***CE 241 MECHANICS OF MATERIALS***

Required Course (for CHE)

**Fall 2008**

**Instructor(s):** *Name:* Semih Küçükarslan

**Course Data:** Hours: MMWW 7856
Room: M1100, M1100, NH 103, NH 103

**Course Description (Catalog):**

**CE241 Mechanics of Materials** **(4+1+0)4**

Concept of modeling and basic principles. Rigid bodies: Equivalent systems of forces. Equilibrium of rigid bodies. Analysis of two-dimensional trusses. Normal and shear forces and movement diagrams in one-dimensional structures. Mechanical properties, static and dynamic loading. Plastic stresses and strains due to axial and shear loading and bending and torsional moments. Transformations of stress and strain, multidimensional stress-strain relations. Stresses due to combined loading. Failure criteria. Deflection of beams. Elastic stability.

**Prerequisite**: PHYS 130 and CHEM 105.

**Course Objectives (Learning Outcomes):**

This course will introduce you to the basic principles of engineering mechanics. Most of this course is concerned with the calculation of forces acting on static (i.e. non-moving) objects and structures. The last part of the course deals with strength of materials – determining the stresses and design of structural members.

**Textbook:**

Hibbeler, R.C., "Statics and Mechanics of Materials", Prentice Hall, 2nd edition, 2004.

**Reference Books:**

Beer, F.P. and E.R. Johnston, "***Vector Mechanics for Engineers. Statics,***" McGraw-Hill, 1998.
Bedford, A., and W. Fowler, "***Statics, engineering mechanics***," Addison Wesley, 1997.
Popov, E.G., "***Engineering Mechanics of Solids***," Second Ed., Prentice Hall, 1998.

**Curricular Context**

This required course constitutes a transition from fundamental math and science topics to specific applications within the context of structural mechanics and engineering. It provides the foundation for advanced design and structural analysis courses. Estimated design content of the course is 30%.

**Laboratory and Computer Usage:**

N/A

**Class Policies:**

Quizzes: Unannounced quizzes to be held almost weekly. Quizzes will be based on homework assignments. 10% of the course grade.
Midterm exams: Two exams, each 25% of the course grade.
Final exam: Comprehensive exam at the end of the semester, 40% of the course grade.

**Contribution of the Course to Program Outcomes:**

(a) An ability to apply knowledge of mathematics, science and engineering
(c) An ability to design a system, component, or process to meet desired needs such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(e) An ability to identify, formulate and solve engineering problems
(k) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice

**Course Assessment:**

Course will be assessed on the basis of the accomplishments regarding the course objectives and the contributions to the program outcomes. The evaluation will consist mainly of the responses from the students, who will provide their comments to various course related questions in the final week of the semester.

| Week | Topics | Reading Assignment | Quizes | Content |
|---|---|---|---|---|
| 1 | General Principles, Force Vectors, Force System Resultants | Chapters 1-3 | | Introduction of general mathematical and physical principles in statics, algebraic procedures for force vectors and system resultants. |
| 2 | | | | |
| 3 | | | Quiz 1 | |
| 4 | Equilibrium of Rigid body | Chapter 4 | | Isolating the rigid body and drawing the free body diagrams |
| 5 | Structural Analysis | Chapter 5 | Quiz2 | Introduction of trusses, beams, frames and arches and analysis of these members |
| 6 | Geometric Properties and distributed loadings | Chapters 6 | | Finding the center of gravity for 2D and 3D bodies. Calculation of moment of inertias |
| 7 | Internal Loading | Chapters 7 | Quiz 3 | Drawing of normal force, shear force and bending moment diagrams |
| 8 | Stress and strain | Chapters 8 | | Review of equilibrium principles. Concepts of stress and strain. Stress components in Cartesian coordinates. Normal and shear stresses. Safety factors and design. Deformation and strain. Normal and shear strains. |
| 9 | Mechanical Properties of Materials | Chapters 9 | Quiz4 | Mechanical properties of materials. Constitutive relations. Hooke’s Law |
| 10 | Axial Load | Chapters 10 | | Axial deformation. St. Venant's Principle. Statically determinate and indeterminate axial loading assemblies. Composite bars. Thermal stresses. |
| 11 | Torsion | Chapters 11 | Quiz5 | Torsional deformation of circular shafts. Torque and angle of twist. Statically determinate and indeterminate torsional loading assemblies. Composite shafts. Thin walled members. Design of shafts. |
| 12 | Bending | Chapter 12 | | Derivation of the differential equations for flexural beam deflections. Boundary conditions. Deflection curve. Statically indeterminate beams.Pure bending of beams. Second moments of area. Parallel axis theorem. Principal axes and moments of area. Flexure formula. Flexural stresses. |
| 13 | Transverse Shear | Chapter 13 | | Shear stresses in beams. Transverse shear and the shear formula. Limitations of the shear formula. Shear flow and shear center. |