

## **ENME665: ADVANCED TOPICS IN VIBRATIONS**

**Instructor:** B. Balachandran, Associate Professor of Mechanical Engineering  
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**Textbooks:** Nayfeh, A. H. and Mook, D. T. (1979). *Nonlinear Oscillations*, Wiley, New York (on reserve in the EPSL Library).

Nayfeh, A. H. and Balachandran, B. (1995). *Applied Nonlinear Dynamics: Analytical, Computational, and Experimental Methods*, Wiley, New York.

**References:** TBA

**Class Notes:** Copies of certain lectures will be provided

**Time and Place:** Lectures: M,W --- 5.00 P.M. to 6.15 P.M.  
Engineering Classroom Building, Room 2154

**Office Hours:** M,W: 6.30 P.M. to 7.30 P.M. or by appointment

**Grading:** Assignments: 10 %; Two Mid-Term Exams (Exam I: Exam to be handed out on October 12<sup>th</sup> and due back on Oct. 18<sup>th</sup>; Exam II: Dates in Nov./Dec. TBA): 50 %; and Project: 40 %

**Course Description:** The theme of the course will be nonlinear oscillations and dynamics of structural and mechanical systems. Starting with classical methods, a blend of computational, geometrical, and analytical methods will be used to provide a unified treatment of nonlinear oscillations and dynamics. Bifurcations with respect to quasi-stationary variations of one or more control parameters will be considered and instabilities such as flutter and divergence will be discussed. The phenomenon called chaos will be explored and demonstrated through experiments with structural systems. Specific topics to be considered include the following: 1) nonlinear oscillations of pendulum, beams, and plates; 2) method of multiple scales; 3) phase plane analysis and Poincare' maps; 4) external, parametric, and internal resonances; 5) stability notions and saddle-node, pitchfork, and Hopf bifurcations of equilibria and periodic solutions; and 6) tools such as dimension calculations and Lyapunov exponents for analyzing nonlinear motions

**Course Pre-requisites:** ENME662 and ENME700 or equivalent set

**Comments:** 1) will be away from campus during the following periods: a) August 29—September 4, b) October 16 and 17, and c) November 7—10 and 2) class web site: <http://www.glue.umd.edu/~balab/courses/enme665>