4/4 B.Tech - SEVENTH SEMESTER

EC7T3 **Radar Systems** **Credits: 4**

Lecture : 4 periods/week **Internal assessment: 30 marks**
Tutorial: 1 period /week **Semester end examination: 70 marks** -------
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Course Objectives:

- To study the principles of operation of operation of various blocks of radar systems and radar range equation in detail
- To study the functions of various blocks of CW radar, FM-CW radar, MTI and Pulse Doppler radars, Tracking radar and their limitations and applications in detail
- To study the functions of various blocks of radar receivers and detection of radar signals in noise in detail
- To study the principles and working of phased array antennas and their applications to radar systems

Learning Outcomes:

The students undergoing this course will know

- The principles of working of various radar systems starting from simple CW-Radar to advanced phased array radar systems for detection of static & tracking of moving objects in space.
- The various techniques employed in radar receivers for detection of signals in noise.

UNIT- I

Introduction to Radar Systems: Introduction, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Related Problems,

UNIT- II

Radar Equation: Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Related Problems.

UNIT- III

Continuous Wave (CW) Radar: Doppler Effect, CW Radar – Block Diagram, Relative velocity of the target in CW radar, Measurement of Doppler Direction with CW radar, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Sideband Super heterodyne Type CW Doppler Radar, Receiver Bandwidth Requirements, Filter Banks in CW Radar Receiver, Applications of CW radar.

UNIT- IV

Frequency Modulated CW Radar: FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Measurement Errors.

UNIT- V

MTI and Pulse Doppler Radar : Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Butterfly effect in MTI Radar, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs, Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, Non-coherent MTI, MTI versus Pulse Doppler Radar.

UNIT- VI

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse. Target Reflection Characteristics and Angular Accuracy, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT- VII

Detection of Radar Signals in Noise : Introduction, 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- VIII

Radar Receivers : Introduction, Noise Figure and Noise Temperature, Displays – types, Duplexers – Branch type and Balanced type, Circulators as Duplexers, Introduction to Phased Array Antennas – Basic Concepts, Applications, Advantages and Limitations.

Learning Resources

Text Books:

1. Introduction to Radar Systems – Merrill I. Skolnik, McGraw-Hill, 3rd Edition, 2001.
2. Understanding Radar Systems – Simon kingsley, McGraw-Hill,1st edition., 1992

References:

1. Introduction to Radar Systems – Merrill I. Skolnik, McGraw-Hill, 2nd Edition, 1981.
2. Radar Principles- Peyton Z. Peebles, Jr., Wiley India Pvt. Ltd., 2009