. In microwave frequencies, the S parameters are more commonly used to represent the linear characteristics of RF circuits and components. Describe the S parameters for a two-port network with suitable S-matrix representation. (CO:1 BL: Knowledge)
2. The Friis Transmission Equation is used to calculate the power received from one antenna when transmitted from another antenna separated by some distance. Suppose you have been asked to design an antenna operating at 1 GHz with a gain of 25 dB. What power should be supplied to the transmitting

antenna such that the minimum power that is delivered to the receiving antenna is 10.8 mW. The transmitting and the receiving antenna are 0.5 km apart. The gain of the receiving antenna is 20 dB.

(CO:1 BL: Comprehension)

1. The Yagi–Uda antenna, is a directional antenna consisting of a reflector, a driven element, and one or more directors. These antennas find their utility in rooftop terrestrial television antennas, in point-to-point fixed communication links, in radar antennas, just to name a few. Suppose you have been asked to design a three-element Yagi-Uda antenna to operate at a frequency of 200 MHz.  
   (i) Mention all the necessary equations for the dimensions of the various elements and the inter-element-spacing.  
   (ii) Evaluate the dimension of all the elements. (CO:1 BL: Comprehension)
2. A microstrip antenna is a modern wireless device capable of transmitting microwave signals with low profile. What are the different types of microstrip antenna? List the applications of Microstrip antenna. (CO:1 BL:Comprehension)
3. Skywave propagation, also known as skip or ionospheric wave propagation, is a type of radio wave transmission that uses the Earth's ionosphere to reflect or refract radio waves back to Earth. Describe Sky-wave propagation with suitable diagrams. Explain the structure of the ionosphere with respect to radio wave propagation. (CO:1 BL:Comprehension)

**PART B**

**Answer any TWO Questions. Each question carries 20 marks. (2Qx 20M= 40M)**

1. A high frequency radio link has to be established between two points at a distance of 2500 Km on the earth’s surface. Considering ionospheric height to be 200 Km and its critical frequency 5 MHz, calculate the maximum usable frequency for the given path.

(CO:1 BL:Application)

1. Calculate the maximum single hop distance for D, E, F1 and F2 layers if their heights are assumed to be 70, 130, 230 and 350 km respectively above the earth and the angle of incidence is 10° in all cases. (CO:1 BL: Application)
2. The Critical frequencies at an instant observed for E, F1 and F2 layers were found to be 3, 5 and 9 MHz. Find the corresponding concentration of electrons in these layers. (CO:2 BL:Application)