

## EOPE3012 RADAR ENGINEERING (3-0-0)

### Course Objectives:

This course provides fundamental and applied knowledge of radar systems, covering radar principles, equations, waveforms, receivers, antennas, clutter, tracking, and detection. Students will learn radar signal processing techniques, Doppler concepts, MTI/MTD operations, and navigation aids. The course aims to develop the analytical skills required to understand and evaluate modern radar systems and their engineering applications.

### MODULE-I: Radar Fundamentals and Types (07 Hours)

Introduction to radar principles, basic radar equation including search and track forms, pulse radar, CW radar, FM-CW radar, radar range and resolution, accuracy and minimum detectable signal, Doppler frequency fundamentals, and an overview of radar classifications and applications.

### Module-II: Radar Transmitters, Receivers and Displays (07 Hours)

Radar transmitters including oscillators, power amplifiers and modulator block diagrams, radar receivers such as the superheterodyne receiver, noise figure, low-noise front ends, mixers and IF processing, duplexers including branch type and balanced type, radar display systems including A-scope, B-scope and PPI, and introduction to radar antennas such as reflector antennas and basic phased array concepts.

### MODULE-III: MTI Radar, Pulse Doppler Radar and Clutter (08Hours)

MTI radar principles including delay line cancellers, MTI receivers and non-coherent MTI operation, pulse Doppler radar principles and Doppler frequency measurement, radar cross section and factors affecting RCS, characteristics of clutter, statistical models for noise and clutter, and techniques for clutter reduction.

### MODULE-IV: Radar Signal Processing and Detection (03 Hours)

Radar waveforms and pulse compression techniques, matched filtering concepts, radar detection principles including thresholding and target classification, basic radar tracking concepts.

### MODULE-V: Navigation Aids and Emerging Radar Technologies (05Hours)

Navigation systems including loop antennas, radio compass systems, hyperbolic navigation systems such as LORAN-A, Instrument Landing System (ILS) including localizer, glide slope and marker beacons, and an overview of emerging radar technologies such as weather radar, automotive radar and modern phased-array-based radars.

### Course Outcomes:

By the end of this course, students will be able to:

- CO1 Explain radar fundamentals, radar equation and the essential components of radar systems.
- CO2 Analyze radar transmitters, receivers, antennas and various radar display mechanisms.
- CO3 Understand MTI and pulse Doppler radar operations, clutter characteristics and radar cross section.
- CO4 Apply radar signal processing concepts including pulse compression, detection methods, CFAR and tracking.
- CO5 Describe the principles of navigation aids and identify current and emerging trends in radar technology.

### Text Books:

1. Merrill I. Skolnik: Introduction to Radar Systems,3/e, Tata McGraw Hill,
2. N.S.Nagaraja: Elements of Electronic Navigation, 2/e, Tata McGraw Hill
3. Hamish Meikle, Modern Radar Systems, 2nd Edition, ARTECH House, Inc, , 2014.
4. Francois Le Chevalier, Principles of Radar and Sonar Signal Processing, Artech House , 2002

### References:

1. Principles of Modern Radar, Richards, Scheer & Holm, SciTech Publishing.
2. Radar Handbook, M. Skolnik, McGraw-Hill.

3. Fundamentals of Radar Signal Processing, Mark A. Richards, McGraw-Hill.