III B.Tech – II Semester
(20EC6637) RADAR ENGINEERING
(Honors)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	1	-	4

Pre-Requisites: Electromagnetic Waves and Transmission Lines, Analog & Digital Communications

Course Objectives:

- To learn Basic Principle of radar and radar range equation.
- To understand Doppler effect and get acquainted with the working principles of CW radar, FM- CW radar.
- To impart the knowledge of functioning of MTI and Tracking Radars.
- To Detect Radar Signals in Noise Matched Filter Receivers.
- To understand Radar Receivers and electronic warfare.

UNIT–I: Basics of Radar: Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, related problems.
Radar Equation: SNR, Envelope Detector – False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), related problems.

UNIT–II: CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, related problems.
FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter, Multiple Frequency CW Radar.

UNIT–III: MTI and Pulse Doppler Radar: Principle, MTI Radar – Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.
Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT–IV: Detection of Radar Signals in Noise: Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise.

UNIT–V: Radar Receivers – 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, Applications, Advantages and Limitations.
Electronic Warfare: Introduction to ESM, ECM and ECCM systems.

Course Outcomes:

After successful completion of the course, the students can be able to:

S. No	Course Outcome	BTL
1	Demonstrate the factors affecting the radar performance using Radar Range Equation	L3
2	Analyze the CW, FM-CW Radar and its characteristics	L4
3	Differentiate between a MTI Radar and a Pulse Doppler Radar based on their working principle and its characteristics	L4
4	Demonstrate an understanding of the importance of Matched Filter Receivers in Radars	L3
5	Familiarize and analyse radar receivers, Displays and Duplexers and electronic warfare	L4

Correlation of COs with POs & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	3	1	-	-	-	-	-	-	-	-	-	3	-
CO 2	2	2	1	-	-	-	-	-	-	-	-	-	3	-
CO 3	2	3	1	-	-	-	-	-	-	-	-	-	3	-
CO 4	1	2	1	-	-	-	-	-	-	-	-	-	2	-
CO 5	1	2	1	-	-	-	-	-	-	-	-	-	2	-

Text Books:

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

Reference Books:

1. Introduction to Radar Systems, 3rd edition – M.I. Skolnik, TMH Ed., 2005.
2. Radar: Principles, Technology, Applications – Byron Edde, Pearson Education, 2004.
3. Radar Principles – Peebles, Jr., P.Z., Wiley, New York, 1998.
4. Principles of Modern Radar: Basic Principles – Mark A. Richards, James A. Scheer, William A. Holm, Yesdee.
5. Radar Engineering – GSN Raju, IK International.