

Eighth Semester B.E. Degree Examination, June/July 2019
RADAR Engineering

Time: 3 hrs.

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:
 - i) Antenna effective aperture A_e (square meters) and antenna gain G in numerically and decibel.
 - ii) Peak transmitter power.
 - iii) Pulse repetition frequencies to achieve a maximum unambiguous range of 200nmi.
 - iv) Average transmitter power, if the pulse width is $2\mu\text{s}$.
 - v) Duty cycle
 - vi) 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:
 - i) What should be the pulse repetition frequency of a radar in order to achieve maximum unambiguous range of 60nmi?
 - ii) How long does it take for the radar signal to travel out and back when the target is at the maximum unambiguous range?
 - iii) 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. Derive the modified RADAR equation in terms of signal-to-noise ratio. (08 Marks)
- b. Discuss briefly following types of signal losses in radar:
 - i) Microwave plumbing losses
 - ii) Antenna losses
 - iii) Signal-processing losses. (08 Marks)

OR

- 4 a. Make use of portion of radar receiver block diagram, discuss with necessary equation the probability of false alarm and probability of detection. (08 Marks)
- b. Illustrate the concepts of pulse-repetition frequency and range ambiguities in case of radar. (08 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. Define monopulse tracker. Using block diagram, explain amplitude comparison monopulse tracking radar in on one angle coordinates. (08 Marks)
- b. With neat block diagram, explain conical scan tracking radar. (08 Marks)

OR

- 8 a. Discuss the concept of phase comparison monopulse. (08 Marks)
- b. Compare monopulse and conical radar tracking system. (08 Marks)

Module-5

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

OR

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