Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Civil Engineering
BCE077- FINITE ELEMENT ANALYSIS
Eighth Semester, 2016-17 (Even Semester)

Course (catalog) description
To study the energy principles, finite element concept, stress analysis, meshing, linear problems and applications

Compulsory/Elective course : Compulsory for Civil students

Credit/ contact hours : 3 credits/ 45 hours

Course Coordinator : Dr.S.J.Mohan

Instructors :

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
T.P Maikandaan	**M.Tech**				

Relationship to other courses:

Pre –requisites : structural analysis I

Assumed knowledge : Basic knowledge in Analysis of structures

Following courses : Structural Dynamics

Syllabus Contents

UNIT I INTRODUCTION 10

Boundary Value problem – Approximate Solution - Variational and Weighted Residual Methods – Ritz and Galerkin Formulations – Concepts of piecewise Approximation and Finite Elements - Displacement and Shape Functions Weak formulation Minimum Potential Energy. Generation of Stiffness Matrix and Load Vector.

UNIT II STRESS ANALYSIS 10

Two dimensional problems – Plane Stress, Plane Strain and Axisymetric problems – Triangular and Quadrilateral Elements – Natural Coordinates –Isoparametric Formulation – Numerical Integration – Plate Bending and Shell Elements Brick elements for Fracture Analysis.

UNIT III MESHING AND SOLUTION PROBLEMS 10

Higher Order Elements – P & H methods of refinement – III conditional Elements – Discretisation Errors – Auto and Adaptive Mesh Generation Techniques – Error Evaluation.

UNIT IV NONLINEAR AND VIBRATION PROBLEMS 10

Material and Geometric Nonlinearity Methods of Treatment consistent System, Matrice Dynamic Condensation – Eigen Value Extraction.

UNIT V THERMAL ANALYSIS 5

Application to Thermal Analysis Problems.

TEXT BOOKS:

1. Bathe, K.J. Finite Elements Procedures in Engineering analysis. Prentice Hall Inc., 1995.•

REFERENCE:

1. Zienkicwicz, O.C. Arid Taylor, R.L. The Finite Elements Method, McGraw Hill, 1987.•
2. Chandrupatla, R.T. and Belegunda. A.D, Introduction to Finite Elements in Engineering, 2nd• Edition, Prentice Hall of India, 1997.
3. Moaveni.S., Finite Element Analysis: Theory and Application with ANSYS, Prentice Hall Inc•

Computer usage: Auto cadd

Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts	-	0%
Professional subject	-	100%

Broad area :

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	February 1st week	Session 1 to 14	2 Periods
2	Cycle Test-2	March 2nd week	Session 15 to 28	2 Periods
3	Model Test	April 2nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

	Correlates to program outcome		
	H	**M**	**L**
CO1 To learn concepts of piecewise Approximation and Finite Elements	a,d,e		
CO2 To know about two dimensional problems in stress analysis.	a,d,e		
CO3 To understand the meshing and solution problems	a,d,e	f	
CO4 To know about the nonlinear and vibration problems	a,d,e		
CO5 To understand the Application to Thermal Analysis Problems.	a,d,e		

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I INTRODUCTION			
1.	Introduction to FEM	No	[T1,R1 & R2]
2.	Boundary Value problem	Yes	
3.	Approximate Solution	No	
4.	Variation & Weighted Residual Methods	No	
5.	Ritz & Galerkin Formulations	No	
6.	Concepts of piecewise Approximation	No	
7.	Displacement and Shape Functions	Yes	
8.	Weak formulation Minimum Potential Energy	No	
9.	Generation of Stiffness Matrix	No	
10.	Generation of Load Vector.	No	
UNIT II STRESS ANALYSIS			
11	Introduction to stress analysis	No	[T1,R1 & R2]
12	Two dimensional problems	Yes	
13	Plane Stress, Plane Strain and Axisymetric problems	Yes	
14	Triangular and Quadrilateral Elements	No	
15	Natural Coordinates	No	
16	Isoparametric Formulation	No	
17	Numerical Integration	Yes	
18	Plate Bending	No	
19	Shell Elements Brick elements for Fracture Analysis.	No	
20	Problems on stress analysis	Yes	
UNIT III MESHING AND SOLUTION PROBLEMS			
21	Introduction to meshing	No	[T1,R1 & R3]
22	Higher Order Elements	No	
23	P & H methods of refinement	No	
24	III conditional Elements	No	
25	Discretisation Errors	No	
26	Auto Mesh Generation Techniques	No	
27	Adaptive Mesh Generation Techniques	No	
28	Problems on Discretisation Errors	Yes	
29	Error Evaluation.	No	
30	Problems on Error Evaluation.	yes	
UNIT IV NONLINEAR AND VIBRATION PROBLEMS			
31	Introduction to Nonlinear Problems	No	[T1,R1 & R3]
32	Introduction to vibration problems	No	
33	Material Nonlinearity Methods of Treatment consistent System	No	
34	Geometric Nonlinearity Methods of Treatment consistent System	No	
35	Problems on Material Nonlinearity Methods	Yes	
36	Problems on Geometric Nonlinearity Methods	Yes	
37	Matrice Dynamic Condensation	No	
38	Problems on Matrice Dynamic Condensation	Yes	
39	Eigen Value Extraction.	No	

40	Problems on Eigen Value Extraction.	yes	
UNIT V THERMAL ANALYSIS			
41	Introduction to thermal analysis	No	[T1,R1 & R2]
42	Application to Thermal Analysis	No	
43	Design procedure of Thermal Analysis	No	
44	Problems on Thermal Analysis	Yes	
45	Discussion on IS code books	no	

teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	5%
Assignment	-	5%
Attendance	-	10%
Final exam	-	70%

Prepared by, Dr.S.J.Mohan Department of Civil **Dated :**

Addendum

ABET Outcomes expected of graduates of B.Tech / Civil / program by the time that they graduate:

a. An ability to apply knowledge of mathematics, science, and engineering
b. An ability to design and conduct experiments, as well as to analyze and interpret data
c. An ability to design a hardware and software system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. An ability to function on multidisciplinary teams
e. An ability to identify, formulate, and solve engineering problems
f. An understanding of professional and ethical responsibility
g. An ability to communicate effectively
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. A recognition of the need for, and an ability to engage in life-long learning
j. A knowledge of contemporary issues
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Program Educational Objectives

PEO1: PREPARATION

Civil Engineering graduates will have knowledge to apply the fundamental principles for a successful profession and/or for higher education in Civil Engineering based on mathematical, scientific and engineering principles, to solve realistic and field problems that arise in engineering and non engineering sectors

PEO2: CORE COMPETENCE

Civil Engineering graduates will adapt to the modern engineering tools and construction methods for planning, design, execution and maintenance of works with sustainable development in their profession.

PEO3: PROFESSIONALISM

Civil Engineering Graduates will exhibit professionalism, ethical attitude, communication and managerial skills, successful team work in various private and government organizations both at the national and international level in their profession and adapt to current trends with lifelong learning.

PEO4: SKILL

Civil Engineering graduates will be trained for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: ETHICS

Civil Engineering graduates will be installed with ethical feeling, encouraged to make decisions that are safe and environmentally-responsible and also innovative for societal improvement.

Course Teacher	Signature
T.P Maikandaan	

Course Coordinator

HOD/CIVIL