SICHUAN UNIVERSITY PITTSBURGH INSTITUTE

ENGR0145 - Statics and Mechanics of Materials 2

Syllabus for 2017 Spring Term

Catalog Description

Second of a two course sequence covering statics and strength of materials. Topics include: flexure; second moment of areas; shear force and bending moment diagrams, composite beams, shearing stresses, beam deflections, energy methods, Castigliano's methods, moment area method, combined static loading and columns. 3 credit hours.

Instructor

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Text

W. F. Riley, L. D. Sturges, and D. H. Morris, *Statics and Mechanics of Materials: An Integrated Approach,* 2nd Edition, John Wiley & Sons, Inc.

Learning Objectives

Chapter 8 Flexural Loading: Stresses in Beams

1. Describe different types of beam.
2. Visualize the existence of the neutral axis, the compression and tension on either side of the neutral axis.
3. Correctly determine the flexural stresses at a given location of the transverse cross section.
4. Define second moment of areas
5. Apply the parallel-axis theorem for second moment of area
6. Determine second moment of composite areas with respect to any reference line.
7. Describe the transformation of cross section of composite beams.
8. Determine the flexural stresses associated with composite beams.
9. Calculate flexural stresses in a beam with a cross section of composite area
10. Define the shear force and bending moment associated with a pure bending.
11. Describe the sign conventions used for shear force and bending moment in beam analysis
12. Analyze statically determinate beams under various loading conditions and supports
13. Describe the relationship between loads, shear force and bending moment for different loading conditions and present the relationship graphically
14. Construct shear force and bending moment diagrams
15. Visualize the shearing stresses in beams and describe them precisely
16. Determine shearing stresses on a transverse section
17. Select the lightest material for a beam based on strength requirements.

Chapter 9 Flexural Loading: Beam Deflection

1. Describe the mathematical form of deflection, slope, moment, shear and load pertaining to a beam.
2. list the characteristics of a force
3. Determine the deflection of a beam by integration of moment equations.
4. Determine the deflection of a beam by integration of shear-force or load equations.

5. Define singularity functions and set up singularity functions correctly.
6. Determine beam deflections by using singularity functions.
7. Describe the method of superposition its assumption and applicability.
8. Determine beam deflection by using the method of superposition.
9. Determine if a beam is statically indeterminate.
10. Solve statically indeterminate beam problems by using superposition method.
11. Explain the strain energy.
12. Describe Castigliano's theorem and the procedure of using it.
13. Determine the beam deflection by using the Castigliano's Theorem.
14. Select beam materials to meet strength and deflection requirements.

Chapter 10 Combined Static Loading

1. Visualize the stresses at a general point in an arbitrarily loaded member.
2. Represent stresses on a 2-d and 3-d element – mathematically and graphically.
3. Explain the stress transformation equations for plane stress.
4. Describe the principal stresses and maximum in-plane stress and their physical meaning.
5. Determine the principal stresses and maximum in-plane stress.
6. Construct a Mohr's circle for a given plane state of stress.
7. Describe the plane strain.
8. Describe the strain transformation equations for plane strain.
9. Determine principal strains and maximum in-plane strain.
10. Describe the similarity between the stress transformation equations and the strain transformation equations and its implication in construction Mohr's circle for strain determination.
11. Describe the principles of strain measurements and strain gage construction.
12. Determine stresses from strain measurements.
13. Visualize the Hoop stress and the normal stress in a thin-wall pressure vessel.
14. Describe the stresses associated with a thin-wall pressure vessel.
15. Analyze a 3-d body system that is subjected to a combine loading of axial, torsional, and flexural loads, and internal pressure.
16. Determine the maximum shearing stress and principal stresses in a combined loading situation.

Chapter 11 Columns

1. Describe the nature of the buckling of columns
2. Describe the Euler bucking of an idealized pin-ended column .
3. Explain the physical meaning of Euler buckling load and critical stress.
4. Analyze the Euler buckling of idealized columns of different end conditions.
5. Describe the definition of the effective length of a column.
6. Describe the effective length of columns of different end conditions.
7. Describe the failure mode curve of an idealized column.
8. Describe the deviation of experimental results from the idealized failure mode curve of columns.
9. Determine critical stress of materials by using various industrial codes.
10. Analyze eccentrically loaded columns by applying the principle of equivalent force and couple system.
11. Explain the differences between the allowable stress method and the interaction method.
12. Design eccentrically loaded columns by using the allowable stress method and the interaction method.

Administration

- All the course information including homework assignments, solution sets for homework assignments, quizzes and midterm examinations, lecture notes will be transmitted to each member of the class by the teaching assistants of the class.
- There are weekly homework assignments due each Tuesday. ***All problems on each assignment will be graded.*** Solutions to all assigned problems will be made available.

- Team quizzes will be given intermittently throughout the semester. Teams will be assigned during the first week of classes.
- The two term tests and the final exam will be closed book, closed notes. An official formula sheet will be provided during the examination.
- There will be problem workout and bonus problems given in the class randomly. Participation and performance in these problems is the key factor of the Discretional Score.
- The date, location and time for the final examination will be determined on a later date.
- Each student's final grade will be determined based on the following contributions:

Assessment Method	Percent of Final Grade
Homework Assignments	15%
Discretional	5%
4 team Quizzes	20%
2 Term Tests	30%
Final Examination	30%

Letter grades for the course will be assigned as follows:

Final Score	Letter Grade
98–100	A+
92–98	A
90–92	A-
88–90	B+
82–88	B
80–82	B-
78–80	C+
72–78	C
70–72	C-
68–70	D+
62–68	D
60–62	D-
0–60	F

Tentative Schedule

Week	Topic	Textbook Sections	Lecture Week Number	Homework Assignment Due
2/27 3/4	Review of Stress and Strain Flexure: Strains and Stresses	4.1 – 4.5 8.1 – 8.3	1	
3/6 3/10	Flexure: Second Moment of Areas	8.4 – 8.5	2	Homework #1
3/13 3/17	Flexure: Shear Force and Bending Moment Diagrams	8.6 – 8.7	3	Homework #2
3/20 3/24	（Quiz 1）Flexure: Composite Beams Flexure: Shearing Stresses	***7.13 – 7.14***· 8.8	4	Homework #3
3/27 3/31	Flexure: Design for Strength Flexure: Beam Deflections	8.9 – 8.10 9.1 – 9.2	5	Homework #4
4/3 4/7	**No Class (Tomb Sweeping Day)**			
4/10 4/14	Term Test 1		6	
4/17 4/21	Flexure: Beam Deflections** Class Changed to 4/21(Friday) 8 – 11 AM	9.3 – 9.6	7	Homework #5
4/24 4/28	Flexure: Beam Deflections	9.7 – 9.10	8	Homework #6
5/1 5/5	(Quiz 2) Flexure: Castigliano's Method	***8.8 –8.9***	9	Homework #7
5/8 5/12	Combined Static Loading	10.1 – 10.6	10	Homework #8
5/15 5/19	Term Test 2		11	
5/22 5/26	Combined Static Loading	10.7 – 10.14	12	Homework #9

· Italicized boldface items refer to the supplementary text *Mechanics of Materials*, 6th Edition (abridged).

5/29 6/2	**No Class (Dragon Day)**			
6/5 6/9	(Quiz 3) Combined Static Loading	10.7 – 10.14	13	Homework #9
6/12 6/16	Combined Static Loading Columns	10.7 – 10.14 11.1 – 11.3	14	Homework #10
6/19 6/23	Columns	11.4 – 11.7	15	Homework #11
6/26 6/30	Final Examination		16	