**IV B.Tech – II Semester**
**(17EC832) RADAR SYSTEMS**
**(Professional Elective-IV)**

| **Int. Marks** | **Ext. Marks** | **Total Marks** | **L** | **T** | **P** | **C** |
|:---:|:---:|:---:|:---:|:---:|:---:|:---:|
| 40 | 60 | 100 | 4 | - | - | 3 |

**Pre-Requisites: Electromagnetic Waves and Transmission Lines, Antenna and Wave Propagation**

**Course Objectives:**
- To provide an understanding of the basic concepts, operation, applications of radar systems
- To provide an understanding of the techniques necessary to analyze the performance of radar systems.

**UNIT-I:**
**Basics of Radar:** Introduction, Maximum Unambiguous Range, simple Radar range Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Illustrative Problems.

**Radar Equation :** Modified Radar Range Equation, SNR, probability of detection, probability of False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Creeping Wave, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative 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. Illustrative 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:** Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Nth Cancellation Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

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

**UNIT-VI:**
**Radar Receivers** –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. Radomes.

**Course Outcomes:**

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

| S. No | Course Outcome | BTL |
|-------|----------------|-----|
| 1. | Understand and classification of Radar Systems | L2 |
| 2. | Analyze the CW Radar and its characteristics | L3 |
| 3. | Analyze the MTI and Tracking Radar and its characteristics | L3 |
| 4. | Apply and to design required parameters of monopulse | L3 |
| 5. | Understand and analysis of noise in radar receivers | L2 |
| 6. | Understand of hardware equipment in radar receivers | L2 |

**Correlation of COs with POs & PSOs:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO 1 | 3 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 2 | 1 |
| CO 2 | 3 | 3 | 2 | - | 2 | - | - | - | - | - | - | - | 3 | 2 |
| CO 3 | 3 | 3 | 2 | - | 2 | - | - | - | - | - | - | - | 2 | - |
| CO 4 | 2 | 2 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | - |
| CO 5 | 2 | 3 | 3 | - | 2 | - | - | - | - | - | - | 2 | 3 | 2 |
| CO 6 | 2 | 3 | 3 | - | 3 | - | - | - | - | - | - | 2 | 3 | - |

**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.