Name of Institute: INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING

Name of Faculty: Prof. Ravi Dabla (Assistant Professor)

Course code: CC0227
Course name: Finite Element Method
Pre-requisites: Machine Design, Computer Aided Design
Credit points: 4
Offered Semester: 2nd M.Tech (CAD/CAM)

Course coordinator (Weeks 1 - 15)
Full name: Prof. Ravi Dabla
Department with siting location: Mechanical. Bhanvar Building, 3rd Floor, DH-1
Telephone: 8866161938
Email: ravidabla.me@indusuni.ac.in
Consultation times: Working Saturday

Course lecturer (Weeks 1 - 15)
Full name: Dr.Mitesh Mungla
Department with siting location: SOM lab,Mechanical. Bhanvar Building, 1st Floor
Telephone: 9904405959
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Consultation times: Working Saturday

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

By participating in and understanding all facets of this course a student will:

1. To present the Finite element method (FEM) as a numerical method for engineering analysis of continua and structures
2. To present Finite element formulation using variational and weighted residual approaches
3. To present Finite elements for the analysis of bars & trusses, beams & frames, plane stress & plane strain problems and 3-D solids, for thermal and dynamics problems.

Course Outcomes (CO)

1. Knowledgeable about the FEM as a numerical method for the solution of solid mechanics, structural mechanics and thermal problems

2. Developing skills required to use a commercial FEA software

Course Outline

(Key in topics to be dealt)

Fundamentals of FEM
FEM for 1D, 2D,3D problems
2D problems using CST
Dynamic and non linier analysis using FEM

Method of delivery
(Face to face lectures, PPT, Active Learning Techniques with solving Tutorial)

Study time

(5 hr per week-Theory -3 hr)

CO-PO Mapping (PO: Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	-	-	-	-	-	-	-	-	-
CO2	-	2	3	2	1	-	-	-	-	-	-	1
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	1	2	2	-	-	-	-	-	-	-	-	-
CO5	1	2	1	-	2	-	-	-	-	-	-	1

Blooms Taxonomy and Knowledge retention:

(Blooms taxonomy has been given for reference)

Figure 1: Blooms Taxonomy

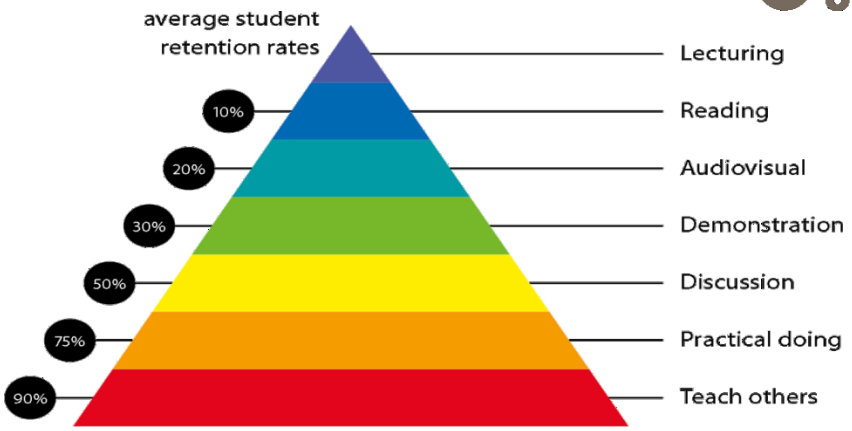

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**

Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

As per the teaching scheme of subject

Lecture/tutorial times

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

Reference Books:

1. T. Chandrupatla and A. G. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall Inc., 2002
2. Rao S S, "The Finite Element Method in Engineering" Butterworth-Heinemann, 2010
3. J. N. Reddy, "Introduction to the Finite Element Method", McGraw-Hill Education, 2005
4. Fish &Belytschko., "A First Course in Finite Elements", Wiley, 2007
5. Zienkiewicz& Taylor, "The Finite Element Method", 5/e, Butterworth-Heinemann, 2000
6. Thompson, "Introduction to the FEM: Theory, Programming and Applications".

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Continuous Internal Evaluation (CIE) - Theory - 60 Marks Bifurcation:

Marks	Bifurcation
10 Marks	Attendance
20 Marks	Assignments/ Tutorials
20 Marks	Class test
10 Marks	Active Participation

University Theory Examination - 40 Marks

Continuous Internal Evaluation (CIE) - Practical - 60 Marks Bifurcation:

Marks	Bifurcation
20 Marks	Active Participation
20 Marks	Write up
20 Marks	Lab work

University Practical Examination - 40 Marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

Finite Element Method Laboratory
List of Experiments/Practical

Sr. No.	Practical/ Experiment title
1	To find deflection and stresses in one dimensional bar problem and validate with analytical method.
2	To find deflection and stresses in cantilever beam problem and validate with analytical method.
3	To find temperature distribution and heat transfer in one dimensional bar problem and validate with analytical method.
4	To find frequency and mode shapes of Fixed-Fixed beam and validate with analytical method.
5	To study two dimensional structural problem using FE software.
6	To study two dimensional axis symmetric problem using FE software.
7	To study three dimensional structural problem using FE software.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

Course schedule (subject to change)

Week	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
Week1	Basic concepts, History of FEM, approximate method vs exact solutions, Comparison of FEM with exact solutions, General procedure for FEM	1	PPT, Tutorial
Week 2	Stress and equilibrium, strain – displacement relations, stress strain relations, potential energy approach	1	PPT
Week 3	Element shapes, nodes, nodal unknowns, coordinate systems, shape functions.Variational methods, weighted residual techniques, weak formulation	1	PPT
Week 4	Introduction, finite element modeling, coordinates and shape functions, the potential energy approach	1	PPT, Tutorial

Week 5	element stiffness matrix, derivation of body and traction forces for 1-D FEM	1	PPT
Week 6	assembly of global stiffness matrix and load vector, treatment of boundary conditions	*1*	PPT
Week 7	basics of quadratic shape functions, temperature effects, numerical	5	PPT, Tutorial
Assignment/Tutorial			
Week 8	Trusses: Introduction, Plane trusses, 2D and 3D trusses, derivation of stiffness matrix, numerical examples	2	PPT, Tutorial
Week 9	2-D FEM using CST: Introduction, finite element modeling, CST: Isoperimetric representation	2,3	PPT, Tutorial
Week 10	potential energy approach, element stiffness	2	PPT
Week 11	force terms, numerical examples	2,4	PPT, Tutorial
Class Test			
Week 12	Isoparametric formulation, element types, numerical integration	2,4	PPT
Week 13	error analysis, Extension to multi-dimensional problems.	4	PPT
Week 14	**Dynamic analysis using finite elements:** Introduction, equation of motion using Lagrange's approach, consistent and lumped mass matrices	4	PPT
Week 15	**Nonlinear analysis using finite elements:** Introduction, classifications of nonlinearities	4	PPT