

MOHAMMED SATHAK A J COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

LESSON PLAN							
Department of Mechanical Engineering							
Name of the Subject	Finite Element Analysis			Name of the handling Faculty	Mr.Mohan S R		
Subject Code	ME 8692			Year / Sem	III/VI		
Acad Year	2021-22			Batch	2019-23		
Course Objective							
To introduce the concepts of Mathematical Modeling of Engineering Problems.							
To appreciate the use of FEM to a range of Engineering Problems.							
Course Outcome							
CO1-Summarize the basics of finite element formulation.							
CO2-Apply finite element formulations to solve one dimensional Problems.							
CO3-Apply finite element formulations to solve two dimensional scalar Problems.							
CO4-Apply finite element method to solve two dimensional Vector problems.							
CO5-Apply finite element method to solve problems on iso parametric element and dynamic Problems.							
Lesson Plan							
Sl. No.	Topic(s)	T / R*	Periods Required	Mode of Teaching (BB / PPT / NPTEL / MOOC / etc)	Blooms Level (L1-L6)	CO	PO
		Book					
UNIT I - INTRODUCTION							
1	Historical Background	R2	1	NPTEL	L1	CO1	PO1, PO2
2	Mathematical Modeling of field problems	T1	1	BB	L2	CO1	PO4,PO2
3	Governing Equations – Discrete and continuous models	T1	1	BB	L3	CO1	PO2,PO4
4	Weighted Residual Methods	T1	3	BB	L4	CO1	PO7,PO4
5	Variational Formulation of Boundary Value Problems – Ritz Technique	T1	2	BB	L4	CO1	PO2,PO4
6	Basic concepts of the Finite Element Method	T1	1	BB	L2	CO1	PO7
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any							
*Tutorials conducted , Assignment given							
Evaluation method							
*Answers are evaluated based on Assignments and Direct interaction during Tutorials							
UNIT –II ONE-DIMENSIONAL PROBLEMS							
7	One Dimensional Second Order Equations	T1	1	BB	L2	CO2	PO1, PO2
8	Discretization – Element types	T1	1	BB	L2	CO2	PO2
9	Linear and Higher order Elements – Derivation of Shape functions	T1	1	BB	L2	CO2	PO4
10	Stiffness matrices and force vectors- Assembly of Matrices -	T1	2	BB	L3	CO2	PO2,PO4
11	Solution of problems from solid mechanics and heat transfer.	T1	2	BB	L4	CO2	PO7
12	Longitudinal vibration frequencies and mode shapes.	T1	1	BB	L4	CO2	PO2,PO4
13	Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.	T1	1	BB	L4	CO2	PO4

Suggested Activity: Assignment / Case Studies / Tutorials/ Quiz / Mini Projects / Model Developed/others Planned if any

*Tutorials conducted , Assignment given

Evaluation method

*Answers are evaluated based on Assignments and Direct interaction during Tutorials

UNIT III- TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS

14	Second Order 2D Equations involving Scalar Variable Functions	T1	1	BB	L2	CO3	PO1,PO2
15	Variational formulation –Finite Element formulation	T1	1	BB	L2	CO3	PO2,PO3
16	Triangular elements	T1	1	BB	L3	CO3	PO4,PO2
17	Shape functions and element matrices and vectors. Application to Field Problems	T1	2	BB	L4	CO3	PO2,PO7
18	Thermal problems	T1	2	BB	L4	CO3	PO4,PO7
19	Torsion of Non circular shafts	T1	1	BB	L4	CO3	PO12,PO4
20	Quadrilateral elements – Higher Order Element	R2	1	BB	L3	CO3	PO2,PO7

Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any

*Tutorials conducted , Assignment given

Evaluation method

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UNIT IV- TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

21	Equations of elasticity	T1	1	BB	L2	CO4	PO1,PO2
22	Plane stress, plane strain	T1	1	BB	L2	CO4	PO4,PO7
23	axisymmetric problems	T1	2	BB	L4	CO4	PO4,PO12
24	Body forces and temperature effects	T1	2	BB	L4	CO4	PO2,PO4
25	Stress calculations	T1	2	BB	L4	CO4	PO2,PO4,PO1
26	Plate and shell elements	T1	1	BB	L3	CO4	PO2,PO4

Suggested Activity: Assignment / Case Studies / Tutorials/ Quiz / Mini Projects / Model Developed/others Planned if any

*Tutorials conducted , Assignment given

Evaluation method

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UNIT-V ISOPARAMETRIC FORMULATION

27	Natural co-ordinate systems	T1	1	BB	L2	CO5	PO1,PO2
28	Isoparametric elements – Shape functions for iso parametric elements	T1	1	BB	L2	CO5	PO4,PO2
29	One and two dimensions – Serendipity elements	T1	1	BB	L3	CO5	PO4,PO7
30	Numerical integration and application to plane stress problems	T1	2	BB	L4	CO5	PO4,PO12
31	Matrix solution techniques	T1	2	BB	L4	CO5	PO2,PO4
32	Solutions Techniques to Dynamic problems	R1	1	NPTEL	L4	CO5	PO4,PO12
33	Introduction to Analysis Software	R1	1	Software/Computer Systems	L4	CO5	PO4,PO12

Suggested Activity: Assignment / Case Studies / Tutorials/ Quiz / Mini Projects / Model Developed/others Planned if any

*Tutorials conducted , Assignment given

Evaluation method

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Content Beyond the Syllabus Planned

1	FEA basics related to material properties
2	Finite Volume Method (FVM)

Text Books

1	Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005													
2	Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.													
Reference Books														
1	Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)													
2	Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice Hall College Div, 1990													
3	Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butterworth Heinemann, 2004													
Website / URL References														
1	https://nptel.ac.in/courses/112/104/112104193/													
Blooms Level														
Level 1 (L1) : Remembering		Lower Order Thinking	Fixed Hour Exams	Level 4 (L4) : Analysing					Higher Order Thinking	Projects / Mini Projects				
Level 2 (L2) : Understanding				Level 5 (L5) : Evaluating										
Level 3 (L3) : Applying				Level 6 (L6) : Creating										
Mapping syllabus with Bloom’s Taxonomy LOT and HOT														
Unit No	Unit Name			L1	L2	L3	L4	L5	L6	LOT	HOT	Total		
Unit 1	INTRODUCTION			1	2	1	2			4	2	6		
Unit 2	ONE-DIMENSIONAL PROBLEMS				3	1	3			4	3	7		
Unit 3	TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS				2	2	3			4	3	7		
Unit 4	TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS				2	1	3			3	3	6		
Unit 5	ISOPARAMETRIC FORMULATION				2	1	4			3	4	7		
Total				1	11	6	15	0	0	18	15	33		
Total Percentage				3.0303	33.3333	18.1818	45.4545	0	0	54.5455	45.4545	100		
CO PO Mapping														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2		1										
CO2	2	2		2			1							1
CO3	3	3		3			3					1	1	1
CO4	2	2		3			2					1	1	
CO5	2	2		3			1					2	1	1
Avg	2	2		3			2					1		
Justification for CO-PO mapping														
CO1	PO1: Basic engineering knowledge of maths / science agreed moderately PO2: Identification of Engineering complex problems agreed moderately PO4: Problem analysis and interpretation of datas agreed lowerely													
CO2	PO1: Basic engineering knowledge of maths / science agreed moderately PO2: Identification of Engineering complex problems agreed moderately PO4: Problem analysis and interpretation of datas agreed moderately PO7: Understanding of impact of engineering solutions in societal aspect agreed lowerely													
CO3	PO1: Basic engineering knowledge of maths / science agreed strongly PO2: Identification of Engineering complex problems agreed strongly PO4: Problem analysis and interpretation of datas agreed strongly PO7: Understanding of impact of engineering solutions in societal aspect agreed strongly PO12: Recognise and preparation of things for life long learning agreed lowerely													
CO4	PO1: Basic engineering knowledge of maths / science agreed moderately PO2: Identification of Engineering complex problems agreed moderately PO4: Problem analysis and interpretation of datas agreed strongly PO7: Understanding of impact of engineering solutions in societal aspect agreed moderately PO12: Recognise and preparation of things for life long learning agreed lowerely													

CO5	PO1: Basic engineering knowledge of maths / science agreed moderately				
	PO2: Identification of Engineering complex problems agreed moderately				
	PO4: Problem analysis and interpretation of datas agreed strongly				
	PO7: Understanding of impact of engineering solutions in societal aspect agreed lowerely				
	PO12: Recognise and preparation of things for life long learning agreed moderately				
3	High level	2	Moderate level	1	Low level
Name & Sign of Faculty Incharge : Mr. Mohan S R					
Name & Sign of Subject Expert : Mr. Vinothkumar K K					
Head of the Department : Dr. S Prasath					

Format No :231