ENGS - 301 - A: Statics & Material Testing

Fall 2022-3, MWF 12:00 – 1:00 (263 T)

Instructor: John F. Pescatore

Office: Trexler #175

Office Hours: 10:00 - 11:00 T W Th and 2:00 – 4:00 T (also by appointment)

Email: pescatore@roanoke.edu

Background

The science of mechanics describes and predicts conditions of bodies under the action of forces. Specifically, the study of mechanics of rigid bodies is subdivided into statics (bodies at rest) and dynamics (bodies in motion).

Mechanics of materials is a branch of applied mechanics concerned with behaviour of solid bodies subjected to various loadings. Furthermore, mechanics of materials, also known as solid mechanics or mechanics of solids, is the study of deformation and motion of solid materials subjected to forces.

The field of strength of materials, also called mechanics of materials, typically refers to various methods of calculating the stresses and strains in structural members, such as beams, columns, and shafts.

The interdisciplinary field of materials science covers the design and discovery of new materials, particularly solids. This field is also commonly termed materials science and engineering to emphasize engineering aspects of building useful items, and materials physics to emphasize the use of physics to describe material properties.

Course description

This course introduces principles required to solve engineering mechanics problems in a systematic manner, specifically resolving forces, both external and internal to the body, moments, and couples responsible for maintaining a state of equilibrium.

Students will learn how forces and moments acting on rigid and deformable bodies affect reactions both inside and outside the bodies. Students will analyze simple structures and communicate their analysis using free-body diagrams and logically arranged equations. The course will also emphasize strength and elastic deflection of engineering materials due to loads applied axially, in torsion, in bending, and in shear.

Learning outcomes

Apply general principles/ equilibrium equations of engineering mechanics (statics) to solve problems in an organized manner.

Calculate the internal forces (shear and bending moment) in a simply supported beam

Calculate static friction forces on an object

Find the center of gravity and centroid of an object

Calculate the moment of inertia of an object

Draw and use free-body-diagrams in the solution of problems.

Calculate stresses for axial, torsion, beam bending, and combined loading.

Analyze beams and draw correct and complete shear and moment diagrams for beams.

Vectors: resolve vectors into components and perform vector addition, scalar product (dot product) and vector product (cross product).

Identify the following quantities on a stress-strain curve: elastic modulus, yield stress, ultimate tensile strength, ductility, and toughness.

Analyze a statistically indeterminate structure.

Apply Mohr's circle to calculate principal stresses and angles in plane stress cases.

Calculate deflections of a beam under combined loads

Tentative course schedule

The following schedule table is approximate and subject to change except for the test dates. The table, albeit subject to modification, should provide a general picture of the timing for content presentation and assignments.

Teaching week	Dates	Lecture material	Assignment
1	8/29 – 9/02	Engineering materials properties, characteristics, and technological advances	
2	9/05 – 9/09	Rigid and deformable bodies; shear and normal stress, stress tensor	
3	9/12 – 9/16	Stress-strain relationships; Hooke's law; Poisson's ratio; Young's modulus, rigidity modulus; torsion	
4 (test #1)	9/19 – 9/23	Mohr's circle	
5	9/26 – 9/30	Description of vector forces, moments, and couples; equilibrium equations; free	

		body diagrams; review of test #1	
6	10/03 – 10/07	Stable and unstable structures; support types and reactions; distributed forces; centroid and centers of gravity	
7 (test #2)	10/10 – 10/14	Truss analysis; method of sections and joints	
Fall break			
8	10/24 – 10/28	Trusses continued; frames; review of test #2	
9	10/31 – 11/04	Moments of inertia; parallel axis theorem	
10 (test #3)	11/07 – 11/11	Shear and bending moments in beams; shear and bending moment diagrams;	
11	11/14 – 11/18	Forces in beams continued	
12	11/21 – 11/25	Continue forces in beams; review of test #3	
13 (test #4)	11/28 – 12/02	Cables; friction	
14	12/05 – 12/09	Review of test #4 and semester review	
Final examination week		**12/12 – 12/16**	

Attendance policy

Class attendance is an especially important aspect of a student's success in this course. ***Each student is expected to attend every class and is accountable for missed content and assignments.*** If you have a temperature of 100.4 or higher or other COVID symptoms, do not come to class. Call Health Services IMMEDIATELY. Do not come to class or go to any public area on campus. For your absence to be excused, you must give Health Services permission to notify me that you have consulted them about COVID symptoms. If Health Services informs you that you should isolate and not attend class for multiple days, inform me so that we can plan to keep you current in the course. All absences caused by consultation with Health Services about Coronavirus symptoms or isolation ordered by Health Services will be excused but you will need to do the work and graded assignments even if we extend a deadline for you.

Athletic commitments

College athletes must notify me of any scheduled absences or unavoidable post-injury absences.

Masks

The college is starting the term without a specific mask mandate. Some offices on campus may require that masks be worn (such as Health Services). For this class, masking is optional.

Course materials

(1) Textbook: There is no specific textbook required. I will provide (a) handouts for each class and digital content on Inquire, (b) non-RC books on reserve at Fintel.

(2) Calculator: A scientific or graphing calculator is required.

(3) MATLAB/Octave will be used in the second half of the semester. The instructor will provide instruction on installing Octave on your personal computer.

Structure and grading

A letter grade will be assigned after final grades are computed for the term as per the scale below. Attendance and class participation will be considered when determining marginal grades.

Grading scale

A (100-93) A-(92.9-90)

B+ (89.9-87) B (86.9-83) B- (82.9-80)

C+ (79.9-77) C (76.9-73) C- (72.9-70)

D+ (69.9-67) D (66.9-63) D- (62.9-60) F (59.9 and down)

The (numerical) final course grade will be determined from the five (5) assessments listed below. Each weighted similarly (20%) for a total of 100%

Assessment	Weighting	Date
Test #1	20%	9/23
Test #2	20%	10/14
Test #3	20%	11/11
Test #4	20%	12/02
Final examination	20%	TBD
Total	100%	

Quantitative type (problem solving) questions will predominate assessments; however, to a lesser extent, there will be some non-computational queries requiring interpretation of graphs/ diagrams from materials testing, identification of certain characteristics of solid bodies or structural members under loading scenarios.

All in-class tests including the final examination are closed book/ notes. The instructor shall provide an equation/formula sheet.

Homework (including required reading) and class notes are absolutely the best sources of review! Tests will not be designed to be cumulative, but as with any course involving physics and math, material from previous tests can be thought of as a prerequisite for future tests. The final examination is cumulative.

Test make-up policy

Test make-ups are administered in accordance with Roanoke College policy. Anticipated, excused absences must be reported to the instructor with appropriate certification well before the scheduled test date. Legitimate emergency absences must be reported with appropriate documentation within one week of returning to class. No other make-ups will be given.

Corrections to grading

If you think an error may have been made in the grading of your test, carefully review the answer key posted on Inquire and then contact the instructor within 1 week of the test's return with your question. Do NOT alter the original work. The entire test may be re-graded, and the test grade is subject to remain the same, increase or decrease at the discretion of the instructor.

Final examination

The final exam will be comprehensive. As with the tests, it will emphasize both mathematical computations and critical thinking. The best way to review for the final is to review your performance on the four assessments; focus on material that you did not master the first time around and review the topics that you did master.

Expected work policy

This course requires you to spend at least 2 hours of study outside of class for every class hour which is a minimum of 12 hours total work each week inside and outside of class.

Electronic devices

I recommend using only your scientific/engineering calculator during class; students who have their laptop/notebook PC open in class tend to migrate to the internet/ social media during class instruction. I prefer cell phones be left in your backpack and set on silent mode; however, I understand you may need your cell phone active in anticipation of a medical-related call, for example, if you have an immediate family member hospitalized.

Inquire policy

Students are required to be knowledgeable of all postings on Inquire. Each student shall regularly monitor Inquire for course information. Any assignment that requires an Inquire upload will not be accepted in any other form. Uploaded files must be PDF format and readable on the instructor's college computer. Each student must ensure the successful submission of any document and resolve technology problems through the college's IT department.

Academic integrity

I expect all students to follow the rules outlined in Academic Integrity policies of Roanoke College because your learning and integrity are at the core of your RC education.

http://www.roanoke.edu/academicintegrity https://www.roanoke.edu/aihandbook

In-class assessments will be closed book/notes; therefore, students are not permitted to consult any texts, notes, or other prepared materials during a testing period as such action is a violation under cheating.

All graded work shall be your own work! Questions about how these policies apply to our class should be directed to the instructor. Any violations of AI policies will automatically be turned over to the Academic Integrity Council.

All source material must be properly cited using the MLA conventions and use paraphrases or quotations when appropriate. Drafts must include citations. Note that paraphrasing is more than rearranging a few words. I am happy to help, but also encourage you to use the Writing Center at all stages of your paper writing. The instructor will address the need for proper citation and references pertaining to the writing assignment

Online testing – the instructor does not anticipate quizzes or tests administered via Inquire unless there is another coronavirus outbreak or similar pandemic. In the event of going online, the instructor will address policy regarding open book/notes. Any use of outside assistance for online assessments such as 'web-based apps and Chegg, Course Hero, and r "homework help" sites is not allowed; further, upload of any quiz or test questions to such sites is forbidden.

Accommodations

If you may require an accommodation in this course, please provide me with your documentation within the first 2 weeks of the semester. I must have your documentation at least 48 hours prior to any accommodation made. (Check with the Center for Learning and Teaching for their scheduling guidelines.)

Subject Tutoring

Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4 pm – 9 pm, Sunday – Thursday. We are a Level II Internationally Certified Training Center through the College Reading and Learning Association (CRLA). Subject Tutors are friendly, highly-trained Roanoke College students who offer free, one-on-one tutorials in a variety of general education and major courses such as: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, INQ 250, and Social Sciences (see all available subjects at www.roanoke.edu/tutoring).

Tutoring sessions are available in 30 or 60-minute appointments. Schedule an appointment at www.roanoke.edu/tutoring, or contact the center at (540) 375-2247 or subject_tutoring@roanoke.edu.

Writing Center

The Writing Center at Roanoke College offers tutorials focused on writing projects and oral presentations for students working in any field. Writers and presenters at all levels of experience may consult the Writing Center at any point in their process— including brainstorming, drafting, organizing, editing, or polishing presentation skills—to talk with trained peer tutors in informal, one-on-one sessions. Schedule an appointment at www.roanoke.edu/writingcenter, where our staff members and workshops are also posted. Questions? Email the center: writingcenter@roanoke.edu.

Accessible Education Services (AES)

AES is in the Goode-Pasfield Center for Learning and Teaching in Fintel Library (clt@roanoke.edu)

AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. To schedule an appointment, call (540) 375-2247 or e-mail aes@roanoke.edu.

If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact the AES at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

References eBooks

available

Beer, F. P., E. Russell Johnston, Jr., J. T. Dewolf and D. F. Mazurek Mechanics of Materials. New York, McGraw-Hill, 2012.

https://www.academia.edu/42040327/Beer_Johnston_Mechanics_of_Materials_6th_Edition

Meriam, J. L. and L.G. Kraige. Engineering mechanics: Statics. New York, John Wiley & Sons, 2006.

https://www.academia.edu/33702396/_Engineering_Mechanics_STATICS_J_L_Meriam_And_L_G_Kraige_7th_Edition_pdf

On reserve at Fintel Library (from the collection of Dr. J. F. Pescatore)

Beer, F. P. and E. Russell Johnston, Jr. Mechanics for Engineers: Statics. New York, McGraw-Hill, 1976.

Meriam, J. L., and L. G. Kraige. Engineering Mechanics: Statics. New York, John Wiley & Sons, 1997.

Popov, E.P. (Egor Paul), Introduction to mechanics of solids. Englewood Cliffs, N.J., Prentice-Hall, 1968.

Riley, William F., and L. D. Sturges. Engineering Mechanics: Statics. New York, John Wiley & Sons, 1993.