



Kadi Sarva Vishwavidyalaya

Gandhinagar-382 015

B.E Semester: 8

Electronics & Communication Engineering

Subject Name: Radar and Navigational Aids

Subject Code : EC-802-B(E P II)

A. Course Objective:

The educational objectives of this course are

- To present a problem oriented introductory knowledge of Radar and Navigational Aids
- To address the underlying concepts and methods behind Radar and Navigational Aids

B. Teaching / Examination Scheme

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
EC- 802-B	Radar and Navigational Aids	4	0	2	6	5	3	70	30	20	30	150

C. Syllabus

- 1 An Introduction to Radar Equation :** Introduction, Radar block diagram, Application of radar, Radar frequencies, Different types of Radar, Simple form of radar equation, Prediction of range performance, Minimum detectable signal, Radar receiver noise and Signal to Noise ratio, System losses, Propagation effect on EM wave in atmospheric conditions.
- 2 CW and Frequency Modulated Radar:** Doppler effect, CW Radar, Frequency modulated CW (FMCW) radar, Multiple Frequencies in CW radar.
- 3 MTI and Pulse Doppler Radar:** Moving target indicator radar, Delay lines and cancellers, Staggered pulse repetition frequencies, Range gated Doppler filters, Digital MTI signal processing, Non coherent MTI, Pulse Doppler radar MTI from moving platform(AMTI), Limitations to MTI performance.
- 4 Tracking Radar:** Tracking with radar, Block diagram of tracking radar, sequential lobbing, conical scanning, Mono pulse tracking, Tracking in range, Acquisition, Synthetic Aperture Radar(SAR), Over the Horizon Radar



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- 5 **Radar Transmitters and Receivers:** Radar RF sources, Klystrons, Multi cavity klystron, Reflex klystron, The travelling wave tube, Backward wave oscillator, Hybrid linear beam amplifier(Twystron), Solid state transmitter, Magnetron oscillators, Radar receivers, Receiver Noise, Mixers, Duplexer, Receiver protectors, Radar displays.
- 6 **Radar Antennas:** Parameters of radar antenna, Reflector antennas, Phased array antennas, Loop antenna.
- 7 **Radio Direction and Ranges:** Methods of Navigation, Classes of direction finders, Loop antenna, Errors in loop direction finder, An aural null direction finder, Adcock direction finder, Goniometer, Automatic direction finders, Radio beacons, Commutated arial direction finder, The low frequency/ Medium frequency, VHF Omni Range(VOR), VOR airborne receiver.
- 8 **Hyperbolic Electronics Navigational Systems:** LORAN, DECCA navigation system.
- 9 **Electronics Aids to Approach and Landing system:** Ground controlled approach, Instrument landing system, Microwave landing system, Distance Measuring Equipment, TACAN.
- 10 **Modern Navigation:** Basic concept of Doppler Navigation, Inertial Navigation and Navstar Global Positioning System.

D. Lesson Planning

Sr. No.	No. of Hrs.	% Weight-age in Exam	Topic
1	10	16	An Introduction to Radar Equation : Introduction, Radar block diagram, Application of radar, Radar frequencies, Different types of Radar, Simple form of radar equation, Prediction of range performance, Minimum detectable signal, Radar receiver noise and Signal to Noise ratio, System losses, Propagation effect on EM wave in atmospheric conditions.
2	05	8	CW and Frequency Modulated Radar: Doppler effect, CW Radar, Frequency modulated CW (FMCW) radar, Multiple Frequencies in CW radar.



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3	08	13	<p>MTI and Pulse Doppler Radar: Moving target indicator radar, Delay lines and cancellers, Staggered pulse repetition frequencies, Range gated Doppler filters, Digital MTI signal processing, Non coherent MTI, Pulse Doppler radar MTI from moving platform(AMTI), Limitations to MTI performance.</p>
4	05	9	<p>Tracking Radar: Tracking with radar, Block diagram of tracking radar, sequential lobbing, conical scanning, Mono pulse tracking, Tracking in range, Acquisition, Synthetic Aperture Radar(SAR), Over the Horizon Radar</p>
5	10	15	<p>Radar Transmitters and Receivers: Radar RF sources, Klystrons, Multi cavity klystron, Reflex klystron, The travelling wave tube, Backward wave oscillator, Hybrid linear beam amplifier(Twystron), Solid state transmitter, Magnetron oscillators, Radar receivers, Receiver Noise, Mixers, Duplexer, Receiver protectors, Radar displays.</p>
6	03	7	<p>Radar Antennas: Parameters of radar antenna, Reflector antennas, Phased array antennas, Loop antenna.</p>
7	07	12	<p>Radio Direction and Ranges: Methods of Navigation, Classes of direction finders, Loop antenna, Errors in loop direction finder, An aural null direction finder, Adcock direction finder, Goniometer, Automatic direction finders, Radio beacons, Commutated arial direction finder, The low frequency/ Medium frequency, VHF Omni Range (VOR), VOR airborne receiver.</p>
8	04	6	<p>Hyperbolic Electronics Navigational Systems: LORAN, DECCA navigation system.</p>
9	05	8	<p>Electronics Aids to Approach and Landing system: Ground controlled approach, Instrument landing system, Microwave landing system, Distance Measuring Equipment, TACAN.</p>
10	03	6	<p>Modern Navigation: Basic concept of Doppler Navigation, Inertial Navigation and Navstar Global Positioning System.</p>
TOTAL	60	100	



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E. Instructional Method & Pedagogy

- At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weight age should be given to all topics while teaching and conduction of all examinations.
- Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
- One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
- Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
- Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
- Experiments shall be performed in the laboratory related to course contents.

Suggested list of Experiments

Sr. No	Name Of Experiment
1	To study working of Doppler Radar.
2	To determine the velocity of the moving object in the radar range.
3	To understand the principle of Doppler radar and to measure time and frequency with the help of moving pendulum.
4	To study the alarm system using radar.
5	To study object counting using radar.



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- 6 To study the detection of vibration of different tuning forks.
- 7 To determine Rotation Per Minute (RPM) of a moving object (Fan).
- 8 To study the effect of different types of material on radar detection.
- 9 To study radiation pattern of antenna used in radar.
- 10 To study microwave power sources used in radar.
- 11 To implement and understand basic radar system using simulation tool.

F. Students Learning Outcomes

On successful completion of the course

- The student can identify different areas of Radar and Navigation. Can find the applications of all the areas in day to day life. Can identify the operations, working, construction, material used in radar technology.

G. Recommended Study Materials

Text/ Reference Books:

1. "Introduction to Radar Systems", Skolnik M., Tata McGraw-Hill, 3rd Edition, 2001
2. "Elements of Electronic Navigation Systems", N.S.Nagaraja, Tata McGraw-Hill, 2nd Edition, 2000
3. "Fundamentals of RADAR, SONAR and NAVIGATION ENGINEERING", K.K.Sharma, S.K. Kataria & sons, 4th Edition