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Question Paper Code: AEC521



# INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)

## MODEL QUESTION PAPER-I

Four Year B. Tech VI Semester End Examinations, December – 2019

### Regulation: R16 RADAR SYSTEMS

**Time: 3 Hours**

**Max Marks: 70**

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**Answer any ONE question from each  
Unit All questions carry equal marks  
All parts of the question must be answered in one place only**

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#### UNIT - I

- 1 a) Derive the radar range equation in terms of radar and target parameters. [7M]
- b) What is Maximum Unambiguous Range? How is it related to PRF? [7M]
- 2 a) Explain in detail about various system losses involved in radar system. [7M]
- b) The bandwidth of IF amplifier in a Radar receiver is 1MHz. If the threshold to noise ratio is 13 dB, determine the false alarm time. [7M]

#### UNIT - II

- 3 a) With the help of a suitable block diagram. Explain the operation of CW radar with non-zero IF in the receiver. [7M]
- b) Explain about the Doppler Effect and draw the graph representing Doppler frequency as a function of radar frequency and target relative velocity. [7M]
- 4 a) Determine the range and Doppler velocity for FMCW if the target is approaching the radar. Given that beat frequency  $f_b(up)$  as 15 KHz and  $f_b(down)$  as 25 KHz for the triangular modulation, the modulating frequency is 1.5 MHz and Doppler frequency shift is 1. [7M]
- b) Discuss about the multiple frequency CW radar. [7M]

#### UNIT – III

- 5 a) Calculate the blind speeds for a radar with the parameters: wavelength = 0.1m and PRF = 200Hz. [7M]
- b) Compare and contrast the situations with a power amplifier and a power oscillator in the transmitter of an MTI system. [7M]
- 6 a) Describe the method of staggering pulse repetition frequency to reduce the effect of blind speeds in an MTI system. [7M]
- b) Describe in brief automatic tracking of a target through range gating technique for unambiguous detection of a moving target. [7M]

#### UNIT – IV

- 7 a) Write the differences between Conical scan and Monopulse Tracking Radar. [7M]
- b) Describe the operation of Monopulse tracking radar with its block diagram. [7M]
- 8 a) Explain the principle and characteristics of a matched filter. Hence derive the expression for its frequency response function. [7M]
- b) Briefly explain about the efficiency of non-matched filters. [7M]

## UNIT – V

- 9 a) Briefly explain the concept of beam steering phased array antennas. [7M]  
b) Derive the expression for the noise figure of two networks that are in cascade. [7M]
- 10 a) Explain the operation of Balanced type duplexer with neat sketch [7M]  
b) Write notes on various displays. [7M]



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Dundigal, Hyderabad - 500 043

## OBJECTIVES:

<b>The course should enable the students to:</b>	
I	Learning and understanding of operation of basic types of radar systems.
II	Learning and understanding of detection and processing of radar signals
III	Learning and understanding of various types of targets, interferences, noises and losses encountered in radars.
IV	Learning and understanding of some important aspects radar transmitters and receivers

## COURSE OUTCOMES:

CO 1	Learning and Understanding of Pulse radar systems
CO 2	Understanding of CW and FMCW radar systems.
CO 3	Exploration of Moving Target Indication and Pulse Doppler Radar systems
CO 4	Analysis of Target detection techniques and Understanding of Tracking Radar
CO 5	Discussion of subsystems of a typical Radar Transmitter and Receiver

## COURSE LEARNING OUTCOMES:

AEC521.01	Learning of the operating principles of Pulse & CW radars
AEC521.02	Understanding of various types of radar targets: point and fluctuating
AEC521.03	Appreciate various types of clutters, noises, losses involved in radar systems
AEC521.04	Preliminary System design of Pulse and Pulse Compression radars
AEC521.05	Preliminary System design of CW and FM-CW radars
AEC521.06	Appreciate various interferences encountered in radar target detection
AEC521.07	Understanding of the operating principles of MTI & Pulse Doppler radars
AEC521.08	Preliminary System design of MTI and Pulse Doppler radars
AEC521.09	Understanding of the operating principles of search and tracking radars
AEC521.10	Understanding & Analysis of detection techniques of target echo signal
AEC521.11	Understanding of tracking techniques of target echo signal
AEC521.12	Understanding of different subsystems of a typical Radar transmitter
AEC521.13	Appreciate the concept of Noise Figure and the estimating the performance of radar receivers
AEC521.14	Understanding of different subsystems of a typical Radar Receiver

**MAPPING OF SEMESTER END EXAMINATION TO COURSE LEARNING OUTCOMES:**

SEE Question No.	CLO Code	Course learning Outcomes	CO code	Blooms Taxonomy Level
1	a	AEC521.01 Learning of the operating principles of Pulse & CW radars	CO 1	Remember
	b	AEC521.01 Learning of the operating principles of Pulse & CW radars	CO 1	Remember
2	a	AEC521.03 Appreciate various types of clutters, noises, losses involved in radar systems	CO 1	Understand
	b	AEC521.04 Preliminary System design of Pulse and Pulse Compression radars	CO 1	Understand
3	a	AEC521.05 Preliminary System design of CW and FM-CW radars	CO 2	Understand
	b	AEC521.06 Appreciate various interferences encountered in radar target detection	CO 2	Remember
4	a	AEC521.06 Appreciate various interferences encountered in radar target detection	CO 2	Understand
	b	AEC521.05 Preliminary System design of CW and FM-CW radars	CO 2	Understand
5	a	AEC521.07 Understanding of the operating principles of MTI & Pulse Doppler radars	CO 3	Understand
	b	AEC521.07 Understanding of the operating principles of MTI & Pulse Doppler radars	CO 3	Understand
6	a	AEC521.08 Preliminary System design of MTI and Pulse Doppler radars	CO 3	Remember
	b	AEC521.08 Preliminary System design of MTI and Pulse Doppler radars	CO 3	Understand
7	a	AEC521.09 Understanding of the operating principles of search and tracking radars	CO 4	Understand
	b	AEC521.09 Understanding of the operating principles of search and tracking radars	CO 4	Understand
8	a	AEC521.10 Understanding & Analysis of detection techniques of target echo signal	CO 4	Understand
	b	AEC521.10 Understanding & Analysis of detection techniques of target echo signal	CO 4	Understand
9	a	AEC521.12 Understanding of different subsystems of a typical Radar transmitter	CO 5	Remember
	b	AEC521.13 Appreciate the concept of Noise Figure and the estimating the performance of radar receivers	CO 5	Understand
10	a	AEC521.14 Understanding of different subsystems of a typical Radar Receiver	CO 5	Understand
	b	AEC521.14 Understanding of different subsystems of a typical Radar Receiver	CO 5	Understand

Signature of Course Coordinator

HOD, ECE