RADAR SYSTEMS AND PROCESSING

VI Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB50	Professional Elective	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

OBJECTIVES:

The Students Will Try To Learn:

I The principle and operation of radar systems and radar range equation for communication.

II The use of doppler frequency shift to detect moving target in stationary clutter, continuous wave radar system in altimeter applications.

III The types of radar receivers, transmitter systems and effect of noise on radar signal detection

COURSE OUTCOMES:

After successful completion of the course, Students will be able to:

CO 1 **Demonstrate** the basic principle of radar system with the help of block diagram.

CO 2 **Understand** the factors affecting the radar performance using radar range equation to calculate transmitter power.

CO 3 **Explain** the working principle of continuous wave radar with the help of block diagram to measure the speed of target

CO 4 **Analyze** the principle of frequency modulated –continuous wave radar and apply it for altimeter applications

CO 5 **Differentiate** the principle of moving target indicator radar and Pulse Doppler radar for moving target indication and clutter rejection.

CO 6 **Describe** the Tracking radar principle to analyze different types of angle tracking for obtaining Target position

CO 7 **Analyze** the statistical parameters of radar cross section of targets to measure signal to noise ratio and system losses

CO 8 **Compare**fixed and moving targets to find out relative advantages and disadvantages of different radars.

CO 9 **Explain**various techniques employed in radar receivers for detection of signals in noise.

CO10 **Analyze** the detection techniques of target echo signal reflected back to the radar antenna for obtaining the location and distance of the reflecting object.

CO 11 **Determine** the performance characteristics of magnetron and two-cavity klystron for obtaining the mathematical expressions related to power gain and efficiency

CO 12 **Compare** different types of display devices & duplexers with their functions to determine the performance of radar systems

CO 13 **Examine** phased array antennas and its radiation pattern for detection and tracking of Multiple objects from different directions.

MODULE - I	INTRODUCTION	Classes: 08
Introduction to Radar - Radar frequency bands and Applications; Radar Range equation; Pulse Radar: Block diagram and Operation; Maximum unambiguous range; Radar wave forms; Prediction of Target range; Minimum detectable signal; Receiver noise, Receiver Bandwidth, SNR; Probability of False alarm, Probability of Target Detection, Integration of echo pulses- SNR improvement; Radar Cross Section (RCS) of targets; RCS fluctuation models, transmitter power, PRF and Range ambiguities; system losses.		
MODULE- II	**CW AND FREQUENCY MODULATED RADAR**	**Classes: 10**
Moving Targets and Doppler Frequency; CW Radar: Introduction, Block Diagram, Isolation between transmitter and receiver, Non-zero IF receiver, Receiver bandwidth requirements, Applications; Frequency Modulated CW radar: Range and Doppler measurement, Mathematical Analysis, Block Diagram and characteristics, FM-CW altimeter, multiple frequency CW radar, Ambiguity Diagram & its application, Concept of pulse compression, Pulse Compression Radars: FM & Phase Coded Radars.		
MODULE- III	**MOVING TARGET INDICATION AND PULSE DOPPLER RADAR**	**Classes: 10**
Moving target indication (MTI) on A scope, butterfly effect, MTI using delay line canceller (DLC), Doppler measurement using Pulse radar, MTI radar (with power amplifier transmitter), MTI radar (with power oscillator transmitter), filter characteristics of DLC, blind speeds, double DLCs, Blind speeds, Staggered PRFs. Range gated doppler filters, MTI radar parameters, moving target detector; MTI radar performance: Parameter Definitions, limitations to MTI performance, non-coherent MTI. Pulse doppler radar; MTI radar versus Pulse Doppler radar		
MODULE-IV	**TRACKING RADAR AND RADAR DETECTION IN NOISE**	**Classes: 08**
Search and Tracking radars, track while scan (TWS) radar, Angle/Bearing Tracking: Sequential Lobing, Conical scan, Monopulse methods; Monopulse Tracking: Amplitude comparison (1D, 2D), Phase comparison, Bearing errors (without mathematical treatment), Glint Noise and Frequency Agility, Tracking in range, Acquisition, Comparison of trackers, Tracking with Surveillance Radar. Matched Filter (MF) receiver, MF response characteristics; Correlation Receiver, Efficiency of non matched filters, Matched filter with non-white noise, Automatic Detection of radar signals: Tapped Delay Line (TDL) detection, CFAR receiver, Radar Clutter: Land and Sea clutter (without mathematical treatment)		
MODULE-V	**RADAR TRANSMITTERS & RECEIVERS**	**Classes: 09**
Advantages and Disadvantages of Magnetron Oscillator, Klystron Amplifier, Traveling wave tube (TWT) Amplifier, Hybrid Linear-Beam Amplifier and Crossed-Field Amplifiers, Solid State Sources & Amplifiers, Methods for employing solid-state transmitters. Receiver Noise Figure (NF) - Noise Temperature; Measurement of NF, NF of Mixers, Basics of Radar Displays and Duplexers; Phased array antennas: Current and Radiation pattern, Beam steering and effects, Basics of Antenna feeds and Phase shifters.		

Text Books:

1. Merrill I Skolnik, “Introduction to Radar Systems”, TMH Special Indian Edition, 2nd Edition, 2007.

Reference Books:

1. Merrill I Skolnik, “Radar Handbook”, McGraw-Hill Professional Publishing, 3nd Edition, 2008.

Web References:

1. https://www.Igniteengineers.com
2. https://www.ocw.nthu.edu.tw
3. https:// www.uotechnology.edu.iq
4. https://www.iare.ac.in

E-Text Books:
1. https://www.bookboon.com/en/concepts-in-electric-circuits-ebook 2. https:// www.www.jntubook.com 3. https://www.archive.org