II B.Tech – II Semester
(20EE4637) ADAPTIVE CONTROL DESIGN & ANALYSIS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	4	-	-	4

Pre-Requisites: Control Systems

Course Objectives: At the end of the course, the students are supposed to

- understand direct and indirect adaptive control and methods of adaptation.
- understand the parameter identification of systems and Robust adaptive algorithmic laws.
- apply the adaptive state feedback control for both continuous and discrete-time models
- apply the model reference adaptive control for both continuous and discrete-time models.

UNIT-I: Introduction to Adaptive Control

Adaptive Control-Adaptive Control Versus Conventional Feedback Control, Fundamental Hypothesis in Adaptive Control, Adaptive Control Versus Robust Control. Basic Adaptive Control Schemes, Open-Loop Adaptive Control, Direct Adaptive Control, Indirect Adaptive Control, Direct and Indirect Adaptive Control. Approaches to Adaptive Control: Gain Scheduling, Model Reference Adaptive control, Self-Tuning Regulators, Stochastic Adaptive Control.

UNIT-II: Preliminaries of Adaptive control

Dynamic System Models – Nonlinear Systems – Linear Systems. System Characterizations. Lyapunov Stability- Stability Definitions- Positive Definite Functions- Lyapunov Direct and Indirect Method. Input-Output Stability: Bellman-Gronwall Lemma-Small-Gain Lemma- Operator Stability- Strictly Positive Real Systems. Signal Convergence Lemmas. Discrete-Time Systems Modelling and Stability. Pole Placement. Problems.

UNIT-III: Adaptive Parameter Estimation

A Parametrized System Model. Linear Parametric Models. Normalized Gradient Algorithm. Normalized Least-Squares Algorithm. Continuous-time Parameter Convergence algorithms. Discrete-time Parameter Convergence algorithms. Robustness of Adaptive Algorithms. Robust Adaptive laws. Problems

UNIT-IV: Adaptive State Feedback Control

Design for State Tracking. Design for Output Tracking. Disturbance Rejection. Parametrization of State Feedback. Discrete-Time Adaptive Control.

UNIT-V: Model Reference Adaptive Control

Control System Structure for both Continuous-time and Discrete-time. Model Reference Control. Adaptive Control & Robustness of MRAC. Indirect Adaptive Control: Model Reference Designs- Pole Placement Designs- Discrete-Time Adaptive Control Systems.

Course Outcomes:

After successful completion of the course, the students will be able to:

S.No	Course Outcome	BTL
1.	Understand the effect of parameter variation and principle of adaptive control schemes.	L2
2.	Distinguish different parametric estimation methods and apply various adaptive algorithms and laws.	L2
3.	design of adaptive state feedback and model reference adaptive controllers for both continuous and discrete-time models	L6
4.	design the indirect adaptive control design for both continuous and discrete-time models	L6

Correlation of COs with POs& PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	1	3	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1	2
CO3	2	3	-	-	-	-	-	-	-	-	-	1	1	2
CO4	2	3	-	-	-	-	-	-	-	-	-	1	1	2

Text Books:

1. Gang Tao, "Adaptive Control Design and Analysis", WILEY-INTERSCIENCE, A John Wiley & Sons, Inc. Publications.
2. Robust adaptive control system by Petros A. Ioannou, Jing Sun. Dover Publications. 2013.
3. Petros loannou and Baris Fidan, Adaptive Control Tutorial, Society for Industrial and Applied Mathematics Philadelphia

Reference Books:

1. S. Sastry and M. Bodson, Adaptive Control, Prentice-Hall, 1989.
2. IoanDoré Landau, Rogelio Lozano, Mohammed M'Saad, Alireza Karimi. Adaptive Control Algorithms, Analysis and Applications, Springer London Dordrecht Heidelberg New York.
3. H. K. Khalil, Nonlinear Systems, Prentice Hall, 3rd edition, 2002