DEPARTMENT OF MECHANICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech. – Open Elective		
Course Title	Finite Element Method		
Course Code	MEOE11	**No. of Credits**	03
Course Code of Pre-requisite subject(s)	-NIL-		
Session	**July 2022**	**Section (if, applicable)**	**NA**
Name of Faculty	Dr. Bishweshwar Babu	**Department**	Mechanical Engg.
Email	bishweshwar@nitt.edu	**Telephone No.**	+91 431 250 3428
Course Type	☐ Core course	☑ Elective course	

SYLLABUS (APPROVED IN BoS)

Introduction - Illustration using spring systems and simple problems - Weighted residual methods Galerkin's method - Variational approach - Rayleigh-Ritz method.

One-dimensional finite element analysis; bar element, beam element, frame element - Heat transfer problems.

Two-dimensional finite element analysis; types of elements, shape functions, natural coordinate systems.

Applications to structural mechanics - Numerical integration - Solution of finite element equations.

Fluid flow problems - Dynamic problems. Error analysis and convergence.

COURSE OBJECTIVES

1. The objective of the course is to apprise the students about the basics of the Finite Element

Technique, a numerical tool for the solution of different classes of problems in solid mechanics.

2. Different application areas will be dealt with after introducing the basic aspects of the method.

3. The analysis methodologies for 1-D, 2-D and 3-D problems with the advantages and disadvantages will be clearly spelt out.

4. It is expected that once the students are exposed to the course, they will be in a position to develop computer codes for any physical problem using Finite Element technique

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
At the end of the course, student will be able to	
1. Illustrate the basic concepts of finite element systems through spring systems and by solving problems.	1-3, 12
2. Interpret one-dimensional and two-dimensional finite element analysis with examples.	1-3, 5, 12
3. Apply finite element methods to real world problems and obtain solutions.	1-3, 5, 12

COURSE PLAN – PART II

COURSE OVERVIEW

The finite element method (FEM) is the most widely used method for solving ODEs/PDEs. Typical problem areas of interest include the traditional fields of structural analysis, heat transfer, fluid flow, mass transport, and electromagnetic potential. This course provides an overview of the important concepts of FEM and its applications.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1	1st Week	Introduction, Illustration using spring systems and simple problems.	Chalk & Talk / PPT
2	2nd Week	Weighted residual methods, Galerkin's method (strong form). Problem solving.	
3	3rd Week	Galerkin's method (weak form), Variational approach, Integral functional. Problem solving.	
4	4th Week	Rayleigh-Ritz method, 1-D finite element analysis (Introduction). Problem solving.	
5	5th Week	Bar element, Truss element (2-D, 3-D). Problem solving.	

6	6th Week	Beam element, frame element (2-D, 3-D). Problem solving.	
7	7th Week	Heat transfer problems. Problem solving.	
8	8th Week	2-D finite element analysis; types of elements, shape functions. Problem solving.	
9	9th Week	Heat transfer and plane stress problems in 2-D using triangular and rectangular elements. Problem solving.	
10	10th Week	Natural coordinate systems, Isoparametric formulation, Numerical integration. Problem solving.	
11	11th Week	3-D finite element analysis. Axisymmetric problems, Plate bending problems. Problem solving.	
12	12th Week	Dynamic problems. Problem solving.	
13	13th Week	Fluid flow problems. Problem solving.	
14	14th Week	Error analysis and convergence.	

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Mid-semester Assessment	10th week	60 mins	20
2	Quizes	–		20
3	Assignments	–		20
CPA	Compensation Assessment (CPA)	16th week	60 mins	20
4	Final Assessment	As per institute policy		40

Essential Readings (Textbooks, Reference Books, Journals, etc.)

1. P. Seshu – Textbook of Finite Element Analysis.
2. J. N. Reddy – An Introduction to the Finite Element Method.
3. K. J. Bathe – Finite Element Procedures.
4. S. S. Rao – The Finite Element Method in Engineering.
5. O. C. Zienkiewicz, R. L. Taylor, & J. Z. Zhu – The Finite Element Method: Its Basis & Fundamentals.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

1. Feedback from the students during class committee meeting.
2. At the end of Mid-semester Assessment, feedback will be obtained for the lecture improvement.
3. End semester feedback on Course Outcomes.

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

<u>**MODE OF CORRESPONDENCE (email/ phone etc)**</u>

1. Email (bishweshwar@nitt.edu) only, NO MOBILE PHONE communications.
2. Student meeting hours: Monday to Friday 15:00 – 17:00
(during this time period, students can come and discuss their doubts, projects, and assignment works)

<u>**COMPENSATION ASSESSMENT POLICY**</u>

If any student is not able to attend Mid-semester Assessment due to some genuine reason, they are permitted to attend the compensation assessment (CPA) with %age weightage equal to the Mid-semester assessment (This is not valid for students who have attendance lag). Syllabus for the test should be the topics covered up to last week before the test.

<u>**ATTENDANCE POLICY (**</u>A uniform attendance policy as specified below shall be followed)

 ➢ **At least 75% attendance in each course is mandatory.**

 ➢ **A maximum of 10% shall be allowed under On Duty (OD) category.**

 ➢ Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

<u>**ACADEMIC DISHONESTY & PLAGIARISM**</u>

 ➢ Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.

> ➢ Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
>
> ➢ The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
>
> The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION

FOR APPROVAL

Course Faculty _____   **CC-Chairperson _____** HOD _____

Guidelines:

a) The number of assessments for a course shall range from 4 to 6.

b) **Every course shall have a final assessment on the entire syllabus with at least 30% weightage.**

c) **One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.**

d) **The passing minimum shall be as per the regulations.**

B.Tech. Admitted in				P.G.
2018	**2017**	**2016**	**2015**	
35% or class average/2 whichever is greater.		Peak/3 or class average/2 whichever is lower		40%

e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.

f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.

g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.