NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF CIVIL ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	**M.TECH STRUCTURAL ENGINEERING**		
Course Title	**FINITE ELEMENT METHODS**		
Course Code	**CE654**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**NA**		
Session	**~~July~~ / January 2021**	**Section (if, applicable)**	**NA**
Name of Faculty	**DR. K. BASKAR**	**Department**	**CIVIL ENGINEERING**
Official Email	**kbaskar@nitt.edu**	**Telephone No.**	**2503161**
Name of Course Coordinator(s) (if, applicable)	**NA**		
Official E-mail		**Telephone No.**	
Course Type (please tick appropriately)	[X] **Core course**		

Syllabus (approved in Senate)

Differential equilibrium equations - strain displacement relation - linear constitutive relation - special cases - Principle of stationary potential energy - application to finite element methods. Some numerical techniques in finite element analysis.

Displacement models - convergence requirements. Natural coordinate systems - Shape function. Interpolation function - Linear and quadratic elements - Lagrange and Serendipity elements - Strain displacement matrix - element stiffness matrix and nodal load vector.

Two dimensional isoparametric elements - Four noded quadrilateral elements - triangular elements - Computation of stiffness matrix for isoparametric elements - numerical integration (Gauss quadrature) - Convergence criteria for isoparametric elements.

Assemblage of elements – Direct stiffness method - Special characteristics of stiffness matrix - Boundary condition and reaction - Gauss elimination and LDLT decomposition - Basic steps in finite element analysis.

Analysis of framed Structures - 2D truss element - 2D beam element. Analysis of plate bending: Basic theory of plate bending - displacement functions - plate bending Elements. Plane stress and plane strain analysis: Triangular elements - Rectangular elements

COURSE OBJECTIVES
1. To study the energy principles, finite element concept, stress analysis, meshing, nonlinear problems and applications. 2. To arrive at approximate solutions to finite element problems. 3. To perform finite element analysis on one dimensional and two dimensional problems. 4. To familiarize students with isoparametric element components. 5. To apply equilibrium equations, strain displacement relation, linear constitutive relation in practical problems.

MAPPING OF COs with POs	
Course Outcomes	**Programme Outcomes (PO)** **(**Enter Numbers only**)**
1. To use displacement models to solve practical problems in structural engineering.	**1, 2, 3, 4, 5**
2. To apply numerical techniques of finite element analysis to solve real time problems.	**1, 2, 3, 4, 5**
3. To make use of shape function and interpolation function to study structural behaviour.	**1, 2, 3, 4, 5**
4. To apply linear and quadratic elements in the finite element analysis of various types of structures.	**1, 2, 3, 4, 5**
5. To predict structural behaviour using strain displacement matrix and element stiffness matrix.	**1, 2, 3, 4, 5**

COURSE PLAN – PART II

COURSE OVERVIEW

This course will provide the energy principles, finite element concept, stress analysis, meshing, nonlinear problems and applications. Students will be able to arrive at approximate solutions to finite element problems. Finite element analysis on one dimensional and two dimensional problems will be demonstrated. Concept of isoparametric element will be provided. Studetns can be able to apply equilibrium equations, strain displacement relation, linear constitutive relation in practical problems.

COURSE TEACHING AND LEARNING ACTIVITIES **(** Add more rows)

S.No.	**~~Week~~/Contact Hours**	**Topic**	**Mode of Delivery**
1	8	Differential equilibrium equations - strain displacement relation - linear constitutive relation - special cases - Principle of stationary potential energy - application to finite element methods. Some numerical techniques in finite element analysis.	MS Team
2	8	Displacement models - convergence requirements. Natural coordinate systems - Shape function. Interpolation function - Linear and quadratic elements - Lagrange and Serendipity elements -	MS Team

		Strain displacement matrix - element stiffness matrix and nodal load vector	
3	8	Two dimensional isoparametric elements - Four noded quadrilateral elements - triangular elements - Computation of stiffness matrix for isoparametric elements - numerical integration (Gauss quadrature) - Convergence criteria for isoparametric elements.	MS Team
4	8	Assemblage of elements – Direct stiffness method - Special characteristics of stiffness matrix - Boundary condition and reaction - Gauss elimination and LDLT decomposition - Basic steps in finite element analysis.	MS Team
5	8	Analysis of framed Structures - 2D truss element - 2D beam element. Analysis of plate bending: Basic theory of plate bending - displacement functions - plate bending Elements. Plane stress and plane strain analysis: Triangular elements - Rectangular elements	MS Team

COURSE ASSESSMENT METHODS (shall range from 4 to 6**)**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment-1	7th week	1 hour	20
2	Assessment-2	13th week	1 hour	20
3	Assignement	3rd,5th,7th,9th week		15
4	Mini Project/Seminar	continuous	NA	15
CPA	Compensation Assessment*	14th week	1 hour	20
5	Final Assessment *	As per	2 hours	30

***mandatory; refer to guidelines on page 4**

COURSE EXIT SURVEY
course feedback will be collected from students and will be evaluated to re-design the course.

COURSE POLICY (including compensation assessment to be specified**)**

1. Assessment-1, Assessment-2 and all assignments are compulsory.
2. Only for genuine cases (with prior information and approval) Compensation Assessment will be conducted.
3. At least 30% mark shall be taken in end assessment to get pass
4. Overall, 40% mark shall be taken by the student to get pass in subject

ATTENDANCE POLICY (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.

ACADEMIC DISHONESTY & PLAGIARISM

- 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, IF ANY

FOR APPROVAL

Course Faculty	CC- Chairperson	HOD
Dr. K. Baskar	Dr. Deendayal Rathod	Dr. G. Swaminathan

Guidelines

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

b) Every theory 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.