SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester VIII

Subject Name: **Radar & Navigational Aids** **Subject Code: BTEC13804**

Type of course: PEC

Prerequisite: Fundamental knowledge of electronics, electromagnetic, antenna and wave propagation.

Rationale: Students shall learn the concepts of RADAR (Radio Detection and Ranging) systems and different methods used for ranging and detection of object and target. In addition, students shall learn modern RADAR and various navigational systems and navigation technology.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	--	--	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	**RADAR Introduction:** Radar basics, radar frequencies, applications of radar, The simple form of radar equation, radar block diagram, minimum detectable signal, receiver noise, signal to noise ratio, matched filter impulse response, integration of radar pulses, radar cross section of simple and complex targets, cross section fluctuations, radar swerling Target Model, transmitter power, pulse repetition frequency and range ambiguities, antenna parameters, system losses, propagation effects, other considerations, bistatic radar, millimeter wave and beyond.	8	15
2.	**CW and FM CW RADAR :** Doppler effect, CW Radar, FM CW Radar, Air born Doppler navigation Applications Multiple frequency CW Radar. **MTI and pulse Doppler radar:** Delay Line Cancellers, Multiple Or Staggered Pulse Repetition Frequencies, Range Gated Doppler Filters, Digital Signal Processing, Other MTI Delay Lines, Limitation To MTI Performance, Non Coherent MTI ,Pulse Doppler Radar, MTI	8	20

	From Moving Platform, Other Types Of MTI.		
3.	**Tracking:** Sequential Lobbing, Conical Scan, Monopulse Tracking, Target Reflection Characteristic, Tracking In Range, Acquisition, Air Surveillance Radar, Synthetic Aperture Radar(SAR), Bistatic Radar , Electronic Counter-Countermeasures .	8	20
4.	**RADAR Antenna, Transmitters and Receivers**: Radar antennas, Microwave oscillator and amplifier, pulse modulators, radar receiver, noise figure, mixer, detection of RADAR signal in noise, Duplexers, Displays.	7	15
5.	**Navigation and Radio Direction Findings:** Four methods of navigation, radio direction findings, radio ranges, hyperbolic systems of navigation-LORAN and DECCA, aids to approach and landing. Loop Antenna, Loop input circuits, aural null direction finder, Goniometer, Errors in Direction Finding, Adcock Direction Finder, Advantages.	7	15
6.	**Modern Navigation** : Distance Measuring Equipment, Operation of DME, TACAN, TACAN Equipment, Instrument Landing System, Ground Controlled Approach System , Microwave Landing System(MLS), 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.	7	15

Suggested Specification table with Marks (Theory/Practical):

% Distribution of 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, **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 Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Introduction to Radar System	M.I. Skolnik	McGraw Hill	2001	2nd

2.	Radar Systems and Radio Aids to Navigation	Bhattacharya	Khanna	1987	7th
3.	Radar Systems Analysis and Design Using MATLAB	Bassem R. Mahafza	CRC	2000	17th
4.	Ground Studies for Pilots: Radio Aids	R.B. Underdown	Black well	2011	6th

Course Outcome:

Sr. No.	CO Statement After learning this subject students will be able to	Marks % weightage
CO-1	Summarize basics of Radar and describe significance of Radar parameters and its operation.	30
CO-2	Use RADAR transmitter system for computation of various RADAR parameter.	20
CO-3	Use RADAR components and systems for scanning and tracking techniques.	30
CO-4	Classify modern navigational techniques and its use with RF system	20

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	-	2	2	2	-	2	2	2	2	2	-		2
CO-2	3	3	-	2	2	2	-	2	2	2	2	2	2	-	2
CO-3	3	3	-	3	2	2	-	2	2	2	2	2	-	-	2
CO-4	3	3	-	3	-	2	-	2	2	2	2	2	-	-	-

List of Open Source/learning website:

- https://nptel.ac.in/courses/108105154- Principles and Techniques of Modern Radar Systems