AME 524: Advanced Engineering Dynamics

Instructor: F. E. Udwadia, Email: feuUSC@gmail.com

The course deals with the fundamentals and the techniques for formulation and solution of dynamical problems that commonly arise in engineering systems. The material covered in the course is basic to the dynamics of structures, and the dynamics of fluids and solids. The wish-list of topics that will be covered are:

- **Fundamentals of Newtonian Dynamics**: Impulse, momentum, work, energy, manifolds
- **Fundamentals of Analytical Mechanics**: Constraints, virtual displacement, tangent bundles
- **Rigid body Dynamics**: Finite rotations, Euler angles, quaternions
- **Fundamental Equations of Analytical Dynamics**: Generalized Inverses, holonomic and nonholonomic constraints
- **Control of Nonlinear Systems:** Use of Fundamental Equation, Stability of dynamic systems
- **Lagrange's Equations**: Ignorable coordinates, Routh's method, Lie derivatives, Hamilton's equations, invariances
- **Other Formulations:** Gibbs-Appell, equations, GI equations, Kane's equations
- **Hamilton's Equations:** Hamilton's Principle, geodesics, Hamilton-Jacobi equations

Grading: 30% Homework, 30% Midterm exam (in about the 7th week of class), 40% Final Exam (as per the university's final exam schedule**)**

Homework Policy: Homework is to be turned in <u>exactly one week to the day</u> after it is given out. <u>No</u> late homework will be accepted. Students can confer with one another on how to solve the homework problems, but each student must write her/his homework <u>independently.</u> Students found copying one another's homework will be given a warning. If found a second time, both students will be given a <u>zero</u> on the 30% of the course grade set aside for homework. Students found cheating on any of the exams will receive an F grade in the course.

Text: *Analytical Dynamics: a new approach*, F. E. Udwadia and R. E. Kalaba, Cambridge University Press

Reference Books: *A treatise on Analytical Dynamics*, L. A. Pars, Oxbow Press

Classical Mechanics, H. Goldstein, C. Poole, and J. Safko, Addison Wesley

Mechanics, L. Landau and E. Lifschitz, Elsevier

Office Hours: 1:00-2:00 PM on Thursday   **TA Office Hours**: 4:00-4:45 PM on: M, Tu., W