

## RADAR SYSTEMS

III Semester: ECE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEC521	Core	L	T	P	C	CIA	SEE	Total
		3	0	0	3	30	70	100
<b>Contact Classes: 45</b>		<b>Tutorial Classes:15</b>		<b>Practical Classes: Nil</b>		<b>Total Classes: 60</b>		

### OBJECTIVES:

The course should enable the students to:

- 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

<b>MODULE - I</b>	<b>INTRODUCTION</b>	<b>Classes: 09</b>
Radar frequencies and applications; Maximum unambiguous range; Radar wave forms; Radar equation; Radar block diagram and operation; Basic pulsed radar system; Moving target indication; Prediction of range performance; Minimum detectable signal; Receiver noise and SNR; Radar cross section of targets; Cross section fluctuations, transmitter power, PRF and range ambiguities; system losses, related problems.		
<b>MODULE - II</b>	<b>CW AND FREQUENCY MODULATED RADAR</b>	<b>Classes: 09</b>
Doppler Effect, CW Radar: Block Diagram; Isolation between transmitter and receiver; Non-zero IF receiver, receiver bandwidth requirements, applications of CW radar, illustrative problems; FM-CW radar, range and Doppler measurement, block Diagram and characteristics (Approaching/ Receding Targets), FM-CW altimeter, multiple frequency CW radar		
<b>MODULE - III</b>	<b>MOVING TARGET INDICATION AND PULSE DOPPLER RADAR</b>	<b>Classes: 09</b>
<p><b>PART:1</b> Introduction to Doppler and moving target indication radar, principle and block diagram of moving target indication, power amplifier transmitter, delay line cancellers, filter characteristics, blind speeds, double cancellation,</p> <p><b>PART:2</b> staggered pulse repetition frequencies, MTI radar parameters, moving target detector; limitations to MTI performance, non-coherent MTI. Pulse doppler radar; radar Equation for pulsed radar; moving target indication versus pulse doppler radar</p>		
<b>MODULE - IV</b>	<b>TRACKING RADAR AND RADAR DETECTION THEORY</b>	<b>Classes: 09</b>
Introduction, single target tracking: range, Doppler and angle measurement, track while scan, angle tracking: sequential lobing, conical scan, monopulse; Tracking radar: Amplitude comparison monopulse (one- and two coordinates), phase comparison monopulse, tracking in range, acquisition and scanning patterns, comparison of trackers. matched filter receiver, response characteristics and derivation, correlation function and cross-correlation receiver, efficiency of nonmatched filters, matched filter with non-white noise.		
<b>MODULE - V</b>	<b>RADAR RECEIVERS</b>	<b>Classes: 09</b>
Noise figure and noise temperature; Displays: Types; Duplexers, branch type and balanced type, circulators as duplexers; Introduction to phased array antennas: Basic concepts, radiation pattern, beam steering and beam width changes, series versus parallel feeds, applications, advantages and limitations.		
<b>TEXTBOOKS:</b>		
<ol style="list-style-type: none"> <li>1. Merrill I Skolnik , —Introduction to Radar Systems, TMH Special Indian Edition, 2<sup>nd</sup> Edition, 2007.</li> <li>2. V.S.Bagad, —Radar Systems, Technical Publications, 1<sup>st</sup> Edition, 2009</li> </ol>		
<b>REFERENCES:</b>		
<ol style="list-style-type: none"> <li>1. Merrill I Skolnik , —Radar Handbook, McGraw-Hill Professional Publishing, 3<sup>rd</sup> Edition, 2008</li> </ol>		