Eastern Illinois University
Revised Course Proposal
PHY 2390, Statics

1. Catalog Description

2390 PHY. Statics. (3-0-3) F. Force and moment resultants of force systems; equilibrium analysis using free-body diagrams; force analysis of trusses, frames, cables, etc.; shear-force and bending-moment distributions; Coulomb friction; centroids, center of mass, moments and products of inertia; virtual work; hydrostatic pressure. Prerequisites: PHY 1351, PHY 1352 or permission of the instructor. Corequisite: MAT 2443. **EGR 942**

Catalog change effective Fall 2004.

2. Student Learning Objectives and Evaluation

a) Students will demonstrate the ability to:
- Determine equivalent force systems for a given set of discrete or distributed forces and couples, including force-couple equivalents, single force equivalents, and screwdriver equivalents.
- Determine reaction forces acting on a system through the use of free body diagrams.
- Determine axial forces in truss members using the method of sections or joints.
- Determine internal axial forces, shear forces and bending moments in frames.
- Create shear-force and bending moment diagrams by using the differential relationships between q, V, and M.
- Determine, by integrating, the frictional forces for plane surfaces, belts, disks, and screws.
- Determine centroids and centers of mass by direct integration and by the method of composite parts.
- Determine moments and products of inertia by integration and by other methods.
- Apply the method of virtual work to determine forces.
- Find the force resultant of hydrostatic pressure forces.

b) Assessment regarding student achievement of the stated learning objectives, and the assignment of grades, will be based upon weekly homework assignments (15%), three hour exams (20% each), and a comprehensive final examination (25%). Homework and exams will involve the use of appropriate mathematical skills (through differential and integral calculus) to solve problems related to topics in statics.
c) N.A.
d) N.A.
e) N.A.

3. Outline of the Course
a) Review of Vector Algebra (2 hr)
  a. Addition, subtraction, and multiplication by a scalar
  b. Unit vectors and orthogonal components
  c. Scalar dot product
  d. Vector cross product
  e. Scalar and vector triple products

Forces and Moments (7 hr)
- Forces and lines of action
- Moment of a force about a point
- Moment of a force about a line
- The couple
- Equilibrium and the relationship between sums of moments
- Equipolence of force systems
- Force and couple resultant
- Simplest resultant of a force system
- Distributed force systems

Analysis of Equilibrium Problems (6 hr)
- The free-body diagram
- Fundamental applications of the equilibrium equations
- Applications of the equations of equilibrium to interacting bodies or parts of a structure

Structural Applications
- Trusses (3 hr)
  1. Method of joints
  2. Method of sections
  3. Space trusses
- Systems containing multi-force members (4 hr)
  1. Axial and shear forces and bending moments
  2. Shear and moment distributions in beams
  3. Differential relationships between $q(x)$, $V(x)$, and $M(x)$
  4. Shear and bending moment diagrams
- Cables (3 hr)
  1. Parabolic
  2. Catenary
  3. Concentrated loads

Friction (3 hr)
- Laws, coefficients, and basic applications of Coulomb friction
- Special applications
  1. Wedges
  2. Flat belts and V-belts
  3. Flat screws
  4. Disks

Centroids and Mass Centers (3 hr)
- Centroids of lines, areas, and volumes
- Method of composite parts
- Center of Mass
- Theorems of Pappus

Inertia Properties of Plane Areas (4 hr)
- Moments of inertia of a plane area
- Polar moment of inertia of a plane area
- Parallel axis theorem and the radius of gyration
- Products of inertia of plane areas
- Parallel axis theorem for products of inertia
- Rotated axes / Mohr's Circle

Special Topics (5 hr)
- Virtual work
- Hydrostatic pressure

Hour Exams (3)

TOTAL HOURS: 45

b) N.A.

4. Rationale

a) This is a required transfer course for many students in our Pre-engineering and B. S. in Engineering programs, and is also a requirement for Physics majors. The course meets IAI criteria for ENGR 942 (Statics), and is equivalent to UIUC's TAM 152 course.

b) Since this course requires pre-requisite mathematical skills at the MAT 2442 level, it is appropriately placed at the sophomore level.

c)
   (1) INT 2953 has some topics in common with this course, but INT 2953 combines Statics and Strength of Materials topics and thus misses some of the topics covered PHY 2390, which is equivalent to UIUC's TAM 152. Further, the INT course only requires student math skill at the level of MAT 1340, whereas students in PHY 2390 need to be functioning at the level of MAT 2442, since students need to be able to perform 2-D and 3-D integrations.

   (2) PHY 2390 already exists. This updates its catalog description.

d) Impact on Program(s):
   (1) There will be no change in currently listed requirements to any program.

   (2) N.A.

5. Implementation

a) Any physics faculty member may teach this course.

b) There is no additional cost to students.

c) <u>Engineering Mechanics, Statics</u>, 2nd Edition, by David J. McGill and Wilton W. King, PWS-Kent, 1989

6. Community College Transfer

A community college course may be judged equivalent to this course.

7. Date approved by the department or school: <u>10 / 02 / 2003</u>

8. Date approved by the college curriculum committee: <u>10/24/2003</u>

9. Date approved by CAA: <u>11/6/2003</u> CGS:<u>_____</u>