

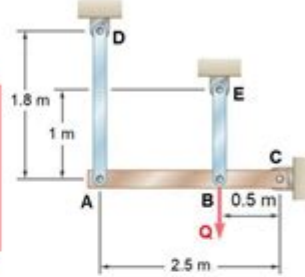
Mechanics Of Materials Final Exam

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Course: MKT2142 Mechanics of Materials Gr1&2	Date/Time: 05.06.2023 / 09:00	Duration: 80 minutes
Exam Type: Final Exam	Course Instructor: Assoc.Prof. Cüneyt Yılmaz	

Question 1 [20 min, 25 Points] : A rigid bar ABC is supported by two links at its points A and B . AD and BE of uniform $30 \times 6 \text{ mm}^2$ rectangular cross-section and made of a steel material that is assumed to be elastoplastic with $E=200 \text{ GPa}$. The magnitude of the force Q applied at B is 150 kN . Assuming an elastic behaviour, determine:

- (i) the stress in EB bar,
- (ii) the deflection of point B .

Tercümesi: Soru 1: Rijit bir ABC çubuğu A ve B noktalarından iki bağlantı ile desteklenmektedir. AD ve BE , $30 \times 6 \text{ mm}^2$ dikdörtgen kesitli ve $E=200 \text{ GPa}$ 'lık bir elastiklik modülüne sahip bir çelik malzemeden yapılmıştır. B 'ye uygulanan Q kuvvetinin büyüklüğü 150 kN 'dir. Elastik bir davranış varsayarak, şunları belirleyin:
(i) EB barındaki gerilimi.
(ii) B noktasının yer değişimini.



Solution 1: Statics: $\sum M_C = 0 : 0.5 (Q - P_{BE}) - 2.5 P_{AD} = 0$

$$P_{BE} + 5P_{AD} = 150 \text{ kN}$$

Deformation: $\delta_{AD} = \frac{2.5}{0.5} \delta_{BE} = 5 \delta_{BE}$

$$\delta_{AD} = \frac{P_{AD} L_{AD}}{E A}, \quad \delta_{BE} = \frac{P_{BE} L_{BE}}{E A}$$

$$\frac{P_{AD} L_{AD}}{E A} = 5 \frac{P_{BE} L_{BE}}{E A} \rightarrow$$

$$P_{AD} = 5 \frac{1}{1.8} P_{BE} \rightarrow P_{AD} = 2.778 P_{BE}$$

From Statics:

$$P_{BE} + 5P_{AD} = 150 \text{ kN} \quad \text{and} \quad P_{AD} = 2.778 P_{BE} \quad \text{give:}$$

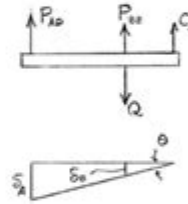
$$P_{BE} + 5 \cdot 2.778 P_{BE} = 150 \text{ kN} \rightarrow P_{BE} = 10.075 \text{ kN}$$

(i)

$$\sigma_{BE} = \frac{P_{BE}}{A} = \frac{10.075 \cdot 10^3}{(30 \cdot 6) \cdot 10^{-6}} = \frac{23621}{1.8 \cdot 10^{-4}} = 55.97 \cdot 10^6 \text{ Pa} = 56 \text{ MPa}$$

(ii)

$$\delta_{BE} = \frac{P_{BE} L_{BE}}{E A} = \frac{10075 \cdot 1}{200 \cdot 10^9 \cdot 225 \cdot 10^{-6}} = 0.00028 \text{ m} = 0.280 \text{ mm}$$



Mechanics of materials final exam preparation is crucial for engineering students aiming to demonstrate their understanding of material behavior under various loads. This subject, often referred to as strength of materials, deals with the study of how different materials deform and fail when subjected to forces. Understanding the fundamental principles of mechanics of materials is essential not only for academic success but also for practical applications in fields like civil, mechanical, and aerospace engineering.

Understanding Mechanics of Materials

Mechanics of materials is a branch of engineering mechanics that focuses on the behavior of solid objects subject to stresses and strains. It is

foundational for various engineering applications, particularly in designing and analyzing structural components.

Key Concepts in Mechanics of Materials

To excel in a mechanics of materials final exam, students must grasp several core concepts:

1. Stress and Strain: Understanding the relationship between internal forces (stress) and deformation (strain) is fundamental.

- Stress is defined as the force applied per unit area ($\sigma = F/A$).
- Strain measures the deformation resulting from applied stress ($\epsilon = \Delta L/L_0$).

2. Elasticity and Plasticity:

- Elastic materials return to their original shape after the removal of loads, whereas plastic materials undergo permanent deformation.
- Familiarity with Hooke's Law ($\sigma = E\epsilon$) is essential, where E represents the modulus of elasticity.

3. Shear and Torsion:

- Understanding shear stress (τ) and shear strain (γ) is vital, especially in applications involving beams and shafts.
- Torsion refers to twisting forces applied to an object, leading to shear stress.

4. Bending Moments and Shear Forces:

- Analysis of beams under various loading conditions involves calculating bending moments and shear forces.
- The relationships between these forces help determine the maximum stress points in beams.

5. Failure Theories:

- Knowledge of different failure theories, such as the von Mises and Tresca criteria, is crucial for predicting material failure under complex loading conditions.

Preparing for the Final Exam

Preparation for the mechanics of materials final exam requires a strategic approach. Here are some effective study strategies:

1. Review Lecture Notes and Textbooks

Start by revisiting lecture notes and essential textbooks. Key areas to focus on include:

- Definitions and formulas
- Important concepts explained in class
- Examples provided during lectures

2. Practice Problem Solving

The mechanics of materials is a problem-solving-intensive subject. Regularly practicing problems can enhance your understanding and application of concepts. Consider these tips:

- Work through examples in textbooks.
- Solve past exam papers to familiarize yourself with the question formats.
- Collaborate with classmates to tackle difficult problems.

3. Utilize Online Resources

Numerous online platforms offer tutorials, video lectures, and practice problems. Some recommended resources include:

- Khan Academy
- Coursera
- YouTube channels dedicated to engineering topics

4. Create a Study Schedule

Organizing your study time effectively can lead to better retention of material. A well-structured schedule might include:

- Daily study sessions focused on specific topics
- Time allocated for practice problems
- Periods for revision before the exam

5. Form Study Groups

Joining or forming study groups can be beneficial. Working collaboratively allows for:

- Sharing different problem-solving techniques
- Clarifying doubts with peers
- Reinforcing learning through teaching concepts to others

Exam Strategies

During the exam, it's essential to apply effective strategies to maximize performance. Here are some tips:

1. Read Instructions Carefully

Understanding the exam format and instructions is crucial. Before diving into solving problems, take a moment to:

- Skim through all questions to gauge the difficulty level.
- Identify questions you are confident in answering first.

2. Allocate Time Wisely

Time management is key during the exam. Consider the following:

- Divide your time based on the marks allocated to each question.
- Keep track of time to ensure you have the opportunity to attempt all questions.

3. Show Your Work

In mechanics of materials, it is essential to show your work clearly. Here's why:

- Partial credit may be awarded for correct methodologies even if the final answer is incorrect.
- Clearly labeled diagrams can enhance your explanations and demonstrate your understanding.

4. Check Your Units

Always ensure that your calculations are in the correct units. Common units in mechanics of materials include:

- Stress (Pascals or psi)
- Strain (dimensionless)
- Force (Newtons or pounds)

5. Review Your Answers

If time permits, review your answers. Look for:

- Calculation errors
- Incorrect assumptions
- Any questions that you may have skipped or rushed through

Common Topics Covered in the Final Exam

While the specific content may vary based on the course, several topics are commonly included in mechanics of materials final exams:

- Basic definitions of stress and strain
- Axial loading and deformation
- Bending of beams
- Torsion of circular shafts
- Combined loading scenarios
- Failure criteria and material selection
- Analysis of composite materials

Conclusion

The mechanics of materials final exam tests not only your understanding of fundamental concepts but also your ability to apply this knowledge in practical scenarios. By focusing on key concepts, preparing effectively, and employing sound exam strategies, you can enhance your chances of achieving a successful outcome. Remember, consistent practice and a clear understanding of the principles will serve as your best tools as you approach the exam. Stay confident, and good luck!

Frequently Asked Questions

What are the primary topics covered in a Mechanics of Materials final exam?

The primary topics typically include stress and strain analysis, axial loading, torsion, bending, shear and moment diagrams, and material properties.

How can I effectively prepare for the Mechanics of Materials final exam?

Effective preparation includes reviewing lecture notes, solving past exam questions, practicing problems from textbooks, and forming study groups to discuss challenging concepts.

What is the difference between normal stress and shear stress?

Normal stress is the stress component perpendicular to a material's cross-section, while shear stress is the stress component parallel to the cross-section.

What is the significance of the yield strength in materials?

Yield strength is the maximum stress that a material can withstand without permanent deformation, making it crucial for determining safe load limits in engineering applications.

What is the purpose of drawing shear and moment diagrams?

Shear and moment diagrams are used to visualize how internal forces and moments vary along a beam, which helps in understanding the behavior and design of structural elements.

How do you determine the centroid of a composite area?

To determine the centroid of a composite area, divide the area into simpler shapes, calculate the centroid of each shape, and use the weighted average based on the area of each shape.

What role does the modulus of elasticity play in material behavior?

The modulus of elasticity measures a material's stiffness and indicates how much it will deform under a given stress, which is essential for understanding elastic deformation.

