

**Eighth Semester B.E. Degree Examination, July/August 2022**  
**Radar Engineering**

Time: 3 hrs.

Max. Marks: 100

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

**Module-1**

- 1 a. Explain conventional pulse radar with super heterodyne receiver with a neat block diagram. (08 Marks)
- b. A radar is expected to detect a target of cross sectional area of  $5\text{m}^2$ . The antenna used is a parabolic dish of diameter 3m. The radar operates at a wavelength of 10cm and transmits peak pulse power of 0.5mW. The receiver can detect a minimum signal power of  $10^{-13}\text{W}$ . Find the maximum range at which target can be detected. (07 Marks)
- c. Explain briefly, various applications of radar. (05 Marks)

**OR**

- 2 a. Define the following terms used in radar.  
i) Maximum unambiguous Range ii) Average power iii) Duty cycle iv) PRF. (08 Marks)
- b. Derive the simple form of radar rang equation. Deduce the equation to other forms also. (07 Marks)
- c. Compute the following related to radar  
i) What should be the PRF 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 of  $1.5\ \mu\text{s}$  (05 Marks)

**Module-2**

- 3 a. Derive the modified radar range equation in term of SNR. (08 Marks)
- b. Discuss with equation, the probability of false alarm and probability of detection using envelope detector. Draw the block diagram. (07 Marks)
- c. Write a note on PRF and range ambiguity with necessary waveforms. (05 Marks)

**OR**

- 4 a. Briefly explain the plumbing loss and antenna losses in radar. (08 Marks)
- b. Explain briefly, the following radar cross section of targets, i) Sphere ii) Cone sphere. (07 Marks)
- c. The bandwidth of an IF amplifier is 4MHz and the average false – alarm time that could be tolerated is 10min.  
i) Find the probability of false alarm  
ii) What is the ratio of threshold voltage to the RMS value of the noise  
iii) Voltage necessary to achieve this false alarm time. (05 Marks)

**Module-3**

- 5 a. Illustrate with a neat block diagram single delay line canceller. Also derive expression for frequency response of single DLC. (08 Marks)

- b. With a block diagram, explain the working of MTI Radar. (07 Marks)
- c. Define Blind speed. MTI order operating at a wavelength of 10cm has a PRF of 1KHz. Calculate the first three blind speeds in KMPH. (05 Marks)

**OR**

- 6 a. Starting from the basic principles, derive the equation for clutter attenuation and MTI improvement factor. (08 Marks)
- b. With necessary equations and block diagram, explain how simple pulse Doppler radar extracts the Doppler frequency shift of the echo signal from the moving target. Also derive the equation for Doppler shift. (07 Marks)
- c. Explain working of moving target detector with block diagram. (05 Marks)

**Module-4**

- 7 a. Define a monopulse tracker. Using block diagram, explain amplitude comparison tracking radar in on one coordinate. (08 Marks)
- b. What are the different types of tracking radar systems? (06 Marks)
- c. Discuss on tracking in range in tracking radar. (06 Marks)

**OR**

- 8 a. What do you mean by sequential lobing and conical scanning? Explain with a neat block diagram, conical scanning radar. (08 Marks)
- b. Compare monopulse and conical scan tracking radar. (06 Marks)
- c. Explain briefly, the phase comparison monopulse. (06 Marks)

**Module-5**

- 9 a. Discuss electronically steered phased array antenna with necessary equation for radiation pattern. (08 Marks)
- b. What are the functions of radar antenna? (06 Marks)
- c. Write a short note on radar displays. (06 Marks)

**OR**

- 10 a. What is the role of a duplexer in radar? Explain the working of balanced duplexer with neat diagram. (08 Marks)
- b. Explain the following antenna parameters  
i) Directive gain ii) Power gain iii) Effective Aperture (06 Marks)
- c. Write a short note on reflector antenna. (06 Marks)

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