

Branch Name:	Signal Processing and Communication
Program Code:	ET214
Course Name:	Radar Signal Processing
Course Code:	2ET2140208T
Pre-requisite Course:	Basic Knowledge of Analog communication and digital communication. Basic knowledge and skill of digital signal processing.

Course Objectives:

1. The Course introduce and develop skills in the students related to understanding and analyzing various signal models, pulse RADAR Signals, Doppler RADAR Signals, Processing of RADAR Signals at various stages.
2. The Course also covers the various signal detecting schemes, Synthesis and analysis of RADAR Signals. Make them familiar with beam forming and adaptive processing for RADAR Systems.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40		-	-	-	100

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
1	Introduction to RADAR Systems:- History and Application of RADAR, Basic RADAR Functions, Elements of pulsed RADAR, Review of Signal processing Concepts and operations, A preview of Basic Radar signal processing, radar system components, Advance RADAR Signal processing.	3	5
2	Signal Models:- Components of a RADAR signal, amplitude models, types of clutters, noise model and signal to noise ratio, jamming, and frequency models: the Doppler shift, spatial models and spectral model.	3	5
3	Sampling and quantization of pulsed RADAR Signals:- Domain and criteria for sampling radar signals, Sampling in the fast time dimension, Sampling in slow time: selecting a pulse repetition interval, sampling the Doppler spectrum, Sampling in the spatial and angle dimension, Quantization, I/Q imbalance and Digital I/Q.	4	10
4	RADAR Waveforms:- Introduction, The waveform matched Filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveforms, frequency modulated pulse compression waveforms, Range side lobe control for FM Waveforms, the stepped frequency waveform, Phase modulated pulse compression waveforms, COSTAS Frequency Codes.	4	10

5	Doppler Processing: -Alternate form of Doppler spectrum, Moving Target indication(MTI),Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair Processing, additional Doppler processing issues, clutter mapping and moving target detector, MTI for moving platforms: adaptive displaced phase centre antenna processing.	6	15
6	Detection Fundamentals: -Radar Detection as hypothesis testing, threshold detection in coherent systems, threshold detection of RADAR signals.	5	15
7	Constant False Alarm Rate (CFAR) Detection: The effect of unknown interference power on false alarm probability, Cell Averaging (CFAR), Order static CFAR, Additional CFAR Topics.	5	15
8	Introduction to Synthetic Aperture Imaging: - Introduction to SAR Fundamentals, Stripmap SAR Data characteristics, Strip map SAR Image formation algorithms, spotlight SAR Data characteristics, The polar format image formation algorithm for spotlight SAR, Interferometric SAR.	5	10
9	Introduction to beam forming and space-Time adaptive Processing: -Spatial Filtering, Space- time signal environment, space-time signal Modeling, processing the space-time signal, Computational issues in STAP, Reduced -dimension STAP, Advanced STAP Algorithms and Analysis, limitations to STAP.	5	15
	Total	40	100

List of Text Book:

1. “Fundamental of Radar signal Processing”, Mark A. Rechar, McGrawhill, New York 2005
2. “Principles of RADAR and Sonar Signal Processing”, Francois Le Chevalier, Artech House

List of Reference Books:

- 1.“Radar Systems, Peak Detection and Tracking”,Michael O kolawole,2010,Elesvier
- 2.“Introduction to RADAR Systems”, 3/E,Skolnik, Mc-Graw Hill
- 3.“Radar Principles”, Peyton Z. peebles,2009 Wiley India
- 4.“Radar Design Principles-Signal Processing and Environment”, Fred E. Nathason, PHI

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand various RADAR Waveforms and Applications. Interpret, Analyze RADAR Signal and Detections	1 Remembering 2 Understanding
CLO2	Perform and design Basic RADAR Signal Processing Mechanisms. Design, interpret and analyze the different Detection Methods.	2 Understanding 5. Evaluate 3 Applying
CLO3	Understand, interpret and analyze SAR Data and applications.	4 Analyze
CLO4	Design RADAR beam forming.	5. Evaluate 3 Applying
CLO5	Perform Space time adaptive signal processing for RADAR	3 Applying 2 Understanding
CLO6	Design, analyze, synthesis complete RADAR Systems and signal processing mechanisms.	2 Understanding 5. Evaluate 3 Applying

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1					L	M						H	H	M	L	
CLO2		H	M	M	L					L		H		M	L	
CLO3		M	H		L									H		L
CLO4		M	H		L			L					L		M	H
CLO5	H	M	H		L				L			H	L		M	H
CLO6	H	M	H		L							M	L		M	H

H: High, M: Medium, L: Low