Code No: R41044 **R10** **Set No. 1**

IV B.Tech I Semester Regular Examinations, December 2013
RADAR SYSTEMS
(Electronics and Communication Engineering)

Time : 3 hours **Max. Marks: 75**

Answer any Five Questions
All Questions carry equal marks
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1 a) 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}). [10]
b) What should be the pulse repetition frequency and duty cycle of radar in order to achieve a maximum unambiguous range of 60 nmi with a pulse width of 1.5 μs? [5]

2 a) Explain the need for integration of radar pulses and how does this factor affect the radar range equation? [7]
b) A radar operates at a frequency of 1.35 GHz has an antenna of diameter 32 ft, a maximum unambiguous range of 220 nmi, and an antenna scan time of 10s. determine
(i) The number of echo pulses per scan received by the radar from a point target.
(ii) The integration loss and the integration improvement factor when the probability of detection is 0.9 and probability of false alarm is 10^{-4}. [3+5]

3 a) List out the applications of CW radar and explain the bandwidth requirements. [5]
b) Explain the FM-CW radar using sideband super heterodyne receiver with the help of a neat block diagram. [10]

4 a) With the help of a neat block diagram explain the operation of MTI radar with power oscillator transmitter and write its applications. [10]
b) Explain how are the moving targets are recognized on a PPI display using MTI radar. [5]

5 a) Explain the working of amplitude comparison monopulse radar in one-angular coordinate with the help of a neat block diagram. [10]
b) Explain why does tracking radar have poor accuracy at low elevation angles? [5]

6 a) Define and write the formulae for gain and effective aperture of an antenna. [5]
b) Explain the different types of phase shifters that can be used to obtain a change in phase in phased arrays. [10]

7 a) Explain the functioning of a Constant-False-Alarm-Rate (CFAR) receiver with a neat diagram. [8]
b) Explain the working of a cross-correlation radar receiver with neat block diagram. [7]

8 a) Explain the operation of a balanced type duplexers with the help of neat diagrams. [8]
b) List out the applications, advantages and limitations of phased arrays. [7]

Code No: R41044 **R10** **Set No. 2**

IV B.Tech I Semester Regular Examinations, December 2013
RADAR SYSTEMS
(Electronics and Communication Engineering)

Time : 3 hours **Max. Marks: 75**

Answer any Five Questions
All Questions carry equal marks
*****

1 a) What do you understand by the terms duty cycle and unambiguous range of radar? [4]
b) Write the various applications of radar. [4]
c) Find the maximum range of radar operating at a frequency of 12 GHz up to which a target of 3 m^2 can be detected, if the average transmitter power of 1Kw with a pulse width of 2 μs, PRF of 600 Hz and power gain of the antenna is 2400. The minimum detectable signal power by the receiver is 10^{-14} w. [7]

2 a) Explain the Radar Cross Section (RCS) of sphere and cone-sphere targets. What is a RCS fluctuation? [5]
b) Explain the different Swerling fluctuating target models in detail? [10]

3 a) Draw the block diagram of FM-CW radar and explain the range and doppler measurement. [10]
b) Explain the measurement of errors introduced in the CW radar. [5]

4 a) Derive an expression for blind speeds of MTI radar. Discuss the effect of large wavelength and large PRF on lowest blind speed of target. [10]
b) What is the highest frequency on which radar can be operated, if it is required to have a maximum unambiguous range of 200 nmi and no blind speeds less than 600 knots. [5]

5 a) Differentiate tracking radar and search radar. Explain the principle of a sequential lobing tracking radar with neat sketches. [10]
b) Compare the merits and demerits of various tracking radars. [5]

6 a) Explain the working principle of a cassegrain antenna with the help of a neat sketch. [8]
b) Explain the characteristics of Radome for ground-based and air-supported radar antenna. [7]

7 a) Derive the expression for the impulse response characteristics of a matched filter receiver that maximizes the peak-signal-to-noise-power ratio. [10]
b) Explain the principle of a coherent detector with a neat block diagram. [5]

8 a) Define the radiation pattern and derive the expression for the radiation pattern of N-element linear phased array antenna with a neat sketch. [10]
b) Explain the different types of displays used in radar receiver. [5]

Code No: R41044 **R10** **Set No. 3**

IV B.Tech I Semester Regular Examinations, December 2013
RADAR SYSTEMS
(Electronics and Communication Engineering)

Time : 3 hours **Max. Marks: 75**

Answer any Five Questions
All Questions carry equal marks
*****

1 a) Draw the block diagram of a pulsed radar and explain the significance of designing IF amplifier. [8]
b) Ground-based air-surveillance radar with peak transmitter power 300 kW, pulse width 1ms, operates at a frequency of 3000 MHz Its antenna is having a radius of 6 ft., and the antenna efficiency is 0.95. Calculate the maximum signal power at the range of 50 nmi for the detection of a target with a radar cross section of 1 m^2. [7]

2 a) Define the probability of false alarm and probability of detection and derive the expression for them. [10]
b) What signal-to-noise ratio is required for radar that makes a detection of the basis of a single pulse, when the probability of detection is 0.5 and the probability of false alarm is 10^{-6}? [5]

3 a) Why is Multiple Frequency CW radar employed? Explain its principle of operation. [10]
b) Explain how the isolation between transmitter and receiver is obtained in CW radar. [5]

4 a) Explain the operation of MTI radar with power amplifier transmitter with the help of a neat block diagram. [8]
b) Differentiate MTI and pulse doppler radar. [4]
c) What is the first blind speed (knots) of L-band radar (1250 MHz) when the PRF has a maximum unambiguous range of 240 nmi? [3]

5 a) Explain the working of a conical scan tracking radar with a suitable block diagram. Explain the various factors that are to be considered in determining the optimum squint angle. [10]
b) Explain the concept of four point tracking. [5]

6 a) Explain the principle and working of a cosecant-squared antenna with a neat sketch. [8]
b) Explain the different types of feeds for phased array antenna in radar. [7]

7 a) Describe the various detection criteria used by the radar receiver. [7]
b) Explain the working of a binary integrator with the help of a neat block diagram. [8]

8 a) Define a duplexer and explain the working of different types of duplexers with neat diagrams. [10]
b) Explain how a circulator can be used as a duplexer. [5]

Code No: R41044 **R10** **Set No. 4**

IV B.Tech I Semester Regular Examinations, December 2013

RADAR SYSTEMS

(Electronics and Communication Engineering)

Time : 3 hours **Max. Marks: 75**

Answer any Five Questions
All Questions carry equal marks
*****

1 a) Derive the radar range equation in terms of noise figure. [8]
b) What is the range of a radar in nautical miles, if it has to detect a target with a radar cross section of 2 m^2, when it operates at a frequency of 2.9 GHz with a rectangular shaped antenna that is 5m wide, 2.7m high, antenna aperture efficiency of 0.6 and a minimum detectable signal equal to 10^{-12}w. [7]

2 a) Explain the concept of integration of radar pulses. Define and obtain the expressions for integration efficiency, integration improvement factor and integration loss. [10]
b) Explain the various types of system losses in the radar systems. [5]

3 a) Define doppler effect and obtain the expression for doppler frequency shift. [4]
b) A satellite orbiting the earth in a circular orbit at an altitude of 5000 nmi has a speed of 2.7 nmi/s. What is the doppler frequency shift if the satellite is observed by a radar operating at a frequency of 450 MHz [4]
c) Draw the block diagram of a CW radar with non-zero IF receiver and explain. [7]

4 a) Explain the concept of staggered PRFs in MTI radar. [5]
b) Draw the block diagram of MTI radar using range gates and filters and explain each block. [10]

5 a) With the help of a neat block diagram explain the working of an amplitude comparison monopulse tracking radar in two-angular coordinates. [10]
b) Explain the target reflection characteristics of tracking radar. [5]

6 a) Explain the different types of frequency-scan radar arrays with the help of neat sketches. [10]
b) Explain the different types of radiating elements for phased arrays. [5]

7 a) Define matched filter and write its properties. [5]
b) Explain the impulse response of a matched filter with necessary equations. [10]

8 a) Define noise figure of a radar receiver and derive the expression for noise figure of N networks connected in cascade. [10]
b) Find the overall noise figure of a radar receiver consisting of a low-noise RF amplifier with noise figure of 1.4 dB and gain of 15 dB, a mixer with 6 dB conversion loss and noise temperature ratio of 1.2, and an IF amplifier with noise figure of 1.0 dB. [5]