

Boston University ENG EK 301: Engineering Mechanics I

SYLLABUS FOR FALL 2022

NOTE: You are expected to read through this document and be familiar with the policies and dates described within; print out, sign, and pass in the signature page with your first homework assignment. Some dates may be subject to change; changes will be announced in class, via email, and on the website. Check this document prior to emailing your instructors for logistical information.

INSTRUCTORS

Prof. Scott Bunch

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SECTIONS, GRADUATE STUDENT TEACHERS, LEARNING ASSISTANTS

A2 (Bunch): Mon/Wed 2:30-4:15 pm, EPC 207. GST: Monan Ma (monan@bu.edu)

LAs: Anushka Rathi (asrathi@bu.edu), Raghavan Ramaswamy (raghu@bu.edu)

A3 (Lejeune): Tues/Thurs 3:30-5:15 pm, PHO 117. GST: Vittorio Giammarino (vgiammar@bu.edu)

LAs: Tara Gill (taragill@bu.edu), Mario Santana (mars02@bu.edu)

A4 (Zhang): Mon/Wed 12:20-2:05 pm, EPC 207. GST: Quan Nguyen (quan@bu.edu)

LAs: Emre Karabay (karabay@bu.edu), Ahmad Beydoun (ahmadb@bu.edu),

Nikola Radakovic (nikola@bu.edu)

A5 (Albro): Mon/Weds 2:30-4:15 pm, PHO 210. GST: Mason Garcia (mjgarcia@bu.edu)

LAs: Yafei Chen (yafeic@bu.edu),

A6 (Duan): Tues/Thurs 1:30-3:15 pm, PHO 205. GST: Rohan Deshpande (rohand@bu.edu)

LAs: Eric Xie (ericx@bu.edu), David Montana (dmontana@bu.edu)

Course description

Fundamental statics of particles, rigid bodies, trusses, frames, and virtual work. Distributed forces, uni-axial stress and strain, shear and bending moment diagrams. Application of vector analysis and introduction to engineering design. Includes design project.

Question-driven Course Synopsis

The big picture goal in EK301 is to understand, with increasing complexity, the manner in which forces are born by and distributed within static structures, when under the influence of one or more applied forces and the structure's own weight. Students will explore this basic goal by first analyzing basic structural elements, and then combining such elements into more complex, multicomponent systems. These systems will be studied in class via small-group and class-wide discussions, as well as individual problem sets, in-class quizzes and exams, and a course design project. Consistent and timely feedback will be provided in each of these scenarios.

Hub Learning Outcomes

Intellectual toolkit: Critical Thinking

Intellectual toolkit: Creativity/Innovation

School, Department, and/or Program Outcomes

EK301 is an Engineering Core course, and is a required course for all undergraduate majors and all Foundation Phase LEAP students in the College of Engineering. Its prerequisite courses are PY211, and its corequisite courses are MA225 and EK125.

Course-Specific Objectives

Note: The relationship to our program {and ABET outcomes} is noted for each course objective. As an outcome of completing this course, students will:

- i. Become proficient in the modeling and analysis of simple static mechanical systems, (2-D and 3-D particle and rigid body equilibrium, 2-D trusses and frames, virtual work, dry friction), and the effects of simplified loading scenarios (distributed forces, uni-axial stress and strain, internal shear and bending moments), including the use of appropriate diagrams (physical, free body, shear and bending moments). {1}
- ii. Hub Unit (Creativity/Innovation): Gain experience in carrying out a complex, long term design project (2-D truss), including experimental measurement and statistical analysis of material properties, computer analysis of member forces to determine failure load, consideration of alternative designs to achieve an optimal outcome under cost and physical constraints, construction of a prototype, and testing of the prototype to confirm the theoretical prediction. {1-7}
- iii. Gain experience in working in a team environment in group problems in class and in the design project. {5}
- iv. Gain an appreciation for the importance of safety factors and engineering ethics through selected homework problems and in-class exercises and the consideration of the effects of over and under prediction of actual truss performance in the design project. {4}
- v. Gain an appreciation of and a facility for producing well-organized and clearly written work to facilitate communications with others and review by supervisors. {3}
- vi. Gain exposure to the greater engineering community through receiving announcements in class of Career Development Office and student professional society activities and through presentations in class on relevant contemporary issues via the Engineers in the Real World program and faculty research. {2}

vii. Hub unit: Critical Thinking. Gain an understanding of the physical laws that govern mechanics, be able to identify logical inconsistencies, and to think critically about the analytical steps required to accurately model such mechanical systems. {1}

Books and Other Course Materials

Required: R.C. Hibbeler, Engineering Mechanics: Statics, 14th ed., Pearson Prentice Hall (12th – 13th editions fine as well)

Additional references:

Meriam, Kraige, & Bolton, Engineering Mechanics Statics, 8th ed., Wiley, 2015

Bedford, Fowler, & Liechti, Statics and Mechanics of Materials, Pearson Prentice Hall

Website/Digital Materials

The course website is on BlackBoard (learn.bu.edu). Electronic materials will be posted periodically throughout the semester, so check the website often for updates. These will include the course syllabus, homework solutions, and document for the truss project. Keep in mind that all sections will have the same homework and project assignments, but the quizzes and exams will be unique for each section. Homework assignments will be submitted via a section-specific Gradescope site.

The course will also offer a Piazza site which will enable students to post questions related to assignments or other course content. Posted questions will be answered by instructors, GSTs, and LAs during their office hours.

Assignments and Grading Criteria

Assignments:

Your progress and evaluation for the course material will consist of weekly problem sets, weekly in-class quizzes, two in-class exams, a design project, and a final exam. The two lowest **quiz** grades and lowest **HW** grade will be dropped. The breakdown for the grade weighting is:

Homework	7.5%
Weekly quizzes	17.5%
Design project	15%
Midterm 1	20%
Midterm 2	20%
Final exam	20%

Due to the importance of the design project, failure to participate in the project will result in a failing grade for the course. Historically, the mean of the overall numeric score in a section is typically the dividing line between a B and a B-.

Grading Criteria:

PROBLEM SETS AND QUIZZES

One of the best methods to learn the material is to read the text *before* the material is presented in class, attend and pay attention in class, and work through the assigned problem sets. The course is structured to give you ample feedback regarding your understanding of the material through the problem sets and quizzes. By working through the problem sets, you will prepare yourself for the in-class quiz, which in turn will prepare you for the in-class exams. Assistance will be provided in the Discussion Section, so please seek out help if you need it!

Another helpful practice is to alternate teaching the problems to your classmates, which will force you to think about how to tackle and solve a problem. It is common for engineers to work in groups, so keeping in mind the Ethics Code, we encourage you to form groups to work out (but not copy) the problem sets. The quizzes and exams are solo efforts, however, so it is in your best interest to make sure you understand the problem set and not rely too heavily on your classmates or the GST & LA.

A perfect homework solution (this applies to quizzes and exams as well) should be:

- (a) legible and well organized, with labeled Free Body Diagrams
- (b) demonstrate a thought process and worked-out steps
- (c) correct!

Each problem will be graded on a 10/7/0 scale. A high score of 10 indicates that you worked through the entire problem and came to a correct or mostly correct solution. A score of 7 indicates that you made a valiant effort and a 0 will be given for a minimal attempt or lack thereof. Partial credit will be given for all forms of evaluation, so steps (a) and (b) are in your best interest! If you are short on time (particularly for the quizzes and exams), please at least attempt to set up and show your steps for how to solve the problem. Please keep the following rules in mind when writing up your solution:

- (a) Your name, section number, and problem set number must appear at the top of every sheet.
- (b) Do not submit work that has ragged edges.
- (c) Start each problem on a new page.
- (d) Indicate the final solution by drawing a solid box around it.

Problem sets will be based on lecture material, and generally will be due via Gradescope submission after the Wednesday/Thursday lecture. Since solutions to the problem sets will be posted following the submission deadline, **late problem sets are not permitted** and will receive a zero.

Quizzes (~15 mins) will be *based* on the homework problems, and will be given on the lecture *following* the homework due date (typically on the next Monday/Tuesday). Each quiz will be graded on a 10-point scale. Your problem sets will likely not be graded and returned to you before the quiz, so please study the posted solutions to the problem sets in order to prepare for the quiz. The two lowest scores will be dropped. **If you miss a quiz, you will be given a zero.**

PROJECT

A chief activity of an Engineer is to apply their skills to design and build, not just study. The goal of an engineering education is to develop the ability to apply your course work to recognize, define, and solve real problems in creative but practical ways. There are many aspects of engineering practice that are as important as writing and solving equations. In EK301 we will introduce you to some of these aspects through an exciting design contest.

The contest will involve designing, building, and testing a truss made from soda straws and straight pins. The truss will have to bridge a pre-specified distance and support a minimum load. You will have to experimentally determine certain physical properties of the soda straws, and use your measurements to analyze and optimize your design to support as much weight as possible. The project will culminate in a contest in which your truss will be loaded until it collapses. Your grade will depend, in part, on how close the results of your failure analysis come to the actual failure results during testing. Further details will be presented later in the semester.

EXAMS

There will be two in-class exams given during the semester, administered in class on October 17/18th and November 16/17th. **DO NOT MAKE TRAVEL PLANS FOR THESE DATES.**

The final exam will be given during the final exam period. Since the Registrar will set the date later during the semester, **DO NOT MAKE TRAVEL PLANS BEFORE THE END OF THE EXAM PERIOD.**

If you qualify for extended time on exams, per evaluation from the Office of Disability Services, it is your responsibility to present your documentation to your instructor at **least** a week before the first exam. If you expect to receive extended time based off previous semesters, please let your instructor know at the beginning of the semester, even if you haven't received your documentation yet. We cannot accommodate last-minute requests (less than a week prior to the first exam) for extended time.

Resources/Support

Office hours: Each instructor will post their office hours by the beginning of the semester. EK301 instruction consists of your biweekly lecture section and an *open-door* discussion section. Your course registration asked you to sign up for a specific discussion section, but attendance is purely voluntary and you are not required to attend the section that you registered for; you can attend any discussion section. The discussion section is held in room 202 (110 Cummington Mall) and is run by the Graduate Student Teachers (GSTs) and Learning Assistants (LAs). The GST/LAs will be present to answer any questions you may have on the lecture material, as well as to provide basic homework assistance. Note that their job is not to do the homework for you! We recommend that you first try the homework on your own, and then visit the discussion section to get help from the GST or LA if you get stuck or have specific questions.

The hours are: Mon 6:30–9:00 pm, Tues 4:00–9:00 pm, Weds 4:00–9:00 pm

Accommodations for Students with Documented Disabilities: If you are a student with a disability or believe you might have a disability that requires accommodations, please contact the Office for Disability Services (ODS) at (617) 353-3658 to coordinate any reasonable accommodation requests. ODS is located at 19 Deerfield Street on the second floor.

Community of Learning: Class and University Policies

Class Policy: We expect that if you are registered for EK301, you should attend class. Most of the course material can be found in a textbook, but not everything, and you will be tested on what is covered in class, not what is simply covered in the textbook. Tuition at B.U. is expensive, so make the most of your time and money by taking advantage of all the resources you are paying for! We also expect that you will do your best to pay attention during lecture. You will have a busy schedule with many academic (and social) demands, so we know from experience that paying attention 100% of the time can be a difficult task. However, we do ask that you not distract your peers if your attention starts to wander. Please ignore all forms of non-approved (!) electronic communication temptation (texting, email, web surfing, etc) and turn off your cell phone during class.

While class attendance is highly encouraged, and successful students often report that attending class is one of the best ways to learn the material, the course faculty treat you as responsible adults with the ability to manage your priorities and therefore do not take attendance as a general rule. Most sections will experience a guest lecture from a BU Engineering alumnus, per invitation by the Dean's Office and its the Engineers in the Real World program. The course instructors are aware of and in agreement with Boston University's Policy on Religious Observance, whereby absences for any religious beliefs are understood and missed assignments on such occasions will be given a chance to be made up. Students are strongly encouraged to notify their instructor in advance, particularly if an accommodation must be made, for such occasions.

Assignment Completion & Late Work

Quizzes and Homework: We do not offer makeup quizzes and do not offer extensions on HW submissions. However, we recognize that circumstances may arise which prevent students from attending class to take quizzes or submitting HW assignments. The course policy of dropping the two lowest quiz grades and lowest HW grade is designed to accommodate these circumstances. There is no need to contact your instructor to inform them that an assignment or quiz will be missed. Grade drops will be applied automatically at the end of the semester. For circumstances that lead to multiple weeks of absence, please contact your section instructor and we will work with you and the BU Academic Counselors to come up with an alternative plan for course completion.

Exams: Makeup exams will be given only in extreme circumstances. It is your responsibility to contact your instructor as soon as possible of an unavoidable conflict or medical emergency.

Academic Conduct Statement

Cheating on homework, quizzes, exams, project reports, or any form of assignment, may be a form of plagiarism and is an infringement of every code of engineering ethics. Plagiarism is a serious academic offense and should not be taken lightly. Understanding your ethical responsibilities is an integral part of becoming a professional. A copy of the Code of Ethics of engineers, promulgated by the Accreditation Board for Engineering and Technology (ABET) and the National Society of Professional Engineers, can be found on the main course web site.

Please recall that when you enrolled at Boston University, you agreed to an Academic Honesty Pledge. The Academic Conduct Code details your responsibilities as well as the results of code violations, and is posted at:

<https://www.bu.edu/academics/policies/academic-conduct-code/>

ACTIVE LEARNING in EK301

EK301 transitioned to a new lecture format starting in the Spring 2012 semester. Our hope is that this new format will better help you learn the material. Periodically throughout each lecture, you will work in 4-person groups on example problems.

Your instructor may opt to have your group work document your work electronically. A large part of the analysis in EK301 comes from successful diagnosis of the forces that act on a structure, so correctly drawing the relevant free body diagram(s) (FBD) is a vital but difficult first step. You and your group will document the steps you took to tackle the problem and the faculty and GSTs will circulate around the room to provide assistance if necessary. Don't hesitate to ask for help! At the end of the exercise your instructor will review the work and highlight correct steps and common mistakes. The goal is to provide you with immediate feedback on your comprehension of the material (particularly on the graphical analysis), rather than have you wait several weeks for your graded assignments to be returned.

You will NOT be graded on the quality or correctness of your work, but don't be surprised if your group's work gets presented to the class during the feedback portion. Your names will not be publicized, but feel free to take credit if your steps were correct. However, since the feedback portion is as important as your work effort, you should show all the steps you followed to the solution, even if you're not sure if they're correct. Just try to be as systematic and orderly as possible so we can make sense of your work.

Groups

Your instructor may assign in-class groups for you to work with throughout the semester. The purpose of the assignments is to generate a working conversation on how to tackle the problem, and working

with someone who you don't necessarily know is a great way to learn. In order to cover the material in a timely fashion and to allow the faculty space to circulate through the lecture hall, please put your bags and coats in the back of the lecture hall when you enter, and sit in your group-designated seats during the entirety of the lecture. If you find you don't particularly enjoy your group, please try to make the best of things and take heart that the groups will be switched up twice throughout the semester. If you find you are experiencing serious problems with one or more group members, please discuss the matter with the faculty and we will try to resolve the situation. You are free to choose your own group from within your section for the design project.

Please designate a member of your group to be in charge of drawing out your work. This person should not be solely responsible for the work! We ask that you rotate this role within your group as the lectures proceed.

I've read through this document and the semester dates.

Name: _____

Signature: _____

EK301 Fall 2022 Semester Mon/Weds Schedule and Syllabus					
L #	Date	Reading	Agenda	Quiz # (on)	HW
1	9/7	C2:1-7	Introduction, vector review		
2	9/12	C3:1-4	Multiple forces, static equilibrium	Q1 (Ethics)	
3	9/14	C3:1-4	Internal tensions		#1 due
4	9/19	C2:8-9	Dot product, projections	Q2 (HW 1)	
5	9/21	C4:1-4	Moments; Cross product		#2 due
6	9/26	C4:5-8	Moment projections; couples; equivalent systems	Q3 (HW 2)	
7	9/28	C5:1-3	2-D static equilibrium; Project introduction		#3 due
8	10/3	C5:1-3	Supports, reaction forces	Q4 (HW 3)	
9	10/5	C5:1-3	Reaction forces		#4 due
10	10/11	C5:4,7	Static indeterminacy; 2-3 force members		
11	10/12	C5:5	3-D supports and static equilibrium	Q5 (HW 4)	
12	10/17	Thru HW 4	EXAM 1 (covers through HW 4 material)		
13	10/19	C6:1-3	Truss analysis: Method of joints		#5 due
14	10/24	C6:4	Truss analysis: Method of sections	Q6 (HW 5)	
15	10/26	C6:6	Frames 1		#6 due
16	10/31	C6:6	Frames 2	Q7 (HW 6)	
17	11/2	C6:6	Frames 3/Frames module		#7 due
18	11/7	C8:1-3	Dry Friction (structures, wedges)	Q8 (HW 7)	
19	11/9	C9:1-2	Distributed forces: centroids		#8 due
20	11/14	C4:9, C9:4	Centroids & COM continued; distributed forces		
21	11/16	Thru HW 8	EXAM 2 (covers through HW 8)		
22	11/21	C7:1-3	Shear/bending		#9 due
23	11/28	C7:1-3	Shear/bending moment eqns & diagrams	Q9 (HW 9)	
24	11/30	C7:1-3	Shear/bending moment eqns & diagrams		#10 due
25	12/5	C11:1-3	Virtual work	Q10 (HW 10)	
26	12/7	C11:1-3	Virtual work		#11 due
27	12/12	C11:1-3	Virtual work		

IMPORTANT SEMESTER DATES	
10/11	Last day to drop without a 'W'
TBD	Straw testing report due
11/14	Last day to withdraw (with a 'W')
TBD	Preliminary design report due
12/2	Final design report due
12/3	In-person Truss testing (Saturday)

EK301 Fall 2022 Semester Tues/Thurs Schedule and Syllabus

L #	Date	Reading	Agenda	Quiz # on...	HW
1	9/6	C2:1-7	Vector review		
2	9/8	C3:1-4	Multiple forces, static equilibrium		
3	9/13	C3:1-4	Internal tensions	Q1 (Ethics)	
4	9/15	C2:8-9	Dot product, projections*		#1 due
5	9/20	C4:1-4	Moments; Cross product	Q2 (HW 1)	
6	9/22	C4:5-8	Moment projections; couples; equivalent systems		#2 due
7	9/27	C5:1-3	2-D static equilibrium; Project introduction	Q3 (HW 2)	
8	9/29	C5:1-3	Supports, reaction forces		#3 due
9	10/4	C5:1-3	Reaction forces	Q4 (HW 3)	
10	10/6	C5:4,7	Static indeterminacy; 2-3 force members		#4 due
11	10/13	C5:5	3-D supports and static equilibrium	Q5 (HW 4)	
12	10/18	Thru HW 4	EXAM 1 (covers through HW 4 material)		
13	10/20	C6:1-3	Truss analysis: Method of joints		#5 due
14	10/25	C6:4	Truss analysis: Method of sections	Q6 (HW 5)	
15	10/27	C6:6	Frames 1		#6 due
16	11/1	C6:6	Frames 2	Q7 (HW 6)	
17	11/3	C6:6	Frames 3/Frames module		#7 due
18	11/8	C8:1-3	Dry Friction (structures, wedges)	Q8 (HW 7)	
19	11/10	C9:1-2	Distributed forces: centroids		#8 due
20	11/15	C4:9, C9:4	Centroids & COM continued; distributed forces		
21	11/17	Thru HW 8	EXAM 2 (covers through HW 8)		
22	11/22	C7:1-3	Shear/bending		#9 due
23	11/29	C7:1-3	Shear/bending moment eqns & diagrams	Q9 (HW 9)	
24	12/1	C7:1-3	Shear/bending moment eqns & diagrams		#10 due
25	12/6	C11:1-3	Virtual work	Q10 (HW 10)	
26	12/8	C11:1-3	Virtual work		#11 due

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