

**COURSE TITLE** : RADAR AND NAVIGATION  
**COURSE CODE** : 6045  
**COURSE CATEGORY** : E  
**PERIODS/WEEK** : 4  
**PERIODS/SEMESTER** : 60/6  
**CREDITS** : 4

**TIME SCHEDULE**

Module	Topics	Periods
1	Introduction to Radar	15
2	Types of Radar	15
3	Navigation	15
4	Approach and Landing Aids	15
<b>Total</b>		<b>60</b>

Course general outcome :

Module	GO	On completion of the study of this course the students will be able :
1	1	To understand the concept of Radar , its applications and different Radar performance factors
2	2	To understand the operation of FM - CW Radar
	3	To understand the operation of MTI & Pulse Doppler Radar
3	4	To understand the concept of Navigation and types of radio navigation
4	5	To understand the two types of landing systems
	6	To understand satellite navigation systems

*GO - General Outcome*

On the completion of the study the student will be able :

**MODULE - I - INTRODUCTION TO RADAR**

**1.1.0 To understand the concept of Radar, its applications and different Radar performance factors**

- 1.1.1 To describe the block diagram of Radar
- 1.1.2 To state the Radar frequency ranges
- 1.1.3 To list the applications of Radar

- 1.1.4 To derive Radar range equation
- 1.1.5 To explain the Radar performance factors

## **MODULE - II - TYPES OF RADAR**

### **2.1.0 To understand the operation of FM -CW Radar**

- 2.1.1 To explain Doppler effect with equation (no derivation)
- 2.1.2 To explain the block diagram of FM - CW Radar
- 2.1.3 To explain the block diagram of FM - CW super heterodyne receiver

### **2.2.0 To understand the operation of MTI & Pulse Doppler Radar**

- 2.2.1 To explain the operation of MTI Radar
- 2.2.2 To explain the operation and block diagram of MTI Radar employing power amplifier
- 2.2.3 To explain the operation of delay line cancellers
- 2.2.4 To explain the block diagram of MTI Signal Processor
- 2.2.5 To describe the operation of Pulse Doppler Radar
- 2.2.6 To explain Tracking Radar and list out its types
- 2.2.7 To explain the types of Radar displays

## **MODULE - III - RADIO NAVIGATION**

### **3.1.0 To understand the concept of Navigation and types of radio navigation**

- 3.1.1 To define the concept of navigation
- 3.1.2 To describe the four methods of navigation
- 3.1.3 To explain the working of loop antenna and Goniometer
- 3.1.4 To explain the working principle of ADF / NDB – Radio compass ADF, VHF phase comparison ADF
- 3.1.5 To explain the working principle of hyperbolic navigation systems – LORAN, Omega, DECCA
- 3.1.6 To explain the principle of different types of radio ranges - VOR, Doppler VOR, DME

## **MODULE - IV - APPROACH AND LANDING AIDS**

### **4.1.0 To understand the two types of landing systems**

- 4.1.1 To explain the function of components in an Instrument Landing System (ILS) with the help of diagram
- 4.1.2 To explain the significance of glide slope and markers
- 4.1.3 To explain Microwave Landing System (MLS)
- 4.1.4 To Understand satellite navigation systems

- 4.1.5 To state the basic principle of INS and DNS
- 4.1.6 To explain the basic ideas of GPS and DGPS
- 4.1.7 To explain GNSS and its classification

## **CONTENT DETAILS**

### **Module - I Introduction to Radar**

Radar – concept - block diagram – operation – frequency ranges – applications – range equation – derivation (no problems) - Radar performance factors – minimum detectable signal -receiver noise – Signal to Noise ratio -Radar cross section of targets – transmitter power – pulse repetition frequency – range ambiguities

### **Module - II - Types of Radar**

Doppler effect - FM - CW Radar - FM - CW Radar with super heterodyne receiver – block diagram - MTI Radar - MTI Radar with power amplifier transmitter -delay line cancelers - MTI Signal Processor - Pulse Doppler Radar - Tracking Radar – basic block diagram – types - Radar displays – A Scope – PPI Scope

### **Module - III - Radio Navigation**

Navigation - methods of navigation - Radio direction finder - loop antenna – goniometer - Radio Navigation systems - ADF / NDB – Radio compass ADF, VHF phase comparison using ADF - Hyperbolic navigation systems – basic principle - LORAN, Omega, DECCA - Radio ranges – VOR – ground equipment – VOR receiver - Doppler VOR – DME

### **Module - IV - Approach and landing aids**

Instrument Landing System (ILS) – elements – localizer - glide slope – marker beacons -lighting systems – operation – limitation - Microwave Landing System (MLS) – operation – advantages – disadvantages - Navigation systems – INS – DNS - Satellite Navigation systems – GPS – DGPS – GNSS – COMPASS – DORIS – GALILEO – IRNSS – QZSS (concept only)

### **Text Book**

1. Introduction to Radar Systems – Merrill I. Skolnik – McGraw Hill

### **Reference**

1. Radar Systems and Radio Aids to Navigation – Dr. A. K. Sen, Dr. A. B. Bhattacharya Khanna Publishers
2. Elements of Electronic Navigation – N. S. Nagaraja – Tata McGraw Hill
3. Radar, Sonar and Navigation Engineering – K. K. Sharma – Katson Books