SYLLABUS
ME 6410 - Finite Element Method

ME6410 Students and SECS Faculty

Kent L. Ko, Associate Professor

Course Syllabus for ME 6410 (Finite Element Method), Winter 2018

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Textbook: *A First Course in the Finite Element Method*, by D.L. Logan, PWS Publishing, Fourth Edition.

COURSE OBJECTIVES:

The primary objective of this course is to provide the student with the background in finite element analysis. The basic theory of using the finite element method to solve one and two-dimensional structural problems will be covered in this course. An additional goal of the course is to assist the student to acquire the ability to understand recent publications in the area of finite element analysis. The course objectives for each section of the course are as follows:

1. Basic Principles of Finite Element Method (**a, e**)

   The student should know how the relationship between Lagrange equation and the finite element method as well as how the energy principle is utilized for the method.

2. Shape Functions and the Finite Element Method (**a, e**)

   (a) The student should be able to apply the shape functions to derive the stiff matrices for the finite element method.

   (b) The student should be able to derive shape functions for spring elements, bar elements, beam elements, and two dimensional elements, including triangular elements, rectangular elements, and quadrilateral elements.

3. Formulate Stiffness Matrices (**a, e**)

The student should be able to formulate stiffness matrices for the spring elements, bar elements, truss elements, beam elements, frame elements, and two dimensional elements, including triangular elements and rectangular elements and to carry out the assembly processes to formulate the final algebraic equations to solve the problem.

4. Model Engineering Problems Using Finite Element Method and Develop Computer Codes to Solve Engineering Problems Using Finite Element Method (**a, e**)

   (a) The student should be able to write a computer code to invert a large size matrix or solve a large number of simultaneous algebraic equations.

   (b) The student should be able to assemble elements for any spring problems, for any bar problems, for any truss problems, for any beam problems, for any frame problems and for any two-dimensional elastic problems by inspection and be able to write a computer code for it.

   (c) The student should be able to solve bar problems using both exact analysis and the finite element method to compare results to understand the limitations of the finite element methods.

5. Perform Numerical Integration Using Gauss Quadrature (**a, e**)

   The student should be able to write the basic equation of Gauss Quadrature and to use it to estimate the values of the stiffness matrix components of a quadrilateral element.

- ABET Program Outcomes:
  (a) an ability to apply knowledge of mathematics, science, and engineering
  (e) an ability to identify, formulate, and solve engineering problems

EXAM DATES:

Test 1 – February 8, 2018, Thursday, 5:30 P.M. – 7:17 P.M.

Test 2 – March 15, 2018, Thursdays, 5:30 P.M. – 7:17 P.M.

Final Exam – April 19, 2018, Thursday, 7:00 P.M. – 10:00 P.M.

Both tests and the final exam will be close-book and close-note. Students will be allowed to prepare a formula sheet for the tests and for the final exam. Only formulas specified by the instructor can be written on the formula sheet. No homework problems, no example problems and no unauthorized equations should appear on the formula sheet. Students should bring the formula sheet to every class period so they

can write down the formulas specified by the instructor in class. Cheating and plagiarism will be reported to the Academic Conduct Committee for hearing.

Make-up exam **won't be** provided. Requesting waiving an exam or test can only be allowed for emergencies, and the instructor should be notified with a telephone communication before the exam. A written proof for the emergency should also be given to the instructor within three days after the exam or test. The instructor will be the only person to judge the merit of the emergency. Vacations, weddings, funerals and in-town job assignments cannot be considered emergencies. Students should notify the instructor of any out-of-town job assignments during the first week of class so the test dates indicated above can be rescheduled to allow every student not to miss any of the two tests. The time and the date for the final exam cannot be changed.

GRADING:

The course grade will be calculated by using the following distribution:

Two Tests	60%
Final Exam	30%
Homework	10%

If the total score of homework is below 30% of the maximum possible score, the course grade will be given as 0.0 regardless of the grades for others. The student will be expected to attend every class lecture for class discussions. If the student misses the class more than 10 times, his or her course grade will be given as 0.0 regardless of the grade earned. An extra credit of 0.1 for the course grade based on the 4.0 system will be given to students who have perfect attendance.

Grading for homework will be based on neatness, clarity and legibility in addition to correct answers and reasoning. Students will be allowed to discuss the solution of homework problems with not more than one partner. In that case, all team members' names should appear on all team members' homework papers and every team member should contribute to the discussions of the problem. Copying a team member's homework paper and/or failing to identify the partner's name on the paper will be considered plagiarism and will be reported to Academic Conduct Committee.

COURSE OUTLINE:

1. Matrix Analysis
2. Spring Elements
3. Truss Elements
4. Plane Frame Analysis

5. Finite Element Analysis of Two-Dimensional Problems