SCHEME OF COURSE WORK

Course Details:

Course Title	**: ADAPTIVE SIGNAL PROCESSING**		
Course Code	**: 13EC2112**	**L P C**	**: 4 0 3**
Program:	**: M.Tech.**		
Specialization:	**: Communication Engineering and Signal Processing**		
Semester	**: II**		
Prerequisites	**: Digital Signal Processing, Advanced Signal Processing, Estimation Theory**		
Courses to which it is a prerequisite	**: --**		

Course Outcomes (COs):

1	Comprehend design criteria and modeling adaptive systems and theoretical Performance evaluation.
2	Design a linear adaptive processor.
3	Apply mathematical models for error performance and stability.
4	Apply mathematical models for error performance and stability.
5	Comprehend the estimation theory for linear systems and modeling algorithms.
6	Design based on Kalman filtering and extended Kalman filtering.

Program Outcomes (POs):

1) Able to apply the knowledge of Electronics and Communication Engineering fundamentals to solve complex problems in communications and signal processing.
2) Able to identify, formulate and analyze problems related to communications and signal processing area and substantiate the conclusions using the first principles of sciences and engineering.

3) Able to Design solutions for communications and signal processing problems and design system components and processes that meet the specified needs with appropriate consideration for public health and safety.

4) Able to perform analysis and interpretation of data by using research methods such as design of experiments to synthesize the information and to provide valid conclusions.

5) Able to select and apply appropriate techniques from the available resources and modern tools, and will be able to predict and model complex engineering activities with an understanding of the practical limitations.

6) Able to collaborate with engineers of other disciplines and work on projects which require multi-disciplinary skills.

7) Able to demonstrate knowledge and understanding of the engineering and management principles and apply the same while managing projects in multidisciplinary environments.

8) Able to communicate fluently on complex engineering activities with the engineering community and society, and will be able to prepare reports and make presentations effectively.
9) Engage themselves in independent and life-long learning in the broadest context of technological change while continuing professional practice in the Communication technologies.

10) Transform into responsible citizens by resorting to professional ethics and norms of the engineering practice.
11) Able to carry out tasks by working independently and also in a group of members.

Course Outcome Versus **Program Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO-1	S	S	S	S	S	M			M		
CO-2	S	S	S	S	S	M			M		
CO-3	S	S	S	S	S	M	M		M		
CO-4	S	S	S	S	S	M			M		
CO-5	S	S	S	S	S	M			M		
CO-6	S	S	S			M					

Assessment Methods:	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	**UNIT – I ADAPTIVE SYSTEMS:** Characteristics, Areas of application, general properties, open and closed loop adaptation, applications of closed loop adaptation, Example of an Adaptive System	CO-1	1. Discuss the characteristics of Adaptive systems. 2.Differentiate Open and Closed Loop Adaptive systems.	▫ Lecture ▫ Discussion ▫ PPT	Assignment 1 (Week 2 - 4)
2	The Adaptive Linear Combiner: Description, Weight Vectors, Desired Response, Performance Function; Gradient and Minimum Mean-Square Error.	CO-1	1.Derive the Performance function of an adaptive linear combiner	▫ Lecture ▫ Discussion ▫ PPT	Mid-Test 1 (Week 9)
3	Approaches to the Development of Adaptive Filter Theory: Introduction to Filtering Smoothing and Prediction-Linear Optimum Filtering, Problem Statement, Principle of Orthogonality, Minimum–MeanSquared Error, Wiener –Hopf Equations, Error Performance, Normal Equation.	CO-2	1. Derive the expressions for Wiener-Hopf Equation. 2.Explain in detail about Linear Optimum filtering.	▫ Lecture ▫ Program solving	
4	**UNIT – II GRADIENT SEARCHING AND ESTIMATION:** Searching the Performance Surface – Methods and Ideas of Gradient Search Methods, Gradient Searching Algorithm and its Solution, Stability and Rate of Convergence	CO-3	1. Discuss about Gradient Search Algorithm in detail	▫ Lecture ▫ Discussion ▫ PPT	
5	Learning Curves, Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of	CO-3	1. Explain about Gradient search by Newton's Method. 2.Discuss about Steepest	▫ Lecture ▫ Discussion ▫ Program solving	

	Learning Curves.		Descent algorithm in detail.		
6	Gradient component estimation by derivative measurement, the performance penalty, derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight vector solution	CO-3	1. Derive the expression for Performance Penalty with multiple weights.	▫ Lecture ▫ Discussion ▫ PPT	
7	**UNIT-III LMS & RLS ALGORITHMS:** Overview, LMS Adaptation Algorithms, Stability and Performance Analysis of LMS Algorithms	CO-4	1. Discuss the stability and Performance Analysis of LMS Algorithms.	▫ Lecture ▫ Discussion	
8	LMS Gradient and Stochastic Algorithms,	CO-4	1. Write a short note on stochastic Algorithms.	▫ Lecture ▫ Program Solving	
9	**Mid-Test 1**				
10	Convergence of LMS Algorithms, RLS algorithms	CO-4	1. Discuss about the Convergence of LMS Algorithms 2.Explain in detail about RLS Algorithm	▫ Lecture ▫ Discussion ▫ Problem solving	Mid-Test 2 (Week 18)
11	**UNIT-IV ADAPTIVE MODELING AND SYSTEM IDENTIFICATION:** General description, adaptive modeling of multipath communication channel	C0-5	1. Explain in detail about adaptive modeling of multipath communication channel.	▫ Lecture ▫ Discussion	Assignment 2 (Week 10 - 14)
12	adaptive modeling in geophysical exploration, adaptive modeling in FIR digital filter synthesis	CO-5	1. Explain in detail about adaptive modeling of FIR digital Filter Synthesis	▫ Lecture ▫ Discussion	
13	general description of inverse modeling, some theoretical examples	C0-5	1. Write a short note on Inverse Modelling of adaptive systems	▫ Lecture ▫ Discussion	
14	**UNIT-V KALMAN FILTERING THEORY:** Introduction, Recursive Mean Square Estimation for Scalar Random Variables, Statement of Kalman Filtering Problem	C0-6	1. Derive the expression for Kalman Filtering Problem.	▫ Lecture ▫ Discussion	
15	Innovation Process. Estimation of State using the Innovation Process	CO-6	1. Discuss about state estimation using the innovation Process.	▫ Lecture ▫ Discussion	Seminar (Week 15)
16	Filtering, Initial Conditions, Summary of Kalman Filters, Variants of the	CO-6	1. What are the variants of the Kalman Filtering.	▫ Lecture ▫ Discussion	

	Kalman Filtering				
17	Extend Kalman Filtering, Identification as a Kalman Filtering Problem.	CO-6	1. Derive the expression for Extended Kalman Filtering.	▫ Lecture ▫ Discussion	
18	**Mid-Test 2**				
19/20	**END EXAM**				