GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electronics Engineering
SUBJECT NAME: Radar & Navigational Aids
SUBJECT CODE: 2171011
B.E.7th SEMESTER

Type of course: Elective

Prerequisite: Fundamental knowledge of Electromagnetics, Wave propagation & Antennas is required.

Course Objectives:
- To introduce the fundamental concepts of RADAR (RAdio Detection And Ranging) and Navigational aids.
- To expose the students to different types of RADAR systems and Navigation.

Learning Outcomes:
- Knowledge in the topics such as Fundamentals of Radar
- Different types of Radar and their working
- Radar signal Detection techniques
- Radar Navigation 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	
3	0	2	5	70	30		30	20	150

Contents:

Sr. No.	Content	Total Hrs	% Weightage
1.	**Introduction** The simple form of Radar Equation, Radar Block diagram and Operation, Radar Frequencies, millimeter and submilimeter waves, Applications of Radar.	03	6
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.	07	13

3.	**CW and FM CW Radar** Doppler effect. CW radar. FM CW radar. Multiple frequency CW Radar.	08	15
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.	06	12
5.	**Tracking Radar** Sequential loping, conical scan, Monopulse, Tracking in range and Doppler, Acquisition.	06	12
6.	**Radar Transmitters, Antennas and Receivers** Hard tube and pulse modulators. Types of Radar antennas, Duplexers, Displays.	06	12
7.	**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	04	7
8.	**Navigational Aids** Introduction, Four Methods of Navigation ,Radio Direction Findings, Radio Ranges, Hyperbolic Systems of Navigation, Aids to approach and Landing	08	16
9.	**Modern Navigation :** 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.	04	7
Total		52	

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 ,Publisher: McGraw Hill
2. Radar Systems and Radio Aids to Navigation, Sen & Bhattacharya, Publisher: Khanna publishers

3. Electronic and Radio Engg. F.E. Terman, Publisher: McGraw Hill
4. Radar Engg. Hand Book M.I. Skolnik, Publisher: McGraw Hill
5. Roger J Suullivan, "Radar Foundations for Imaging and Advanced Topics".
6. N S Nagaraja, "Elements of Electronic Navigation", TMH.

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.

List of Tutorials:

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.

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 submit to GTU.