SYRACUSE UNIVERSITY
COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

ECS 325 - MECHANICS OF SOLIDS
Fall 2015

CATALOG DESCRIPTION
Theory of Deformation; Stress, Stress Resultants; Stress Transformation; Elastic and Inelastic Constitutive Behavior; Equilibrium; Tension and Compression, Torsion of Bars; Flexure and Shear of Beams; Pressure Vessels; Elastic and Inelastic stability; Energy Methods

CLASS MEETING TIMES AND LOCATIONS
Tuesday & Thursday 9:30 AM – 10:50 AM (Newhouse 3 – 250)
Wednesday 3:45 PM – 4:40 PM (Life Sciences – 105)

Recitation: Monday 11:40 AM – 12:35 PM (Link Hall 200)

INSTRUCTOR INFORMATION

Name: **Hossein Ataei, Ph.D., M.B.A., P.Eng.**
Office: Link Hall 151-F
E-mail: HAtaei@syr.edu
Office Hours: Wednesday 1:00 pm – 3:30 pm

Name: **Michael Roppo, Ph.D.**
Office: Link Hall 279
E-mail: mnroppo@syr.edu
Office Hours: Tuesday & Thursday 11:00 AM – 1:00 PM

By appointment: If the above timeframes do not work for your schedule or if the instructor had another meeting or engagement during the announced office hours, you may send an email to the instructor for another meeting time that would be mutually more convenient.

TEACHING ASSISTANT:
Name: **Sara Sotoud**
Office: Link Hall 154
Email: ssotoud@syr.edu
Office Hours: Tuesday & Thursday 2:00 - 4:00 PM

RECITATION SESSION:
The Recitation Sessions are normally reserved as interactive classroom time for the students with the TA. These sessions will also be used for exam preparations and as problem-solving sessions. It may happen, during the course of the semester, depending

on the course schedule and needs, the instructor might use the recitation sessions to advance the remaining parts of the weekly lectures.

COURSE WEB ADDRESS
http://blackboard.syr.edu

TEXTBOOK

Mechanics of Materials, 7th Edition
Ferdinand P. Beer, E. Russell Johnston, Jr., John T. DeWolf, David Mazurek
Hardcover, 896 pages
©2015, ISBN-13 9780073398235

Optional Reader: (Not Required)

Mechanics of Materials, 9/E
Russell C. Hibbeler
ISBN-10: 0133409325 • ISBN-13: 9780133409321
©2014 • Prentice Hall

PREREQUISITES BY TOPIC
To succeed in this course, students should possess the following knowledge and skills:

1. Statics (ECS221)
2. Calculus and Differential Mathematics (MAT295, MAT296)

COURSE OBJECTIVES
The objectives of this course are:

A. To introduce the concepts of stresses and strains in deformable bodies.
B. To discuss the relationship between stresses and strains, stress and stress resultants, and strains and deformations.
C. To introduce analysis methods for simple statically determinate and statically indeterminate engineering systems.
D. To understand the behavior of deformable bodies under externally applied and temperature loads.

COURSE OUTCOMES
At the completion of the course, each student should be able to:

A.
1. understand the different types of stresses that are present in a deformable body under a given loading.
2. understand the different types of strains that are present in a deformable body under a given loading.

[STUDENT OUTCOMES a,e]

B.

1. use Hooke's Law and Generalized Hooke's Law to compute stresses from strains, and vice versa.
2. differentiate the difference between uniaxial, biaxial and triaxial stress and strain states.
3. understand the difference between plane stress and plane strain idealizations.
4. calculate internal stresses and strains in a deformation body under a given loading condition.
5. perform stress (and strain) analysis using stress (or strain) transformation equations and Mohr Circle.

[STUDENT OUTCOMES a,e,k]

C.

1. draw free body diagrams and calculate internal forces and moments using equilibrium equations.
2. write shear and bending moment equations and draw shear and bending moment diagrams for beams.
3. understand the difference between statically determinate and statically indeterminate systems.
4. understand the concept of consistent displacements and write compatibility equations for statically indeterminate systems.
5. apply energy principles to solve statically determinate and statically indeterminate truss and beam problems.

[STUDENT OUTCOMES a,e,k]

D.

1. understand system behavior under externally applied loads and temperature loading.
2. Compute thermal stresses and strain for statically determinate and statically indeterminate systems.

[STUDENT OUTCOMES a,c,e]

ABET STUDENT OUTCOMES (a-k)

a. Ability to apply knowledge of math, science, and engineering.
b. Ability to design and conduct experiments; analyze and interpret data.
c. Ability to design a system, component, or process to meet needs.
d. Ability to function on multidisciplinary teams.
e. Ability to identify, formulate, and solve engineering problems.
f. Understanding of professional and ethical responsibility.
g. Ability to communicate effectively.
h. Understand impact of engineering solutions in a global and societal context.
i. Desire and ability to engage in life-long learning.
j. Knowledge of contemporary issues.
k. Ability to use techniques, skills, and modern engineering tools.

Course evaluation

A course evaluation summarizing each student's preparedness and effort spent for the course as well as the student's perception and opinions about the course and each of the instructors will be conducted at the conclusion of the course.

ACADEMIC INTEGRITY

Syracuse University's Academic Integrity Policy holds students accountable for the integrity of the work they submit. Students should be familiar with the policy and know that it is their responsibility to learn about course-specific expectations, as well as about university policy. The university policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same written work in more than one class without receiving written authorization in advance from both instructors. The presumptive penalty for a first offense by an undergraduate student is course failure, accompanied by a transcript notation indicating that the failure resulted from a violation of Academic Integrity Policy. The standard sanction for a first offense by a graduate student is suspension or expulsion. For more information and the complete policy, see http://academicintegrity.syr.edu/academic-integrity-policy/

DISABILITY-RELATED ACCOMMODATIONS

If you believe that you need accommodations for a disability, please contact the Office of Disability Services (ODS), http://disabilityservices.syr.edu, located in Room 309 of 804 University Avenue, or call (315)443-4498, TDD: (315)443-1371 for an appointment to discuss your needs and the process for requesting accommodations. ODS is responsible for coordinating disability-related accommodations and will issue students with documented Disabilities Accommodation Authorization Letters, as appropriate. Since accommodations may require early planning and generally are not provided retroactively, please contact ODS as soon as possible.

RELIGIOUS OBSERVANCES POLICY

SU religious observances policy, found at http://supolicies.syr.edu/emp_ben/religious_observance.htm, recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holidays according to their tradition. Under the policy, students are provided an opportunity to make up any examination, study, or work requirements that may be missed due to are religious observance provided they notify their instructors before the end of the second week of classes. For fall and spring semesters, an online notification process is available through **MySlice/StudentServices/Enrollment/MyReligiousObservances** from the first day of class until the end of the second week of class.

TENTATIVE COURSE OUTLINE:

Chapter:

1.1: Concept of Stress – *(Will be covered by Prof. Roppo)*
1.2 Review of Statics
1.3 Stresses in the Members of a Structure
1.4 Analysis and Design
1.5 Axial Loading; Normal Stress
1.6 Shearing Stress
1.7 Bearing Stress in Connections
1.8 Application
1.11 Stress on an Oblique Plane under Axial Loading **
1.12 Stress under General Loading Conditions **
1.13 Design Considerations

2.1 Axial Loading - *(Will be covered by Prof. Roppo)*
2.2 Normal Strain
2.3 Stress-Strain Diagram
2.4 True Stress and True Strain *
2.5 Hooke's Law; E-Modulus
2.6 Elastic and Plastic Deformation
2.7 Fatigue
2.8 Deformations under Axial Loading
2.10 Temperature Changes *
2.11 Poisson's Ratio
2.14 Shearing strain
2.15 Further Discussion of Deformations under Axial Loading **
2.18 Stress Concentration *
2.19 Plastic Deformation **
2.20 Residual Stresses *

3.1 Torsion - *(Will be covered by Prof. Roppo)*
3.2 Stresses in a Shaft
3.3 Deformations in a Circular Shaft
3.4 Stresses in the Elastic Range
3.5 Angle of Twist
3.6 Design of Transmission Shafts

4.1 Pure Bending - *(Will be covered by Prof. Roppo)*
4.2 Symmetric Member in Pure Bending
4.3 Deformations in Pure Bending
4.4 Stresses and Deformations in the Elastic Range
4.5 Deformations in a Transverse Cross Section
4.6 Bending of Members Made of Different Materials
4.12 Eccentric Axial Loading

6.1 Shearing Stresses in Beams and Thin-Walled Members- *(Will be covered by Prof. Roppo)*
6.2 Shearing on the Horizontal Face of a beam Element
6.3 Determination of Shearing Stresses in a Beam
6.4 Shearing Stresses in Common Types of Beams
6.7 Shearing Stresses in Thin-Walled Members**

5.1 Design of Beams for Bending - *(Will be covered by Prof. Ataei)*
5.2 Shear and Bending-Moment Diagram
5.3 Load, Shear and Bending Moment
5.4 Design of Prismatic Beams for Bending

7.1 Transformations of Stress and Strain - *(Will be covered by Prof. Ataei)*
7.2 Transformation of Plain Stress
7.3 Principal Stresses
7.4 Mohr's Circle for Plane Stress
7.9 Stresses in Thin-Walled Pressure Vessels

9.1 Deflection of Beams - *(Will be covered by Prof. Ataei)*
9.2 Deformation under Traverse Loading
9.3 Equation of the Elastic Curve
9.5 Statically Indeterminate Beams
9.7 Method of Superposition
9.8 Superposition of Statically Indeterminate Beams **

10.1 Columns - *(Will be covered by Prof. Ataei)*
10.2 Stability of Structures
10.3 Euler's Formula for Pin-Ended Columns
10.4 Columns with Other End Conditions

11 Energy Methods (Theories and Methods**) **- *(Will be covered by Prof. Ataei)***

* Optional materials
** Time permitted

GRADE BREAKDOWN AND PERFORMANCE MEASUREMENT

Participation (Strongly encouraged)

Students are expected to attend lectures and recitations and be active participants in the class. Although there will not be any "official" marks associated with the student's attendance and participation. However, based on prior experience, the final grade will have a significant correlation with the student's attendance and participation in the lectures and discussions.

Homework assignments (15% of final grade)

Homework related to the course material will be assigned during the semester. All homework assignments will be collected and graded.

Note: **Late homework will NOT be accepted.**

All assignments must be done in a neat and professional format on letter (8-1/2" by 11") or legal size (A4) papers. They must also conform to the specified criteria. All sheets must be stapled or bound together using a paper clip. Homework not conforming to the neatness requirement may be returned for rectification and resubmission.

Quizzes (15% of final grade)

Unannounced or announced short quizzes will be given during the semester to gauge student progress throughout the duration of the course.

Examinations (70% of final grade)

Two full-period in-class examinations, each account for 20% of the course grade, and a comprehensive final exam that will account for 30% of the course grade, will be given for the course.

- The First Midterm will be on or about **Week 6** of the classes
- The Second Midterm will be on or about **Week 9** of the classes
- Final Exam: (Comprehensive), **Friday Dec. 18th 2014; 5:15 pm – 7:15 pm**

Notice: ***During the course of the semester, based on the class progress and the students' performances, the instructors reserve the right to change and modify any part of the course syllabus. Students must be prepared for possible changes in the exam dates, grading weights or the teaching structure that would generate the best output for the students' collective learning experience.***