Tennessee Technological University
Department of Civil & Environmental Engineering
CEE 4130 (5130) Matrix and Finite Element Methods
Elective
Fall Semester 2007

2007 Catalog Data: CEE 4130 (5130): Matrix and Finite Element Methods. Lecture 3. Credit 3. Matrix formulations; using flexibility and stiffness methods for structural analysis of skeletal structures. Finite element formulations and applications. Prerequisite: CEE 3320 or ME 3620 and MATH 2010 or MATH 4510.

Textbook: None

Reference: None

Coordinator: G. Ramirez, Associate Professor of Civil Engineering

Goal: The goal of CEE 4130 (5130) "Matrix and Finite Element Methods" is to extend the student's knowledge in the analysis and design of structures (both skeletal and plate) by modern matrix and computer methods.

Course learning objectives:
1. The student is to develop an understanding of the process used by computers to solve structures.
2. The student is to develop an understanding of a variety of both skeletal and plate elements.
3. The student is to develop an ability to model and solve skeletal and plate structures.

Course measurable outcomes:
Students will be expected to:
1. solve beam, frame or truss problems by matrix methods;
2. model and solve special case problems such as nonprismatic continuous beams, support settlement, and spring supports;
3. model and solve plate structures using a Constant Strain Triangular element;
4. model and solve plate structures using a Linear Strain Rectangular element;
5. model and solve plate structures subjected to both in-plane and bending loads; and
6. explain the development process for a variety of finite elements.

Topics covered: (Three lecture classes per week, 55 minutes each)
1. Introduction to computer methods for design of structures (1 class)
2. Flexibility or stiffness method (1 class)
3. Decomposition of linear equations (3 classes)
4. Beam elements (5 classes)
5. Orthogonal frames (3 classes)
6. Nonorthogonal frames and trusses (5 classes)
7. Special elements to model support restraints (3 classes)
8. Computer applications for analysis and design of skeletal structures (6 classes)
9. Two-dimensional plane stress and plane strain elements (6 classes)
10. Plate elements in bending (4 classes)
11. Computer applications for analysis and design of plate structures (2 classes)
12. Tests (3 classes)

Contribution of the course to meeting professional component:
This course is a part of the engineering topics of the curriculum and is an elective.

ABET category content as estimated by faculty member who prepared this course description:

Engineering Science: 2 credits or 67%

Engineering Design: 1 credit or 33%

Relation of course to program outcomes:

Outcome 1: The graduates will have a broad understanding of the relevant principles of mathematics, science, and engineering.
Outcome 2: The graduates will have a general comprehension of four technical areas appropriate to civil engineering.
Outcome 4: The graduates will be capable of design activities and have the ability to identify, formulate, and solve civil engineering problems.
Outcome 8: The graduates will have the ability to use techniques, skills, and modern engineering tools needed for engineering practice.

Relation of course to ABET Criteria:

General Criteria		Bloom's Level of Achievement
(3a)	Knowledge of math, science, engineering	3
(3c)	Design a system, component, or process	3
(3e)	Identify, formulate, and solve engineering problems	4
(3k)	Techniques, skills, modern tools for engineering practice	3

Program Criteria		Bloom's Level of Achievement
1.	Apply knowledge of math and sciences	3
2.	Apply knowledge of four technical areas appropriate to civil engineering	3
3.	Design a system, component, or process in more than one civil engineering context	3

Computer usage:

1. Each student is required to review and modify in some cases a series of progressive FORTRAN 77 programs starting with matrix operations, then linear equation solving, and concluding with structural and finite element programs.
2. A series of in-house programs are utilized for confirmation solutions to problems solved by traditional "hand" methods.
3. SPAR, a commercial finite element program developed by NASA is used to introduce students to commercial programs and to confirm solutions done using other special element in-house programs.

Laboratory projects: None

Prepared by: Guillermo Ramirez Date: April 2007