



# GUJARAT TECHNOLOGICAL UNIVERSITY

## Bachelor of Engineering (Part Time)

Subject Code: 2971108

Semester – VII

Subject Name: Radar and Navigational Aids

Type of course: - Professional Elective

**Prerequisite:-** Analog and Digital Communication, Signals and Systems, Microwave Theory and Techniques, Antennas and Propagation

**Rationale: -**

The course addresses the fundamentals of Radio Detection And Ranging (RADAR) and Navigational Aids. It describes the Radar as a microwave communication system and types of Radars like CW and Pulsed. It describes various navigational aids including GPS and NavIC.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

**Content:**

Sr.No.	Topic	Total Hours
1.	<b>Introduction:</b> Block diagram and operation of Radar, Radar frequencies, Millimeter and submillimeter waves, Applications of Radar	03
2.	<b>Radar Equation:</b> The simple form of Radar equation Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Signal to Noise Ratio, Matched filter impulse response, Integration of radar Pulses, Radar Cross Section of Targets, Cross section Fluctuations, Radar Clutter-surface clutter, sea clutter and Land clutter, weather clutter, Transmitter Power, Pulse Repetition Frequency and Range ambiguities, Antenna Parameters, System losses, Propagation effects, other considerations.	06
3	<b>CW and FM CW Radar</b> Doppler effect, CW Radar, FMCW Radar, Applications Multiple frequency CW Radar	03
4	<b>MTI And Pulse Doppler Radar</b> Introduction, Delay line Cancellers, Multiple or staggered Pulse Repetition Frequencies, Range gated Doppler Filters, Block Diagram of Digital Signal Processor, Example of MTI radar Processor, Pulse Doppler Radar, Non coherent MTI, MTI from moving platform, Other types of MTI and Airborne radar	06
5.	<b>Tracking Radar</b> Tracking with Radar, Monopulse tracking, Conical scan and Sequential lobing, Tracking in range, Automatic tracking with Surveillance Radars and Doppler,	03



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	Acquisition.	
6.	<b>Radar Transmitters, Antennas and Receivers</b> Hard tube and pulse modulators, Types of Radar antennas, Duplexers, Displays.	05
7.	<b>Electronic Scanning Radar</b> Principle of phased array for electronic scanning, Advantages and capabilities of electronic scanning, block diagram of an electronic scanning system and its operation	04
8.	<b>Navigational Aids</b> Introduction, Four Methods of Navigation, Radio Direction Findings, Radio Ranges, Hyperbolic Systems of Navigation-LORAN and DECCA, Aids to approach and Landing	08
9.	<b>Modern Navigation :</b> Doppler navigation-Doppler Effect, New configuration, Doppler frequency equations, Track stabilization, Doppler navigation system, GPS-Principle of operation, Position location determination, principle of GPS receiver, Global Navigation Satellite System, GAGAN, IRNSS-NAVIC Receiver and applications. Mention of Navigation Satellites of different countries such as Galileo, Glonass and Compass.	07

**Suggested Specification table with Marks (Theory): (For UG only)**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	10	20	10	0

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books: -

1. Introduction to Radar System M.I. Skolnik, Publisher: McGraw Hill
2. Electronic and Radio Engg. F.E. Terman, Publisher: McGraw Hill
3. Radar Engineering Hand Book, M.I. Skolnik, Publisher: McGraw Hill
4. N S Nagaraja, "Elements of Electronic Navigation", TMH.
5. Bernhard Hofmann-Wellenhof et al, GNSS – Global Navigation Satellite Systems: Springer Wien New York

**Course Outcomes: After completion of this course students will be able to...**

Sr.	CO statement	Marks %
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No.		weightage
CO-1	Gain familiarity with the basics of Radar,significance of Radar parameters and its applications	10
CO-2	Understand the working of pulsed and CW Radar transmitters and receivers	30
CO-3	Understand Radar signal detection techniques and different types of radars	30
CO-4	Understand principles of navigation and modern navigational techniques with their applications	30

### Suggested List of Experiments:-

Programming in any language may be used to analyze the mathematical equations and their significance in Radar operations.

1. Introduction to RADAR range equation and the effects of various parameters
2. Analysis of Radar Signal to Noise Ratio against target detection range for different values of target Radar cross section.
3. Analysis of Radar Signal to Noise Ratio against target detection range for different values of Radar peak power .
4. Determination of the velocity of the object moving in the Radar range
5. Understanding the principle of Doppler Radar and the time and frequency measurement
6. Study of the object counting with the help of Radar.
7. Study the effect of different types of materials on Radar signal detection.
8. Understanding the principle of GPS Technology
9. Establishing the link between the GPS Satellite and GPS Receiver Trainer & Measurement of latitude, longitude (Position or Location determination) with the help of GPS.
10. Understanding of Indian navigation system NavIC.
11. A project on comparison of global navigation systems.
12. Write a program for computing minimum detectable power for radar.
13. Write a program for computing radar range including noise
14. Write a program for radar cross section.
15. Write a program for computing Doppler frequency.
16. Write a program for matched filter.
17. Write a program in for single line delay canceller.
18. Write a program in for double line delay canceller.
19. Write a program in for linear antenna field Intensity.
20. Write a program in for synthetic aperture radar