2.032 Dynamics Fall 2014

http://web.mit.edu/course/2/2.032/www/

- Instructors

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  Office hours: MW 10–11 am and by appointment

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- Homework

  A principal goal of 2.032 is to develop analytical problem-solving skills in dynamics. To this end, in addition to the examples worked out in class, there will be about 10 sets of homework problems. These will be posted on the 2.032 website weekly (typically on Wednesday) along with solutions. The homework problems are for practice only; homework will not be collected and will not count towards the final grade. It is strongly recommended though that you make an effort to solve the homework problems (you may collaborate with others if you wish), before checking with the solutions posted on the website.

- Recitation

  An informal recitation will be held by the TA on Tuesdays, 4:00 – 5:30pm, in Room TBA. (The first meeting will be on September 9th.) The main purpose of the recitation is to discuss questions related to the homework posted the previous week. Naturally, the recitation would be most helpful to students who have already worked on and are familiar with the problem set prior to going to class. If you miss a recitation or have further questions about homework, you may seek additional help by making an appointment via email to meet with the TA.

- Exams

  There will be three in-class exams. They are scheduled for

  Wednesday, October 8
  Wednesday, November 12
  Wednesday, December 10

  All exams will be closed-book. There will be no final exam.

- Grading

  Each exam will count equally (1/3) towards the final grade.

- Textbook

  The subject will be based on the material presented in the lectures. There is no required textbook. A list of books placed on reserve in Barker Library and other references is provided on a separate sheet.

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Outline

I. Introduction

Organization, scope of subject. Review of momentum principles for system of particles; work, kinetic and potential energy

II. Kinematics of rigid bodies

Review of plane motion. Finite vs. infinitesimal rotations in 3-D, angular velocity; Euler angles; kinetic energy of rigid body; the inertia tensor

III. Momentum principles for rigid bodies

Angular momentum about general point. Examples

QUIZ 1

IV. Variational formulation

Holonomic and non-holonomic constraints; generalized variables; Lagrange's equations. Examples

V. Stability of motion

Equations governing small perturbations to steady motions. Introduction to bifurcation analysis and the phase plane.

VI. Vibration of discrete systems

Review of normal modes and natural frequencies, forced response of discrete systems; Rayleigh quotient; damping effects; phase-plane analysis of finite-amplitude oscillations

QUIZ 2

VII. Continuous systems

Vibrations of beams and strings. Introduction to wave propagation, dispersion and group velocity

VIII. Gyroscopic effects

Torque-free motion of rigid body; Euler euqations. Spinning symmetric top, rolling coin

QUIZ 3

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Reading List

- On reserve in Barker Library
    - J. Ginsberg, *Engineering Dynamics*, Cambridge University Press, 2008
    - S.H. Crandall, D.C. Karnopp, E.F. Kurtz, Jr. and D.C. Pridmore-Brown, *Dynamics of Mechanical and Electromechanical Systems*, Krieger, 1982
- Other References

H. Goldstein, *Classical Mechanics*, Addison Wesley, 1959.

D.T. Greenwood, *Classical Dynamics*, 2nd edition, Prentice-Hall, 1988.

J.P. Den Hartog, *Mechanics*, Dover, 1961.

J.B. Marion, *Classical Dynamics of Particles and Systems*, 2nd edition, Academic Press, 1970.

L.D. Landau and E.M. Lifshitz, *Mechanics*, 3rd edition, Pergamon, 1976.

J.H. Williams, Jr., *Fundamentals of Applied Dynamics*, John Wiley, 1996.

F.C. Moon, *Applied Dynamics*, John Wiley, 1998.

J.P. Den Hartog, *Mechanical Vibrations*, McGraw-Hill, 1956.

L. Meirovitch, *Elements of Vibration Analysis*, McGraw-Hill, 1975.

L. Meirovitch, *Analytical Methods in Vibrations*, Macmillan, 1967.

A.B. Pippard, *Response and Stability*, Cambridge University Press, 1985.

A.H. Nayfeh and D.T. Mook, *Nonlinear Oscillations*, Wiley-Interscience, 1979.

S.H. Strogatz, *Nonlinear Dynamics and Chaos*, Perseus, 1994.