Advanced Control System Design for Aerospace Vehicles - Video course

COURSE OUTLINE

In this course concepts and techniques of linear and nonlinear control system analysis and synthesis will be studied in the modern control (state space) framework.

It will have preferential bias towards aerospace applications, especially towards guidance and control of aircrafts and missiles.

However, the theory as well as many demonstrative examples will be quite generic and hence this course is expected to be useful to the students from many other engineering disciplines as well.

COURSE DETAIL

S.No	Topics
1	**1.Introduction and Motivation** 1. Introduction and Motivation for Advanced Control Design
2	**2.Review of Classical Control** 2. Classical Control Overview – I 3. Classical Control Overview – II 4. Classical Control Overview – III 5. Classical Control Overview – IV
3	**3.Flight Dynamics** 6. Basic Principles of Atmospheric Flight Mechanics 7. Overview of Flight Dynamics – I 8. Overview of Flight Dynamics – II

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Aerospace Engineering

Pre-requisites:

1. Some exposure to Classical Control Theory, Matrix Theory and Differential Equations.

Coordinators:

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4	**4.Representation of Linear Systems** 9. Representation of Dynamical Systems – I 10. Representation of Dynamical Systems – II 11. Representation of Dynamical Systems – III
5	**5. Review of the Matrix Theory** 12. Review of Matrix Theory – I 13. Review of Matrix Theory – II 14. Review of Matrix Theory – III
6	**6. Review of Numerical Methods** 15. Review of Numerical Methods
7	**7. Linearization of Nonlinear Systems** 16. Linearization of Nonlinear Systems
8	**8. Time Response, Stability, Controllability and Observability of Linear Systems** 17. First and Second Order Linear Differential Equations 18. Time Response of Linear Dynamical Systems 19. Stability of Linear Time Invariant Systems 20. Controllability and Observability of Linear Time Invariant Systems
9	**9. Pole Placement, Controller and Observer Design of Linear Systems** 21. Pole Placement Control Design 22. Pole Placement Observer Design
10	**10. Static Optimization** 23. Static Optimization: An Overview
11	**11. Optimal Control Design** 24. Calculus of Variations: An Overview 25. Optimal Control Formulation using Calculus of Variations 26. Classical Numerical Methods for Optimal Control

	27. Linear Quadratic Regulator (LQR) Design – I 28. Linear Quadratic Regulator (LQR) Design – II
12	**12. Linear Control Applications in Flight Control Design** 29. Linear Control Design Techniques in Aircraft Control – I 30. Linear Control Design Techniques in Aircraft Control – II
13	**13. Nonlinear System Analysis Using Lyapunov Theory** 31. Lyapunov Theory – I 32. Lyapunov Theory – II 33. Constructions of Lyapunov Functions
14	**14. Nonlinear Control Synthesis** 34. Dynamic Inversion – I 35. Dynamic Inversion – II 36. Neuro-Adaptive Design – I 37. Neuro-Adaptive Design – II 38. Neuro-Adaptive Design for Flight Control
15	**15. Nonlinear Observer and Kalman Filter Design** 39. Integrator Back-Stepping; Linear Quadratic (LQ) Observer 40. An Overview of Kalman Filter Theory

References:

1. N. S. Nise: Control Systems Engineering, 4th Ed., Wiley, 2004.

2. K. Ogata: Modern Control Engineering, 3rd Ed., Prentice Hall, 1999.

3. B. Friedland: Control System Design, McGraw Hill, 1986.

4. E. Bryson and Y-C Ho: Applied Optimal Control, Taylor and Francis, 1975