Hall Ticket No | | | | | | | | | | | Question Paper Code: AECB50

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech VII SEMESTER END EXAMINATIONS (REGULAR/SUPPLEMENTARY) - DECEMBER 2022

Regulation: R18

RADAR SYSTEMS AND PROCESSING

(ELECTRONICS AND COMMUNICATION ENGINEERING)

Time: 3 Hours **Max Marks: 70**

Answer FIVE Questions choosing ONE question from each module
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) With the help of suitable diagrams, describe the working principle of pulse radar. [BL: Understand| CO: 1|Marks: 7]

   (b) Mention the different range frequencies that radar can operate. A radar system transmits radar pulses of duration 2 s with a repetition rate of 1 kHz. Determine the maximum and minimum range of a radar. [BL: Apply| CO: 1|Marks: 7]

2. (a) Determine the radar range equation. Discuss about the factors that influence the prediction of radar range. [BL: Understand| CO: 1|Marks: 7]

   (b) Calculate the maximum unambiguous range of a pulse radar system whose operating wavelength is 8 cm, peak transmitter power is 1000kW, minimum detectable signal power is 10 to 13 W, area of the antenna aperture is $4m^2$, assuming a target of cross sectional area of 60sqm. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

3. (a) Demonstrate with the help of a suitable block diagram, the working principle of continuous waveradar. [BL: Understand| CO: 2|Marks: 7]

   (b) Calculate the operating wavelength if the target is moving with acceleration as same as acceleration of gravity and the received signal bandwidth is 50 Hz. [BL: Apply| CO: 2|Marks: 7]

4. (a) What is Doppler shift? Determine the equation for the relative velocity of the target with respect to radar. [BL: Understand| CO: 2|Marks: 7]

   (b) Certain radar uses linear frequency modulation to identify the stationary targets. The radar shows maximum frequency sweep of 15 MHz in 2.67 meter seconds. Determine the range of the target if the receiver produces a beat frequency of 2400 Hz. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

5. (a) How bind speed is measured? Explain bind speed and the methods for reducing the effects of blind speed. [BL: Understand| CO: 3|Marks: 7]

(b) A pulse doppler radar used a PRF of 40KHz,doppler filter bank was implemented digitally using a 1024-point discrete fourier transform (DFT). What is the bandwidth of each filter? If a moving target had a relative speed of 280m/s, in which filter the echo signal power appears dominantly? The radar used a carrier frequency of 4GHz. [BL: Apply| CO: 3|Marks: 7]

6. (a) Illustrate the working principle of the MTI radar in determining the range and velocity of the target with a suitable diagram. [BL: Understand| CO: 4|Marks: 7]

(b) A s-band radar utilizes a staggered waveform with four different PRFs which are 1422, 1031, 1438, 1100 Hz. What is first blind speed of the staggered PRF wave form? Note the N_i for these four frequencies are : 27,32,29,33 respectively. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

7. (a) Outline the sequential lobbing type of tracking technique in a tracking radar system with the neat block diagram. [BL: Understand| CO: 5|Marks: 7]

(b) For ground-based search radar with a beam width of 1.5 deg, the pulse repetition frequency is 300 Hz, and the antenna scan rate is 5 rpm (30deg /sec). Find the number of pulses returned from appoint target as the radar scans through the beam width. [BL: Apply| CO: 5|Marks: 7]

8. (a) Describe the working principle of a phase comparison mono pulse tracking radar system with a functional block diagram. [BL: Understand| CO: 5|Marks: 7]

(b) If the one way antenna power pattern of a conical scan tracking antenna is described by the Gaussian function, what is the loss received signal when the target is directly at the beam cross over? The antenna half power beam width is 2^0 and the squint angle is 0.75^0.
[BL: Apply| CO: 5|Marks: 7]

MODULE – V

9. (a) What is the purpose of slow wave structures used in TWT amplifiers? How are spurious oscillations generated in TWT amplifier? Explain. [BL: Understand| CO: 6|Marks: 7]

(b) A two cavity klystron operates at 10 GHz with $I_0 = 3.6$ mA, $V_0 = 10$ kV. The drift length is 2 cm and the output cavity total shunt conductance is $G_{sh} = 20$ μmho and beam coupling coefficient $\beta_0 = 0.92$. Find the maximum voltage gain. [BL: Apply| CO: 6|Marks: 7]

10. (a) Explain the working of the balanced duplexer using TR tubes in transmission conditions with the help of a suitable diagram. [BL: Understand| CO: 6|Marks: 7]

(b) A receiver with a mixer front end has noise figure of 6.4dB. An LNA with a noise figure of 2.2dB and gain of 15 dB is inserted ahead of mixer to reduce the overall receiver noise figure.

i) How much of the new noise figure is due to mixer noise, and by how much has the dynamic range of the receiver been reduced?

ii) If the gain of LNA were increased to 30 dB, what would be the receiver noise figure and the decrease in dynamic range? [BL: Apply| CO: 6|Marks: 7]

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