What is this course about?

This course is a sequel to your previous studies in the area of dynamics and emphasizes the practical application of the principles of dynamics to the set of connected rigid bodies known as machines and/or mechanisms. During the course, we will examine the kinematics and dynamics of various basic types of machinery (4-bar linkages, slider-cranks, simple cam-follower systems, gear trains, etc.). We will begin by looking at the types of problems encountered in position analysis and move from there to velocity and acceleration analyses. Once we've covered the fundamentals of machine kinematics, we'll use Newton's Laws and their Euler extensions to relate accelerations to the forces. By the end of the term, you should be able to analyze the forces in most simple machines. You'll certainly appreciate why no one likes to do such analyses by hand!

We approach the motion of machines from two perspectives: 1) the motion that results when forces and moments are applied to various component os a machine; and 2) the forces/torques required to cause specific types of motion. These are often called forward and reverse problems although which is forward and with is reverse is rather arbitrary. Along the way, we will examine: how many actuators are needed to drive a particular machine; how we can determine the position of any particle on any component of the machine; how we can determine the velocity of any particle on any component of the machine; and how we can determine the acceleration of any particle on any component of the machine; how we can determine the forces active at any location on any component of the machine; how we can determine the forces exerted by the machine on the support framework; and how we can balance rotating and/or reciprocating machinery.

Weekly plan

(Subject to change as the semester progresses)

Week	Reading material	Lecture topics	Problem set
1	Text: Ch. 1	Introduction; Nomenclature; Mobility analysis	Set #1
2	Text: Ch. 2	Constraint analysis; Solutions to vector equations; Position analysis	
3	Text: Ch. 2	Position analysis (continued); Vector loop equations	Set #2
4	Text: Ch. 3	Introduction to velocity analysis; absolute and relative velocity; rotating frames	
5		Velocity analysis (continued); joints/contact conditions	Set #3
6	Text: Ch. 3	Instantaneous center of zero velocity; velocity of the IC itself	
7	Text: Ch. 4	Centers of curvature; Hartmann's construction (a graphical interpretation); Euler-Savary equation	Set #4
8	Text: Ch. 4	Acceleration analysis; absolute and relative acceleration; rotating frames	
9	Text: Ch. 4	Acceleration analysis (continued) joints/contact conditions	Set #5
10	Text: Ch. 13	Static force analysis	
11	Text: Ch. 14 Bb: Rigid body motion handout	Dynamic force analysis	Set #6
12	Text: Ch. 14 Bb: Rigid body motion handout	Dynamic force analysis (continued) 2-D constrained motion	
13	Text: Ch. 17	Balancing; shaking forces/moments;	Set #7

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Week	Reading material	Lecture topics	Problem set
14	Text: Ch. 18	Cam dynamics	Set #8
15		Catch up, review, etc.	
—	Study and final exam period		