ENGR30 STATICS OF RIGID BODIES AND STRUCTURES
(Required for AE, ME, and MSE)

Catalog Data: **ENG30: Statics of Rigid Bodies and Structures (Credit Units: 4)** Addition, resolution, and equivalent system of forces. Distributed forces, centroids, rigid-body equilibrium under concentrated and distributed forces. One-dimensional cables and bars under axial loads. Statical determinacy. Stress, strain, elastic behavior. Numerical analysis of statically determinate and indeterminate trusses. Corequisite or prerequisite: Mathematics 2D and 2J. Prerequisites: Physics 7C; MAE10 (or CEE10 or EECS10). Same as MAE30. Only one course from MAE30, ENGR30, and CEE30 may be taken for credit. (Design units: 0)

Textbook: F.P Beer, E.R. Johnston and E.R. Eisenberg, *Vector Mechanics for Engineers Statics,* 7th edition, McGraw-Hill, 2004.

References:

Coordinator: Lorenzo Valdevit

Relationship to Program Outcomes: This course relates to the Program Outcomes for
AE: a, e, and, k, as stated at:
http://undergraduate.eng.uci.edu/degreeprograms/aerospace/mission
ME: a, e, and, k, as stated at:
http://undergraduate.eng.uci.edu/degreeprograms/mechanical/mission

Course Outcome/Performance Criteria: Students will:
Analyze and draw free body diagrams for single particles and rigid body systems under concentrated forces and moments.
Establish equilibrium equations of particles and rigid bodies under concentrated forces and moments and solve for support reactions.
Calculate centroids of areas to establish equilibrium equations for solid bodies under distributed forces and solve for support reactions.
Understand the difference between cables, bars and beams, trusses and frames.
Appreciate the difference between statically determinate and indeterminate structures.
Use the methods of joints and sections to analyze simple statically determinate trusses, and solve for support reactions and internal forces in the bars.
Assemble the stiffness matrix for a given truss and use it to check for kinematical determinacy.
Use a programming language (e.g. MATLAB) to write a finite element code to analyze arbitrarily complex trusses (whether statically determinate or indeterminate).

Prerequisites By Topic: Newtonian mechanics, kinematics, and dynamics of motion. Differential and integral calculus of real-valued functions of several real variables (including applications). Familiarity with scientific programming.

Lecture Topics: Introduction to fundamental concepts, units, vector and scalar quantities.
Addition and resolution of forces. *(Week 1)*
Equilibrium of a particle and free body diagrams. *(Week 2)*

Equilibrium of rigid bodies under concentrated forces and moments: equivalence of force systems. Reaction forces. *(Week 3)*
Equilibrium of rigid bodies under distributed forces (e.g. gravity): calculation of centroids. *(Week 4)*
Structural elements with one degree of freedom: cables and bars. Internal forces. Trusses. *(Week 5)*
Concept of statical and kinematical determinacy; Maxwell's rule. *(Week 6)*
Analysis of statically determinate trusses: solution of simple trusses by the methods of sections and joints. *(Week 7)*
Introduction to stress, strain and elastic behavior for bars under axial load *(Week 8)*
Deformable trusses: finite element solution of arbitrarily complex trusses ([K]{d}={f}) (with MATLAB). *(Weeks 9-10)*

Class Schedule: Meets for 3 hours of lecture and 1 hour of discussion each week for 10 weeks.

Computer Usage: Students will use a commercial programming language (e.g. MATLAB) to write a finite element code that allows the solution of arbitrarily complex trusses.

Professional Component: Contributes toward the Mechanical Engineering Topics courses. Contributes toward the Aerospace Engineering Topics courses.

Grading Criteria:

Homework:	40%
Quarterly Exam 1:	15%
Quarterly Exam 2:	15%
Final Exam:	30%
	100%

Estimated ABET Category Content:

Mathematics and Basic Science: ___ credit units or ___%
Engineering Science: 4 credit units or 100%
Engineering Design: 0 credit units or 0%

Prepared by: Lorenzo Valdevit **Date:** July 2008

CEP Approved: Fall 2008