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ME 226 (AUG) 3:0
APPLIED DYNAMICS I

Instructor(s): Andy Ruina, Jishnu Keshavan

Course description:

Part A: Tools for analysis of planar mechanisms. A 2D mechanism is a collection of rigid objects interacting with each other or to the fixed environment via hinges, sliding connections, collisions, springs, dashpots, non-holonomic constraints (rolling or skates) or body forces (e.g. gravity).

Part B: Analysis of motion of a single rigid object in 3D using dyads for representation of rotation and inertia tensors. Special cases of 3D motion including fixed axes rotation (static and dynamic balance), steady precession of axisymmetric objects, stability of rotation about a principle axis, and chaotic motions of a mass suspended by a spring.

Prerequisites:

Undergraduate Engineering Mathematics courses that include: vectors, linear algebra, differential equations, facility with computers (This course will use Matlab, but facility with any programming language suffices as preparation).

Resources:

1. Instructor's notes and lecture videos.
2. Classical Mechanics, John R. Taylor; University Science, 2004.
3. Principles of Dynamics, Donald T. Greenwood; Prentice Hall, 1988.
4. Dynamics of Particles and Rigid Bodies: A Systematic Approach, Anil Rao; Cambridge University Press, 2006.
5. Getting started with Matlab, Rudra Pratap; Oxford University Press, 2017.

Outcomes:

At the end of the course the student will be able to

1. Start with a sketch or verbal description of *any* 2D mechanism and write EoM (equations of motion) using Newton-Euler with minimal coordinates, or with Lagrange Equations, or using Maximal coordinates and DAEs (Differential Algebraic Equations); Solve the EoM numerically and animate the solutions (system response); Apply various checks (conservation laws, comparison between methods, limiting cases) to assure the validity of the results;

2. Have facility with various skills; solving ODEs with events, root finding, optimization, symbolic derivation of EoM, animation;

3. Have facility with dyads; Have some intuition for 3D rotations, including representation using dyads, matrices, and axis-angle; Be able to animate 3D motion of a rigid object.

Additional information:
A portfolio of completed HW problems brought to the final project presentation (50%); 2 midterm exams (10% each); A final exam (10%); Final (individual) project presentation (20%)

Course website: https://piazza.com/iisc.ernet.in/fall2022/mexxxx