ME240 August 3:0

Dynamics and Control of Mechanical Systems

Instructor

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Department: Mechanical Engineering

Course Time: Tue.,Thu., 11:30-1:00 am

Lecture venue: ME Department Lecture Hall

Detailed Course Page: http://www.iisc.ernet.in/info-stu/soi/soime.htm

Announcements

Brief description of the course

This course is for first year M Tech Students from Mechanical Engineering. Students for Aerospace Engineering have also attended this course in the past. The first half of the course is on rigid multi-body systems, kinematics, orientation, Euler angles, deriving equations of motion using Lagrangian formulation and other approaches, and modeling and simulation of multi-body systems. The second half of the course is on introduction to classical control (root locus, bode plots) and preliminary ideas on State Space Methods. The aim of the course is to bring up to speed M Tech students who may or may not have been exposed to these topics.

Prerequisites

Undergraduate mathematics, dynamics and familiarity with using computational tools such as Matlab.

Syllabus

Representation of translation and rotation of rigid bodies, degrees of freedom and generalised coordinates, motion of a rigid body and multi-body systems, Lagrangian formulation and Newton-Euler approaches to derive equations of motion, small vibrations, computer generation and solution of equations of motion,

classical control methods, pid controller, root locus, Bode diagrams, State space method, stability, controllability and observability, Matlab implementation.

Course outcomes

The students will learn concept of degree of freedom and generalised coordinates of a rigid body and multi-body system, how to specify orientation of a rigid body using Euler angles and other representations, obtain linear and angular velocities of rigid multi-body systems, analyse kinematics of rigid multi-body systems, learn about the Lagrangian and Newton-Euler formulation to derive equations of motion and solve them numerically, perform linearization of the equations of motion to analyse small motions. The students will be exposed to classical control techniques using root locus and bode plots and to modern state space methods. They will be introduced to the concepts of stability, controllability and observability in linear control systems.

Grading policy

Mid term 1 -- 20%

Mid term 2 -- 20%

Assignments -- 10%

Final -- 50%

Assignments

Typically 5 assignments are given two of which are computational.

Resources

Haug, E. J., Computer Aided Kinematics and Dynamics of Mechanical Systems, Vol. 1, Allyn and Bacon, 1989.

Franklin, G. F., Powell, J. D., and Abbas Emami-Naeini, Feedback Control of Dynamic Systems, Addison Wesley, 1987.

Ghosal A, Robotics : Fundamental Concepts and Analysis, Oxford University Press 2006