Boston University ENG EK 301: Engineering Mechanics I
SYLLABUS FOR SPRING 2023

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.

SECTION INFORMATION

A1 CDS B64, Mondays & Wednesdays, 10:10-11:55 am
Instructor Prof Caleb Farny, farny@bu.edu
Office hours (ENG 207): Mondays 4:30-5:30 pm, Tuesdays 10-12 pm, or by appointment
GST: Pooja Chainani pooja13@bu.edu
LAs: Anushka Rathi asrathi@bu.edu, Mario Rodriguez mars02@bu.edu

A2 PHO 117, Tuesdays & Thursdays, 9 – 10:45 am
Instructor Prof Chuanhua Duan, duan@bu.edu
Office hours (EMA 202C): Tuesdays and Thursdays 11-12 pm
GST: Mehdi Kermanshah mker@bu.edu
LAs: Ben Pedi bpedi@bu.edu, Raghavan Ramaswany raghu@bu.edu

A3 PHO 117, Tuesdays & Thursdays, 3:30 – 5:15 pm
Instructor Prof Emma Lejeune, elejeune@bu.edu
Office hours (EMA 209): Tuesdays and Thursdays 5:15-6 pm
GST: Nguyen Phuc nguyenpn@bu.edu
LAs: Yafei Chen yafeic@bu.edu, Nicolas Malamug nmalamug@bu.edu

A4 PHO 117, Mondays & Wednesdays, 2:30-4:15 pm
Instructor Prof Caleb Farny, farny@bu.edu
Office hours (ENG 207): Mondays 4:30-5:30 pm, Tuesdays 10-12 pm, or by appointment
GST: Yingqing Chen yqchenn@bu.edu
LAs: Ahmad Beydoun ahmadb@bu.edu, Katie Fang katieffs@bu.edu

Discussion section: EK301 instruction consists of your lecture section and an *open-door* discussion section. Attendance is purely voluntary and you can attend any discussion section. The discussion section 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.

Location: Room 202, 110 Cummington Mall
Time: Mondays 6:30–8:30 pm, Wednesdays 4:30–9 pm, Thursdays 4:30–9 pm

Course description
Fundamental statics of particles, rigid bodies, trusses, frames, and virtual work. Distributed forces, 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 Hub {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

Course materials will primarily be posted on a course-wide Blackboard (learn.bu.edu) site. 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. The course-wide site will host the shared syllabus, homework, and project documents for all sections. Lecture notes will be posted either on Blackboard (Farny; Duan) or on Piazza (Lejeune). Electronic materials will be posted periodically throughout the semester, so check the site often for updates.

Piazza: The course will have a universal Piazza discussion board. We encourage you to ask questions when you're struggling to understand a course policy or concept (you can post questions anonymously) and to chime in with a response to someone else's question if you think you have a good grasp on the question. We discourage and will not respond to questions about direct analyses of specific problems. We will monitor and respond to questions during normal business hours. Questions involving sensitive information (e.g. grade or health issues) should be addressed via email to your instructor and not transmitted via Piazza.

Gradescope: Homework and project assignment submissions are to be due through Gradescope. Each section will have a separate Gradescope site.

Class updates: Occasionally the instructors, GSTs, and LAs need to send course-wide updates relating to assignment deadlines or assignment clarification. Such updates will be posted as a Blackboard announcement and simultaneously via email. It is your responsibility to monitor these communication streams.

Assignments and Grading Criteria

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 lowest **homework** and two lowest **quiz** grades will be dropped. The breakdown for the grade weighting is:

Homework	7.5%
Weekly quizzes	17.5%
Design project	15%
Each 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. Nominally, the mean of the overall score in a section will set the dividing line between a B and a B-.

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 discuss (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 10/7/3/0 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, 3 points designates a few correct steps, 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 to Gradescope by midnight on most Thursdays. 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) are weekly individual assignments that will be *based* on the homework problems, and will be given in the lecture *following* the homework due date (typically on the next Monday or 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 we recommend that you study the posted solutions to the problem sets in order to prepare for the quiz.

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 a design project.

The project will involve designing, building, and testing a truss made from acrylic bars and binding tape. 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 acrylic bars, and use your measurements to analyze and optimize your design to support as much weight as possible. The project will culminate in a test 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.

It is **very** important that you pay attention to logistics regarding material pickup! It is **YOUR** responsibility to respond to information about obtaining the project material!

Exams

There will be two midterm exams given during the semester per the course schedule. The final exam will be given during the final exam period.

Make-up exams will be given only in extreme circumstances. It is your responsibility to let your instructor know as far in advance as possible of an unavoidable conflict or medical emergency.

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

Accommodations for students with documented disabilities: If you are a student with a disability or believe you might have a disability that requires accommodations, requests for accommodations must be made in a timely fashion to Disability & Access Services, 25 Buick St, Suite 300, Boston, MA 02215; 617-353-3658 (Voice/TTY). Students seeking academic accommodations must submit appropriate medical documentation and comply with the established policies and procedures.

We will make every effort to accommodate such requests but (a) please notify us at the beginning of the semester if you've received approved accommodations in previous semesters (even if you haven't received your documentation for this semester yet) and (b) our policy is that we need at least one week's notification prior to each exam so we can make the necessary arrangements.

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) 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.

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. Therefore, each student will be granted two quiz "exceptions" and one HW "exception." We recognize that unforeseen circumstances may arise at the last minute, there is no need to contact your instructor to use these exceptions. If you do not use your exceptions by the end of the semester the two lowest quiz grades and lowest HW grade will be dropped automatically when your final grade is calculated. 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 format will help you to better learn the material. Periodically throughout each lecture, you will work in small groups on example problems. We have observed that engaging with your peers is a very effective method for learning the material.

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, GST, and LAs will circulate around the room to provide assistance if necessary. Don't hesitate to ask for help!

At the end of the exercise you are expected to upload your work to Gradescope. 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 work gets presented to the class during the feedback portion. Your name 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. Try to be as systematic and orderly as possible so we can make sense of your work.

EK301 Spring 2023 MW Semester Schedule				
L #	**Date**	**Text**	**Agenda**	**Quiz # (topic)**
1	1/23	Ch 2:1-7	Introduction, vector review	
2	1/25	Ch 3:1-4	Multiple forces, static equilibrium	
3	1/30	Ch 3:1-4	Internal tensions	Q1 (Ethics)
4	2/1	Ch 2:8-9	Dot product, projections	
5	2/6	Ch 4:1-4	Moments; Cross product	Q2 (HW 2)
6	2/8	Ch 4:5-8	Moment projections; couples; equivalent systems	
7	2/13	Ch 5:1-3	2-D static equilibrium; Project introduction	Q3 (HW 3)
8	2/15	Ch 5:1-3	Supports, reaction forces	
9	2/21	Ch 5:1-3	Reaction forces	Q4 (HW 4)
10	2/22	Ch 5:4,7	Static indeterminancy; 2-3 force members	
11	2/27	Ch 5:5	3-D supports and static equilibrium	
12	3/1	Thru HW 5	**EXAM 1** *(through HW 5)*	
13	3/13	Ch 6:1-3	Truss analysis: Method of joints	No quiz
14	3/15	Ch 6:4	Truss analysis: Method of sections	
15	3/20	Ch 6:6	Frames 1	Q5 (HW 6)
16	3/22	Ch 6:6	Frames 2	
17	3/27	Ch 6:6	Frames 3	Q6 (HW 7)
18	3/29	Ch 8:1-3	Dry Friction (structures, wedges)	
19	4/3	Ch 8:3, Ch 9:1-2	Friction, Distributed forces: centroids	
20	4/5	Thru HW 8	**EXAM 2** *(covers through HW 8 material)*	
21	4/10	Ch 4:9, Ch 9:4	Centroids & COM continued; distributed forces	No quiz
22	4/12	Ch 7:1-3	Shear/bending	
23	4/19	Ch 7:1-3	Shear/bending moment eqns & diagrams	Q7 (HW 9)
24	4/24	Ch 7:1-3	Shear/bending moment eqns & diagrams	Q8 (HW 10)
25	4/26	Ch 11:1-3	Virtual work	
26	5/1	Ch 11:1-3	Virtual work	Q9 (HW 11)
27	5/3	Ch 11:1-3	Virtual work	

IMPORTANT SEMESTER DATES		**HW:** Thurs 11:30 pm deadline	
TBD	**Project: Buckling lab**	1	26-Jan
2/23	**Last day to drop without a 'W'**	2	2-Feb
TBD	**Project: Buckling lab report due**	3	9-Feb
3/31	**Last day to withdraw (with a 'W')**	4	16-Feb
TBD	**Preliminary design report due**	5	23-Feb
4/28	**Final design report due**	6	16-Mar
4/29	**Truss testing**	7	23-Mar
		8	30-Mar
		9	13-Apr
		10	20-Apr
		11	27-Apr
	Due @ 11:30 pm 5/3 >>	12	3-May

EK301 Spring 2023 TR Semester Schedule				
L #	**Date**	**Text**	**Agenda**	**Quiz # (topic)**
1	1/19	Ch 2:1-7	Introduction, vector review	
2	1/24	Ch 3:1-4	Multiple forces, static equilibrium	
3	1/26	Ch 3:1-4	Internal tensions	Q1 (Ethics)
4	1/31	Ch 2:8-9	Dot product, projections	
5	2/2	Ch 4:1-4	Moments; Cross product	
6	2/7	Ch 4:5-8	Moment projections; couples; equivalent systen	Q2 (HW 2)
7	2/9	Ch 5:1-3	2-D static equilibrium; Project introduction	
8	2/14	Ch 5:1-3	Supports, reaction forces	Q3 (HW 3)
9	2/16	Ch 5:1-3	Reaction forces	
10	2/23	Ch 5:4,7	Static indeterminancy; 2-3 force members	Q4 (HW 4)
11	2/28	Ch 5:5	3-D supports and static equilibrium	
12	3/2	Thru HW 5	**EXAM 1** *(covers through HW 5 material)*	
13	3/14	Ch 6:1-3	Truss analysis: Method of joints	No quiz
14	3/16	Ch 6:4	Truss analysis: Method of sections	
15	3/21	Ch 6:6	Frames 1	Q5 (HW 6)
16	3/23	Ch 6:6	Frames 2	
17	3/28	Ch 6:6	Frames 3	Q6 (HW 7)
18	3/30	Ch 8:1-3	Dry Friction (structures, wedges)	
19	4/4	Ch 8:3, Ch 9:1-2	Friction, Distributed forces: centroids	
20	4/6	Thru HW 8	**EXAM 2** *(covers through HW 8 material)*	
21	4/11	Ch 4:9, Ch 9:4	Centroids & COM continued; distributed forces	No quiz
22	4/13	Ch 7:1-3	Shear/bending	
23	4/18	Ch 7:1-3	Shear/bending moment eqns & diagrams	Q7 (HW 9)
24	4/20	Ch 7:1-3	Shear/bending moment eqns & diagrams	
25	4/25	Ch 11:1-3	Virtual work	Q8 (HW 10)
26	4/27	Ch 11:1-3	Virtual work	
27	5/2	Ch 11:1-3	Virtual work	Q9 (HW 11)

IMPORTANT SEMESTER DATES	
TBD	**Project: Buckling lab**
2/23	**Last day to drop without a 'W'**
TBD	**Project: Buckling lab report due**
3/31	**Last day to withdraw (with a 'W')**
TBD	**Preliminary design report due**
4/28	**Final design report due**
4/29	**Truss testing**

HW: Thurs 11:30 pm deadline	
1	26-Jan
2	2-Feb
3	9-Feb
4	16-Feb
5	23-Feb
6	16-Mar
7	23-Mar
8	30-Mar
9	13-Apr
10	20-Apr
11	27-Apr
Due @ 11:30 pm 5/3 >> 12	3-May