

RADAR AND SONAR SIGNAL PROCESSING

(Elective Subject)

Course Code:	13M1WEC432	Semester:	4 th Semester, M. Tech (ECE)
Credits:	3	Contact Hours:	L-3, T-0, P-0

Course Objectives

The objectives are to study the basics of a radar systems and its components and to analyse of radar systems..

Course Outcomes

After the successful completion of the course student should be able to:

1. Know the basic building blocks of a radar system.
2. Have an in-depth knowledge on different types of signals that are used.
3. Know about the ambiguity function and its significance in radar signal processing.
4. To know the principle of operation of sonar and sound propagation in water.
5. Apply the knowledge acquired in this course in real time applications.

Course Contents

Unit	Topics	References (chapter number, page no. etc)	Lectures
1.	Introduction to radar and radar equation, radar wave propagation. Radar block diagram, resolutions in range velocity, radar equation, types of radars. Atmospheric effects on radar wave propagation. Radar cross section, radar displays.	Peebles	6
2.	CW and FM radar and MTI radar: Doppler radar, CW radar, FMCW radar, multiple frequencies CW radar, MTI radar, delay line cancellers, staggered pulse repetitive frequencies, pulse Doppler radar, limitations of MTI radar.	Skolnik	8
3	Radar waveforms: Matched filter, Pulse compression, ambiguity function, LFMCW, HFM waveforms, Doppler invariant waveforms.	Peebles	8
4	Radar antennas and radar tracking: Radar antennas and radar tracking Antenna basics, antenna arrays, analysis and synthesis of	Elliot	9

	antenna arrays. Buttlar's matrix, tracking of radar. Synthetic aperture radar.		
5	Radar transmitters and receivers: Noise figure, amplifiers, mixers, power dividers and phase shifters.	Pozar	8
6	Introduction to sonar: Under water propagation, types of sonar, sonar transducers.	Hansen	3
Total Number of Lectures			42

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
 - 10 Marks : Class performance, Tutorials & Assignments
 - 10 Marks : Quizzes
 - 5 marks : Attendance

Text Books

1. Peebles, Peyton Z. *Radar principles*. John Wiley & Sons, 2007.
2. Skolnik, Merrill I. "Introduction to radar." *Radar Handbook 2* (1962).
3. Elliot, Robert S. *Antenna theory and design*. John Wiley & Sons, 2006.
4. Pozar, David M. *Microwave engineering*. John Wiley & Sons, 2009.
5. Hansen, Roy Edgar. "Introduction to sonar." *Course Material to INF-GEO4310, University of Oslo,(Oct. 7, 2009)* (2009).

Reference Books

1. Stutzman, Warren L., and Gary A. Thiele. *Antenna theory and design*. John Wiley & Sons, 2012. Cheng, David Keun. *Field and wave electromagnetics*. Pearson Education India, 1989.
2. Hodges, Richard P. "Introduction to Sonar." *Underwater Acoustics: Analysis, Design and Performance of Sonar*: 1-15.
3. Navigation, Guidance and control, NPTEL lectures by Debasish Ghose.