Kingdom of Saudi Arabia Ministry of Higher Education **Qassim University** College of Engineering	Qassim University جامعة القصيم	المملكة العربية السعودية وزارة التعليم العالي **جامعة القصيم** **كليه الهندسه**

CE602 Finite Elements Method in Structural Analysis

College:	Engineering

Department:	Civil Engineering

First: Course Definition

1- Course Code: CE 602

2- Units: **3**

3- Semester:

4- Prerequisite:

5- Co-requisite:

6- Location (if not on main Campus):

Second: Course Objectives: The objectives of this course are for the student to become able to:

1. Develop comprehensive knowledge in the fundamental mathematical and physical basis of the finite elements analysis.
2. Know how to do build finite elements models of physical problems.
3. Develop a complete finite elements solution strategy.

Third: Course Specifications

1- Topics to be covered

Subject	No of Weeks	Units
Basic principles and concepts of Finite element methods	1	3
Potential Energy and Approximate Analysis	2	6
Finite Element Formulation and Application of Bar Elements	2	6
Introduction to Theory of Elasticity	2	3
Shape Functions for 2-D Problems	2	6
FE Formulation and Application by Constant Stress Triangular (CST) Element	2	6
Practical Consideration in Modelling	1	3
Isoparametric 2-D Elements	1	3

FE Formulation of the 4 Node Isoparametric Element	1	3
Steady State Field Problems	1	3

2- Course components (Total hrs in the Semester: 42

Lecture	Exercise	Other
42	-	0

3- Intended Learning Outcomes of the Course (ILO's)

Know the basic equations and various boundary conditions applied in beam and uni-axial problems.
Understand the Rayleigh-Ritz method as an Introduction to the FE method.
Perform a FE analysis for a complete bar problem in order to evaluate displacements & stresses.
Understand the basic equilibrium and kinematic equations, the constitutive relations as well as the potential energy expression for 2-D plane stress and plane strain elasticity problems.
Recognize various types of elements used to solve 2-D & 3-D plane problems.
Derive the stiffness matrix as well as the load vector due to various load conditions acting on a stress element.
Recognize some basic considerations when laying out a FE mesh including element size.
Understand the concepts and advantages of isoparametric elements.
Derive the stiffness matrix as well as the load vector due to various load conditions acting on a four node isoparametric 2-D element.
Apply the Gauss Quadrature method in evaluating the stiffness matrix and the load vector for a four node isoparametric element.
Recognize that different problems in various engineering fields can be solved using the same type of finite elements.

a. Knowledge

i) Description of the knowledge to be acquired- ***:***

Know the basic equations and various boundary conditions applied in beam and uni-axial problems.
Understand the Rayleigh-Ritz method as an Introduction to the FE method.
Perform a FE analysis for a complete bar problem in order to evaluate displacements & stresses.
Understand the basic equilibrium and kinematic equations, the constitutive relations as well as the potential energy expression for 2-D plane stress and plane strain elasticity problems.
Recognize various types of elements used to solve 2-D & 3-D plane problems.
Derive the stiffness matrix as well as the load vector due to various load conditions acting on a stress element.
Recognize some basic considerations when laying out a FE mesh including element size.
Understand the concepts and advantages of isoparametric elements.
Derive the stiffness matrix as well as the load vector due to various load conditions acting on a four node isoparametric 2-D element.

Apply the Gauss Quadrature method in evaluating the stiffness matrix and the load vector for a four node isoparametric element.
Recognize that different problems in various engineering fields can be solved using the same type of finite elements.

ii) Teaching strategies to be used to develop that knowledge
Class lectures
Term projects
Students' presentations
Group discussion
Seminars
Instructor-student face-to-face interaction

iii) Methods of assessment of knowledge acquired
Examinations
Quizzes
Homework assignments
Term projects
Written reports
Oral Examinations and presentations

b- Cognitive (Intellectual) Skills

i) Cognitive skills to be developed
Advanced concepts of structural analysis and modeling
Computer applications in structural Analysis

ii) Teaching strategies to be used to develop these cognitive skills
Class lectures
Term projects
Students' presentations
Group discussion
Seminars
Instructor-student face-to-face interaction

iii) Methods of assessment of students' cognitive skills
Examinations
Quizzes
Homework assignments

Term projects
Written reports
Oral Examinations and presentations

c. Interpersonal Skills and Responsibility

i) Description of the interpersonal skills and capacity to carry responsibility to be developed
Decision making based on engineering analysis and modeling
Communication skills
Team work

ii) Teaching strategies to be used to develop these skills
Class lectures
Term projects
Case studies of analysis and design

iii) Methods of assessment of students' interpersonal skills and capacity to carry responsibility
Term project
Written reports
Students' seminars and presentations

d. Communication, Information Technology and Numerical Skills

i) Description of the skills to be developed in this domain
Literature research
Problems modeling
Utilization of computer applications in the analysis and design of concrete structures

ii) Teaching strategies to be used to develop these skills
- Class lectures
- Case studies analysis
- Computer lab sessions
- Term projects

iii) Methods of assessment of students numerical and communication skills
- Term projects
- Written reports
- Students' seminars and presentations

e. Psychomotor (if applicable) & Other Non-cognitive Skills

i) Description of the psychomotor or other skills to be developed and the level of performance required

- NA

ii) Teaching strategies to be used to develop these skills-

- NA

iii) Methods of assessment of student's psychomotor skills

- NA

4- Student Assessment Schedule

Serial	Assessment tool (test, group project, examination etc.)	Week due	Weight
1	Term Project – 1	3rd	15 %
2	Mid Term Exam -1	7th	15 %
3	Term Project – 2	10th	15 %
4	Term Project – 3	13th	15 %
5	Final Exam	16th	40 %

5- Student Support

- Providing electronic library of textbooks and scientific periodicals
- Providing the necessary computer applications for the course

6- Learning Resources

i) Essential Books (References)

Bathe,K. J. "Finite Element Procedures," Klaus-Jurgen Bathe, 2007. ISBN-10: 097900490X ISBN-13: 978-0979004902

Rao, S. S. "The Finite Element Method in Engineering," 5th edition Butterworth-Heinemann, 2010. ISBN-10: 1856176614 ISBN-13: 978-1856176613

Saeed, M. "Finite Element Analysis Theory and Application with ANSYS," Prentice Hall; 2007.

Zienkiewicz, O. C. and Taylor, R. L. "The Finite Element Method for Solid and Structural Mechanics," Butterworth-Heinemann, 6/e, Sep. 2005.

ii) Course Notes: NA

iii) Recommended Books

iv) Electronic Books & Web Sites*:*
Scientific journals and forums
Instructor's instructions

v) Periodicals
ASCE scientific journals
British **Structural Engineering** journal
Canadian journal of **Structural Engineering**

7- Course Evaluation and Improvement Processes

i) Strategies for Obtaining Student Feedback on Effectiveness of Teaching
Students' questioners
Students' evaluation of course and instructor

ii) Other Strategies for Evaluation of Teaching by the Instructor or by the Department
Public faculty seminars
Assessment by external evaluators of student's achievements

iii) Processes for Improvement of Teaching
Assessment of students' work by external examiners
Analysis of students' evaluation of course and instructor
Seminars by industry professionals

iv) Processes for verifying standards of student achievement
Check marking by an independent faculty member of a sample of student work
Periodic exchange and re-marking of a sample of assignments/exams with an external evaluator

v) Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

- Assessment and evaluation of the level of achieving the course outcomes through a continuous improvement process (part of a quality assurance system established by the university),
- Consequently, actions are to be taken to improve the course delivery when necessary.
- Review of the course objectives, outcomes and curriculum every 2 years.