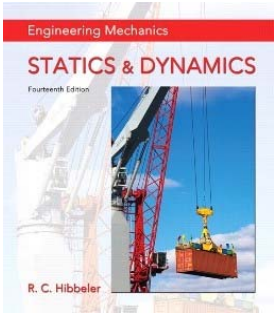

University of California, Merced
ENGR 057
Statics and Dynamics

Spring 2017

Synopsis: For many students ENGR_057 is their first formal introduction to engineering analysis. Therefore the course aims not only to have students learn the mechanics of analysis but also to see its broader application in the engineering professions. The course may also serve to aid in decision-making about pursuing an engineering major.

This class is divided into two sections. The first half of this course will cover Statics: equilibrium of 2D/3D force systems; computations of reactions and internal forces; determinations of centroids and moments of inertia; introduction to vector mechanics. The second half of the course will cover the kinematics and equations of motion of a particle for rectilinear and curvilinear motion; planar kinematics of rigid bodies; kinetics for planar motion of rigid bodies, including equations of motion and principles of energy and momentum.

Expected Learning Outcomes: Students completing this course will develop problem solving skills in engineering mechanics through the application of concepts in statics and dynamics to complex problems. During the semester you will develop an understanding of the fundamentals and principles of engineering mechanics: statics and dynamics of particles and rigid bodies in two and three dimensions including: kinematics and kinetics of particles, and rigid bodies in 2D and 3D motion, rotations, translations, and oscillations. You will also learn to solve equilibrium of rigid bodies including the calculations of moment of force, inertia moments of solid bodies, and basic structural analysis, and be able to determine the requirement for the equilibrium of particles and solid bodies. Finally, students will develop the ability to apply Newtonian mechanics to model and predict the responses of simple dynamical system (particle and rigid body) subjected to applied forces.

More specifically, upon completion of this course students will be ability to:

(1) Explain and demonstrate the role that analysis and modeling play in engineering design and engineering applications more generally.
(2) Construct free-body diagrams and to calculate the reactions necessary to ensure static equilibrium.
(3) Perform analysis of distributed loads.
(4) Understand and calculate internal forces and moments in members.
(5) Calculate centroids and moments of inertia.
(6) Perform kinematic and kinetic analyses and energy and momentum methods for particles and systems of particles.
(7) Perform kinematic and kinetic analyses and energy and momentum methods for rigid bodies.
(8) Communicate about systems using mathematical, verbal and visual means, and
(9) Describe how engineering analysis fits into the larger framework of professional engineering.

Prerequisites: Introductory Physics (PHYS 8 or PHYS 18 or equivalent) and Calculus (MATH 21 or equivalent)

The Teaching Team
Faculty Instructor: Robert Rice, School of Engineering
Office Hours: **regular office hours (COB 365), Tuesday, 1 – 2:30PM** or by appointment (in person, by phone 228-4397, or by email rrice@ucmerced.edu). *Don't hesitate to email me and the TAs---often confusion can be cleared up quickly, and without waiting for office hours!*

Teaching Assistants: Teaching Assistants (TAs) are a critical part of the teaching team. You will be spending considerable time with these individuals, both in discussion/lab and in office hours. They are there to support your learning

Timothy Lincoln (tlincoln2@ucmerced.edu)
Mohammad Rasool Vazirisereshk (mvazirisereshk@ucmerced.edu)
TBD (TBD@ucmerced.edu)

Lab/Discussion Sections
Mohammad Rasool Vazirisereshk: 11:30 - 12:20P (05D) Wednesday Kolligian 396
TBD: 12:30 - 1:20P (06D) Wednesday Kolligian 396
Timothy Lincoln: 1:30 - 2:20P (02D) Wednesday Kolligian 396
Timothy Lincoln: 2:30 - 3:20P (03D) Wednesday Kolligian 396
Mohammad Rasool Vazirisereshk: 3:30 - 4:20P (04D) Wednesday Kolligian 396

TA Office hours
Timothy Lincoln: Monday, 2:30 – 4:00PM, SE2, 1st floor atrium
Mohammad Rasool Vazirisereshk: Friday, 2:30 – 4:00 PM, location TBD
TA2: TBD

Lectures: TTh 9:00 – 10:15 AM COB2 130. Lectures are used as a time to introduce the theoretical foundation of Statics and Dynamics. An important aspect of this introduction is clearly defining the assumptions and limits of the relationships. Students are encouraged to ask questions throughout the lecture. Examples of the application in engineering analysis are presented.

Discussion/Lab Sections: The discussion sections meet on Wednesdays. **NOTE:** Enrollment is high in this class, so please stay with the lab/discussion section for which you registered.

Theory and applications are complemented by demonstrations, hands-on exercises, and lab assignments. Lab write-ups must be turned in at the end of class. The labs endeavor to give students a hands-on feel for both quantities and concepts. In addition, the labs get students working in small groups. The labs planned this semester are:

Free body diagrams
Hyatt Regency case study
Jenga
Long Board Design (Part I)
Long Board Design (Part II)

Seating during class sessions will be by assigned a team (TBD by Faculty instructor). Discussion/labs are often highly interactive with your classmates and your TAs, so you are asked to come prepared to participate (as described below), and turn off your cell phone and other electronics (including laptops).

Team Learning in Lab/discussion Sessions
Most discussion/lab during this course will include a team learning activity, in which you will cooperate in working on a problem with your team. Cooperative activities offer several advantages for achieving the course outcomes, and are also good preparation for your future responsibilities as a professional, whether in engineering or another field.

Several benefits team learning as well as guidelines for routines we will follow during team learning in class are described here.
Benefits from Team Learning: Research conducted over the past 70 years has demonstrated several advantages that can result from small-group problem solving:

- **1+1>1**. Pooling resources provides advantages over working individually. The benefits come about only when the team members make genuine efforts to cooperate and communicate, and the payoff can be quite substantial for both team members and for individuals.
- **Deeper, "metacognitive" learning.** The main advantage from team learning emerges during the social interaction, when team members discuss and explain their thinking about how to approach a problem. Metacognition means "thinking about your thinking," which is viewed as an important skill by many companies today. Team learning can seem inefficient because it takes time for others to discuss their thinking, but this reflection – slowing down to review your work – is essential for deeper learning.

- **Social motivation**. Working with another person can oftentimes be more engaging and rewarding than working in isolation. The more experience you have with cooperative learning, the greater the motivational advantages. Not to mention, that team learning can be fun!

Guidelines for Team Learning: To benefit the most from team learning in class, it is important to keep these guidelines in mind:

- **Be sure that all team members are on board.** Introduce yourself! Before starting work on a new and/or complex problem, all team members must connect with one another and agree on roles.
- **Plan of Action**: **Review, Record, Reflect, Report**. When working individually, a common approach is to simply dive into the problem. However, the "four R's" are the roles that need to be handled during problem solving, whether when working as an individual or as part of a team. In Team Learning, the routine includes development of a plan: Deciding on roles, laying out a timeline, taking notes, and deciding on who will take the responsibility for reporting when the job is finished. These activities are an essential part of the job of a professional engineer.

For more details regarding lab/discussion see class calendar.

Textbooks and Supplementary Reading Materials: Readings will be assigned on a regular basis from the required textbook listed below and from class handouts (see schedule). These readings will be supplemented by class notes distributed at the lectures and available on the website. The following textbook is required and is available for purchase at the campus bookstore:

Statics and Dynamics, 14th Edition, R.C. Hibbeler, Prentice Hall (2015) and Master Engineering.

Course Web Site: Course information, including the semester schedule for lecture slides, handouts, videos, and all assignments and their due dates, is available at the course web site. You can access the course site through the Canvas portal: https://canvas.ucmerced.edu/courses/6881.

Course Workload & Grading

Grading: The course grade is determined by performance on problems sets, examinations, and lab reports. Note that attendance is highly recommended for lectures and discussion sections:

Product	Points	
Lab/discussion participation (incl. labs)	**15%**	
Problem Sets	**15%**	**11 problem sets (lowest dropped)**
Exam #1	**20%**	
Exam #2	**20%**	
Final Project (Bridge Design)	**20%**	
Quizzes	**10%**	
Total	**100%**	

******A cumulative course grade of 67.5% must be maintained to receive a passing grade (C-)******

2 exams -- see lecture schedule; subject to change with lecture pace, etc.
Final Project – Details to be provided during semester.
Final exam – No Final Exam.

All examinations for this course will be closed book and will consist of primarily problems to solve. The examinations will be designed to test knowledge of concepts and definitions important to an understanding of Statics and Dynamics, and problem solving skills. Questions on these topics will be drawn from the material presented in lecture and from the homework assignments.

Problem sets (homework assignments) are due on roughly a weekly basis (due dates will be clearly indicated on the assignment). You are strongly encouraged to try the homework on your own first, but you can work together with other students (please make sure you are doing your part to understand the material or you will likely have difficulties with the exams!). *These assignments must be completed in a professional manner (neat/legible, with work process and logic made clear), and will be*

graded on appearance, effort, and correctness of approach (grading rubric is provided and posted on Cat Courses). There will be 11 problems sets, and you will be allowed to drop your lowest score.

Here are some basic requirements for homeworks that are aligned with how professional engineers undertake analysis and present their work. These requirements will contribute to your better learning the concepts and procedures and they will facilitate better homework grading (format is posted on crops):

(1) *Work* problems on standard 8-1/2 x 11" **engineering paper** (often green) in PENCIL; use only the front side of each page (note that on the back side there is typically a dark grid that faintly shows through to the front side);
(2) *Staple* the pages together in the upper left-hand corner; write your name, class and discussion section, HW_#, and page numbers (see example on crops).
(3) *Show your work*. An "answer" placed on paper is not considered an acceptable solution without your supporting work. Showing your work generally means including a drawing, a list of assumptions, and supporting calculations. Be neat and write legibly;
(4) *Box your answers*. Place a box around your answers. For numerical answers include units and the appropriate number of significant figures (generally 3 significant figures).

Policy on late assignments: Late assignments will not be accepted. Sorry for the need to be strict about this, but it becomes difficult to manage all the assignments with a large class otherwise.

Grading Policy: You have 2-weeks to dispute grading on exams, homeworks, labs/discussions from the date the grade is posted on Cat Courses. Once that 2-week period has passed the grade cannot be change. All grade disputes must be brought to the instructor, not the TA.

Cell Phone Policy: Anyone texting, social networking, etc. during class will be politely asked to pack-up and leave class and continue all phone activities outside of the classroom. You will be done for the day.

Academic Dishonesty Policy
a. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.
b. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e mail, an e mail attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.
c. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Disability Statement: Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

Engr 057 Statics and Dynamics (Spring 2017)

Teaching Team

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(TA@ucmerced.edu)

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Course Schedule

NOTES:

1) Check on-line for updates! (https://canvas.ucmerced.edu/courses/6881)
2) Many of the assignments will be delivered through the course website under the tabs for "resources".
3) Sometimes we need to change the schedule, EXAM DATES, etc to accommodate travel, illnesses, etc. **(*** so please read your ENGR 057 Cat Courses for announcements)**
4) **Mastering Engineering access code: RICESPRING2017**

Date	Lecture	Subject and Reading and Problems
Jan 17 (T)	1	Course overview + General Principals: Newton's laws **Reading: Ch 1 (Hibbeler)** **Problems: Ch. 1 (1, 13, Mastering Engineering (ME), 18, 20)**
Jan 19 (Th)	2	General Principals; Vectors and Forces **Reading**: **2.1-2.6** **Problems**: **Ch.2 (3, 15, 27, 58, ME)**
Jan 24 (T)	3	Vectors and Forces: Particle Equilibrium and Free-Body Diagrams **Reading:2.7-2.9; 3.1 – 3.2** **Problems: Ch.2 (62, 81, ME, 94, 101)** ****HW_1 due: Lecture 1 and 2****
Jan 26 (Th)	4	Particle Equilibrium **Reading: 3.3 – 3.4** **Problems: Ch.2 (111, 125); Ch.3 (ME, 3, 5, 15, 27, 37)**
Jan 31 (T)	5	Moment of a Force **Reading: 4.1 – 4.5** **Problems: Ch.3 (57, 65); Ch.4 (7, 19, ME)** ****HW_2 due: Lecture 3 – 4****
Feb 2 (Th)	6	Couples and Distributed loads; Simplification of a force and couple system; **Reading: 4.6 – 4.7**

		Problems: Ch.4 (35, 43, 57, ME, 73, 93, 102)
Feb 6 (T)	7	Distributed loads; Equilibrium of a Rigid Body, FBD, and **Reading 4.8-4.9; 5.1 -5.2** **Ch.4 (110, ME, 134, 139, 157)** ****HW_3 due: Lecture 5 - 6****
Feb 9 (Th)	8	Eq. of Equilibrium; Two and three force members, 3D FBD, Constraints and statical determinacy **Reading: 5.3 – 5.6** **Problems: Ch.5 (1, ME, 15, 25, 47, 59)**
Feb 14 (T)	9	Structural analysis; simple trusses, method of joints, zero-force members **Reading: 5.7, 6.1 - 6.3,** **Problems: Ch.5 (63, ME, 71, 78) Ch.6 (10)** ****HW_4 due: Lecture 7 – 8****
Feb 16 (Th)	10	Structural Analysis; method of sections; frames and machines; Internal forces: Internal forces **Reading: 6.4, 6.6, 7.1** **Problems: Ch.6 (17, ME, ME, 35, 42, 70, 97)**
Feb 21 (T)	11	Internal Forces; Shear and bending moments **Reading:7.2, 8.1 – 8.2** **Problems: Ch.7 (7, 19, ME, 47, 59)** ****HW_5 due: Lecture 9 – 10****
Feb 23 (Th)	12	Friction; Center of Gravity and Centroids; **Reading: 8.3, 8.5, 9.1** **Problems: Ch.8 (ME, 14, 50, 58, 86)**
Feb 28 (T)	13	Center of Gravity and Centroids; composite bodies **Reading: 9.2** **Problems: Ch.9 (3, 34, 63, 65)**
Mar 2 (Th)	14	Review Exam #1 ****HW_6 due: Lecture 11 - 13****
Mar 7 (T)	-	**Exam #1 Chapters 1 – 9**
Mar 9 (Th)	15	Kinematics of particles; rectilinear motion **Reading: 12.1 – 12.3** **Problems: Ch.12 (2, 9, 26, 42, 63, 71, 97)**
Mar 14 (T)	16	Kinematics of particles; curvilinear, projectile, curvilinear n-t, **Reading:12.4 – 12.7** **Problems: Ch.12 (109, ME, 113, 122, 141)**
Mar 16 (Th)	17	Kinematics of particles; cylindrical, dependent & relative motion; **Reading:12.8 – 12.9 and 13.1 – 13.4** **Problems: Ch. 12 (ME, 167, 183, 198, 207, 218, 230)** ****HW_7 Due: Lecture 15 and 16****
Mar 21 & 23	-	**Spring Break**
Mar 28 (T)	18	Kinetics of a particle: Force and Acceleration, Newtons 2nd law, Equation of Motion; Force and Acceleration, systems of particles, rectangular coords **Reading: 13.1 – 13.4**

		Problems: Ch.13 (ME, 5, 15, 27, 35)
Mar 30 (Th)	19	Kinetics of a Particle: Forces and Acceleration, n-t & cylindrical **Reading: 13.5 – 13.6** **Problems: Ch.13 (ME, 74, 81, 93, 101)**
Apr 4 (T)	20	Work, Energy, & Potential Energy **Reading: 14.1 – 14.4** **Problems: Ch.14 (11, ME, 15, 29, 37)** ****HW_8 Due: Lecture 17, 18, and 19****
Apr 6 (Th)	21	Work, Energy, & Potential Energy **Reading: 14.5 – 14.6** **Problems: Ch.14 (ME, 53, 69, 86, 90)**
Apr 11 (T)	22	Impulse and Momentum **Reading: 15.1 – 15.3** **Problems: Ch.15 (ME, 5, 30, 38, 57)** ****HW_9 Due: Lecture 20 – 21****
Apr 13 (Th)	23	Impulse and Momentum; impact, **Readings:15.4 – 15.7** **Problems: Ch.15 (61, 70, 74, 81, ME, 93)**
Apr 18 (T)	24	angular momentum, moment of force V. angular momentum Planar motion (2D) of Rigid Bodies; Rotation and Translation **Readings: 16.1 – 16.3** **Problems: Ch.15 (103), Ch.16 (ME, 3, 10, 17, 21)** ****HW_10 Due: Lecture 22 - 23****
Apr 20 (Th)	25	Planar Kinetics of a Rigid Body; Eq. Motion **Reading: 17.1 – 17.4** **Problems: Ch.17 (2, 15, 33, 47, ME)**
Apr 25 (T)	26	Planar Kinetics of a Rigid Body; General Plane Motion **Reading: 17.5** **Problems: Ch.17 (58, 67)**
Apr 27 (Th)	27	Review Exam #2 ****HW_11 Due: Lecture 24 – 26****
May 2 (T)	-	**Exam #2 Chapters 12 - 17**
May 4 (Th)	-	**No Class**
May 5 (Fri)	-	********Bridge Design Reports due 5PM*********** **COB 365**

Discussion/Lab Schedule

	Topic
Jan 18 (Wed)	Review Lab/Discussion Syllabus/ Free Body Diagrams
Jan 25 (Wed)	Intro to Hyatt Regency and Factors of safety
Feb 1 (Wed)	Hyatt Regency Walkway
Feb 8 (Wed)	Jenga
Feb 15 (Wed)	Introduction Madison Long Board Truck Lab
Feb 22 (Wed)	Madison Long Board Truck Lab
Mar 1 (Wed)	Exam 1 Review and Lab Reports Due
Mar 8 (Wed)	Introduction to Final project (Bridge design)
Mar 15 (Wed)	Introduction to Final project (Bridge design)
Mar 29 (Wed)	Introduction to Madison Long Board Deck Lab
Apr 5 (Wed)	Madison Long Broad Deck Lab
Apr 12 (Wed)	Bridge testing (i.e. destroy bridges)
Apr 19 (Wed)	Open
Apr 26 (Wed)	Exam 2 review and Madison Long broad Deck Lab report due
May 3 (Wed)	No discussion
May 5 (Fri)	Bridge design reports due at 5PM (COB365)