II Year II Semester **L T P C**

Code: 20EE4634 **4 0 0 4**

ADVANCED CONTROL SYSTEM DESIGN

Preamble: Control systems play a fundamental role in modern technological systems. The benefits of improved control systems in the industry can be immense. This subject aims to study modern control system analysis and design methods for the single-input single-output and the multi-input multi-output systems

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

1. provide a theoretical understanding of advanced linear control systems and strategies
2. Apply the optimal and robust controller design procedures to dynamic systems
3. impart knowledge on intelligent control system design
4. analysis of MIMO control loops and exploit SISO design methods into MIMO design problems

Course Outcomes: At the end of the course, the students can able to

1. Apply the time-domain methods for modelling, analysing linear time-invariant (LTI) dynamic systems.
2. execute a wide variety of state variable feedback and optimal control system design methods for linearized dynamic systems
3. Apply robust and intelligent control system design methods forlinearized dynamic systems
4. To exploit the SISO design methods to MIMO problems and analyze the issues of robustness

PO& PSOs	Program Outcomes (POs)												PSOs		
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3	-	-	-	-	-	-	-	-	-	1	2	2	-
CO2	3	-	2	-	-	-	-	-	-	-	-	1	2	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	1	1	2	-
CO4	3	-	2	-	-	-	-	-	-	-	-	1	1	2	-

*Mapping Strength: **Strong-3; Moderate-2; Low-1**

Unit – I: Spate Space Methods For Control System design

Introduction to state space approach. Solution of the state vector differential equation-Transient solution from a set of initial conditions. Controllability and Observability relating Pole-zero cancellation. State variable feedback design: Pole Placement. State Observer. Effect of full-order state observer on a closed-loop system. Reduced-order state observer.

Unit – II: Optimal Control System Design

Review of Optimal control-Types of optimal control-selection of the performance index. linear quadratic regulator-tracking problem. Kalman filter-state estimation process-single and multi-variable estimation process. Linear Quadratic Gaussian control system design. $H_2 \& H_\infty$ −Optimal control

Unit – III: Robust Control System Design
Introduction. Internal Model Control(IMC)-structured and unstructured model uncertainty. Robust stability and Performance. Multivariable $H_2 \& H_\infty -$ robust control

Unit – IV: Intelligent Control System Design
Intelligent control systems-Intelligent in the machines-Control system structure. Fuzzy logic control systems. Neural network control systems-Neurofuzzy Control. Genetic Algorithm and their application to control design.

Unit – V: MIMO Control Loop Analysis and Design
Models for multivariable systems, the basic MIMO control loop, closed-loop stability, steady-state response for step inputs, frequency domain analysis, robustness issues. Exploiting SISO techniques in MIMO control-completely decentralized control-pairing of inputs and outputs, robustness issues in decentralized control, feed forward action in decentralized control converting MIMO problems to SISO problems.

Text Books:

1. -Ronald S Burns. "Advanced Control Engineering", ISBN:0-7506-5100-8
2. -Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado, "CONTROL SYSTEM DESIGN", Pearson, ISBN: 978-0139586538

Reference Books:

1. *Bernard Friedland* "Advanced Control System Design", Prentice-Hall, 1996