Code No: R05410404 **Set No.1**

IV B.Tech. I Semester Regular Examinations, November -2008
RADAR SYSTEMS
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Discuss the parameters on which maximum detectable range of a radar system depends.
   (b) Compute the maximum detectable range of a radar system specified below:
   Operating wavelength = 3.2 cm
   Peak pulse transmitted power = 500 kW.
   Minimum detectable power = 10^{-13} W.
   Capture area of the antenna = 5 sq.m.
   Radar cross-sectional area of the target = 20 sq.m. [8+8]
2. (a) Describe how threshold level for detection is decided in the presence of receiver noise for a specified probability of occurrence of false alarms.
   (b) Describe the effect of pulse repetition frequency on the estimated unambiguous range of radar. [8+8]
3. (a) With the help of a suitable block diagram ,explain the operation of a CW Doppler radar in a sideband super heterodyne receiver.
   (b) Calculate the Doppler frequency of stationary CW radar transmitting at 6 MHz frequency when a moving target approaches the radar with a radial velocity of 100 Km/Hour.
   (c) List the limitations of CW radar. [5+5+6]
4. (a) With the help of suitable block diagram, explain the operation of a FM-CW altimeter.
   (b) Discuss all the possible errors in the measurement accuracy of altitudes using a FM-CW radar. [8+8]
5. (a) What is a delay line canceller? Illustrate the concept of blind speeds based on the frequency response of a single delay line canceller.
   (b) Discuss the factors limiting the performance of an MTI system. [8+8]
6. (a) Discuss the effect of surface quality and reflection characteristics of a target on the angular tracking accuracy of a tracking radar.
   (b) Describe the phase comparison monopulse tracking technique in a radar system with the help of necessary block diagram. [8+8]
7. (a) Explain the principle behind the operation of duplexers and receiver protectors.

(b) Explain how a circulator can be utilized for a radar receiver protection.

(c) Define noise figure and noise temperature of a receiver system. [5+5+6]

8. Write short notes on the following:

(a) Displays for visual presentation of radar echo signal.

(b) Radiation patterns and feed arrangements for array antennas in a radar system. [8+8]

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Code No: R05410404 **Set No.2**

IV B.Tech. I Semester Regular Examinations, November -2008
RADAR SYSTEMS
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Derive fundamental radar range equation governed by minimum receivable echo power s_{min}.
   (b) Modify the range equation for an antenna with a transmitting gain G and operating at a wavelength, λ. [8+8]
2. (a) Describe the effect of (in terms of wavelength of operation) size of a simple spherical target on determination of radar cross section of the sphere.
   (b) What are multiple-time-around echoes? Explain the relation between unambiguous range estimation and multiple-time-around echoes. [8+8]
3. (a) What is Doppler frequency shift? Establish a relation between Doppler frequency shift and radial velocity of a moving target.
   (b) Explain how isolation between transmitter and receiver of a radar system can be achieved if single antenna is used for transmission and reception. [8+8]
4. (a) List out the possible errors for measurement of altitudes accurately using a FM-CW altimeter.
   (b) Discuss the results of multiple frequency usage for operating FM-CW radar while mentioning the limitations of multiple frequency usage in CW radars. [8+8]
5. (a) What are blind speeds? Suggest a method to reduce the effect of blind speeds for unambiguous detection of a moving target.
   (b) Calculate the lowest blind speed of an MTI system operating at 3.6 cm wavelength and transmitting at a pulse repetition time of 330 μS.
   (c) Explore the possibility of broadening the clutter rejection null using a second dlay line canceller in the MTI radar system. [5+5+6]
6. (a) With the help of a suitable block diagram, Sequential lobing type of tracking technique in a tracking radar system.
   (b) Compare and contrast conical scan and sequential lobing type tracking techniques.
   (c) Describe the process of acquiring a moving target prior to tracking it along with the patterns used for acquisition. [5+5+6]
7. (a) Derive the impulse response of a matched filter that is commonly used in a radar receiver.

(b) Describe any two types of duplexers used in radar receivers. [8+8]

8. Write short notes on the following:

(a) Visual displays to view radar echo signals in all types of radar systems.

(b) Applications, advantages and limitations of phased array antennas in radar systems. [8+8]

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Code No: R05410404 **Set No.3**

IV B.Tech. I Semester Regular Examinations, November -2008
RADAR SYSTEMS
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Draw the functional block diagram of simple pulse radar and explain the purpose and functioning of each block in it.
   (b) List major applications of radar in civil and military systems. [8+8]
2. (a) Establish a relation between the probability of false alarm and detection threshold level of a radar receiver in the presence of noise.
   (b) Estimate the radar cross-section of a spherical target if the wavelength of transmitting signal with reference to the target size is in Rayleigh region. [8+8]
3. (a) What is Doppler frequency shift? Discuss the effect of receiver bandwidth on the efficiency of detection and performance of a CW Doppler radar.
   (b) With the help of a suitable block diagram, explain the operation of a CW tracking illuminator application of a CW radar. [8+8]
4. Write short notes on the following:
   (a) Range and Doppler measurement of a target using a FM-CW radar.
   (b) Unwanted signals and the measurement errors in FM altimeter. [8+8]
5. (a) What are blind speeds? Suggest a method to reduce the effect of blind speeds for unambiguous detection of a moving target.
   (b) Calculate the lowest blind speed of an MTI system operating at 4.2 cm wavelength and transmitting at a pulse repetition time of 286 μS.
   (c) Explore the possibility of broadening the clutter rejection null using a second delay line canceller in the MTI radar system. [5+5+6]
6. (a) Describe automatic tracking of a target through range gating technique.
   (b) Describe sequential lobing type of error signal generation to track a target automatically.
   (c) List the merits and demerits of monopulse tracker over conical scan type tracker. [5+5+6]
7. (a) Define noise figure and equivalent noise temperature of a radar receiver.
   (b) A radar receiver is connected to a 50 ohm resistance antenna that has an equivalent noise resistance of 30 ohms. Calculate the noise figure of the receiver and the equivalent noise temperature of the receiver.

(c) Describe a method for beam steering of a phased array of antennas. [5+5+6]

8. (a) Describe briefly various visual displays to view radar echo signals in radar systems.

(b) Explain the necessity of a matched filter in aradar receiver to improve its signal-to-noise ratio based on the frequency response characteristic of the matched filter. [8+8]

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Code No: R05410404 **Set No.4**

IV B.Tech. I Semester Regular Examinations, November -2008
RADAR SYSTEMS
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) With the help of a suitable block diagram explain the operation of a pulse radar.
   (b) For the specifications of a radar listed below, compute the power received at 50 Km distance from the radar antenna.
   Operating wavelength = 3.0 cm
   Peak pulse transmitted power = 320 kW
   Transmitting gain, G of the antenna = 9.6 × 104
   Effective aperture area of receiving antenna = 5 sq.m
   Radar cross-sectional area of the target, σ = 12 sq.m. [8+8]

2. (a) Justify the requirement of integration of radar pulses to improve target detection process.
   (b) List all the possible losses in a radar system and discuss the possible causes of each of them. [8+8]

3. (a) With the help of a suitable block diagram, explain the operation of a CW radar with non-zero IF in the receiver.
   (b) Describe methods to achieve isolation between transmitter and receiver of a CW Doppler radar if same antenna is to be used for transmission and reception. [8+8]

4. (a) With necessary mathematical expressions, describe range and Doppler measurement if the transmitted signal of a CW radar is frequency modulated.
   (b) Describe the effect of sinusoidal modulating signal in the place of rectangular pulses on the performance of a radar. [8+8]

5. (a) With the help of necessary block diagram explain the operation of an MTI radar system with a power amplifier in the transmitter.
   (b) Compare and contrast the situations with a power amplifier and a power oscillator in the transmitter of an MTI system
   (c) Describe the method of staggering pulse repetition frequency to reduce the effect of blind speeds in an MTI system. [5+5+6]

6. Draw the block diagram of an amplitude comparison monopulse tracking radar in azimuth and elevation directions. Explain the functioning of this two dimensional tracking radar. [16]

7. (a) Describe the principle behind the operation of a phased array antenna in a radar system.

   (b) Substantiate the requirement of duplexers in efficient radar systems. Describe the operation of branch and balanced type duplexers with necessary diagrams. [8+8]

8. Write short notes on the following:

   (a) Beam steering and variations in beam width with variations in steering angle of an antenna array system.

   (b) Advantages, limitations and applications of antenna arrays in radar systems. [8+8]

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