R15

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN

IV B.Tech I Semester Examinations
RADAR SYSTEMS
(Electronics & Communication Engineering)

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

Note: This question paper contains two parts A and B
Part A is compulsory which carriers 20 marks and all questions are to be answered .
Part B Consists of 5 SECTIONS (One SECTION for each UNIT). Answer all FIVE Questions, Choosing ONE Question from each SECTION and each Question carries 10 marks.

PART A **(20 Marks)**

1.

a) Radar angular measurements are referenced to true north and local horizontal plane. With reference to them Define Azimuth and Elevation angles and their ranges. [2M]
b) Define the term radar range resolution and write the equation. [2M]
c) Describe the Doppler Effect. [2M]
d) Establish a relation between Doppler frequency shift and radial velocity of a moving target. [2M]
e) Define MTI radars. [2M]
f) What are Range gate Doppler filters? [2M]
g) List out and describe the basic methods of scanning. [2M]
h) What is Squint angle? [2M]
i) What is a matched filter Receiver? [2M]
j) Write the equation for Noise figure. [2M]

Part B **50 Marks**

2. Derive the simple radar range equation in terms of minimum detectable signal to noise ratio $(S/N)_{min}$ and explain why $(S/N)_{min}$ is a better measure of a radar detection than the minimum detectable signal (S_{min}).

(OR)

3. Explain the Radar Cross Section (RCS) of sphere and cone-sphere targets.
4. Explain the principle of operation of CW Doppler radar with non zero IF receiver.

(OR)

5. Explain how range and Doppler measurements are performed using FM CW radar.
6. (a) Explain the principle of operation of MTI radar with power oscillator transmitter with a neat block diagram.
   (b) Discuss about blind speeds.

(OR)

7. What are Delay line cancellers and explain their filter characteristics?
8. Explain the operation of a two-coordinate Amplitude comparison mono pulse Tacking Radar.

(OR)

9. Write the differences between conical and mono pulse Tracking Radars.

10. (a) What is a matched filter receiver? Derive its frequency response function.

    (b) Describe the operation of matched filter with non white noise.

(OR)

11. Explain the following:

    i) Branch type duplexer

    ii) Balanced type duplexer

R15

MODEL PAPER –II

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN

IV B.Tech I Semester Examinations

RADAR SYSTEMS

(Electronics & Communication Engineering)

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

Note: This question paper contains two parts A and B
Part A is compulsory which carriers 20 marks and Answer all questions.
Part B Consists of 5 SECTIONS (One SECTION for each UNIT). Answer FIVE Questions, Choosing ONE Question from each SECTION and each Question carries 10 marks.

PART A **(25 Marks)**

1.

a) Explain the importance of Radar Pulse repetition frequency in determining the minimum range of radar. [2M]
b) List out some important applications of a radar system. [2M]
c) If the transmitting source is fixed and the radar target is approaching the source, What type of change the received frequency will undergo? [2M]
d) Why isolation between Transmitter and Receiver is required in CW Radar? [2M]
e) Define pulse Doppler radars [2M]
f) What is Butter fly effect? [2M]
g) What is sequential Lobing? [2M]
h) Explain Boxcar Generator in conical Scanning? [2M]
i) Define Noise Temperature and give it's relationship with Noise figure. [2M]
j) Explain what is a A scope display [2M]

Part B **50 Marks**

2. Write explanatory notes on:
   i) Minimum detectable signal
   ii) False alarm
   iii) Missed detection.

(OR)

3. Derive the maximum range for a radar system from first principles. Explain the applications of radar.
4. Define Doppler effect. Explain how it is used in CW radar.

(OR)

5. Explain the principle of operation of FMCW altimeter with suitable diagram.

6. Explain the concept of staggered PRFs in MTI radar.

(OR)

7. Draw the block diagram of MTI radar using range gates and filters and explain each block.

8. Explain the operation of amplitude comparison monopulse tracking radar with the help of a block diagram.

(OR)

9. Explain in detail about limitations to tracking accuracy.

10. a) Derive the matched filter characteristic.
    b) Discuss about efficiency of non-matched filters.

(OR)

11. a) Write short notes on various displays.
    b) Explain the operation of branch type duplexer with neat sketch.

R15

MODEL PAPER –III

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN

IV B.Tech I Semester Examinations

RADAR SYSTEMS

(Electronics & Communication Engineering)

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

Note: This question paper contains two parts A and B
Part A is compulsory which carriers 20 marks and Answer all questions.
Part B Consists of 5 SECTIONS (One SECTION for each UNIT). Answer FIVE Questions, Choosing ONE Question from each SECTION and each Question carries 10 marks.

PART A **(25 Marks)**

1.

a) Explain the relation between Pulse Repetition period and Pulse Repetition frequency in a Radar System. [2M]
b) Define Unambiguous range in a radar system. [2M]
c) Write the applications of CW Radar [2M]
d) What is the principle of FM Radar? [2M]
e) What is a delay line canceller? [2M]
f) Explain Staggered PRFs. [2M]
g) What is conical scanning? [2M]
h) What is Amplitude Comparison monopulse? [2M]
i) Give an expression for the effective Noise temperature of N cascaded stages [2M]
j) Explain what is a PPI display [2M]

Part B **50 Marks**

2. Write explanatory notes on:
   i) Receiver noise
   ii) Signal to noise ratio
   iii) Radar cross section of targets.

(OR)

3. a) Explain the basic principles of Radar and discuss about various parameters which improve the performance of the Radar.
   b) Discuss about Radar frequencies.
4. Explain how isolation between transmitter and receiver is obtained in CW radar.

(OR)

5. Explain how the noise signals are limiting the performance of FMCW altimeter.

6. Explain the following limitations of MTI radar.
   a) Equipment instabilities.
   b) Scanning modulation.

c) Internal fluctuation of clutter.

(OR)

7. a) Draw and explain the frequency response characteristics of a MTI using Range gates and filters.
   b) A MTI Radar operates at frequency of 6Ghz with a PRF of 800 PPS. Calculate the lowest blind speeds of this Radar.

8. a) Draw and explain the following with respect to Tracking in range:
      i. Echo pulse
      ii. Early-late range gates
      iii. Difference signal between early and late range gates.
   b) Limitations of automatic detection and tracking.

(OR)

9. a) Draw and explain the wave front phase relationships in phase comparison monopulse radar.

   b) Write a brief note on acquisition and scanning patterns.

10. a) Explain the basic concept of phased array antennas.
    b) Explain characteristics of different radar displays.

(OR)

11. a) Write notes on:
      i) Noise figure
      ii) Noise temperature.
    b) Explain any two types of mixers

R15

MODEL PAPER –IV

RAVIDRA COLLEGE OF ENGINEERING FOR WOMEN

IV B.Tech I Semester Examinations

RADAR SYSTEMS

(Electronics & Communication Engineering)

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

Note: This question paper contains two parts A and B
Part A is compulsory which carriers 20 marks and Answer all questions.
Part B Consists of 5 SECTIONS (One SECTION for each UNIT). Answer FIVE Questions, Choosing ONE Question from each SECTION and each Question carries 10 marks.

PART A **(25 Marks)**

1.

a) Distinguish between average power and Peak power and express the relation between the two. [2M]
b) Write simple Radar Equation. [2M]
c) If the target and the Frequency source are moving close to each other, with constant velocity, explain the change in the frequency? [2M]
d) What is the principle of CW Radar? [2M]
e) What are blind speeds? [2M]
f) What limitations of MTI Performance? [2M]
g) What is Monopulse Tracking Radar? [2M]
h) What is AGC in conical Scanning? [2M]
i) Explain what is a matched filter with a Non White Noise and give the expression for it's frequency response. [2M]
j) Explain the effect of Beam steering on the Beam width in a Phased array Radar and also give the expression for the beam width . [2M]

Part B **50 Marks**

2. What is Maximum Unambiguous Range? How is it related with pulse repetition rate?

(OR)

3. Explain in detail various system losses involved in Radar system.
4. a) What is the Doppler effect? What are some of the ways in which it manifests itself? What are its radar applications?
   b) What is the relation between bandwidth and the acceleration of the target with respect to radar?

(OR)

5. Discuss about the Multiple Frequency CW Radar.
6. a) Explain the function of time domain filter in a MTI Radar with an example.
   b) A MTI radar operates at 10GHz with a PRF of 300 pps. Calculate the lowest blind speed?

(OR)

7. a) What is an MTI Radar and how does it operate.
   b) Define blind speed. A MTI radar operates at 5 Ghz with a PRF of 100PPS. Find the three lowest blind speeds of this Radar. Explain the importance of Staggered PRF.
8. a) Compare the tracking techniques.

b) Explain in detail about limitations to tracking accuracy.

(OR)

9. a) With a neat diagram explain the operation of a conical scan Radar. Explain the various factors that need to be considered for optimum squint angle.

b) Explain with the help of a neat block diagram Amplitude comparison Monopulse radar for extracting error signals in both Azimuth and Elevation.

10. What is meant by correlation? Explain cross relation with the help of neat block diagram.

(OR)

11. Establish the impulse response characteristic for a matched filter

R15

MODEL PAPER –V

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN

IV B.Tech I Semester Examinations

RADAR SYSTEMS

(Electronics & Communication Engineering)

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

Note: This question paper contains two parts A and B
Part A is compulsory which carriers 20 marks and Answer all questions.
Part B Consists of 5 SECTIONS (One SECTION for each UNIT). Answer FIVE Questions, Choosing ONE Question from each SECTION and each Question carries 10 marks.

PART A **(20 Marks)**

1.

a) Explain the relation between Pulse Repetition period and Pulse Repetition frequency in a Radar System. [2M]

b) Explain what is meant by false alarm. [2M]

c) Explain how the Doppler effect is used to determine velocity of targets in Radar systems? [2M]

d) What is FM-CW Altimeter? [2M]

e) Compare and contrast the situations with a power amplifier and a power oscillator in the transmitter of an MTI system. [2M]

f) Distinguish between MTI and Pulse Doppler Radar. [2M]

g) What is Phase Comparison Monopulse? [2M]

h) Define Beam, rotation and Target axis in conical scanning. [2M]

i) What is the Rule of Thumb relation between the Bandwidth B and the pulse width v in a matched filter receiver [2M]

j) State a few important advantages of Phased array Radars [2M]

Part B **50 Marks**

2. a) Explain how a threshold level is selected in threshold detection?
   b) How to find the number of pulses that returned from a point target as the radar antenna scans through its beam width?
   c) Why most of the radar receivers are considered as envelop detectors while calculating the SNR?

(OR)

3. a) A low power, short range radar is solid-state throughout, including a low-noise RF amplifier which gives it an overall noise figure of 4.77dB. If the antenna diameter is 1m, the IF bandwidth is 500 kHz, the operating frequency is 8 GHz and the radar set is supposed to be capable of detecting targets of 5m2 cross sectional area at a maximum distance of 12 km, what must be the peak transmitted pulse power?
   b) The average false alarm time is a more significant parameter than the false alarm probability. Give the reasons.
   c) Why post detection integration is not as efficient as pre-detection integration of radar pulses?
4. a) Draw the block diagram of a FMCW Radar using side band super heterodyne receiver and explain it's operation.

b) With a transmit (CW) frequency of 5GHz, calculate the Doppler frequency seen by a Stationary Radar when the target radial velocity is 100 km/h (62.5 mph)?

(OR)

5. a) Explain the operation of the two frequency CW Radar.
   b) How to select the difference between the two transmitted signals of CW radar?
6. a) Compare MTI Radar with Pulse Doppler radar.
   b) Explain the function of a single delay line canceller and derive an expression for the frequency response function.

(OR)

7. a) Compare and contrast the situations with a Power amplifier and Power oscillator in the transmitter of a MTI system.
   b) Calculate the blind speed for a Radar with the following specifications: Wave length: 0.1 mtr and PRF : 200 Hz
8. Why is amplitude comparison mono pulse more likely to be preferred over the phase comparison mono pulse and conical scan tracker over sequential lobbing, or lobe switching tracker? Explain.

(OR)

9. a) Discuss in detail about the Amplitude fluctuations and how its effects are minimized.
   b) Explain Mono pulse tracking in two angle coordinates.
10. Explain the expression for frequency response of the matched filter with Non White noise.

(OR)

11. Explain how beam width of a phase array antenna will vary with steering angle.

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN

IV B.Tech I Semester Examinations

RADAR SYSTEMS

MODEL QUESTIONS UNIT WISE

UNIT I (**BASICS OF RADAR &RADAR EQUATION)**

1. Draw the block diagram of a Pulsed radar and explain its operation
2. Write the relative factors between the radar's cross section of the target and its true cross sections
3. Derive basic radar's equation
4. Explain about the frequencies used for radar
5. Discuss in detail the choice of various parameters that are affecting the radar range
6. Derive the range equation and discuss about its limitations
7. what do you understand by false alarm
8. A pulsed radar operating at 10GHz has an antenna with a gain of 28dB and a transmitter power of 2KW . If it is defined to detect a target with a cross section of 12sq.m and the minimum detectable signal is Pmin= -90dBm. What is the maximum range of the radar
9. What is meant by minimum detectable signal in radar. Discuss the effects of integration of radar pulses
10. What are the desirable pulse characteristics and the factors that govern them in a radar system
11. Discuss about detection of signals in noise
12. Describe the different noise components present in radar systems
13. Explain about PRF and range ambiguities
14. Explain about radar cross section of targets

UNIT II(CW AND FREQUENCY MODULATED RADAR)

1. Explain about Doppler effect
2. Explain the operation of CW radar with neat block diagram
3. derive the expression for the velocity of the target when the target is moving away from the radar in the case FM-CW radar
4. an 8GHZ Police radar measures a Doppler frequency of 1788HZ from a car approaching the stationary police vehicle in an 80 km/h speed limit zone .what should the police officer do?
5. Differentiate the operation of pulse radar from simple CW radar

6. Draw the block diagram of non coherent MTI radar and explain the function of each block in detail
7. Explain the advantages of non coherent MTI Radar
8. Explain the applications of CW radar.
9. Explain the principle of Doppler effect and its application CW radar.
10. Derive an expression for unambiguous range of a two frequency CW radar.
11) Explain the principle of operation FM –CW altimeter with suitable diagrams.
12) Determine the beat frequency due to range and the quantization error if range=100m, and the frequency excursion is 75Hz and modulating frequency is 1Khz.
13) Explain the operation of sideband superhetreodyne CW Doppler radar with block diagram.
14) Explain how the noise signals are limiting the performance of FM-altimeter .
15) What are advantages and disadvantages of FM-CW radar over multiple frequency CW radar.

UNIT III (**MTI AND PULSE DOPPLER RADAR)**

1) A simple MTI delay line canceller is an example of time domain filter .Why? Explain.
2) Enumerate the advantage of the time delay line canceller as compared to the convention frequency domain filter.
3) Draw the bloc diagram of four pulse canceller and find the weight for the same.
4) Differentiate three- pulse canceller from four pulse canceller.
5) Description of Range gate Doppler filters.
6) Differentiate blind phases from blind speeds.
7) Explain the effect of Doppler frequency ‘fd’ for the stationary objects and moving targets.
8)Explain the butterfly effect that is produced by MTI.
9) Draw and explain frequency response characteristics of a MTI using range gates and filters.
10) How does MTI radar differ from CW radar?
11) How does MTI radar differ from pulse Doppler radar?
12. What is the distinctive feature that makes the MTI radar and Pulse Doppler to differ ?

UNIT IV (**TRACKING RADAR)**

1) Explain Tracking Principles
2) Explain the block diagram of amplitude comparison monopulse radar for single angular coordinate and explain its operation
3).Explain phase comparison monopulse tracking radar technique
4).Explain the block diagram of AGC portion of tracking radar receiver
5).Explain about sequential Lobing
6).What are the advantages of monopulse radar over conical scan radar?
7).Distinguish between search radar and tracking radar?

8).Compare the tracking techniques
9).How is radar target acquired in a typical radar?

UNIT V(DETECTION OF RADAR SIGNALS IN NOISE &RADAR RECEIVERS)

1).Explain the characteristics of a matched filter receiver with necessary equations
2).Explain about matched and non –matched filters
3).Explain the characteristics of a cross –correlation receiver with a block diagram
4)Derive and explain the efficiency of non-matched filters
5).Explain about matched filter with non –white noise
6).Define the following terms
a)noise figure b)noise temperature c)system noise
7).Explain various types of radar displays
8).Three networks units ,each of 6db noise figure and 10db, 6db and 3db gains respectively are cascaded. Determine the Overall noise figure of the system.
9).Explain different types of Duplexers
10).Explain about Phased Array Antennas.