FREQUENTLY ASKED QUESTIONS in AEM 250

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About the exams...

A typical Mechanics of Materials exam consists of three problems to be worked in 90 minutes. Each exam is comprehensive to the date that it is given, although the emphasis will be on the material since the last exam. The final exam usually consists of five problems to be worked in 150 minutes. The final exam is comprehensive and will include material covered in the course during study week. All exams are closed-book and closed-notes. The exam problems are typically 30-35 points each, but may vary between 20-40 points.

Exam problems are generally similar in style and content to the homework problems that you have been assigned. You will be expected to understand the meaning of the terminology used in the homework problems. Each problem will be unique and not exactly like any homework problem you have previously worked, because when you apply Mechanics of Materials as an engineer, you will be facing new and unique problems.

What I look for when I grade:

Basically, I need to assess your work and see if you understand the basic concepts of Mechanics of Materials and have the ability to achieve the correct or best answer. Specifically, I will look for:

A free body diagram, or other diagram as required for the problem (objects in equilibrium must be shown to be in equilibrium by the proper use of the free body diagram--this includes stress elements).

A proper **procedure** for working the problem, including appropriate equations. (I'm not interested in *just* the final answer.)

Proper units. (The answer is meaningless without the proper units. Five points of each problem is usually assigned to units.)

A correct and indicated final answer.

A proper amount of significant digits on the final answer. (No more than 3-4 unless more are justified.)

Hints: It helps to be organized in your thoughts. Before writing anything down, take a moment and think about how you need to proceed to solve the problem.

It helps to be organized in your work. Better organization means that you'll be less likely to forget something.

Work the easy problems first. This will keep you from getting 'bogged-down' and spending too much time on one problem.

Don't memorize example problems or very specific formulas. Instead, memorize only the basic formulas and ideas. There are usually only 3-4 basic ideas covered in each exam.

What should I be expected to do for any exam?

As a *minimum*, you should expect to be able to:

draw proper free body diagrams,

find reactions and internal forces and moments of simple structures such as trusses and beams,

know units of stress, strain, and loads (forces and moments),

use a proper amount of significant digits,

clearly indicate a final answer.

Note: the information about exams given below are typical exam content. The student is responsible for all course content whether specifically listed below or not.

More specifically, what should I be expected to know for exam number 1?

Be able to compute stresses on an inclined plane using statics and the area of the inclined plane (not the stress formulas in the text) and be sure to be able to find forces in simple trusses.

As a *minimum*, you should expected to be able to:

find axial stress and strain in a bar from loads and temperature changes,

find the average shearing stress and shearing strain,

find stresses on an inclined plane in an axially loaded bar,

use statics to find forces and reactions in simple trusses and other structures (see assigned and un-assigned homework problems in the text for sample structures),

apply the idea of a safety factor to a structure,

know the meaning of double-shear,

understand and indicate the meaning of compressive and tensile normal stresses,

know how to use the engineering stress-strain curve for a material, and its important parts (ultimate stress, modulus of elasticity, etc.),

relate stresses and strains by 1-D and 3-D Hooke’s law.

More specifically, what should I be expected to know for exam number 2?

Exam two will typically have the following types of questions: one axial load problem, one torsional load problem, and one beam bending problem. Of the axial and torsional loading problems, one will typically be statically determinate, and one will typically be statically indeterminate.

As a *minimum*, you should expected to be able to:

sketch the stress distributions for axial, torsional, and beam (bending and transverse shear) loadings,

find axial stresses, strains, and deformations in statically determinate and statically indeterminate axially loaded bars,

find shearing stresses, strains, and rotational deformation in statically determinate and statically indeterminate torsionally loaded bars,

find bending stresses and transverse shearing stresses in beams,

be able to use the section modulus for determining a beam cross-section,

sketch shear force and bending moment diagrams for beams with point forces and moments, and constant and triangular distributed loads,

find the centroid and moment of inertia of beam cross-sections.

More specifically, what should I be expected to know for exam number 3?

Exam three will typically have these questions: combined loading/pressure vessels, Mohr's circle, and a beam deflection problem.

As a *minimum*, you should expected to be able to:

identify is a beam is statically determinate or statically indeterminate,

determine the deflection equation of a statically determinate beam by integrating the moment equation and applying the appropriate boundary conditions--for either simple supports or cantilevered supports,

determine support reactions for statically indeterminate beams,

be able to apply the concept of matching boundary conditions,

use 2-D or 3-D Mohr's circle of stress [strain] to determine maximum principal stresses [strains] and the maximum in-plane and absolute maximum shearing stress [strain],

use 2-D Mohr's circle of stress [strain] to compute a new set of stress [strain] components for a rotated set of coordinate axes,

determine the state of stress on cylindrical and spherical pressure vessels, and

calculate the state of stress for bars subjected to combined loading (including axial forces, bending moments, torques, transverse shear forces, and pressure loading).

More specifically, what should I be expected to know for final exam?

As a *minimum*, you should expected to be able to:

understand the topics listed above for exams 1-3,

compute the critical buckling load for pin ended columns for the first and higher mode shapes,

compute the critical buckling load for columns with support conditions of fixed-free, pinned-fixed, and fixed-fixed for the first mode shape.

how to use stress concentration factor charts, and

how to apply failure criteria for ductile and brittle materials.

Note that not all of these topics may be covered in every semester--check your syllabus.

The format of the final exam is typically five questions in length. The questions may combine more than one idea per problem. For example, combined loading and failure criteria may be in one problem. It would be wise to study Hooke's Law, combined loading, Mohr's Circle, indeterminate structures, and design topics in detail.

Common Problems and Frequently Asked Questions:

I run out of time when I take the test.

Make sure you have studied enough to know what solution procedures to apply to problems before you take the exam. If you have test anxiety or related concern, please contact the University of Alabama Office of Disability Services.

How do I know if I should feel confident about taking the exam?

Look in the book at the other homework problems in the same sections of assigned homework problems. Practice setting up those problems. If those problems all start to look similar, then you probably have a good grasp of the subject.

I make little mistakes on exams, and lose a lot of points.

If the mistake is a conceptual mistake, then it's serious. If it is a problem with units or using your calculator, then try to make enough time to check your work (see above).

How should I study for the exams?

Be prepared--work the homework on your own, read the text before class, attend class, ask questions and seek help when you need it.

Practice for the exam on a daily basis as you work the homework problems. (A marathon runner wouldn't try to get in shape the night before a race, and it is not a good idea to study for an exam just the night before the test.)

Look at the course notes (headings, sub-headings, etc.) for the major ideas and concepts in the class. Make a short list of these before the test, and try to think how you might be tested on them.

I'm a graduating senior or **I'm a graduate student.**

All students are treated the same in Mechanics of Materials. If you are a senior in your last semester or a graduate student, make certain that you work hard enough to learn the material so that you attain the grade you desire.

I just took an hour exam or the final exam, and wanted to let you know that I really know the material but was not able to demonstrate it on the hour exam or the final.

To be fair to everyone in the class, I have to grade what is on the paper. Scoring of the exam takes into account the ability to communicate your solution.

It’s the end of the semester, and I was less than 2% from the next higher letter grade. Couldn’t I just be ‘bumped-up’ to the next level?

If necessary, I adjust the class average of each exam score as the exam is taken based on class performance, the level of the exam, and my knowledge of the past performance of other Mechanics of Materials classes. Therefore, I use a straight-scale grading system at the end of the semester.

This has two important consequences: 1) you know exactly what your grade is in the course at any given instant, and 2) I won’t ‘bump-up’ grades for an individual because they have already been adjusted.

It’s the end of the semester, and I got a D+. Why can’t I get a C-?

Assigning a D+ (or any grade) occurs because the points that you have earned on your exams, homework, and the final exam, **plus any added points on exams, any attendance points added to exams, homework bonus, and points added to the final exam** (when applicable) result in a composite score that falls within the straight-scale grade range for the grade you received. Additionally, I round the scores to two significant digits, so that **a 69.5% is rounded up to a 70%.**

Therefore, all adjustments that could be applied to your grade have already been applied to your grade (in a manner consistent and fair to all students) and no additional adjustment will be made.

But I explained in my email to you that I have very good reasons that I should get a C-.

If you send an email to me after the grades have been assigned, then I will email this and the preceding response back to you. You are welcomed to make an appointment with me when I am available and we can go over your final exam, homework score, and computation of your final composite score. However, unless there is an error in your grade computation, the score will stand.

Keep in mind that there is usually some indication throughout the semester that a D+ is a possibility--very low homework scores and borderline D-C exam averages are the typical indicators. Lastly, as unpleasant at it may be to receive a D+ score, the important aspect for a future career in engineering is not the grade you get, but your ability to understand mechanics of materials and your ability to demonstrate your knowledge to a certain minimum, adequate level. Your livelihood may depend on this knowledge, as well as literally the lives of the public.

It’s the end of the semester, and I did not get the grade that I wanted, but I had extenuating personal circumstances. Can I promise to work extra credit assignments and get a better grade?

No. All students are treated the same in Mechanics of Materials. If you have extenuating personal circumstances during the semester, it is your job to communicate them to the instructor at the time, during the semester when accommodations can be made consistent with course policy. After semester grades have been assigned, your options include a discussion of your situation with your advisor and/or the Dean of Undergraduate Studies.

Do you drop any homework grades?

[Note: applies when homework is collected and graded]

Even better! At the end of the semester, you'll typically have about 35 homework sets completed for a total of 350 points. I usually determine your homework average by taking your score and dividing it by 33. So if you have a perfect (or nearly perfect) homework score, it is possible to end up with better than 100% for your homework average.

Why do we go through the development of equations in class--wouldn't it be easier to just write down the formula and solve examples?

If engineering was all about using formulas, then computers would have replaced all aspects of engineering already. There are many reasons for going through the development of equations, including those below:

Engineering often involves finding relationships between the product and the physical world. By covering the theory behind an equation, you are not only learning about the particular theory, but also how to approach new problems.

Engineering equations are developed with certain assumptions, and are valid only in specific circumstances. By going through the development of the equation, we have a chance to precisely examine its limitations.

What is the College of Engineering withdrawal policy?

From Associate of Dean Students in the College of Engineering:

‘‘The policy states that a student may only withdraw from a course up through the 10th week of a fall/spring semester, up through the 3rd week of a 5-week summer session, or up through the 6th week of a 10-week summer session.

Beyond those cut-off dates a student must remain in the course. Please note that with this new policy, the old WP or WF options no longer exist.

The official school calendar can be found on the UA web site at http://registrar.ua.edu/calendar/

Engineering Student Services requires advisor/departmental approval of any course withdrawal request. Course withdrawal can adversely impact progress towards degree (hurting financial aid qualification and delaying graduation), and may impact full-time status (which may have many ramifications such as a student not being able to remain on their parents health insurance, etc).

Extraordinary circumstances, like medical reasons, certainly exist but in a case like that a student should seek a medical withdrawal and should be withdrawing from all classes.

Please contact me or Greg Singleton if you have any questions.’’

I am dropping the lecture class. Do I need to drop the lab, too?

Yes, you must drop the lab if you are granted a withdrawal from the lecture, regardless of the point in the semester in which the lecture was dropped. This policy is clearly stated in the lab syllabus.

You took off points on the test for something that the grader counted as OK on the homework or quiz.

The grader makes his/her own solution by which to grade the homework, without the aid of a solution manual. So, sometimes the homework solution may be incorrect or the grader may miss something that I specifically look for (such as equilibrium).

It is the student’s responsibility to verify that the homework solutions are correct before using them to study for exams. The best methods to do this are to see how solutions to problems are presented in class or in the Tegrity videos, or to visit with the instructor before the exam--preferably on a regular basis.

Do I have to know [insert topic] for the exam or final exam?

Although I give a list topics that you should definitely know for your final exam, I will not rule any topic out. Keep in mind that if I felt a topic was something that you didn’t have to know, I wouldn’t teach it.

Can you give me example problems to work that are like the final exam problem?

When you work as an engineer, you will be faced with new problems on a regular basis. There is usually no textbook problem that is the same as the problem you need to solve. You will need to draw upon your experience and knowledge that you have learned in order to arrive at the best solution for you or your employer.

In this context, the final exam is meant to determine if you are able to apply mechanics of materials concepts in new situations. This is differs from the regular exams in which you are tested on the mastery of very specific concepts. Therefore, when I mention that final exam problems may combine more than one topic per problem, there usually will not be any problem in the textbook that is exactly like the problem you have on the final.

The following page lists some equations and concepts that you should know for the final exam.

AEM 250

EQUATIONS YOU SHOULD KNOW

STRESS = $\frac{\text{FORCE}}{\text{AREA}}$ $\quad \sigma = \frac{F}{A}, \quad \tau = \frac{V}{A}$

1-D Hooke's Law $\quad \sigma_{axial} = E\epsilon_{axial}, \quad \nu = -\frac{\epsilon_{transverse}}{\epsilon_{axial}}, \quad \epsilon_{axial} = \frac{\Delta L}{L_0}$

Shear Hooke's Law $\quad \tau = G\gamma, \quad \gamma = \frac{\pi}{2} - \theta^*$ $\quad \epsilon^{TH} = \alpha\Delta T$

3-D Hooke's Law (can get from 1-D) $\quad \epsilon_x = \frac{\sigma_x}{E} - \frac{\nu\sigma_y}{E} - \frac{\nu\sigma_z}{E} + \alpha\Delta T, \quad \tau_{xy} = G\gamma_{xy}$

& two more similar eqns, & two more similar eqns.

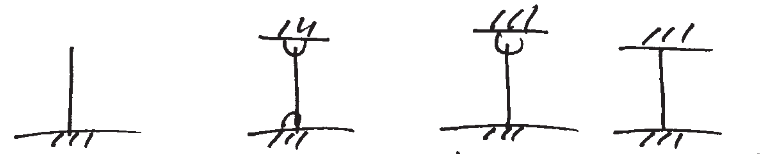
Deformation: axial $\quad e = \frac{FL}{AE} + \alpha\Delta T L$, torsional $\quad \phi = \frac{TL}{I_p G}$

Torsional shear stress: $\quad \tau = \frac{T\rho}{I_p}, \quad \tau_{max} = \frac{T\,d/2}{I_p}$

Beam Stresses: $\quad |\sigma| = \frac{My}{I}, \quad \tau = \frac{VQ}{It} \quad Q = (\bar{y}A)_{shaded}$

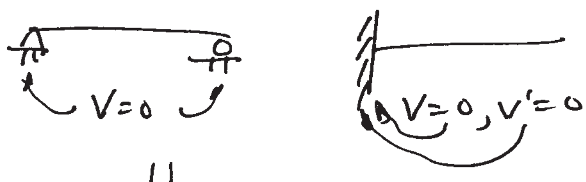
Pressure Vessels: $\quad \sigma_H = \frac{pr}{t} \quad \sigma_A = \frac{pr}{2t} \quad \sigma_S = \frac{pr}{2t}$ $\quad$ r = inside radius, t = wall thickness

Columns: $\quad P_{CR} = \frac{n^2\pi^2 EI}{(KL)^2}$



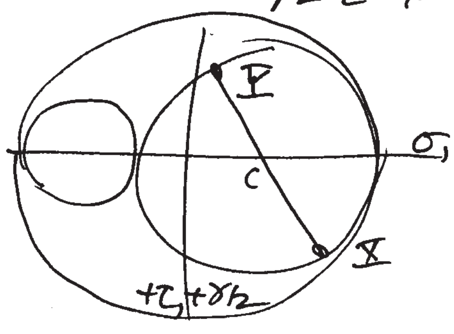
K = 2.0 $\quad$ K = 1.0 $\quad$ K = 0.7 $\quad$ K = 0.5

Beams: $\quad EIv'' = M$



Failure Criteria: $\quad \tau_{max\,ABS} \geq \frac{\sigma_{yield}}{2}$, MAX PRIN $\geq$ σ_{ULT}, $\sigma_{VM} \geq \sigma_{yield}$

$$\sigma_{VM} = \frac{1}{\sqrt{2}}\left[(\sigma_x - \sigma_y)^2 + (\sigma_y - \sigma_z)^2 + (\sigma_z - \sigma_x)^2 + 6\tau_{xy}^2 + 6\tau_{xz}^2 + 6\tau_{yz}^2\right]^{1/2}$$



C: $(\sigma_{ave}, 0)$

X: (σ_x, τ_{xy})

Y: $(\sigma_y, -\tau_{xy})$

$R^2 = h^2 + d^2$

other concepts: • statics, units

- V & M diagrams, centroids & inertias
- stress distributions
- stress concentrations
- statically indeterminate