Code No: **R1641041** **R16** **Set No. 1**

IV B.Tech I Semester Regular Examinations, October/November - 2019

RADAR SYSTEMS

(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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PART–A *(14 Marks)*

1. a) Define the Probability of detection. [2]
   b) Write the applications of CW Radar. [2]
   c) What is the first blind speed of an l-band Radar operating at 1.25 GHZ, when the PRF has a maximum unambiguous range of 380 km? [3]
   d) What are the drawbacks in sequential-lobing tracking? [2]
   e) Define noise temperature and describe the relation between noise figure and noise temperature. [3]
   f) Write the various functions of a duplexer. [2]

PART–B *(4x14 = 56 Marks)*

2. a) With the help of a neat block diagram, explain the principle of operation of Radar. [7]
   b) A Pulse Radar transmits a peak power of 1 MW. It has a PRT equal to 1000 micro sec. and the transmitted pulse width is 1 micro sec. Calculate (i) Maximum unambiguous range (ii) Average Power (iii)Duty Cycle (iv) Energy transmitted. [7]

3. a) How the Doppler shift and Radar range can be measured with FM-CW Radar? Explain. [7]
   b) Explain the operation of the multiple frequency CW Radar. [7]

4. a) Explain the operation of an MTI Radar with power oscillator transmitter. [7]
   b) Explain the frequency response characteristics of a MTI Radar using Range gated Doppler filters. [7]

5. a) Draw the block diagram and explain the operation of a Conical scan tracking Radar. [7]
   b) What is automatic detection and tracking? Explain its limitations. [7]

6. a) Explain the principle and characteristics of a Matched filter. [7]
   b) Derive the expression for matched filter's frequency response function. [7]

7. a) Draw and explain the structures of balanced duplexer during transmission and reception modes. [7]
   b) Briefly explain the concept of beam steering of Phased array antennas. [7]

Code No: **R1641041** **R16** **Set No. 2**

IV B.Tech I Semester Regular Examinations, October/November - 2019

RADAR SYSTEMS

(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B

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PART–A *(14 Marks)*

1. a) Describe the functions performed by the Radar. [3]
   b) Define the Doppler effect. [2]
   c) What are the limitations of MTI Radar? [2]
   d) Define the elevation angle with respect to Radar. [2]
   e) Define the efficiency of a Matched filter. [2]
   f) Write advantages of phased array antennas. [3]

PART–B *(4x14 = 56 Marks)*

2. a) What are the various Radar system losses? Explain in detail. [7]
   b) A monostatic radar uses the same circular aperture antenna for transmission and reception at 8 GHz; its diameter is 2.6 m, aperture efficiency of 60%; and radiation loss of 1.04; the transmit path loss is 1.4. The radar is to produce a minimum detectable signal of $4x10^{-14}$ w, when the targets radar cross section is 1 m^2 at a maximum range of 92 km. If the channel has a one way loss of 1.6, what transmitter peak power is required if the antenna points directly to the target? [7]

3. a) Explain the principle of operation of Frequency Modulated Continuous Wave Radar with a neat block diagram. [7]
   b) Calculate the Doppler frequency seen by a Stationary Continuous Wave Radar with a transmit frequency of 5 GHz when the target radial velocity is 100 km/h. [7]

4. a) What is the importance of staggered pulse repetition frequencies in the design of an MTI Radar? Explain. [7]
   b) Explain the function of a single delay line canceller and derive an expression for the frequency response function. [7]

5. a) Explain amplitude comparison Monopulse tracking radar with the help of a neat block diagram. [7]
   b) Write a brief note on acquisition and scanning patterns. [7]

6. a) Derive the expression for the frequency response of a Matched filter receiver with non white noise input. [7]
   b) Derive an expression for the effective Noise figure of two cascaded networks. [7]

7. a) Explain the functioning and characteristics of PPI display and A-Scope display. [7]
   b) What are Radomes? Explain its characteristics. [7]

Code No: **R1641041** **R16** **Set No. 3**

IV B.Tech I Semester Regular Examinations, October/November - 2019

RADAR SYSTEMS

(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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PART–A *(14 Marks)*

1. a) Write the applications of Radar. [2]
   b) What are the limitations of CW Radar? [2]
   c) Define Blind Speed and write the expression for it. [3]
   d) What are the functions of AGC in tracking Radar? [2]
   e) Define noise figure and describe the relation between noise figure and noise temperature. [3]
   f) Define beam width of an antenna and write the expression for it. [2]

PART–B *(4x14 = 56 Marks)*

2. a) What is probability of false alarm? Derive the expression for it. [7]
   b) In a Radar receiver the mean noise voltage is 80 mV and the IF bandwidth is 1 MHz. If the tolerable false alarm time is 25 minutes, calculate the threshold voltage level and the probability of false alarm. [7]

3. a) Explain the principle of operation of Continuous Wave Radar with non-zero IF receiver. [7]
   b) List down and explain the applications of CW and FM-CW Radar. [7]

4. a) Explain the operation of an MTI Radar with power amplifier transmitter. [7]
   b) A S-band air surveillance Radar operating at 3.1 GHz utilizes a staggered waveform with four different PRFs, which are 1222, 1031, 1138 and 1000 Hz.
      (i) What is the 1^{st} blind speed if a constant PRF is used which has a PRT is equal to average of four periods of the staggered waveform?
      (ii) What is the first blind speed of the staggered PRF waveform? (Note that n_i for these four frequencies are 27, 32, 29 and 33 respectively). [7]

5. a) Explain the basic principle of a sequential lobing tracking Radar with neat diagrams. [7]
   b) What are the factors need to be considered for optimum squint angle? Explain. [7]

6. a) Derive the frequency response function of the matched filter. [7]
   b) Explain about the efficiency of non-matched filters. [7]

7. a) What is a Duplexer and explain the principle of operation of typical Duplexer with a schematic diagram. [7]
   b) How the beam width of a Phased array antenna varies with the steering angle? Explain. [7]

Code No: **R1641041** **R16** **Set No. 4**

IV B.Tech I Semester Regular Examinations, October/November - 2019

RADAR SYSTEMS

(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B

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PART–A *(14 Marks)*

1. a) Describe the classification of Radars. [2]
   b) List out the advantages of FM-CW Radar. [2]
   c) Compare the MTI and Pulse Doppler Radar. [3]
   d) Define the azimuth angle with respect to Radar. [2]
   e) Write the properties of Matched filter. [3]
   f) Write the limitations of phased array antennas. [2]

PART–B *(4x14 = 56 Marks)*

2. a) Derive the expression for Radar range equation in terms of Signal-to-noise ratio. [7]
   b) A Radar uses one antenna with a gain of $3x10^4$ and operates with a peak transmitter power of 50 kW, wavelength of 7.5 cm and a total loss of 1.6. For a target range of 97.2 nmi, what target radar cross section is needed to produce an available received power of $2x10^{-12}$ W, if antenna points directly to the target? [7]

3. a) Explain the principle of operation of FM-CW altimeter with a near diagram. [7]
   b) What are the factors that limit the amount of isolation between Transmitter and Receiver of CW Radar? Explain. [7]

4. a) What are the limitations of MTI Radar? Explain. [7]
   b) MTI radar is operating at a frequency of 9 GHz with a PRF of 3000 Hz. Calculate the first two lowest blind speeds for this radar. Derive the formula used. [7]

5. a) Explain the Monopulse tracking in two angel coordinates. [7]
   b) Compare the various tracking techniques. [7]

6. a) What is meant by correlation? Explain cross correlation with the help of a neat block diagram. [7]
   b) Define noise figure and noise temperature. Obtain the relation between them. [7]

7. a) Explain characteristics of different radar displays. [7]
   b) Draw and explain the radiation pattern of phased array antennas. [7]