Academic Course Description

BHARATH UNIVERSITY

Faculty of Engineering and Technology

Department of Mechanical Engineering

BME 602-FINITE ELEMENT ANALYSIS

Sixth Semester, 2015-16 (Even Semester)

Course (catalog) description

To introduce the concepts of Mathematical Modeling of Engineering Problems. To appreciate the use of FEM to a range of Engineering Problems.

Compulsory/Elective course: Compulsory for Mechanical students

Credit & Contact hours **:** 4 & 60

Course Coordinator : Dr.V.Balambica

Instructor(s) **:** Dr.V.Balambica, C.M.Meenakshi, Lenin Rakesh, Sharavanan

Name of the instructor	Class handling	Office location	Office phone	Email (domain: @bharathuniv.ac.in)	Consultation
Dr.V.Balambica	Third year MECH	JR 003		balambica.mech@ bharathuniv.ac.in	9.00 - 9.50 AM
Dr.V.Balambica	Third year MECH	JR 004		balambica.mech@ bharathuniv.ac.in	1.30 to 2.20 PM
C.M.Meenakshi	Third year MECH	JR002		meenakshi.mech@ bharathuniv.ac.in	10.50 TO 11.40 AM
C.M.Meenakshi	Third year MECH	SK 002		meenakshi.mech@ bharathuniv.ac.in	11.40 TO 12.30 PM
Lenin Rakesh	Third year MECH	SKOO3		Leninrakesh.mech@ bharathuniv.ac.in	9.00 - 9.50 AM
Sharavanan	Third year MECH	SK001		Sharavanan.mech@ Bharathuniv.ac.in	2.20-3.10 PM

Relationship to other courses

Pre-requisites : Numerical Methods

Assumed knowledge : KNOWLEDGE ON MECHINE COMPONENTS AND TYPES OF FORCES AND STRESS

Following courses : Nil

Syllabus Contents

UNIT I AN INTRODUCTION TO FINITE ELEMENT METHODS 12

Field problems – Elementary treatments – Elements and types – Steady state problems – Propagation problems – Eigen value problems – Differential formulation – Weighted residual Method- Galarkin Approach – Variational methods – Convergence criteria.

UNIT II BAR ELEMENTS 12

Bar element – Mechanical and Thermal loads – Shape functions – Lagrange's Interpolation – Temperature effects and strain distributions.

UNIT III HEAT TRANSFER IN FE 12

Heat Transfer-Conduction, Convection, Radiation, Elasticity concepts – Plane stress and Plane strain - Euler - Bernoulli Beam Elements – Trusses and Frames.

UNIT IV GAUSS QUADRATURE METHODS 12

Node numbering – Natural co-ordinates – Isoparametric formulation – Gauss quadrature – Choice of quadrature rule – Gauss Point.

UNIT V COMPUTERIZED FEA 12

Computerized FEA – Preprocessing –Element types - Mesh generation – Solution – Post processing – Procedures of Case studies.

TEXT BOOKS:

1. J.N.Reddy – An introduction to Finite Element Method – McGraw Hill, 2007.
2. S.Senthil- An introduction to Finite Element Analysis – Laxmi Publications.

REFERENCES :

1. K.J.Bathe – Finite Element Procedure – Prentice Hall of India, 1996.
2. O.C.Zienkiewicz–The Finite Element Method in Engineering Science, McGrawHill, 2000.
2. T.R.Chandraputla , A.D.Belegundu – Introduction to Finite Elements in Engineering – Prentice Hall of India, 2002.
3. S.S.Bhavikati – Finite Element Analysis, New Age International Publishers.
4. https://www.amazon.in/...**FINITE**-**ELEMENT**-**ANALYSIS**...**ebook**/.../B0

Computer usage: ANSYS

Professional component

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

Broad area : | Engineering

Test Schedule

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

Mapping of Instructional Objectives with Program Outcome

To understand the functions and design principles of Jigs, fixtures and press tools To gain proficiency in the development of required views of the final design.	Correlates to program outcome		
	H	M	L
Upon completion of this course, the students can able to understand different mathematical Techniques used in FEM analysis and	a	b,g,j	
Understand the concepts of Nodes and elements	a	j	h
Understand use of FEA in Structural and thermal problem	a	j	H,l
Understand the application of FEA in heat transfer problem			k
Learn how to do analysis learn the various concepts and types of analysis		g	
Learn finite element modeling techniques.		e	l

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

Lecture No.	Topic (Unit No.)	No of hrs	Solving problems	Reference Books
1	Introduction to the subject	**1**	NO	R1,R3,R4
2	**Unit –I** Steps in FEA, WRM procedure	**4**	YES	R1,R3,R4
3	Rayleigh method	**4**	YES	R1,R3,R4
4	Types of element	**2**	NO	R1,R3,R4
5	Application, advantage ,disadvantage of FEA	**1**	NO	R1,R3,R4
6	**Unit-II** I –D elements introduction	**1**	NO	R3.R4
7	ID element shape function stiffness matrix ,derivation on the above parameters.	**2**	YES	R3.R4
8	Structural/mechanical problems using ID elements	**3**	YES	R3.R4

9	Introduction to temperature effect	**2**	NO	R3.R4
10	Problem solving in temperature effect.	**4**	YES	R3.R4
11	**Unit-III** Introduction to heat transfer problems	**3**	NO	R3.R4
12	CST elements	**3**	YES	R3.R4
13	Plane stress and strain condition	**2**	YES	R3.R4
14	Truss and frame	**4**	YES	R3.R4
15	**Unit-IV** Introduction to iso parametric elements	**1**	NO	R3.R4
16	Iso parametric axis and co-ordinates	**2**	YES	R3.R4
17	Derivation of jacobian matrix	**2**	YES	R3.R4
18	Problems solving using isoparametric element	**4**	YES	R3.R4
19	Gauss point method	**3**	YES	R3.R4
20	Unit-V			R2
21	Computerized FEA procedure	**1**	NO	R2
22	Mesh generation	**1**	NO	R2
23	Mechanical problens solving procedure	**4**	NO	R2
24	Hands on training in solving mechanical problem in	**1**	NO	R2

	ANSYS			
25	Thermal problem solving procedure	**4**	NO	R2
26	Hands on training in solving thermal problem in ANSYS	**1**	NO	R2
	TOTAL NO OF HRS	**60**		

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.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.
- Slide presentations and video demos.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment / Seminar / Online Test / Quiz	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by: Dr.V.Balambica

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

a) The ability to apply knowledge of mathematics, science, and engineering fundamentals.

b) The ability to identify, formulate and solve engineering problems.

c) The ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d) The ability to design and conduct experiments, as well as to analyze and interpret data

e) The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

f) The ability to apply reasoning informed by the knowledge of contemporary issues.

g) The ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

h) The ability to understand professional and ethical responsibility and apply them in engineering practices.

i) The ability to function on multidisciplinary teams.

j) The ability to communicate effectively with the engineering community and with society at large.

k) The ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.

l) The ability to recognize the need for, and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION:
Mechanical Engineering graduatesare enthusiastic to provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Mechanical Engineering.

PEO2: CORE COMPETENCE:
Mechanical Engineering graduates have competence to enhance the skills and experience in defining problems in the field of Mechanical Engineering and Technology design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

PEO3: PROFESSIONALISM:
Mechanical Engineering graduates made competence to enhance their skills and embrace new thrust areas through self-directed professional development and post-graduate training or education.

PEO4: PROFICIENCY:
Mechanical Engineering graduates became skilled to afford training 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:
Mechanical Engineering graduates are morally merged to apply the ethical and social aspects of modern Engineering and Technology innovations to the design, development, and usage of new products, machines, gadgets, devices, etc.

COURSE TEACHER	SIGNATURE
DR.V.Balambica	
C.M.MEENAKSHI	
Lenin rakesh	
sharavanan	

CO-ORDINATOR **HOD**

DR.V.Balambica