GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION ENGINEERING (11)
RADAR & NAVIGATIONAL AIDS
SUBJECT CODE: 2181103
B.E. 8th SEMESTER

Type of course: Elective

Prerequisite: Fundamental knowledge of electronics, measuring instruments, electromagnetic, antenna and wave propagation is required.

Rationale:
- To introduce the fundamental concepts of RADAR (RAdio Detection And Ranging) and

  Navigation
  aids.
- To explain the students to different types of RADAR and Navigation systems
- To make students learn modern radar and navigational techniques

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Contents:

Sr No	Content	Total Hrs	% Weightage
1	**Introduction** The simple form of Radar Equation, Radar Block diagram and Operation, Types of transmitters, duplexer and displays. Radar Frequencies, millimeter and submilimeter waves, Applications of Radar.	4	07
2	**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.	7	14
3	**CW and FM CW Radar** Doppler effect. CW radar. FM CW radar. Airborne Doppler Navigation, Multiple CW radar	3	06
4.	**MTI And Pulse Doppler Radar** 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, Airborne radar.	5	11

5.	**Tracking and Imaging Radar** Tracking with Radar ,Monopulse tracking,Conical scan and Sequential lobing, Low angle tracking ,Air surveillance radar, Introduction to Synthetic aperture radar(SAR).tracking in range and Doppler, Acquisition.	4	7
6.	**Electronic Scanning Radar** Principle of phased array for electronic scanning, Advantages and capabilities of electronic scanning, block diagram of an electronic scanning system and its operation	4	7
7.	**Navigation:** Introduction, Four Methods of Navigation.	2	04
8.	**Radio Direction Findings:** Loop Antenna, Loop input circuits, aural null direction finder, Goniometer, Errors in Direction Finding, Adcock Direction Finder, Its advantages over loop antenna, .	4	07
9.	**Radio Ranges:** LF/MF Four course Radio Range, VHF Omni Directional Range, and VOR receiving Equipment	3	06
10.	**Hyperbolic Systems of Navigation**: LORAN, DECCA navigation systems	4	07
11.	**Aids to approach and Landing:** Instrument Landing System, Ground controlled Approach System, Microwave landing system , Distance Measuring Equipment, TACAN Doppler navigation-Doppler Effect, New configuration, Doppler frequency equations, Track stabilization, Doppler	5	10
12.	**Recent trends in Satellite Navigation :** GPS principle of operation, Position location determination, principle of GPS receiver and applications, **Brief note on :**Global Satellite Navigation system, Martitime Satellite ,Satellite Constellations ,Navigation Satellites of different countries such as Glonas and Compass, GAGAN,IRNSS, NAVIC Receiver and applications	7	14

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	**30**	**10**	**15**	**10**	**5**

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 ,McGraw Hill
2. Elements of Electronic Navigation Systems", Tata McGraw-Hill,
3. Radar Systems and Radio Aids to Navigation, Sen & Bhattacharya, Khanna publishers
4. Radar Principles", Peyton Z. Peebles ,JohnWiley, 2004
5. J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004
6. Radar Systems Analysis and Design Using MATLAB, Bassem R. Mahafza, Ph.D. CHAPMAN & HALL/CRC
7. Radar Engg. Hand Book M.I. Skolnik, Publisher: McGraw Hill
8. Roger J Suullivan, "Radar Foundations for Imaging and Advanced Topics".
9. Global Navigation Satellite Systems Insights into GPS, GLONASS, Galileo, Compass, and others B. Bhatta BSP Books

10. Global Navigation Satellite Systems Rao,TMH
11. Global Navigation Satellite Systems R, Acharya ,Academic Press
12. Radar and ARPA Manual Alan Bole, Bill Dineley, Alan Wall, Elsevier

Web Resources:

http://nptel.iitm.ac.in/courses.php?branch=Ece
http://www.radartutorial.eu/07.waves/wa04.en.html

List of Experiments:

1. Introduction to RADAR (Radio Detection And Ranging)

2. Analysis OF RADAR Range Equation.

3. Analysis of Radar Signal to Noise Ratio against target detection range for different values
   of target Radar cross section.

4. Analysis of Radar Signal to Noise Ratio against target detection range for different values
   of Radar peak value.

5. Determination of the velocity of the object moving in the Radar range

6. Understanding the principle of Doppler Radar of time and frequency measurement with the help
   of moving pendulum.

7. Study of the object counting with the help of Radar.

8. Study the effect of different types of materials on Radar receiving or detection.

9. Understanding the principle of GPS Technology

10. Establishing the link between the GPS Satellite and GPS Receiver Trainer & Measurement of
    latitude, longitude (Position or Location determination) with the help of GPS.

11. For MATLAB exercise, refer Radar Systems   Analysis and Design Using MATLAB,
    Bassem R. Mahafza, Ph.D. CHAPMAN & HALL/CRC”

Design Engineering Problems:

1. Introduction to RADAR Equation using MATLAB/Scilab SNR versus detection range for three
   different values of radar peak power.

2. Plot of RCS, SNR, Detection Range using MATLAB/Scilab SNR versus detection range for three
   different values of RCS.
     I.   SNR versus detection range for three different values of RCS.
     II. SNR versus detection range for three different values of radar peak power.

3. Obtain Graph of Circular Dish Antenna pattern using MATLAB/Scilab.

4. Obtain Graph of Linear Array Antenna using MATLAB/Scilab.

5. Obtain Graph of Rectangular Array Antenna using MATLAB/Scilab.

6. To study & interpret the data on the display pertaining to location of vehicles (air
   crafts/ships) and collision avoidance. (reference: Radar and ARPA Manual Alan Bole, Bill
   Dineley, Alan Wall, Elsevier)

Active Learning Assignments:

Preparation of power-point slides, which include videos, animations, pictures, graphics for better
understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups
of students so that the entire syllabus to be covered. The power-point slides should be put up on the
web-site of the College/ Institute, along with the names of the students of the group, the name of the
faculty, Department and College on the first slide. The best three works should be submitted to GTU.