Course Syllabus

VM 543

Analytical Dynamics

Summer 2018 (WK1-8)

Course Description:

Vectors and tensor. Scalar, vector and tensor products. Second order tensors. Coordinate systems. Differential geometry of curves, surfaces and three dimensional mappings. Basis principles of dynamics. Newton's laws for particles and systems of particles. The geometric description of rotations. Euler angles. Time and spatial derivatives. Kinematics of rigid bodies. Kinetics of rigid bodies. Variational and energy principles in dynamics. Use of motion simulation and virtual prototyping software for multibody dynamics.

Instructor:

Name: Dr. Shawn Duan
Email: duans22000@yahoo.com
Phone: ??
Office: Room
Office hour: 4-5PM Monday and Wednesday, 9-10AM Friday

Textbook:

1. Thomas R. Kane/David A. Levinson, Dynamics: Theory and Application, 2005 (the instructor will provide the book PDF resource for the students enrolled in VM 543 with the copyright permission)
2. Jerry H. Ginsberg, Advanced Engineering Dynamics, 2nd edition Cambridge University Press, 1998, ISBN-13: 978-0521646048, ISBN-10: 0521646049
3. Reference book (optional): Ahmed A. Shabana, Dynamics of Multibody Systems, the 4th edition, Cambridge University Press, 2013

Course Prerequisites: Vm 440 Intermediate Dynamics and Vibration

Course Website: https://umjicanvas.com/

Supplies: Laptop or desktop PC, and Hand Calculator

Computer Software Usage: Students will use virtual prototyping software in and out of class for lab, lecture, and assignment. Matlab is also required for modeling and simulation.

Grading Policy (Assignments %, Project, Exams, etc.)**:**

The student's academic performance will be evaluated according to the homework assignments, quizzes, modeling and simulation case study, projects, tests and final exam. Grade distribution will be based on the following

Reading, Homework, quiz & computing assignment	25%
Course projects	25%
Midterm	25%
Final exam	25%
Discretionary evaluation extra credit up to	5%

The discretionary evaluation includes overall class behavior, class effort (turning homework and reading assignment, the quality of the homework such as neatness, contribution to the class, etc.), and in particular, honesty in homework, tests and exam.

At the end of the course, the overall grade earned by each student will be calculated from the percentage distribution above. An average grade for the overall class will then be established. If the class average grade is 70% or above, then no corrective action will be taken, and the letter grades will be assigned based on the following scale

91.00~100.00%	=>	A
89~90.99%	=>	A^-
86.00~88.99%	=>	B^+
81.00~85.99%	=>	B
79.00~80.99%	=>	B^-
76.00~78.99%	=>	C^+
71.00~75.99%	=>	C
69.00~70.99%	=>	C^-
67.00~68.99%	=>	D^+
61.00~66.99%	=>	D
59.00~60.99%	=>	D^-
58.99 or below	=>	F

If the class average of the final overall grade is below 70%, the difference between 70% and the class average will be added to each student's overall grade, and the letter grades will be assigned according to the scale above

Honor Code Policy:

The academic dishonesty policy of JI will be followed in this class. Please see JI student handbook for details.

Teaching Schedule:

Week	NO.	Date	lectures and Exams	Comments
1	1	5/14	Introduction to modeling in multibody dynamics and computer simulation	Chapter 1 assignment
	2	5/16	Scalar, vector & matrix operations; Various coordinates & unit vectors;	Chapter 1 assignment
	3	5/18	Simple rotation; Vector function & differentiation	Chapter 1 assignment
2	4	5/21	Research project proposal presentation	
	5	5/23	Kinematics; Rotation transformation; finite rotations	Chapter 2 assignment
	6	5/25	Angular velocity & angular accelerations; Kinematics; Two points fixed on a rigid body	Chapter 2 assignment
3	7	5/28	Kinematics: One point moving on a rigid body; Partial velocity and partial angular velocity	Chapter 2 assignment
	8	5/30	Mass center; Tensor; Inertia dyadic; Inertia matrix;	Chapter 3 assignment
	9	6/1	Parallel axes theorem; Principal axes; Principal plan;	Chapter 3 assignment
4	10	6/4	Forces, moments & equivalent force systems; Generalized active forces	Chapter 4 assignment
	11	6/6	**Midterm**	
	12	6/8	Interaction forces; Bringing noncontributing forces into evident; Generalized inertia forces	Chapter 4 assignment
5	13	6/11	Equations of motion: Newton-Euler method;	Chapter 5 assignment
	14	6/13	Equations of motion: Newton-Euler method;	Chapter 5 assignment
	15	6/15	Research project progress report & presentation	
6	16	6/18	Equations of motion: Lagrange’s method;	Chapter 5 assignment
	17	6/20	Equations of motion: Lagrange’s method;	Chapter 5 assignment

	18	6/22	Equations of motion: Kane’s method; non-constrained systems	
7	19	6/25	Equations of motion: Kane’s method; constrained systems	
	20	6/27	Numerical issues, computer simulation and virtual prototyping	
	21	6/29	Integration of CAD/CAE/CAM	
8	22	7/2	Final review	
	23	7/4	Final exam	
	24	7/6	Project final presentation	

(1) This is a tentative course plan for VM543
(2) This plan is subject to change to accommodate student learning needs and learning progress.