MECH 410D: Engineering Dynamics

(September 2019)

Prerequisite: MECH 221 (Dynamics) or equivalent at UBC, or its equivalent at other universities.

Who should take this? Students who have taken a first course in engineering dynamics (see above) and who desire to understand the advanced dynamics tools used in transportation, robotics, gaming, sports, and space industries. *Emphasis is on vector and matrix methods used in modern computational dynamics tools.*

Course Objectives:

(1) *Perform* kinematic analysis (both in 2D and 3D) of machine components and mechanisms using *vector* methods; (2) *Apply* kinetics to deduce governing equations of motion using force (Newtonian) and energy (Lagrangian) methods; (3) *Analyse* gyroscopic motion and balancing of rigid rotors; (4) *Use* numerical methods to solve computational dynamics problem.

Course Outline: Read the sections indicated below from the course text book (TB) before each lecture and solve the assigned problems. Lectures: **Tu & Th 5–6:30 pm in DMP 101**.

Suggested Reading: (a) *Engineering Dynamics* by Jerry Ginsberg; (b) *Principles of Dynamics* by Donald T Greenwood; (c) *Engineering Dynamics– a primer* by Oliver M.O'Riley; (d) *Dynamics of multibody systems* by Ahmad A Shabana. Most of these books can be downloaded from the UBC library.

No	Topic (Approximate number of lectures)
1	**Introduction** (1L)
2	**Mechanisms** (8L)
2.1	Classification of mechanisms
2.2	Kinematics of Planar mechanisms
2.3	Kinematics of Spatial mechanisms
2.4	Force analysis
2.5	Application examples from machines and robotics
3	**Rotating Systems** (4L)
3.1	Gyroscopic motion
3.2	Rigid rotors
3.3	Balancing
4	**Work-Energy Methods** (5L)
4.1	Principle of virtual work
4.2	Lagrange equations
4.3	Constrained systems
4.4	Hamilton's principle
5	**Computed Aided Multibody Dynamics** (5L)
5.1	Formulation of matrix equations and solution algorithms
5.2	Introduction to computational miltibody dynamics
5.3	Applications from vehicle dynamics, robotics and aerospace

MECH 410D will be on CANVAS. 1L=1.5hrs.

Assessment: Midterm Exams (20%); Computer aided dynamics project (30%);
Final Exam (50%). All exams are take-home and will involve coding.

Exam dates: $\boxed{TBA}$

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