Roll No. .... Total Pages : 04

BT-8/M-14 **8811**

RADAR ENGINEERING

ECE-404-E

Time : Three Hours] [Maximum Marks : 100

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Describe the basic principle and discuss various applications of radar. **10**

   (b) By defining various parameters, derive a simple form of the radar equation. **10**

2. (a) Explain the following factors impacting the performance of a radar system :

   (i) Collapsing loss

   (ii) Operator loss

   (iii) Radar system losses

   (iv) Losses due to Doppler Processing. **12**

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   (b) Five identical radars, each with a receiver having a square law detector, have partial overlap in their radar coverages so that not all radars are guaranteed to see each target. The outputs of all five radars are combined before a detection decision is made. If a target is seen on only one of the five radars and the other four radars see only receiver noise, what is the collapsing loss when the detection probability is 0.5 and the false alarm probability is 10^{-4} ? **8**

Unit II

3. (a) With the help of a diagram, describe the principle of an FM-CW radar ? How is the measurement of range carried out in this radar system ? **10**

   (b) Explain the function of the MTI delay line cancellor and derive an expression for clutter attenuation. **10**

4. (a) Draw the block diagram of a digital MTI signal processor with I and Q channels and explain its working. What are the factors that limit the system performance ? **8+3**

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(b) Compare the characteristics of airborne Doppler radars for (i) high prf, (ii) medium prf, and (iii) low prf pulse Doppler. 9

Unit III

5. (a) Draw the block diagram of two-coordinate amplitude comparison monopulse tracking radar and explain its working. 10

(b) Describe various factors that affect the accuracy of a tracking radar. 10

6. (a) Explain various functions performed by an automatic detection and tracking system, assuming a ground-based 2D air surveillance radar. 12

(b) Show that the phase of the echo from a dumbbell target (two unresolved isotropic scatters separated by a distance D) oriented along the radial direction is decorrelated if the frequency is changed by at least $c/2D$, where c is the velocity of propagation. 8

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Unit IV

7. (a) Define noise figure. Show that the noise figure of a mixer is approximately the product of its conversion loss and the IF amplifier noise figure, when the diode mixer has a low noise temperature ratio. 10

(b) Explain the effect of local oscillator on the receiver's dynamic range. 5

(c) Explain why a diode-limiter following the duplexer sometimes used as a receiver protector. 5

8. (a) Describe various types of stable oscillators which can be used in radar receivers. 10

(b) Explain the working of the following displays used in radar receivers :
(i) CRT display
(ii) Flat Panel Displays. 10

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