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Question Paper Code: AECC32

# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

**B.Tech VI SEMESTER END EXAMINATIONS (REGULAR) - JULY 2023**
**Regulation: UG-20**
**MICROWAVE AND RADAR ENGINEERING**

**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) Obtain the expression for various parameters that describe the wave propagation of TE/TM mode in rectangular waveguide. [BL: Understand| CO: 1|Marks: 7]

   (b) A wave guide operating in TE10 mode has dimensions a = 2.26 cm and b = 1 cm. The measured guide wave length is 4 cm. Find

   i) Cut off frequency of the propagating mode

   ii) The frequency of operation

   iii) Maximum frequency of propagation in this mode [BL: Apply| CO: 1|Marks: 7]

## MODULE – II

2. (a) How does a magnetron sustain oscillations using cross-field? Assume $\pi$-mode of operation to explain the same. [BL: Understand| CO: 2|Marks: 7]

   (b) The beam voltage $V_0$ = 250v, beam current $I_0$= 15mA, and the signal voltage $V_{in}$= 35v are the parameters of a reflex klystron which operates at the mode n= 2. Find the input voltage and electronic efficiency. [BL: Apply| CO: 2|Marks: 7]

## MODULE – III

3. (a) Discuss the salient features of microwave measurements. Explain in detail the measurement of low and high voltage standing wave ratio (VSWR) meter with a neat diagram of Bench setup. [BL: Understand| CO: 3|Marks: 7]

   (b) For the given scattering parameters for a two-port network calculate the equivalent impedance parameters if the characteristic impedance is 50Ω.

   S11 = 0.4 + j0.7

   S12 = S21 = j0.6

   S22 = 0.3 - j0.8 [BL: Apply| CO: 3|Marks: 7]

4. (a) With neat diagrams demonstrate any two methods to measure impedance at microwave frequencies. [BL: Understand| CO: 4|Marks: 7]

   (b) List the precautions to be taken during microwave measurements. Describe with neat diagram, the working of CW radar with non zero IF. [BL: Understand| CO: 4|Marks: 7]

## MODULE – IV

5. (a) What are blind speeds? Suggest a method to reduce the effect of blind speeds for unambiguous detection of a moving target. [BL: Understand| CO: 5|Marks: 7]

   (b) Determine the range and doppler velocity of an approaching target using a triangular modulation FMCW radar. Given beat frequency fb(up) = 15KHz and fb(down) = 25KHz, modulating frequency=1MHz, $\triangle$f=1KHz and operating frequency=3GHz [BL: Apply| CO: 5|Marks: 7]

6. (a) With the aid of the block diagram, explain fully operation of an MTI system using a power amplifier in the transmitter. [BL: Understand| CO: 5|Marks: 7]

   (b) Calculate the minimum pulse interval and pulse repetition frequency required for Radar to detect unambiguous targets up to a range of 125miles. [BL: Apply| CO: 5|Marks: 7]

## MODULE – V

7. (a) Distinguish between branch type and balanced type duplexers. Draw and explain balanced type duplexer. [BL: Understand| CO: 6|Marks: 7]

   (b) An amplifier with a gain of 12 dB, a bandwidth of 150 MHz, and a noise figure of 4 dB feeds a receiver with a noise temperature of 900 K. Find the noise figure of the overall system. [BL: Apply| CO: 6|Marks: 7]

8. (a) Classify different types of displays? Explain them in detail. Give the relation between noise figure and noise temperature. [BL: Understand| CO: 6|Marks: 7]

   (b) The noise figure of a microwave receiver front-end is measured using theY-factor method. A noise source having an ENR of 22 dB, and a liquid nitrogen cold load (77 K) are used, resulting in a measured Y-factor ratio of 15.83 dB. What is the noise figure of the receiver? [BL: Apply| CO: 6|Marks: 7]

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