

# CBCS SCHEME

15EC833



## Eighth Semester B.E. Degree Examination, November 2020 RADAR Engineering

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions irrespective of modules.*

### Module-1

- 1 a. Explain maximum unambiguous range of a radar with equation and graph. (06 Marks)  
b. Starting from the basic principles, derive simple form of radar range equation. Deduce the equation to other forms also. (06 Marks)  
c. A radar transmitter operates at 10GHz and transmits 250KW of peak pulse power. If the antenna has a gain of 4000 and power received from a target at 50KM is  $10^{-11}$  watts, find the radar cross section area of the target. (04 Marks)
- 2 a. Explain a conventional pulse radar with a superheterodyne receiver with a neat block diagram. (06 Marks)  
b. Draw a typical radar pulse waveform and explain PRF, PRI, duty cycle, peak transmitter power, average transmitter power neatly. (06 Marks)  
c. Explain the applications of radar. (04 Marks)

### Module-2

- 3 a. Briefly discuss on the prediction of radar range performance and the detection of signals in noise. (06 Marks)  
b. Explain on the radar cross section of sphere and cone-sphere targets. (08 Marks)  
c. An S – Band 3GHz radar is found to have a total two-way microwave plumbing loss of 4.8dB. The 100ft of RG – 113/U aluminum waveguide line loss is 1.0dB, duplexer and related devices loss is 2.0dB, rotary joint loss is 0.8B, connectors and bends loss is 0.3dB. Estimate the loss due to other RF devices. (02 Marks)
- 4 a. Explain the modified radar range equation with all details. (06 Marks)  
b. Discuss with equation and graphs the probability of false alarm and the probability of detection using a envelope detector. Draw the block diagram. (08 Marks)  
c. Briefly discuss on transmitter power, PRF and range ambiguities. If the noise figure of a receiver is 2.5dB, what reduction (measured in dB) occurs in the signal-to-noise ratio at the output compared to the signal-to-noise ratio at the input. (02 Marks)

### Module-3

- 5 a. With necessary equations and graphs, explain a CW Doppler radar and pulse Doppler radar with neat block diagrams. (08 Marks)  
b. Explain a N-pulse delay line canceler with neat block diagram, equations, waveforms and graphs. (06 Marks)  
c. A VHF radar at 220MHz has a maximum unambiguous range of 180nmi.
  - i) What is its first blind speed (in knots)?
  - ii) Repeat, but for an L – band radar at 1250MHz
  - iii) Repeat, but for an X – band radar at 9375MHz. (02 Marks)

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(02 Marks)

- 6 a. Explain the original moving target detector signal processor with neat block diagram and illustration diagram. (05 Marks)
- b. With neat block diagram explain a MTI radar with power amplifier transmitter. (05 Marks)
- c. Starting form basic principles, derive the equations for clutter attenuation and MIT improvement factor. (06 Marks)

**Module-4**

- 7 a. What are the different types of tracking radar systems? Explain with diagrams, how Angle – Tracking is done? (08 Marks)
- b. Explain with neat block diagram and waveforms, a conical scan tracking radar. (04 Marks)
- c. Compare and contrast the two major tracking systems. (04 Marks)
- 8 a. Explain a two coordinate (Azimuth and elevation) amplitude comparison monopulse tracking radar with neat block diagram. (06 Marks)
- b. Discuss on tracking in range of a tracking radar. (06 Marks)
- c. What do you mean by sequential Lobing and Conical scan? (04 Marks)

**Module-5**

- 9 a. List the functions of the radar antenna. (05 Marks)
- b. Explain receiver noise figure and derive the expression for noise figure of networks in cascade. (06 Marks)
- c. With all necessary details, explain a superheterodyne receiver. (05 Marks)
- 10 a. Explain directive gain, power gain, antenna radiation pattern, effective aperture and polarization of radar antennas with necessary equation and graphs. (05 Marks)
- b. Discuss on electronically steered phased array antennas. (05 Marks)
- c. Compare and contrast different types of display presentations in radar. (06 Marks)

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