DEPARTMENT OF PRODUCTION ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI – 620015

COURSE PLAN – PART I	
Name of the programme and specialization	M.Tech. – Manufacturing Technology –II Semester
Course Title	MODELING OF MANUFACTURING PROCESSES

Course Code	PR 611	No. of Credits	03
Course Code of Prerequisite subject(s)	-		

Session	January - 2019	Section (if, applicable)	-
Name of Faculty	Dr. V. Senthilkumar	Department	Production Engineering
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Name of Course Coordinator(s) (if, applicable)	-		
E-mail	-	Telephone No.	-

Course Type (Please tick appropriately)	☐ Core course	✓ Elective course

Syllabus (approved in BoS)

Review of manufacturing processes, need for numerical solution – Review of basic concepts of numerical methods

FE concepts – variational and weighted residual approaches – Element types – 2D elements – plane triangular, quadrilateral, 3 dimensional axi-symmetric, plate and shell elements – mapping of elements

FE solution for Steady state and transient problems. FE procedure for non-linear problems - Material and geometric non-linearities – solution using implicit and explicit methods

Lagrangean and Eulerian formulations for modelling of machining, rolling, forging, drawing. ALE elements

Thermal modeling for induction hardening, arc welding, cooling of castings – deduction of cooling rate and metallurgical transformations.

REFERENCES:

1. M.Asghar Bhatti "Advanced Topics in Finite Element Analysis of Structures" John Wiley & sons, Inc,2006.

2. Lewis R.W.Morgan, K, Thomas, H.R. and Seetharaman, K.N. The Finite Element Method in Heat Transfer Analysis, John Wiley, 1994.

3. Edward R Champion Jr, "Finite Element Analysis in Manufacturing Engineering", McGraw Hill, 1992.

4. Prakash M. Dixit, Uday S. Dixit"Modeling of Metal Forming and Machining Processes", 1st Edition, 2008, Springer Verlog.

5. Lars-Erik Lindgren, "Computational welding mechanics" , 1st Edition, 2007, CRC Press,

COURSE OBJECTIVES

► To learn basic principles of finite element analysis procedure .
► To learn the theory and characteristics of finite elements that represent engineering structures.
► To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses performed by others.
► Learn to model complex geometry problems and solution techniques.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
CO1: Apply direct stiffness, Rayleigh-Ritz, Galerkin method to solve engineering problems and outline the requirements for convergence.	1, 2 , 5 , 6
CO2: Analyze linear 1D problems like bars and trusses; 2D structural problems using CST element and analyse the axi-symmetric problems with triangular elements.	1, 2 , 4, 7, 8
CO3: Write shape functions for 4 and 8 node quadrilateral, 6 node triangle elements and apply numerical integration to solve; 1D and 2D; stiffness integrations.	1, 2, 9, 10
CO4: Solve linear 2D structural beams and frames problems; 1Dheat conduction and convection heat transfer problems.	1, 2, 5, 6, 9
CO5: Evaluate the Eigenvalues and Eigenvectors for stepped bar and beam, explain nonlinear geometric and material non linearity.	1, 2, 3, 6, 11

COURSE PLAN – PART II

COURSE OVERVIEW

► Arrange the application of numerical method for non-linear problems.
► Apply numerical methods for manufacturing processes.
► Evaluate the numerical results of manufacturing processes.

COURSE TEACHING AND LEARNING ACTIVITIES

S. No	Week / Contact Hours	Topic	Mode of Delivery
		UNIT - I	
1	1st Week / 3 Hours	Introduction to FEA, Fundamentals of modeling processes, Fundamentals of manufacturing processes	PPT / Chalk and Talk
2	2nd Week / 3 Hours	Review of manufacturing processes, Need for numerical solution, Review of basic concepts of numerical methods	
3	3rd Week / 1 Hour	Finite Element Analysis Process	
		UNIT - II	
4	3rd Week / 1 Hour	FE concepts, Variational and weighted residual approaches	PPT / Chalk and Talk
5	4th Week / 3 Hours	Element types – 2D elements, Plane triangular, quadrilateral, 3 dimensional axi-symmetric	
6	5th Week / 2 Hours	Plate and shell elements, Mapping of elements	
		UNIT - III	
7	5th Week / 1 Hour	FE solution for Steady state problems	PPT / Chalk and Talk
8	6th Week / 3 Hours	FE solution for transient problems, FE procedure for non-linear problems, Material and geometric non-linearities	
9	7th Week / 1 Hour	Solution using implicit methods, Solution using explicit methods,	
		UNIT - IV	
10	7th Week / 1 Hour	Fundamentals of machining	PPT / Chalk and Talk
11	8th Week / 3 Hours	Lagrangean formulations for modelling of machining, Eulerian formulations for modelling of machining, Rolling	
12	9th Week / 3 Hours	Forging, Drawing, ALE elements	

UNIT - V			
13	10th Week / 2 Hours	Fundamentals of Thermal processes, Thermal modeling for induction hardening	PPT / Chalk and Talk
14	11th Week / 3 Hours	Arc welding, Cooling of castings, Deduction of cooling rate	
15	12th Week / 3 Hours	Metallurgical transformations, Heat treatment problems	

COURSE ASSESSMENT METHODS				
S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Cycle Test 1	6th Week	60 Minutes	20
2	Assignment I / Seminars	7th Week		05
3	Cycle Test 2	10th Week	60 Minutes	20
4	Assignment II / Seminars	11th Week		05
CPA	Compensation Assessment	13th Week	60 Minutes	Refer course policy
5	Final Assessment Descriptive type examination	15th Week	180 Minutes	50
Total Assessment				100

COURSE EXIT SURVEY
(mention the ways in which the feedback about the course shall be assessed)
•   Feedback from the students during class committee meetings   •   Anonymous feedback through questionnaire
COURSE POLICY **(preferred mode of correspondence with students, policy on attendance, compensation assessment, academic honesty and plagiarism etc.)**

MODE OF CORRESPONDENCE (email/ phone etc)

1. All the students are advised to check their NITT WEBMAIL regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be done through their webmail only.

2. Queries (if required) to the course teacher shall only be emailed to the email id specified by the teacher.

ATTENDANCE

1. Attendance will be taken by the faculty in all the contact hours. Every student should maintain minimum 75 % physical attendance in these contact hours along with assessment criteria to attend the end semester examination.

2. Any student, who fails to maintain 75% attendance need to appear for the compensation assessment (CPA). Student who scores more than 60 % marks in the CPA along with assessment criteria will be eligible for attending the end semester examination.

3. Those students who have attendance lag and also missed any of the continuous assessments (CAs) can appear for CPA to get eligibility for writing the end semester examination as quoted in Pt. 2. Their scores in the CPA WILL NOT be taken into account for computing marks for CA.

4. Students not having 75% minimum attendance at the end of the semester and also fail in CPA (scoring less than 60%) will have to RE DO the course.

COMPENSATION ASSESSMENT

1. Attending all the assessments is MANDATORY for every student.

2. If any student is not able to attend any of the continuous assessments (CAs: Cycle test) due to genuine reason, student is permitted to attend the compensation assessment (CPA) with 20 % weightage. (This is not valid for students who have attendance lag also. Refer Pt. 3 under Attendance)

3. At any case, CPA will not be considered as an improvement test.

4. Students are expected to score minimum 30% of the maximum mark of the class in the CAs to attend the end semester examination in addition to the attendance requirement. Otherwise the student is permitted to attend CPA and is expected to score more than 60% marks to get eligibility to appear for

end semester examination. However, the score in CPA WILL NOT be considered for computing marks for CA. Student who fails to score 60% in CPA will take up additional assignments to get eligibility for writing End Semester examination.

5. Finally, every student is expected to score minimum 40% of the maximum mark of the class in the total assessment (1, 2, 3, 4 and 5) to pass the course. Otherwise the student would be declared fail and 'F' grade will be awarded. Further he can take up only FORMATIVE ASSESSMENT.

ACADEMIC HONESTY & PLAGIARISM

1. All the students are expected to be genuine during the course work. Taking of information by means of copying simulations, assignments, looking or attempting to look at another student's paper or bringing and using study material in any form for copying during any assessments is considered dishonest.

2. Tendering of information such as giving one's program, simulation work, assignments to another student to use or copy is also considered dishonest.

3. Preventing or hampering other students from pursuing their academic activities is also considered as academic dishonesty.

4. Any evidence of such academic dishonesty will result in the loss of marks on that assessment. Additionally, the names of those students so penalized will be reported to the class committee chairperson and HoD of the concerned department.

5. Students who honestly producing ORIGINAL and OUTSTANDING WORK will be REWARDED.

ADDITIONAL INFORMATION

The faculty is available for consultation at times as per the intimation given by the faculty.

FOR APPROVAL

Course Faculty _____   CC-Chairperson _____   HOD _____