

# CBCS SCHEME



15EC833

## Eighth Semester B.E. Degree Examination, June/July 2023 RADAR Engineering

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. With neat block diagram explain conventional pulse radar with a superheterodyne receiver. (08 Marks)
- b. A ground based air-surveillance radar operates at frequency of 1300 MHz (L band). Its maximum range is 200nmi for the detection of a target with a radar cross section of one square meter ( $\sigma = 1\text{m}^2$ ). Its antenna is 12m wide by 4m high, and the antenna aperture efficiency is  $\rho_a = 0.65$ . The receiver minimum detectable signal is  $S_{\min} = 10^{-13}\text{W}$ . Determine the following:
- Antenna effective aperture  $A_e$  (square meters) and antenna gain  $G$  in numerically and decibel.
  - Peak transmitter power.
  - Pulse repetition frequencies to achieve a maximum unambiguous range of 200nmi.
  - Average transmitter power, if the pulse width is  $2\mu\text{s}$ .
  - Duty cycle
  - Horizontal beam width (in degrees). (08 Marks)

OR

- 2 a. Briefly describe the major areas of radar applications. (08 Marks)
- b. Compute the following related to radar:
- What should be the pulse repetition frequency of a radar in order to achieve maximum unambiguous range of 60nmi?
  - How long does it take for the radar signal to travel out and back when the target is at the maximum unambiguous range?
  - If radar has a peak power of 800kW, what is its average power? Choose pulse width  $1.5\mu\text{s}$ . (03 Marks)
- c. Explain basic principle of RADAR with neat block diagram. (05 Marks)

### Module-2

- 3 a. Describe the different noise components present in radar systems. (07 Marks)
- b. Discuss various system losses in radar system. (04 Marks)
- c. Describe briefly range ambiguities in radar system. (05 Marks)

OR

- 4 a. Define Radar Cross Section (RCS)? State its properties and its expression. (06 Marks)
- b. L band radar operating at 1.25GHZ used a peak pulse power of 3MW and must have a range of 185.2Km for objects whose radar cross section is  $1\text{m}^2$ . If  $P_{\min}$  is  $2 \times 10^{-13}$  watt. What is the smallest diameter the antenna reflector could have, Assuming it to be full paraboloid with  $\eta = 0.65$ . (06 Marks)
- c. What are the roles of threshold in deciding minimum detectable signal? (04 Marks)

**Module-3**

- 5 a. With neat block diagram, explain how simple pulse radar extracts the Doppler frequency shift of the echo signal from the moving target. Also derive the equation for Doppler frequency shift. (08 Marks)
- b. Explain the working of digital Moving Target Indicator (MTI) Doppler signal processor with neat diagram. (08 Marks)

**OR**

- 6 a. Illustrate with neat block diagram single-delay line canceller. Also derive the expression for frequency response of single-delay line canceller. (08 Marks)
- b. List the limitations of single delay line cancellers and derive its associated equations. (08 Marks)

**Module-4**

- 7 a. Explain one angle co-ordinate amplitude comparison mono-pulse tracking with neat diagram. (06 Marks)
- b. Give comparison of monopulse and conical scan tracking. (04 Marks)
- c. Explain phase comparison monopulse Radar. (06 Marks)

**OR**

- 8 a. Explain sequential lobing technique for tracking radar. (08 Marks)
- b. Explain two angle co-ordinate amplitude comparison monopulse with block diagram. (08 Marks)

**Module-5**

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- 9 a. List the different functions served by radar antenna. (08 Marks)
- b. What is the role of duplexers in radar system? Illustrate the transmit condition and receiver condition in case of balanced duplexer. (08 Marks)

**OR**

- 10 a. List the advantages and limitations of electronically steered phased array antenna. (08 Marks)
- b. Explain different types of radar display system. (08 Marks)

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