Indian Institute of Science

Mechanical Engineering
Indian Institute of Science
Bengaluru, 560 012
India

E-mail: chair.me@iisc.ac.in
URL: www.mecheng.iisc.ac.in
Telephone: +91 (80) 2293 2332 (office)

ME 232 (JAN) 3:0
Applied Dynamics II

Instructor(s): Andy Ruina & Jishnu Keshavan

Course description:
This is the second of the two Applied Dynamics courses. Course I emphasizes basic tools needed for analysis of dynamic systems. Course II (this course) considers applications and examples of advanced dynamic systems of practical interest. The exact list of topics and their emphasis will depend on student interest. Likely topics include: Robot arms (forwards and inverse kinematics and dynamics), simple models of walking (balance and energetics), airplane dynamics in 2D (lift, drag, L/D, static margin, phugoid motions, stability), sailboat statics and dynamics (lift, drag, sailing upwind, Lanchester Course Theorem), the falling cat (rotation with zero angular momentum), car dynamics (tire models, over- and under-steer, stability), bicycle dynamics (control and dynamics), and drones (control and dynamics).

References:
1. Instructors lecture notes. There is no single book that covers this, or a similar, range of topics. Many references are available online for individual topics.

Prerequisites:
Applied Dynamics I (or equivalent). Representative MATLAB commands that you should be comfortable using, or be able to learn quickly: backslash (i.e., x=Anb); ODE45 using events; fsolve (numerical root finding); solve (symbolic root finding); equationsTomatrix (symbolically convert a set of equations to a matrix equation; matlabFunction (turn a symbolic expression into a numerical MATLAB function).

Additional information:
This course is open to master's students, doctoral students and undergraduates who feel that they are adequately prepared.

Course Outcomes:
At the end of the course, the student will

1. be able to use all of the skills from Applied Dynamics I in the service of understanding real dynamical systems, including finding steady motions, finding periodic motions, and evaluation of stability of steady or periodic motions;
2. have deeper understanding of how various real systems work.

Grading:
Final grade will be based on

1. A portfolio of completed HW problems, assigned weekly, brought to the final project presentation (70%);

2. A final exam (10%); 3. Final (individual) project presentation (20%).

Final Project:

A student will choose a real mechanical system of interest and, at a minimum, make a model, find the EoM, solve the EoM, animate the solutions, and validate the solutions. At best, the student will go on to find interesting features, optimize a design, etc. Each student will have 25 minutes to show their HW portfolio and present their final project and answer questions about their project.