

EM217 Strength of Materials

**United States Naval Academy
Mechanical Engineering Department
EM217 Strength of Materials**

Catalog Description: EM217 Strength of Materials

Credit: 4 (3-2-4)

A first course in mechanics of deformable bodies with emphasis on the engineering approach to the responses of these bodies to various types of loadings. Topics include stress-strain relationships, stress-strain analysis, stress and strain transformation (Mohr's circle), load-deflection, bending, torsion, buckling, and temperature effects.

Prerequisites: EM211 Statics

Corequisites: SM212 Differential Equations

Textbooks: Philpot, Mechanics of Materials, Third Edition, John Wiley & Sons, 2013.

Course Director: Associate Professor Peter J. Joyce

Course Content:

| No. | Topic or Subtopic | hrs. |
|-----|---|------|
| 1 | Statics review and review of sectioning | 4 |
| 2 | Introduction to stress and stress components | 2 |
| 3 | Stress on inclined planes | 1 |
| 4 | Stress transformation | 2 |
| 5 | Mohr's circle of plane stress | 4 |
| 6 | Introduction to strain and strain components | 1 |
| 7 | Strain transformation | 1 |
| 8 | Mohr's circle of strain | 1 |
| 9 | Strain gage rosette analysis | 1 |
| 10 | Tensile mechanical properties | 3 |
| 11 | Stress-strain relationships | 1 |
| 12 | Thermal strain | 1 |
| 13 | Design loads and factors of safety | 1 |
| 14 | Deformation of axially loaded members | 1 |
| 15 | Statically indeterminate axially loaded members | 1 |
| 16 | Stress concentrations | 2 |
| 17 | Thin walled pressure vessels | 2 |
| 18 | Torsion | 6 |
| 19 | Beam bending, stress-strain | 11 |
| 20 | Combined loading | 6 |
| 21 | Beam deflection | 7 |
| 22 | Statically indeterminate beams | 1 |
| 22 | Beam design | 3 |
| 23 | Buckling | 2 |

Assessment Methods:

| | YES | NO |
|------------------------------|------------|-----------|
| A. Quizzes | X | |
| B. Homework | X | |
| C. Exams | X | |
| D. Laboratory Reports | X | |
| E. Oral Presentations | X | |
| F. Design Reports/Notebooks | | X |
| G. Prototypes/Demonstrations | | X |
| H. Projects | | X |
| I. Other | | X |

¹
Course Outcomes : *By the end of this course, the student will be able to*

1. Calculate how applied forces, pressures, and temperature changes affect the shape of deformable bodies. (A,B,C,D,E)
2. Explain the definitions of and relationships between stress and strain. (A,B,C,D,E)
3. Calculate stress and strain component transformations using equations and the Mohr's circle construction. Calculate principal stresses, principal strains, maximum shear stress, and maximum shear strain and apply in design context. (A,B,C,D,E)
4. Predict stresses and strains in structural elements undergoing axial, torsional, and bending loads (including thin-walled pressure vessels) in a combined loading state. (A,B,C,D,E)
5. Determine the elastic curve of elastic beam deflection and resulting beam deflections. (A,B,C,D,E)
6. Solve statically indeterminate problems. (A,B,C,D,E)
7. Integrate strength as well as deformation considerations in design applications. (A,B,C)
8. Predict the buckling load for cases of long thin columns in compression. (A,B,C)
9. Apply experimental strain measurements to validate the predicted stresses in a structural element or structure. (D)
10. Write complete and accurate technical reports that describe the experiments conducted, analyze results, and report appropriate conclusions. (D)

¹ Letters in parenthesis represent assessment method used.

| | Course Outcomes | | | | | | | | | |
|------------------|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Program Outcomes | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| a. | X | X | X | X | X | X | X | X | X | X |
| b. | | | | | | | | | X | X |
| c. | | | | | | | X | | | |
| d. | | | | | | | | | | |
| e. | X | X | X | X | X | X | X | X | X | X |
| f. | | | | | | | | | | |
| g. | | | | | | | | | | X |
| h. | | | | | | | | | | |
| i. | | | | | | | | | | |
| j. | | | | | | | | | | |
| k. | X | X | X | X | X | X | X | X | X | X |

Date of Latest Revision: 25NOV 2014 by Associate Professor Peter J. Joyce