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

Applied Finite Elements

College: **College of Engineering (Qassim University)**

Department: **Mechanical Engineering Department**

First: Course Definition

1- Course Code: **ME 640**

2- Units: 3 credit hrs

3– Semester:

4 -Prerequisite:
ME 351 (or equivalent mechanics of material course)

5- Co-requisite: **Non**

6- Location (if not on main Campus):

Second: Course Objectives

1) To give students an understanding of the fundamentals of the finite element method (FEM) with an emphasis on the underlying theory and implementation issues for solution of solid mechanics problems, heat transfer problems and fluid problems.
2) To give students an understanding of how to obtain useful approximations to solutions of solid mechanics problems, heat transfer problems and fluid mechanics problems.

Third: Course Specifications

1-Topics to be covered

Subject	No of Weeks	Units
1) Basics of Finite Element Method -History	1	3

-Matrix notation -General steps of FEM, - Applications of FEM, Advantage and Limitations		
2) Stiffness (Displacement) Method -Stiffness Matrix - Spring Element, Matrix Derivation, Assembly - Shape Functions -Boundary Conditions	**2**	**6**
3) Truss Equations -Bar Element, Derivation of Stiffness Matrix -Global Stiffness Matrix - Solution of Plane Truss - Weighted Residual (Galerkin's Residual Method)	**2**	**6**
4) Beam Equations - Beam Stiffness. - Global Stiffness Matrix - Shape Functions - Distributed Load, Nodal Hinge - Weighted Residual (Galerkin's Residual Method)	**2**	**6**
5) Plane Stress and Plane Strain Stiffness Equations - Plane stress and Plane Strain Concepts - Constant Strain Triangular Element (CST) - Linear Strain Triangular Element (LST)	**2**	**6**
6) Isoparametric Formulation - Bar Element - Review Numerical Integration (Gaussian & Newton-Cotes Quadrature) - Plane Element, Stiffness, Shape Functions - Higher Order Shape Functions	**2**	**6**
7) Heat Transfer - Basic Differential Equations - One Dimensional Elements - Two Dimensional Elements	**2**	**6**
8) Fluid Flow - Basic Differential Equations - One Dimensional Elements - Two Dimensional Elements	**2**	**6**

2- Course components (Total hrs in the Semester)

Lecture	Exercise or lab	Other
45	**---**	**---**

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

a. *Knowledge*

i) Description of the knowledge to be acquired:

- **Define important terms associated with the course (e.g. FEM, stiffness matrix, global stiffness matrix, assembly, boundary conditions, shape functions, weighted residual,Galerkin's residual method, plane stress &strain, CST, LST, isoparametric element etc.)**
- **Describe the main step in the FEM**
- **List the various assumptions associated with the derived equations**

ii) Teaching strategies to be used to develop that knowledge

- **Lectures**
- **Class discussions**
- **Reading assignments and research (internet or books)**

iii) Methods of assessment of knowledge acquired

-Home assignments

- **Quizzes**
- **Exams**

b- Cognitive (Intellectual) Skills

i) Cognitive skills to be developed

-Discuss the advantages of FEM

- **Discuss the limitations of FEM**
- **Utilize the FEM to study stresses on a component, to study heat transfer on a component and to study simple fluid flow problems.**
- **Transformation of a physical problem into a mathematical problem in order to allow the application of FEM.**
- **Apply the FEM to conceptualize a design that meets specified criteria's.**

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

- **Lectures**
- **Case studies**

- Class discussions
- Reading and research assignments

iii) Methods of assessment of students cognitive skills

-Home assignments
- Quizzes
- Exams
- Projects

c. Interpersonal Skills and Responsibility

i) Description of the interpersonal skills and capacity to carry responsibility to be developed

-Team work
- Sharing of ideas with colleagues
- Time management
- Keeping of deadlines

ii) Teaching strategies to be used to develop these skills

- Class discussions
- Team projects
- Home assignments

iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility

-Peer-peer assessments in projects
- Project (with specified and enforced deadlines)
- Home assignments (with specified and enforced deadlines)

d. Communication, Information Technology and Numerical Skills

i) Description of the skills to be developed in this domain

-Conveying ideas in a clear manner
- Report writing
- Use of internet
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ii) Teaching strategies to be used to develop these skills

-Class discussion

- Home assignments

- Project assignments

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iii) Methods of assessment of students numerical and communication skills

-Project reports

- 10-15 min presentations

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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

-N/A

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

- N/A

iii) Methods of assessment of student's psychomotor skills

-N/A

4- Student Assessment Schedule

Serial	*Assessment tool (test, group project, examination etc.)*	*Week due*	*Weight (%)*
1	Homework (7)	Every 2 weeks	5
2	Quizzes (4-5)	Distributed Through Semester	10
3	Midterm 1	6	15
4	Midterm 2	12	15
5	Project report	15	3
6	Attendance and Class Participation	1-15	2
7	Final Exam	16-18	50
Total			100

5- Student Support

Office hours: 4hrs a week

6- Learning Resources

i) Essential Books (References)

- **Daryl L. Logan, A First Course in the Finite element Method, 5th Ed., Thomson, 2011**

ii) Course Notes

- **Notes provided by instructor as needed**

iii) Recommended Books

- **David V. Hutton, Fundamental of Finite Element Method, McGraw Hill, 2004.**
- **Roger T. Fanner, Finite Element Methods for Engineers, Imperial College Press, 1997**

iv)Electronic Books & Web Sites:

- **Course website (Course material, recommended articles, homework, project details, announcements etc)**

v) Periodicals

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7-Course Evaluation and Improvement Processes

i) Strategies for Obtaining Student Feedback on Effectiveness of Teaching

- **Student questioners at the end of the course (input about course for future improvement)**
- **Instructors solicitation of anonymous feedback (instructors effort to improve current course on minor issues)**

ii) Other Strategies for Evaluation of Teaching by the Instructor or by the Department

- **Use of anonymous questioners at the end of the semester to assess the instructor**

iii) Processes for Improvement of Teaching

- **Acting on the results of the surveys and questioners**
- **Staying up-to-date with new teaching strategies and teaching technologies such as the smart board**
- **Periodical contact with the different engineering authorities and industries for evaluating and getting their feedback and suggestions concerning the course outlines.**

iv) Processes for verifying standards of student achievement (e.g. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution)

-Check marking of a sample of student work by an independent faculty member

- **Annual statistical analysis of students performance and education progress (detailed in the annual report)**

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 periodically**