Nonlinear Control System - Web course

COURSE OUTLINE

The tools to analyze stability of linear systems is well-developed, while in the nonlinear setting, there is a limited repertoire of techniques to investigate the stability of motion.

The course begins with a review of basic concepts from set theory and then introduces to modeling of simple mechanical systems using Lagrangian formulation, thereby formulating state-space representation of nonlinear ordinary differential equations.

A qualitative analysis of second-order systems using phase-portraits is then introduced to analyze the behaviour of trajectories in the vicinity of the equilibrium points. The notion of limit cycle forms an important study in this course.

Stability is central to control system design and here we will study various notions of stability such as Lagrange stability, Lyapunov stability, asymptotic stability, global asymptotic stability, exponential stability, relative stability and instability.

The tools that we will use to infer the stability properties include Lyapunov's direct and indirect method, La Salle's invariance property and singular perturbations.

Contents:

Mathematical preliminaries from point set toplogy, Euler-Lagrange equations of motion, Equilibrium points, Linearization, State-space formulation, Second-order systems, Phase-portrait, Limit cycle, Lyapunov stability**.**

COURSE DETAIL

Sl. No	Topic	No. of hours
1	Review of mathematical preliminaries on point-set topology, normed spaces, Lipschitz continuity, existence and uniqueness of solution of ODE's.	8
2	Modelling of simple mechanical systems, degree-of-freedom, configuration spaces and state-space representation, equilibrium points/operating points, Jacobian linearization.	8
3	Notion of vector field, trajectories, vector field plot, phase-plane portrait, positively invariant sets and classification of equilibrium points.	8
4	Second-order systems, Periodic solution, Bendixson's theorem and Poincare-Bendixson criteria.	4
5	Various notions of stability such as Lyapunov stability,	4

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Electrical Engineering

Pre-requisites:

1. Linear Control Systems.

Additional Reading:

1. Mathematical Analysis by T. Apostol.

Coordinators:

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	Asymptotic stability, Exponential stability.	
6	Stabilty analysis using Lyapunov's direct and indirect method, La Salles's invariance principle and singular perturbation.	8
	Total	**40 Hrs**

References:

1. Nonlinear System Analysis: M. Vidyasagar.
2. Nonlinear Systems: H. K. Khalil.