446.204A Dynamics
Fall 2013
Syllabus

Introduction: This course is an introduction to the dynamics of rigid bodies and multibody systems. The practical goals are to enable students to derive the equations of motion for rigid multibody systems such as robots, vehicles, spacecraft, and other mechanical devices, and to extract qualitative and quantitative information about such systems. The material also serves as a foundation for upper level courses in advanced dynamics and vibration, robotics, biomechanics, and control.

Lectures: Lectures will be held Mondays and Wednesdays from 3:30-5:00 PM, in lecture hall 301-105.

Discussion Section: In addition to the lectures, students are expected to attend a one-hour discussion section each week. Discussion groups, consisting of approximately 20 students each, will be organized and run by the teaching assistants on a weekly basis, with the goal of reviewing the lecture material, solving practice problems, and giving the students an opportunity to ask questions. Discussion sections will meet on Thursdays and Fridays in the late afternoon; the meeting times and locations will be announced at a later date. **Attendance in the discussion sections is mandatory**.

Course Instructor: The instructor for the course is Frank Chongwoo Park. His office is located in Building 301, Room 1515. He can be reached at 880-7133, or by email at *fcp@snu.ac.kr*. The instructor will be available for questions and discussion after each lecture; other times can be arranged by appointment.

Teaching Assistants: The teaching assistants for the course will be announced later on the first day of class. TA offices are located in the Robotics Laboratory, Building 302, Room 413. The main lab telephone number is 880-7149. Office hours maintained by each TA will be announced at a later date.

Course Webpage: A course webpage will be maintained at *http://etl.snu.ac.kr*. All lecture notes, homework assignments, solutions, and announcements will be made available on the course webpage. A monitored course discussion board will also be available. Personal communications with the teaching assistants should be conducted by email rather than through this course discussion board.

Course Text: The course text will be *Vector Mechanics for Engineers: Dynamics* by F. Beer and E. Johnston. Supplemental notes will be distributed throughout the class.

Grading: The grading for the course will be based on weekly problem sets (5%), four in-class 30-minute quizzes (5% each), a midterm exam (25%), a final exam (40%), and participation in discussion sections (10%). The weights are approximate, and may be adjusted accordingly at the discretion of the instructor. Tentative dates for the quizzes and exams are as follows:

- Quiz 1: Monday September 23 (in class, 30 min)
- Quiz 2: Monday October 14 (in class, 30 min)
- Midterm Exam: Wednesday October 23 (6-9 PM)
- Quiz 3: Monday November 18 (in class, 30 min)
- Quiz 4: Monday December 2 (in class, 30 min)
- Final Exam: Wednesday December 11 (6-9 PM)

Prerequisites: Students should have a solid understanding of the classical physics of particles and ordinary differential equations as taught in a first year class. Students are also expected to have an understanding of statics as covered in an introductory course on the mechanics of solids, and vector calculus and matrix algebra as covered in an introductory engineering mathematics course.

Lecture Topics:

- **Kinematics of a particle**: reference frames, coordinates, angular velocities, fixed and moving frames, derivation of velocities and accelerations.
- **Dynamics of a particle**: Newton's Second law, equations of motion, work, kinetic and potential energy, linear and angular momentum, impact, solution methods based on energy and momentum.
- **Dynamics of a rigid body**: Equations of motion for a system of particles, work, energy and momentum, moments of inertia of a rigid body, equations of motion for a single rigid body, coordinate transformations.
- **Lagrange's Equations**: kinematics of multibody systems, degrees of freedom, generalized coordinates, generalized forces, virtual work, derivation of Lagrange's equations, applications.