Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)
Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

GR 20 Regulations **I Year II sem**

FEM IN STRUCTURAL ENGINEERING (GR20D50012)

UNIT I

Introduction: History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, and Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress. Method of Weighted Residuals: Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, polynomial Forms, Applications.

UNIT II

Beam and Truss Elements: Flexure and axial Elements, Element Stiffness Matrix, Element Load Vector and Element stress Vector.

UNIT III

Types:Triangular Elements, Axi-Symmetric Elements,

UNIT IV

Isoparametric Formulation, Rectangular Elements, Three-Dimensional Elements, Numerical Integration, Gaussian Quadrature.

UNIT V

Introduction to non – linear analysis, various methods and their limitations.

TEXT BOOKS :

1. G.S.Krishna Murthy, Finite Element Analysis, theory and programming, 3rd edition, 1994

2. Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991.

3. Finite Element Analysis, Seshu P., Prentice-Hall of India, 2005.

REFERENCE BOOKS :

1. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.

2. Fundamentals of Finite Element Analysis, Hutton David, Mc- Graw Hill, 2004.

3. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.

4. Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000

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Department of Civil Engineering

I M.Tech II (Semester Structural Engineering)

FINITE ELEMENT METHODS IN STRUCTURAL ENGINEERING (GR20D5012)

COURSE FILE CHECK LIST

S.No.	Name of the Format	Page
1.	Syllabus	
2.	Time Table	
3.	Program educational Objectives	
4.	Program objectives	
5.	Course Objectives	
6.	Course Outcomes	
7.	Students Roll List	
8.	Guide lines to study the course books & references, course design & delivery	
9.	Course schedule	
10.	Unit plan/Course Plan	
11.	Evaluation Strategy	
12.	Assessment in relation to COB's and Co's	
13.	Tutorial Sheets	
14.	Assignment Sheets	
15.	Rubric for Course	
16.	Mappings of CO's and Po's	
17.	Model question papers	
18.	Mid-I and Mid-II question papers	
19.	Mid –I marks	
20.	Mid –II marks	
21.	Sample answer scripts and Assignments	
22.	Course materials like notes, PPT's, Videos etc.,	

Gokaraju Rangaraju Institute of Engineering & Technology (Autonomous)

Name of the college & Code : Gokaraju Rangaraju Institute of Engineering & Technology, 24
Name of the PG Program : Master of Technology
Specialization : Structural Engineering
Academic Year & Semester : 2021-22, II Semester

Room No: 4203

Time Table

w.e.f: 11-04-2022

DAY/TIME	9:00AM-10:00AM	10.00 AM-11.00 AM	11.00 AM-12.00 PM	12.00 PM-1:00 PM	1.00 PM - 2.00 PM	2.00 PM - 3.00 PM	3.00 PM-4.00 PM
MON	FEMin SE						
TUE							
WED							
THU	FEM in SE						
FRI							
SAT							

S.No.	Subject Code	Name of the Subject	Name of the Teacher	JNTUH Faculty ID
1	GR20D5012	Finite Methods In Structural Engineering	Dr. G V V Satyanarayana	03150331-231935
2				
3				
4				
5				
6				
7				
8				

Dr. V.Srinivasa Reddy
M.Tech Coordinator

Dr.V. C.Lavanya
HOD

Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)
Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

Name of the Program: M.Tech (Structural Engineering) **Year: I**

Course/Subject: **FEM in Structural Engineering**
Course Code: GR20D5012

Program Educational Objective's

PEO 1:

Graduates of the program will equip with professional expertise on the theories, process, methods and techniques for building high-quality structures in a cost-effective manner**.**

PEO 2:

Graduates of the program will be able to design structural components using contempory software and professional tools with quality practices of international standards.

PEO 3:

Graduates of the program will be effective as both an individual contributor and a member of a development team with professional, ethical and social responsibilities.

PEO 4:

Graduates of the program will grow professionally through continuing education, training, research, and adapting to the rapidly changing technological trends globally in structural engineering.

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Name of the Program: M.Tech (Structural Engineering) **Year: I**

Course/Subject: **FEM in Structural Engineering**
Course Code: GR20D5012

Programme Outcomes

Graduates of the Civil Engineering programme will be able to

PO 1: An ability to independently carry out research / investigation and development to solve practical problems

PO 2: An ability to write and present a substantial technical report / document.

PO 3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor's.

PO 4: Assess the impact of professional engineering solutions in an environmental context along with societal, health, safety, legal, ethical and cultural issues and the need for sustainable development.

PO 5: Possesses critical thinking skills and solves core, complex and multidisciplinary structural engineering problems.

PO 6: Recognize the need for life-long learning to improve knowledge and competence.

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COURSE OBJECTIVES

Academic **Y**ear : 2021-22

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering

Designation: PROFESSOR

On completion of this Subject/Course the student shall be able to:

S.No	Objectives
1	To understand the usage of minimum potential energy principle, weighted residual methods and generating global stiffness matrices.
2.	To enable the student should learn to formulate the global load vectors for flexure and axial elements.
3	To understand the effective usage of CST and axi-symmetric element in Finite element method.
4	To introduce of Iso-parametric, rectangular element and estimate error usingNumerical method.
5	To understand the non-linear analysis.

Signature of HOD Signature of faculty

Date: Date:

Note: Please refer to Bloom's Taxonomy, to know the illustrative verbs that can be used to state the objectives.

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COURSE OUTCOMES

Academic **Y**ear : 2021-22

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering

Designation: PROFESSOR.

The expected outcomes of the Course/Subject are:

S.No	Outcomes
1	Use minimum potential energy principle ad weighted residual methods in Finite Element Method.
2	Analyse one dimensional elements like beam and truss element using FEM approach.
3	Evaluation of stress and strains in 2D CST and axisymmetric elements.
4	Formulation of rectangular using Isoparametric formulation, Three dimensional element and estimate the error using numerical methods
5	Differentiate various types of non-linear analysis

Signature of HOD Signature of faculty

Date: Date:

Note: Please refer to Bloom's Taxonomy, to know the illustrative verbs that can be used to state the outcomes.

Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)

Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

M.Tech (Structural Engineering)
I Year II Semester

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Academic Year 2021-22

S.No	Student Name	Roll No
1	ATKAPURAM PRASHANTH	21241D2001
2	BANDI SRI RAM GOPAL	21241D2002
3	CHALLA MADHAVI	21241D2003
4	PAMMI DIVYA	21241D2004
5	DUMMA UMESH KUMAR	21241D2005
6	K LATHASREE	21241D2006
7	MARIYALA VAISHNAVI	21241D2007
8	MAVOORI PRANAV	21241D2008
9	MITTAPALLI NAGA ASHWINI	21241D2009
10	RAVULA VENKATA SURAJ REDDY	21241D2010
11	REPATI MOHAN BABU	21241D2011
12	CHERUKU SANDHYA	21241D2012
13	SHAIK FEROZ	21241D2013
14	S K SAI CHANDRA	21241D2014
15	THOTA HARSHAVARDHAN	21241D2015
16	VARIKUPPULA LALITHA	21241D2016
17	YAMBA RAMA GNANENDRA SAI	21241D2017
18	YENUMALA DEVESH GOUD	21241D2018
19	S PRASHANTH KUMAR	21241D2019
20	BAVANDLAPELLI THARUN TEJA	21241D2020
21	G NITISH KUMAR	21241D2021

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GUIDELINES TO STUDY THE COURSE / SUBJECT

Academic **Y**ear : 2021-22

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I
Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering

Designation: PROFESSOR

Guidelines to study the Course/ Subject: Finite Element Methods in Structural Engineering

Course Design and Delivery System (CDD):

- The Course syllabus is written into number of learning objectives and outcomes.
- These learning objectives and outcomes will be achieved through lectures, assessments, assignments, experiments in the laboratory, projects, seminars, presentations, etc.
- Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.
- The Learning Process will be carried out through assessments of Knowledge, Skills and Attitude by various methods and the students will be given guidance to refer to the text books, reference books, journals, etc.

The faculty be able to –

- Understand the principles of Learning
- Understand the psychology of students
- Develop instructional objectives for a given topic
- Prepare course, unit and lesson plans
- Understand different methods of teaching and learning
- Use appropriate teaching and learning aids
- Plan and deliver lectures effectively
- Provide feedback to students using various methods of Assessments and tools of Evaluation
- Act as a guide, advisor, counselor, facilitator, motivator and not just as a teacher alone

Signature of HOD Signature of faculty

Date: Date:

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COURSE SCHEDULE

Academic **Y**ear : 2021-22
Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering

Designation: PROFESSOR

The Schedule for the whole Course / Subject is:

S. No.	Description	Duration (Date)		Total No. Of Periods
		From	To	
1.	Unit – I Introduction	11-04-2022	02-05-2022	14
2.	Unit- II Beam and Truss Elements	05-05-2022	12-05-2022	06
3.	Unit-III Types: Triangular Elements, Axi-Symmetric Elements	16-05-2022	13-06-2022	12
4.	Unit-IV Isoparametric Formulation	16-06-2022	11-06-2022	17
5.	Unit-V Introduction to non-linear analysis	14-07-2022	25-07-2022	06

Total No. of Instructional periods available for the course: 60 Hours / Periods

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SCHEDULE OF INSTRUCTIONS
COURSE PLAN

Academic **Y**ear : 2021-22
Semester : II
Name of the Program: M.Tech (Structural Engineering)
Course/Subject: FEN in Structural Engineering
Name of the Faculty: Dr.GVV Satyanarayana
Designation: PROFESSOR

UNIT NO.: I TO V
Year: I
Course Code: **GR20D5012**
Dept.: Civil Engineering

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.: ____to ____
1.	1.	11-04-2022	1	Introduction about FEM and concepts of FEM	1 & 1	ntroduction to Finite Element method by Tirupathi Chandra Patla & Belegundu. P 17-17
	2.	11-04-2022	1	History and applications of FEM	1 & 1	P 17-17
	3.	14-04-2022	1	Minimum Potential energy principle	1 & 1	P 26-26
	4.	14-04-2022	1	Discuss on bar and spring element	1 & 1	P 26-27
	5.	18-04-2022	1	Evaluation of stiffness matrix for bar element using minimum potential energy method	1 & 1	P 26-27
	6.	18-04-2022	1	Evaluation of stiffness matrix for bar element using direct stiffness method	1 & 1	P 28-29
	7	21-04-2022	1	Assembly of global stiffness matrices.	1 & 1	P 82-85
	8	21-04-2022	1	Evaluation of stresses and strains in bar element	1 & 1	P 86-94
	9	25-04-2022	1	Discuss on nodal equilibrium equations	1 & 1	P 18-24
	10	25-04-2022	1	Introduction about Method of weighted Residual method	1 & 1	P 30-34
	11	28-04-2022	1	Explain the various Method of weighted Residual method	1 & 1	P 30-34
	12	28-04-2022	1	Explain compatibility & completeness requirements	1 & 1	P 86-87
	13	02-05-2022	1	Polynomial forms and their applications	1 & 1	P 71-74
	14	02-05-2022	1	One dimensional FEM Introduction about 1-D element	1 & 1	P 26-27

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.: ____to ____
2.	1.	05-05-2022	1	Derivation of stiffness matrix for flexure element using minimum potential energy method	2 & 2	Introduction to Finite Element method by Tirupathi Chandra Patla & Belegundu. P 166-172
	2.	05-05-2022	1	Derivation of stiffness matrix for flexure element using direct stiffness approach method	2 & 2	P 166-172
	3.	09-05-2022	1	Evaluation of stresses in a flexure element	2 & 2	P 173-175
	4.	09-05-2022	1	Evaluation of strains in a flexure element	2 & 2	P 173-175
	5.	12-05-2022	1	Derivation of stiffness matrix for truss element	2 & 2	P 133-136
	6.	12-05-2022	1	Derivation of stresses and strains matrix for truss element	2 & 2	P 137-145

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.:____to ____
3.	1.	16-05-2022	1	Introduction to Triangular element using in FEM's	3 & 3	Introduction to Finite Element method by Tirupathi Chandra Patla & Belegundu. P 204-207
	2.	16-05-2022	1	Evaluation of stiffness matrix for a triangular element	3 & 3	P 207-213
	3.	19-05-2022	1	Evaluate the stresses and strains induced in triangular element	3 & 3	P 207-213
	4.	19-05-2022	1	Evaluate the forces, stresses and strains induced in triangular element	3 & 3	P 207-213
	5.	23-05-2022	1	Evaluate the forces, stresses and strains induced in triangular element	3 & 3	P 207-213
	6.	23-05-2022	1	Evaluation of stiffness matrix for a CST element	3 & 3	P 214-221
	7.	26-05-2022	1	Evaluation of stiffness matrix for a Axi-Symmetric element	3 & 3	P 258-269
	8.	26-05-2022	1	Evaluate the stresses and strains induced in Axi-Symmetric element	3 & 3	P 269-272
	9.	02-06-2022	1	Evaluate the stresses and strains induced in Axi-Symmetric element	3 & 3	P 269-272
	10.	02-06-2022	1	Exercise problems	3 & 3	
	11.	13-06-2022	1	Solve old question paper problems	3 & 3	
	12.	13-06-2022	1	Solve old question paper problems	3 & 3	

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.: ____to ____
4.	1.	16-06-2022	1	Unit-4 Explain Interpolation elements	4 & 4	Introduction to Finite Element method by Tirupathi Chandra Patla & Belegundu. P 289- 290
	2.	16-06-2022	1	Evaluate the stresses and strains induced in rectangular element	4 & 4	P 289- 295
	3.	20-06-2022	1	Evaluate the stresses and strains induced in rectangular element	4 & 4	P 289- 295
	4.	20-06-2022	1	Evaluate the forces, stresses and strains induced in rectangular element	4 & 4	P 289- 295
	5.	23-06-2022	1	Evaluate the stresses and strains induced in rectangular element	4 & 4	P 289- 295
	6.	23-06-2022	1	Evaluate the forces, stresses and strains induced in rectangular element	4 & 4	P 289- 295
	7.	27-06-2022	1	Evaluate the forces, stresses and strains induced in three dimensional element	4 & 4	P 328- 334
	8.	2706-2022	1	Evaluation of stiffness matrix for a three dimensional element	4 & 4	P 328- 334
	9.	30-06-2022	1	Exercise problems	4 & 4	
	10.	30-06-2022	1	Exercise problems	4 & 4	
	11.	04-07-2022	1	Exercise problems	4 & 4	
	12.	04-07-2022	1	Solve old question paper problems	4 & 4	
	13.	07-07-2022	1	Solve old question paper problems	4 & 4	
	14.	16-06-2022	1	Solve old question paper problems	4 & 4	
	15.	11-07-2022	1	Explain Numerical integration method used in FEM	4 & 4	P 295- 302
	16.	11-07-2022	1	Explain Gauss quadrature method	4 & 4	P 295- 302
	17.	14-07-2022	1	Estimate the error calculations using Gauss quadrature method	4 & 4	P 295- 302

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.: ____to ____
5.	1.	14-07-2022	1	Unit-5 Introduction in Non-linear analysis used in FEM	5 & 5	Introduction to Finite Element method by Tirupathi Chandra Patla & Belegundu. P 318 - 319
	2.	18-07-2022	1	Differentiate between various non-linear analysis	5 & 5	P 318 - 319
	3.	18-07-2022	1	Differentiate between various non-linear analysis	5 & 5	P 319 - 320
	4.	21-07-2022	1	Explain the importance of non-linear analysis	5 & 5	P 319 - 320
	5	21-07-2022	1	Explain the importance of non-linear analysis	5 & 5	P 319 - 320

Signature of HOD

Date:

Signature of faculty

Date:

Note: 1. ENSURE THAT ALL TOPICS SPECIFIED IN THE COURSE ARE MENTIONED.
2. ADDITIONAL TOPICS COVERED, IF ANY, MAY ALSO BE SPECIFIED IN BOLD
3. MENTION THE CORRESPONDING COURSE OBJECTIVE AND OUT COME NUMBERS AGAINST EACH TOPIC.

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EVALUATION STRATEGY

Academic **Y**ear : 2021-22

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering

Designation : PROFESSOR

1. TARGET:

A) Percentage for pass: 98%

b) Percentage of class: 1st class with distinction - 55%
1st class - 45%

2. COURSE PLAN & CONTENT DELIVERY

(Please write how you intend to cover the contents: i.e., coverage of Units/Lessons by lectures, design, exercises, solving numerical problems, demonstration of models, model preparation, experiments in the Lab., or by assignments, etc.)

3. METHOD OF EVALUATION

3.1 ☐ Continuous Assessment Examinations (CAE-I, CAE-II)

3.2 ☐ Assignments/Seminars

3.3 ☐ Mini Projects

3.4 ☐ Qui
3.5 ☐ Semester/End Examination

3.6 ☐ Others

4. List out any new topic(s) or any innovation you would like to introduce in teaching the subjects in this Semester.

……..

Signature of HOD
Date:

Signature of faculty
Date:

GR20D5012 FEM in Structural Engineering	**Course Outcomes**				
Course Objectives	1	2	3	4	5
1	X				
2		X			
3			X		
4				X	
5					X

GR20D5012 FEM in Structural Engineering	**Course Outcomes**				
Assessment	1	2	3	4	5
1	X				
2		X			
3			X		
4				X	
5					X

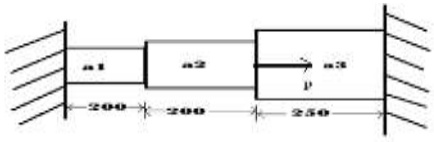
Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)

Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

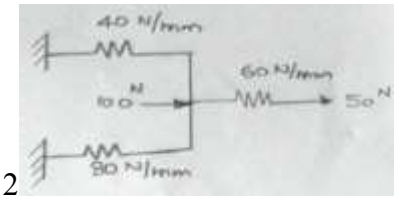
TUTORIAL SHEET - 1

Academic **Y**ear : 2021-22 Date: 02-05-2022
Semester : II
Name of the Program: M.Tech (Structural Engineering) Year: I
Course/Subject: **FEM in Structural Engineering** Course code:**GR20D5012**
Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering
Designation : PROFESSOR
This Tutorial corresponds to Unit No. 1/ Lesson **Introduction**

Q1. What is basic concept of FEM and its origin?
Q2. What are the merits and demerits of FEM?
Q3. Evaluate the value of central deflection for a simply suppoprted beam having central point load 'W'. The beam is uniform through out. Use Rayeleigh Ritz approach.
Q4. Generate stiffness matrix for bar or 1-D element using direct stiffness matrix and minimum potential Energy methods.
Q5. For the stepped bar shown in the figure below, determine the nodal displacements, element stress and reactive reactions. Take P = 250 kN, E 200 GPa, a_1=120 mm^2, a_2 = 150 mm^2 and a_3 = 350 mm^2.



Q6. Determine the nodal displacements and redundant forces of the spring system as shown in Figure below:



2

Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 1……

Outcome Nos.: 1……

Signature of HOD Signature of faculty

Date: Date:

Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)

Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

TUTORIAL SHEET - 2

Academic **Y**ear : 2021-22 Date: 12-05-2022

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** **GR20D5012**

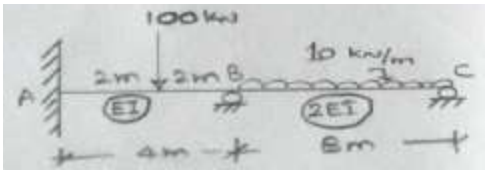
Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering

Designation : PROFESSOR

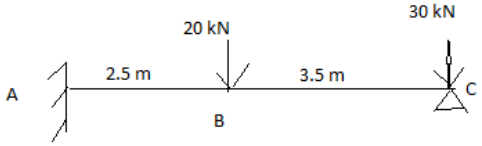
This Tutorial corresponds to Unit No. 2/ Lesson **Beam and Truss Elements**

Q1. Generate stiffness matrix for beam element.

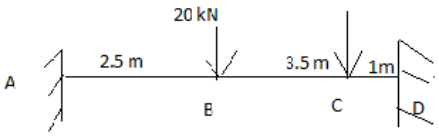
Q2. Analyse the beam as shown below:



Q3. Analyse the propped cantilever beam using FEM.



Q4. Analyse the propped cantilever beam using FEM.



Q5. Analyse the propped cantilever beam using FEM..

Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 2……

Outcome Nos.: 2, 3……

Signature of HOD Signature of faculty

Date: Date:

Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)

Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

TUTORIAL SHEET - 3

Academic **Y**ear : 2021-22 Date: 13-06-2022

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

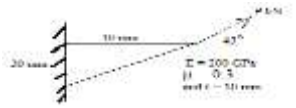
Designation : PROFESSOR

This Tutorial corresponds to Unit No. 3/ Lesson Types: Triangular and Axi symmetric elements

Q1. Evaluate the shape functions for a CST element.

Q2. The nodal co-ordinates of a CST element are (1, 2), (5, 3) and (4, 6) at node 1, 2 and 3 respectively. If 'P' is the point inside the element whose X coordinate is 3.3 and shape function at node 1 is 0.3. Determine the other shape functions and Y coordinate of the point 'P'.

Q3. Develop stiffness matrix for the two dimensional plate as shown below:



Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 3……

Outcome Nos.: 3……

Signature of HOD Signature of faculty

Date: Date:

Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)

Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

TUTORIAL SHEET - 4

Academic **Y**ear : 2021-22 Date: 14-07-2022
Semester : II
Name of the Program: M.Tech (Structural Engineering) Year: I
Course/Subject: **FEM in Structural Engineering** **GR20D5012**
Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering
Designation : PROFESSOR

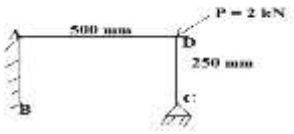
This Tutorial corresponds to Unit No. 4/ Lesson Iso-Parametric Elements

Q1. Explain the various types of Iso-parametric elements with suitable figures.

Q2. Evaluate shape functions for 4 noded quadrilateral element.

Q3. Determine the Jacobian matrix for 4 noded quadrilateral element.

Q4. Compute the displacements of joint D as shown in figure below for the plane stress condition. Let E = 210 GPa.



Q5. Evaluate the Jacobian matrix at the local co-ordinates ζ, η are (0, 0) for the Element shown in the below.

Q6. Evaluate the strain displacement matrix [B] matrix for an axisymmetric element.

Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 4……

Outcome Nos.: 4 ……

Signature of HOD Signature of faculty

Date: Date:

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(Autonomous)
Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

TUTORIAL SHEET - 5

Academic **Y**ear : 2021-22 Date: 25-07-2022

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation : PROFESSOR

This Tutorial corresponds to Unit No. 5/ Lesson **Introduction to Non-linear Analysis**

Q1. Explain the basic concept used in non-linear analysis method?

Q2. State and explain various methods used in non-linear analysis.

Q3. Explain the Iterative procedure and modified Iterative procedure for the analysis of material non-linear problems and its limitation.

Q4. Explain Incremental procedure to handle material non-linear problems and its limitation.

Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 5……

Outcome Nos.: 5……

Signature of HOD Signature of faculty

Date: Date:

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(Autonomous)
Bachupally, Kukatpally, Hyderabad – 500 090, (040) 6686 4440

ASSIGNMENT SHEET – 1

Academic **Y**ear : 2021-22 Date: 02-05-2022

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

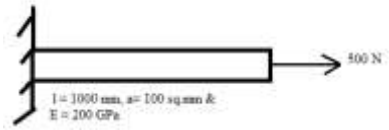
Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.G.V.V. Satyanarayana Dept. Civil Engineering

Designation : PROFESSOR

This Assignment corresponds to Unit No.1(**Introduction)**

Q1. What are the merits and demerits of FEM?
Q2. Explain minimum potential energy or Rayleigh Ritz method .
Q3. Evaluate the deflection at centre of simply supported beam subjected udl of intensity w per unit run over whole length of beam. Let consider length of span is 'L' and uniform flexural rigidity use minimum potential energy Rayleigh Ritz method.
Q4. Derive the relationship between stress and strain in form of matrix.
Q5. Evaluate the stiffness matrix for bar element using
a) Direct Stiffness method and b) Minimum Potential energy method.
Q6. Describe the procedure for assembling stiffness matrix from individual element stiffness matrices.
Q7. Determine the displacement, stress and strains in the bar as shown figure below:



Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 1

Outcome Nos.: 1

Signature of HOD Signature of faculty

Date: Date:

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ASSIGNMENT SHEET – 2

Academic **Y**ear : 2021-22 Date: 12-05-2022

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

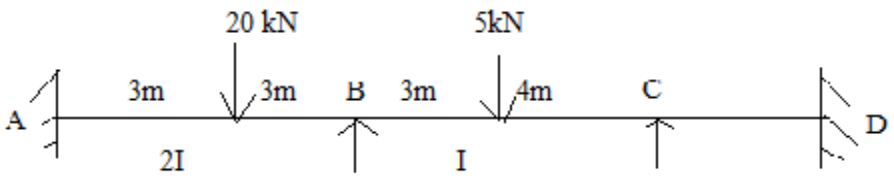
Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.G.V.V. Satyanarayana Dept. Civil Engineering

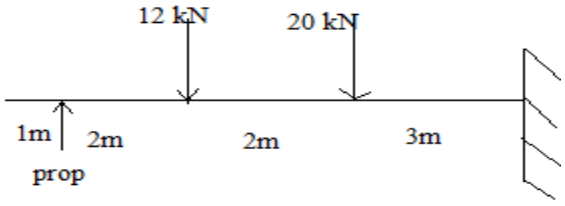
Designation : PROFESSOR

This Assignment corresponds to Unit No-2. **(Beam Elements)**

Q1. Derive stiffness matrix for beam or flexure element.
Q2. Analyse beam as shown below using FEM.



Q3. Analyze the propped cantilever beam as shown in the figure below. Also draw the BMD and SFD's.



Q4. Evaluate the relationship between stress and strains.

Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 2
Outcome Nos.: 2

Signature of HOD Signature of faculty

Date: Date:

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(Autonomous)

Bachupally, Kukatpally, Hyderabad – 500 090, (040) 6686 4440

ASSIGNMENT SHEET – 3

Academic **Y**ear : 2021-22 Date: 13-05-2022
Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.G.V.V. Satyanarayana Dept. Civil Engineering

Designation: PROFESSOR

This Assignment corresponds to Unit No.3 **Method of Weighted Residuals**

Q1.Explain different weighted residual methods.

Q2.What is polynomial expression and state the precaution while selection of a polynomial?

Q3. Differentiate between Compatibility conditions and convergence requirements.

Q4. Evaluate the deflection at centre of simply supported beam subjected udl of intensity w per unit run over whole length of beam. Let consider length of span is 'L' and uniform flexural rigidity use Galerkin's method

Q5. Evaluate the deflection at centre of clamped beam subjected udl of intensity w per unit run over whole length of beam. Let consider length of span is 'L' and uniform flexural rigidity use different weighted residual methods.

Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 3

Outcome Nos.: 3

Signature of HOD Signature of faculty

Date: Date:

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(Autonomous)
Bachupally, Kukatpally, Hyderabad – 500 090, (040) 6686 4440

ASSIGNMENT SHEET – 4

Academic **Y**ear : 2021-22 Date: 14-07-2022

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I
Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.G.V.V. Satyanarayana Dept. Civil Engineering

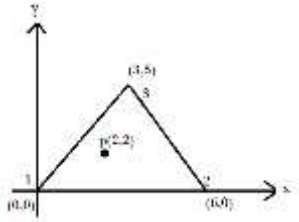
Designation : PROFESSOR

This Assignment corresponds to Unit No-4 (**Types)**

Q1. Determine stiffness matrix for CST element.

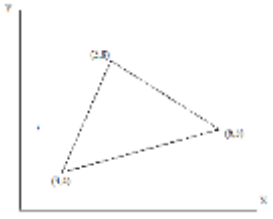
Q2. Estimate the following values for the given displacement field in plane stress condition.
u = $(2x^2 - 3xy + y^2)\ 10^{-2}$ and v = $(6x + 3y)\ 10^{-4}$ ε_x, ε_x and γ_{xy} where, x=1 and y=2.

Q3. Define the term shape function. And Evaluate the shape functions N1, N2 and N3 at the interior point P for the triangular element shown in the figure below.

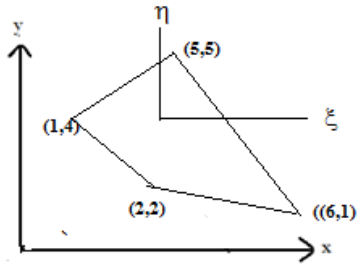


Q4. Consider the Iso-parametric quadrilateral with the nodes 1, 2, 3 and 4 at (15, 0), (17.12), (7,10) and (6,2) respectively, which has local coordinates are (0.5,0.5).
a) Compute the Jacobian matrix.
b) Evaluate the shape functions of 8 nodded rectangular quadrilateral element using Lagrange method.

Q5. Compute the strain displacement matrix for the axisymmetric triangular element as shown in figure below. Also determine the element strains if the nodal displacements are $u_1 = 0.00$, $u_2 = 0.002$, $u_3 = -0.002$, $w_1 = 0.001$, $w_2 = -0.005$ and $w_3 = 0.006$.



Q6. Evaluate strain displacement matrix for the element as shown in figure below at the point (0.5, 0.5)



Q7. a) Explain solution techniques for static loads.

b) Evaluate the integral I = $\iint (3x^3 + 2xy - 7y^3)\, dx\, dy$ using Gauss quadrature method.

c) Evaluate the Integral I = $\int_{-1}^{1} (3e^x + x^2 + \frac{1}{(x+2)})$ using one point and two point Gauss quadrature. Compare this with exact solution.

Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 4

Outcome Nos.: 4

Signature of HOD

Signature of faculty

Date:

Date:

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(Autonomous)
Bachupally, Kukatpally, Hyderabad – 500 090, (040) 6686 4440

ASSIGNMENT SHEET – 5

Academic **Y**ear : 2021-22 Date: 25-07-2022

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: II

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.G.V.V. Satyanarayana Dept. Civil Engineering

Designation : PROFESSOR

This Assignment corresponds to Unit No-5.

Q1. Differentiate between linear and non-linear approaches used in FEM.
Q2.What are the basic methods used in FEM.
Q3. Explain various application to special structures.
Q4. What are the different software's used in FEM.
Q5. Explain the overall importance of Finite element method in civil engineering.

Please write the Questions / Problems / Exercises which you would like to give to the students and also mention the Objectives/Outcomes to which these Questions / Problems / Exercises are related.

Objective Nos.: 5

Outcome Nos.: 5

Signature of HOD Signature of faculty

Date: Date:

RUBRIC SHEET

Academic **Y**ear : 2021-22
Semester : II
Name of the Program: M.Tech Structural Engineering Year: I
Course/Subject: FEM in Structural Engineering
Course Code: **GR20D012**
Name of the Faculty: Dr.G V V Satyanarayana Dept.: Civil Engineering
Designation: Professor
Objective: To learn basics and concepts of Structural analysis.
Student Outcome: Behavioural studies or analyze the structural elements under loading and study different parameters such as induced forces, bending moments, shear forces, stresses, strains, deflection etc.,

			Beginning	**Developing**	**Reflecting Development**	**Accomplished**	**Exemplary**	**Score**
S. No	**Name of the Student**	**Performance Criteria**	**1**	**2**	**3**	**4**	**5**	
1	21241D2007	Analysis of structural elements	Low level of knowledge on calculation of support reactions	Able to discuss the principles of energy theorems	Ability to explain the application of energy theorems	Full knowledge on application of energy theorems	Analyzing and implement in structures	5
		The level of knowledge on types structures such as beams, trusses and frames statically determinate and indetermin ate structures	Low level of knowledge on types structures such as beams & trusses statically determinate and indeterminat e frames	Able to discuss types of structures and their importanc e in civil engineeri ng constructi ons	Ability to explain types of structures and their importance in civil engineering constructio ns	Full knowledge on types of structures and their importance in civil engineering construction s	Analysing and application of knowledge on types of structures and their importance in civil engineering constructions	4
		The level of knowledge to analyse various engineering structures.	Low level of knowledge to analyse various engineering structures.	Ability to discuss and to study the various engineeri ng structures	Ability to explain various engineering structures.	Full knowledge on various engineering structures.	Analysing and implementing the knowledge of various engineering structures.	3
							Average Score	4

MAPPING

GR20D5012 FEM in Structural Engineering	Course Outcomes				
Course Objectives	1	2	3	4	5
1	X				
2		X			
3			X		
4				X	
5					X

GR20D5012 FEM in Structural Engineering	Course Outcomes				
Assessment	1	2	3	4	5
1	X				
2		X			
3			X		
4				X	
5					X

GR20D5012 FEM in Structural Engineering	Course Objectives				
Assessments	1	2	3	4	5
1	X				
2		X			
3			X		
4				X	
5					X

Course	Program Outcomes					
	1	2	3	4	5	6
GR20D5012 FEM in Structural Engineering	X	X	X	X	X	X

GR20D5012 FEM in Structural Engineering	Program Outcomes					
Course Outcomes	1	2	3	4	5	6
1. Use minimum potential energy principle ad weighted residual methods in Finite Element Method.	H				M	M
2. Analyse one dimensional elements like beam and truss element using FEM approach.	M		M	M	M	M
3. Evaluation of stress and strains in 2D CST and axisymmetric elements.	H	M	M		M	M
4. Formulation of rectangular using Isoparametric formulation, Three dimensional element and estimate the error using numerical methods	M		M	M	`	M
5. Differentiate various types of non-linear analysis	M	M	M	M	M	M

CODE:GRGR20D5012	GR	SET - 1

I M.TechII Semester Regular Examinations
Model Question Paper

FEM IN STRUCTURAL ENGINEERING
(Civil Engineering)

Time: 3 hours **Max Marks: 70**

< **Note:** Type the questions in the given format only, Times New Roman font , size 12 >

Instructions:

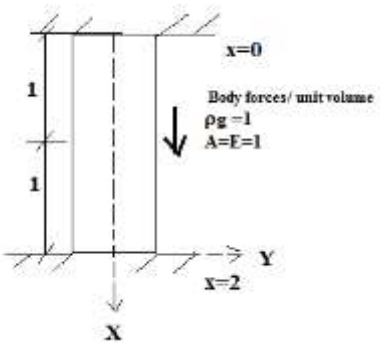
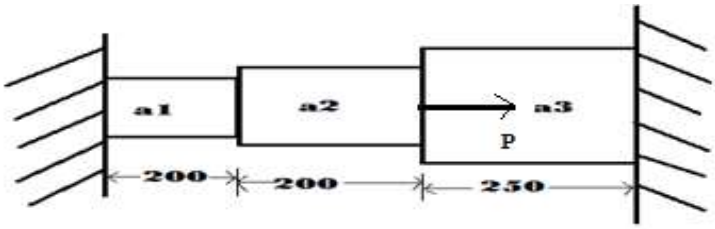
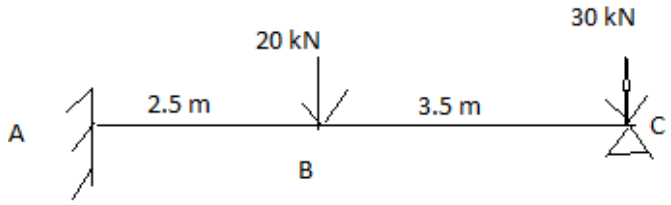
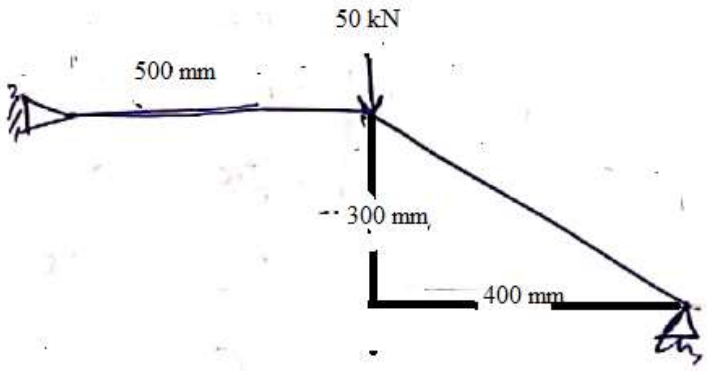
1. Question paper comprises of **Part-A** and **Part-B**
2. **Part-A** (for 20 marks) must be answered at one place in the answer book.
3. **Part-B** (for 50 marks) consists of **five questions with internal choice,** answer all questions.

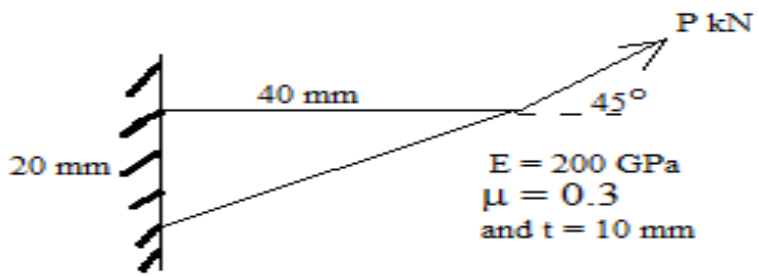
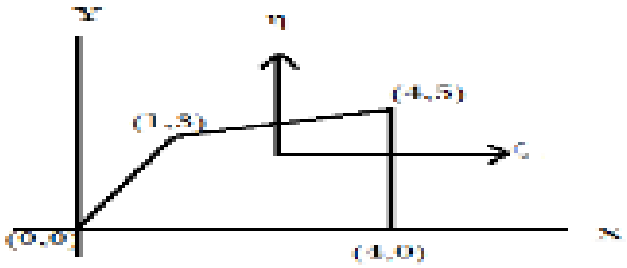
PART – A
(Answer ALL questions. All questions carry equal marks)
10 * 2 = 20 Marks

1. a.	**What are the applications of FEM?**	**[2]**	**1**	**1**
b.	**List out Weighted Residuals Method**	**[2]**	**1**	**1**
c.	**Write the stiffness matrix for beam element.**	**[2]**	**2**	**1**
d.	**Demonstrate the various boundary conditions used in FEM approach**	**[2]**	**2**	**1**
e.	**Distinguish between CST and LST elements**	**[2]**	**3**	**4**
f.	**The nodal co-ordinates of a CST element are (1, 2), (5, 3) and (4, 6) at node 1, 2 and 3 respectively. If 'P' is the point inside the element whose X coordinate is 3.3 and shape function at node 1 is 0.3. Determine the other shape functions and Y coordinate of the point 'P'.**	**[2]**	**3**	**4**
g.	**Compare between Iso, sub and super parametric elements**	**[2]**	**4**	**5**
h.	**Discuss briefly on Gauss quadrature method.**	**[2]**	**4**	**6**
i.	**What is non-linear analysis?**	**[2]**	**5**	**1**
j.	**Explain the basic concept non-linear analysis.**	**[2]**	**5**	**1**

PART – B
(Answer ALL questions. All questions carry equal marks)
5 * 10 = 50 Marks

2.	**(a)Explain the step wise procedure involved in Finite Element method.** **(b))**Use Rayleigh Ritz method to find the displacement as shown in figure below: Let the bar is not subjecting any point loads and tractive forces.	**[10]**	**1**	**1**

				
	OR			
3.	For the stepped bar shown in the figure below, determine the nodal displacements, element stress and reactive reactions. Take P = 250 kN, E = 80 GPa, a_1=120 mm^2, a_2 = 150 mm^2 and a_3 = 350 mm^2. 	**[10]**	**1**	**5**
4.	Analyse the propped cantilever beam using FEM. 	**[10]**	**2**	**4**
	OR			
5.	**Determine the global stiffness matrix for the truss as shown in figure: below** 	**[10]**	**2**	**5**
6.	**(a) Evaluate the shape functions for a CST element**	**[10]**	**3**	**5**

	(b) Develop B- matrix for the two dimensional plate as shown below: 			
	OR			
7.	**(a) Why Axi-symmetric is treat as two dimensional element?** **(b) Find out the strain displacement matrix [B] matrix for an Axisymmetric element**	**[10]**	**3**	**1**
8.	**Evaluate the Jacobian matrix at the local co-ordinates ξ and η are (0, 0) for the Element shown in the below.** 	**[10]**	**4**	**5**
	OR			
9.	**(a) Evaluate the shape functions for brick element using Lagrange Approach.** **(b) Evaluate the Integral** $I = \int_{-1}^{1}(3e^x + x^2 + \frac{1}{(x+2)})$ **using two point Gauss Quadrature method and compare this with exact solution**	**[10]**	**4**	**5**
10.	**(a) What is non linear analysis?** **(b) Distinguish between linear and non-linear approaches used in FEM.**	**[10]**	**5**	**4**
	OR			
11.	**Explain different non-linear analysis with their limitations.**	**[10]**	**5**	**2**

*****

Course Outcomes:

1. Use minimum potential energy principle ad weighted residual methods in FiniteElement Method.
2. Analyse one dimensional elements like beam and truss element using FEM approach.
3. Evaluation of stress and strains in 2D CST and axi-symmetric elements.
4. Formulation of rectangular using Iso-parametric formulation, Three dimensional element and estimate the error using numerical methods
5. Differentiate various types of non-linear analysis

CO Mapping Table

	CO 1	CO 2	CO 3	CO 4	CO 5	Total
1 (a to j)	4	4	4	4	4	**20**
2a	5					5
2b	5					5
3	10					10
4		10				10
5		10				10
6a			5			5
6b			5			5
7a			5			5
7b			5			5
8				10		10
9a				5		5
9b				5		5
10a					5	5
10b					5	5
11					10	10
	24	**24**	**24**	**24**	**24**	70

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M.Tech Structural Engineering I year-II Semester- GR20 A.Y.2021-22		
FEM in Structural Engineering (GR20D5012) (MID-I)		
S.No	**Roll No**	**Maximum Marks (20 M)**
1	21241D2001	10
2	21241D2002	15
3	21241D2003	16
4	21241D2004	13
5	21241D2005	17
6	21241D2006	17
7	21241D2007	17
8	21241D2008	11
9	21241D2009	16
10	21241D2010	09
11	21241D2011	12
12	21241D2012	15
13	21241D2013	12
14	21241D2014	12
15	21241D2015	12
16	21241D2016	15
17	21241D2017	10
18	21241D2018	AB
19	21241D2019	AB
20	21241D2020	10
21	21241D2021	08

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M.Tech Structural Engineering. I year-II Semester- GR20 A.Y.2021-22		
FEM in Structural Engineering (GR20D5012) (MID-II)		
S.No	**Roll No**	**Maximum Marks (20 M)**
1	21241DD2001	14
2	21241DD2002	17
3	21241DD2003	15
4	21241DD2004	11
5	21241DD2005	17
6	21241DD2006	08
7	21241DD2007	17
8	21241DD2008	13
9	21241DD2009	17
10	21241DD2010	12
11	21241DD2011	11
12	21241DD2012	13
13	21241DD2013	10
14	21241DD2014	14
15	21241DD2015	14
16	21241DD2016	13
17	21241DD2017	09
18	21241DD2018	AB
19	21241DD2019	AB
20	21241DD2020	10
21	21241DD2021	11

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SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : 2021-22
Semester : II
Name of the Program: M.Tech (Structural Engineering)
Course/Subject: FEM in Structural Engineering
Name of the Faculty: Dr.GVV Satyanarayana
Designation: PROFESSOR.

UNIT NO.: I
Year: I
Course Code: **GR20D5012**
Dept.: Civil Engineering

Lesson No.	Date	No. of Periods	Topics / Sub - Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.:____to ____
1.	11-04-2022	1	Introduction about FEM and concepts of FEM	1 & 1	Introduction to Finite Element Method By Tirupathi Chandra Patla
2.	11-04-2022	1	History and applications of FEM	1 & 1	Finite Element Methods By Bhavikatti
3.	14-04-2022	1	Minimum Potential energy principle	1 & 1	
4.	14-04-2022	1	Discuss on bar and spring element	1 & 1	
5.	18-04-2022	1	Evaluation of stiffness matrix for bar element using minimum potential energy method	1 & 1	
6.	18-04-2022	1	Evaluation of stiffness matrix for bar element using direct stiffness method	1 & 1	
7.	21-04-2022	1	Assembly of global stiffness matrices. Element strain & stress	1 & 1	
8.	21-04-2022	1	Evaluation of stresses and strains in bar element	1 & 1	
9.	25-04-2022	1	Discuss on nodal equilibrium equations	1 & 1	
10.	25-04-2022	1	Introduction about Method of weighted Residual method	1 & 1	
11.	28-04-2022	1	Explain the various Method of weighted Residual method	1 & 1	
12.	28-04-2022	1	Explain compatibility & completeness requirements	1 & 1	
13.	02-05-2022	1	Polynomial forms and their applications	1 & 1	
14.	02-05-2022			1 & 1	

Signature of HOD
Date:

Signature of faculty
Date:

Gokaraju Rangaraju Institute of Engineering and Technology
(Autonomous)
Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : 2021-22

Semester : II UNIT NO.: II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering

Designation: PROFESSOR.

Lesson No.	Date	No. of Periods	Topics / Sub - Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.:____to ____
1.	05-05-2022	1	Derivation of stiffness matrix for flexure element using minimum potential energy method	2 & 2	Introduction to Finite Element Method By Tirupathi Chandra Patla
2.	05-05-2022	1	Derivation of stiffness matrix for flexure element using direct stiffness approach method	2 & 2	Finite Element Methods By Bhavikatti
3.	09-05-2022	1	Evaluation of stresses in a flexure element	2 & 2	
4.	09-05-2022	1	Evaluation of strains in a flexure element	2 & 2	
5.	12-05-2022	1	Derivation of stiffness matrix for truss element Derivation of stresses and strains matrix for truss element	2 & 2	
6.	12-05-2022	1	Derivation of stresses and strains matrix for truss element	2 & 2	

Signature of HOD
Date:

Signature of faculty
Date:

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SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : 2021-22
Semester : II UNIT NO.: III
Name of the Program: M.Tech (Structural Engineering) Year: I
Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**
Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering
Designation: PROFESSOR.

Lesson No.	Date	No. of Periods	Topics / Sub - Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.:____to ____
1.	16-05-2022	1	Introduction to Triangular element using in FEM's	3 & 3	Introduction to Finite Element Method By Tirupathi Chandra Patla
2.	16-05-2022	1	Evaluation of stiffness matrix for a triangular element	3 & 3	Finite Element Methods By Bhavikatti
3.	19-05-2022	1	Evaluate the stresses and strains induced in triangular element	3 & 3	
4.	19-05-2022	1	Evaluate the forces, stresses and strains induced in triangular element	3 & 3	
5.	23-05-2022	1	Evaluate the forces, stresses and strains induced in triangular element	3 & 3	
6.	23-05-2022	1	Evaluation of stiffness matrix for a cSt ement	3 & 3	
7.	26-05-2022	1	Evaluation of stiffness matrix for a Axi-Symmetric element	3 & 3	
8.	26-05-2022	1	Evaluate the stresses and strains induced in Axi-Symmetric element	3 & 3	
9.		1	Evaluate the stresses and strains induced in Axi-Symmetric element	3 & 3	
10.	02-06-2022		Exercise problems		
11.	13-06-2022		Solve old question paper problems		
12.	13-06-2022		Solve old question paper problems		

Signature of HOD Signature of faculty

Date: Date:

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SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : 2021-22
Semester : II
Name of the Program: M.Tech (Structural Engineering)
Course/Subject: FEM in Structural Engineering
Name of the Faculty: Dr.GVV Satyanarayana
Designation: PROFESSOR.

UNIT NO.: IV
Year: I
Course Code: **GR20D5012**
Dept.: Civil Engineering

Lesson No.	Date	No. of Periods	Topics / Sub - Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.: ____to ____
1.	16-06-2022	1	Unit-4 Explain Interpolation elements	4 & 4	Introduction to Finite Element Method By Tirupathi Chandra Patla
2.	16-06-2022	1	Evaluate the stresses and strains induced in rectangular element	4 & 4	Finite Element Methods By Bhavikatti
3.	20-06-2022	1	Evaluate the stresses and strains induced in rectangular element	4 & 4	
4.	20-06-2022	1	Evaluate the forces, stresses and strains induced in rectangular element	4 & 4	
5.	23-06-2022	1	Evaluate the stresses and strains induced in rectangular element	4 & 4	
6.	23-06-2022		Evaluate the forces, stresses and strains induced in rectangular element		
7.	27-06-2022		Evaluate the forces, stresses and strains induced in three dimensional element		
8.	26706-2022		Evaluation of stiffness matrix for a three dimensional element		
9.	30-06-2022		Exercise problems		
10.	30-06-2022		Exercise problems		
11.	04-07-2022		Exercise problems		
12.	04-07-2022		Solve old question paper problems		
13.	07-07-2022		Solve old question paper problems		
14.	16-06-2022		Solve old question paper problems		
15.	11-07-2022		Explain Numerical integration method used in FEM		
16.	11-07-2022		Explain Gauss quadrature method		
17.	14-07-2022		Estimate the error calculations using Gauss quadrature method		

Signature of HOD
Date:

Signature of faculty
Date:

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SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : 2021-22

Semester : II UNIT NO.: V

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering

Designation: PROFESSOR.

Lesson No.	Date	No. of Periods	Topics / Sub - Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.:____to ____
1.	14-07-2022	1	Unit-5 Introduction in Non-linear analysis used in FEM	5 & 5	Introduction to Finite Element Method By Tirupathi Chandra Patla
2.	18-07-2022	1	Differentiate between various non-linear analysis	5 & 5	Finite Element Methods By Bhavikatti
3.	18-07-2022	1	Differentiate between various non-linear analysis	5 & 5	
4.	21-07-2022	1	Explain the importance of non-linear analysis	5 & 5	
5.	21-07-2022	1	Explain the importance of non-linear analysis	5 & 5	
6.	25-07-2022	1	Explain Numerical integration method used in FEM	5 & 5	

Signature of HOD
Date:

Signature of faculty
Date:

Course Objectives.docx

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COURSE COMPLETION STATUS

-**A**cademic **Y**ear : 2021-22

Semester : II

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana Dept.: Civil Engineering

Designation: PROFESSOR

Actual Date of Completion & Remarks, if any

Units	**Remarks**	**No. of Objectives Achieved**	**No. of Outcomes Achieved**
Unit 1	Introduction of FEM	1	1
Unit 2	Beam and Truss elements	2	2
Unit 3	Types: Triangular and axisymmetric elements	3	3
Unit 4	Iso-parametric formulation and Rectangular elements	4	4
Unit 5	Non-linear analysis	5	5

Signature of HOD Signature of faculty

Date: Date:

Note: After the completion of each unit mention the number of Objectives & Outcomes Achieved.

GR20D5012 | **GR** | **SET - 1**

I M.TechII Semester Regular Examinations, Sepetember 2022

FEM IN STRUCTURAL ENGINEERING

(Civil Engineering)

Time: 3 hours **Max Marks: 70**

Instructions:

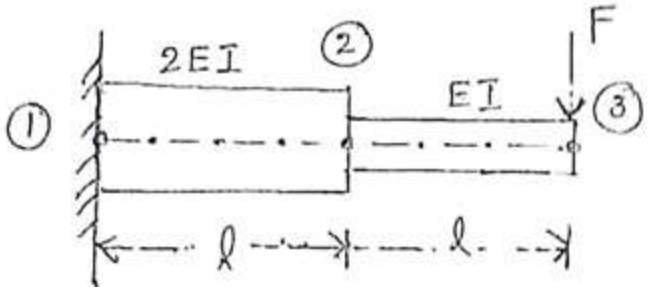
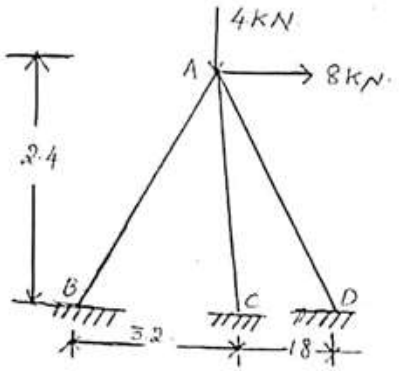
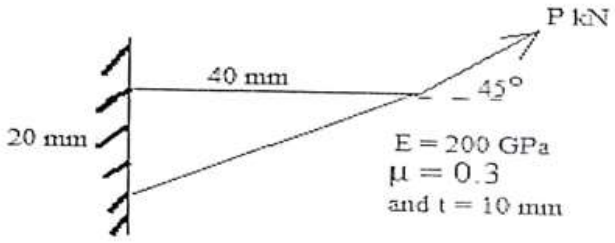
1. Question paper comprises of **Part-A** and **Part-B**
2. **Part-A** (for 20 marks) must be answered at one place in the answer book.
3. **Part-B** (for 50 marks) consists of **five questions with internal choice,** answer all questions.

PART – A
(Answer ALL questions. All questions carry equal marks)
10 * 2 = 20 Marks

1. a.	Explain briefly about the concept of weighted residual method	**[2]**	**1**	**2**
b.	**Mention the basic steps involved in Galerkin's method.**	**[2]**	**1**	**2**
c.	**Define natural co-ordinate systems**	**[2]**	**2**	**2**
d.	**Write stiffness matrix of beam element.**	**[2]**	**2**	**1**
e.	**What do you mean by axisymmetric elements?**	**[2]**	**3**	**1**
f.	**Define plain strain with suitable example**	**[2]**	**3**	**2**
g.	**What are the different Isoparametric elements?**	**[2]**	**4**	**1**
h.	**Discuss briefly on Gauss quadrature method.**	**[2]**	**4**	**2**
i.	**Discuss the basic concept of non-linear analysis**	**[2]**	**5**	**2**
j.	**What is non-linear analysis?**	**[2]**	**5**	**1**

PART – B
(Answer ALL questions. All questions carry equal marks)
5 * 10 = 50 Marks

2.	a) Find the solution of the problem using Rayleigh Ritz method by considering two term solutions as y(x) C_1 (1-x) + C_2 x^2 (1-x) b) What are the steps involved in Finite Element Method. Define of Freedom and principle of virtual work	**[10]**	**1**	**1**
	OR			
3.	a) Illustrate the concept of element strain and stress. Distinguish between the problems of 'Plane stress' and 'Plane strain' b) Write short note on Galerkin's method in FEA. List some disadvantages of using 3-D elements.	**[10]**	**1**	**3**
4.	**Calculate the transverse displacement at the free end of the cantilever stepped beams shown in figure.**	**[10]**	**2**	**4**

				
	OR			
5.	**a) What is displacement and shape function? Derive the element stiffness matrix for beam elements?** **b) Using 2 DOF truss element determine the horizontal and vertical displacement of joints and the forces in all the members of the plane pin jointed frame shown in fig. joints B,C, D are at the sane level as shown in figure, c/s area = 2400 mm^2, E = 2 X 10^5 N/mm^2** 	**[5]** **[5]**	**2** **2**	**1** **4**
6.	**a) Write the shape functions for constant strai triangle by usding polynomial function?** **b) The nodal coordinates of the triangulat element are 1 (1,1), 2(4,2), 3(3,5). At the interior poin P, the x coordinate is 3.5 and N1 is 0.4. Determine N2, N3 and y coordinate at pointP?**	**[10]**	**3**	**3**
	OR			
7.	**Develop B Matrix for the two dimensional plate as shown in below:** 	**[10]**	**3**	**3**
8.	**Derive the shape functions for the four noded quadrilateral isoparametric element indicate the purpose for the computing its stiffness matrix.**	**[10]**	**4**	**4**
	OR			
9.	**Plate with small centre hole of 3 mm diameter is subjected to 50 N tensile load as shown in figure. Thickness of the plate is 6 mm and width of the plate is 28mm. Take E = 210 GPa and poisson ratio as 0.3.**	**[10]**	**4**	**3**

	Write the procedure to solve this problem using finite element software?			
10.	**a) Distinguish between linear and non linear approaches used in FEM.** **b) Describe Newton-Raphson technique for solving material non-linearity problems.**	**[10]**	**5**	**4**
	OR			
11.	**a) Explain different non-linear analysis with their limitations.** **b) List some disadvantages of using 3-D elements.**	**[10]**	**5**	**2**

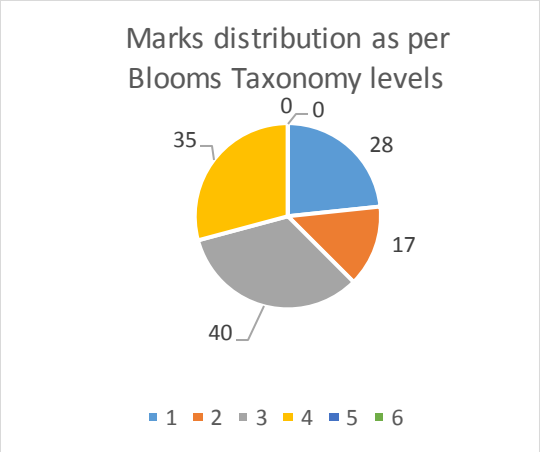
*****

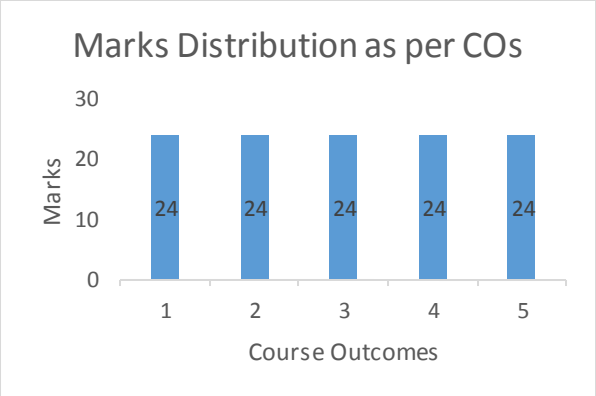
Course Outcomes:

1. Use minimum potential energy principle ad weighted residual methods in FiniteElement Method.
2. Analyse one dimensional elements like beam and truss element using FEM approach.
3. Evaluation of stress and strains in 2D CST and axi-symmetric elements.
4. Formulation of rectangular using Iso-parametric formulation, Three dimensional element and estimate the error using numerical methods
5. Differentiate various types of non-linear analysis

CO Mapping Table

	CO 1	CO 2	CO 3	CO 4	CO 5	Total
1 (a to j)	4	4	4	4	4	**20**
2 a,b	10					10
3 a,b	10					10
4		10				10
5 a		05				05
b			05			05
6 a, b			10			10
7			10			10
8				10		10
9				10		10
10 a, b					10	10
11 a, b					10	10
	24	**19**	**29**	**24**	**24**	70





GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING (2016-17)

Subject: FEM in Structural Engineering **Class: M.Tech., I/II (Section - A)**

Name : Dr.G V V SATYANARAYANA **Sub Code: GR20D5012**

S.No	Date`	Unit No	Session Duration	Topics
1.	11-04-2022	I		Introduction about FEM and concepts of FEM
2.	11-04-2022			History and applications of FEM
3.	14-04-2022			Minimum Potential energy principle
4.	14-04-2022			Discuss on bar and spring element
5.	18-04-2022			Evaluation of stiffness matrix for bar element using minimum potential energy method
6.	18-04-2022			Evaluation of stiffness matrix for bar element using direct stiffness method
7.	21-04-2022			Assembly of global stiffness matrices. Element strain & stress
8.	21-04-2022			Evaluation of stresses and strains in bar element
9.	25-04-2022			Discuss on nodal equilibrium equations
10.	25-04-2022			Introduction about Method of weighted Residual method
11.	28-04-2022			Explain the various Method of weighted Residual method
12.	28-04-2022			Explain compatibility & completeness requirements
13.	02-05-2022			Polynomial forms and their applications
14.	02-05-2022			One dimensional FEM Introduction about 1-D element
15.	05-05-2022	II		Derivation of stiffness matrix for flexure element using minimum potential energy method
16.	05-05-2022			Derivation of stiffness matrix for flexure element using direct stiffness approach method
17.	09-05-2022			Evaluation of stresses in a flexure element
18.	09-05-2022			Evaluation of strains in a flexure element
19.	12-05-2022			Derivation of stiffness matrix for truss element Derivation of stresses and strains matrix for truss element
20.	12-05-2022			Derivation of stresses and strains matrix for truss element
21.	16-05-2022	III		Introduction to Triangular element using in FEM's
22.	16-05-2022			Evaluation of stiffness matrix for a triangular element
23.	19-05-2022			Evaluate the stresses and strains induced in triangular element
24.	19-05-2022			Evaluate the forces, stresses and strains induced in triangular element
25.	23-05-2022			Evaluate the forces, stresses and strains induced in triangular element
26.	23-05-2022			Evaluation of stiffness matrix for a cSt ement
27.	26-05-2022			Evaluation of stiffness matrix for a Axi-Symmetric element
28.	26-05-2022			Evaluate the stresses and strains induced in Axi-Symmetric element
29.	02-06-2022			Evaluate the stresses and strains induced in Axi-

				Symmetric element
30.	02-06-2022			Exercise problems
31.	13-06-2022			Solve old question paper problems
32.	13-06-2022			Solve old question paper problems
33.	16-06-2022			Unit-4 Explain Interpolation elements
34.	16-06-2022			Evaluate the stresses and strains induced in rectangular element
35.	20-06-2022			Evaluate the stresses and strains induced in rectangular element
36.	20-06-2022			Evaluate the forces, stresses and strains induced in rectangular element
37.	23-06-2022			Evaluate the stresses and strains induced in rectangular element
38.	23-06-2022			Evaluate the forces, stresses and strains induced in rectangular element
39.	27-06-2022			Evaluate the forces, stresses and strains induced in three dimensional element
40.	26706-2022	**IV**		Evaluation of stiffness matrix for a three dimensional element
41.	30-06-2022			Exercise problems
42.	30-06-2022			Exercise problems
43	04-07-2022			Exercise problems
44.	04-07-2022			Solve old question paper problems
45.	07-07-2022			Solve old question paper problems
46.	16-06-2022			Solve old question paper problems
47.	11-07-2022			Explain Numerical integration method used in FEM
48.	11-07-2022			Explain Gauss quadrature method
49.	14-07-2022			Estimate the error calculations using Gauss quadrature method
50.	14-07-2022			Unit-5 Introduction in Non-linear analysis used in FEM
51.	18-07-2022			Differentiate between various non-linear analysis
52.	18-07-2022	**V**		Differentiate between various non-linear analysis
53.	21-07-2022			Explain the importance of non-linear analysis
54.	21-07-2022			Explain the importance of non-linear analysis
55.	25-07-2022			Explain Numerical integration method used in FEM
56.	25-07-2022			Revision in unit-1
57.	28-07-2022			Revision in unit-2
58.	28-07-2022			Revision in unit-3
59.	01-08-2022			Revision in unit-4
60.	01-08-2022			Revision in unit-5

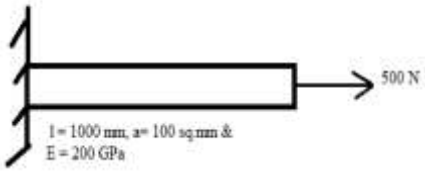
Gokaraju Rangaraju Institute of Engineering and Technology
(Autonomous) Department of Civil Engineering
I M.Tech. II Semester MID I EXAMINATION March--2022
FEM in Structural Engineering (GR20D5012)

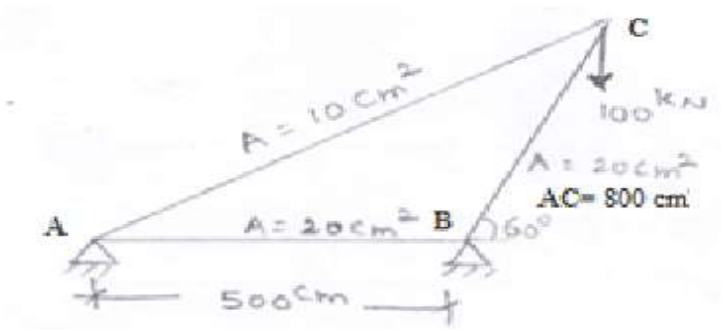
Time: 75 Minutes **Date of examination 06-06-2022**
Max.Marks: 15 Marks 3x5=15 Marks

Name : _____ Roll No. | | | | | | D | | | | |

Answer all questions.

Part-B

	M	COs	BLs	PIs
1. a. Explain the History of Finite Element Method.	**2**	**1**	**2**	**1.1.1**
b. Interpret the displacement, stress and strains in the bar as shown figure below: 	**3**	**1**	**2**	**3.4.1**
OR				
c. Consider the differential equation for a problem such that, $\frac{d^2y}{dx^2} + 300\,x^2 = 0$. with the boundary conditions y(0) = 0 and y(l) = 0 compare four weight residual methods	**5**	**1**	**2**	**3.4.2**
2. Analyse given structure is shown in Fig. below Take, E = 200 G Pa and I = 4 X 10^{-6} m^4 	**5**	**2**	**4**	**5.3.1**
OR				
b. Analyse given structure is shown in Fig. below All members with E = 210 GPa.	**5**	**2**	**4**	**5.3.1**

				
3. a. What is CST element? **b**. Compare between CST ad LST elements	**2** **3**	**3** **3**	**1** **5**	**3.2.1** **3.2.1**
c What are the properties of stiffness matrix? **d**. Compare between Plane stress and plane with suitable examples	**2** **3**	**3** **3**	**1** **5**	**3.2.1** **3.2.1**

Gokaraju Rangaraju Institute of Engineering and Technology
(Autonomous) Department of Civil Engineering
I M.Tech. II Semester MID I EXAMINATION March--2022

Finite Element Methods in Structural Engineering
(GR20D5012)

Time: 15 Minutes **Date of examination 06-06--2022**
Max.Marks: 5 Marks $10x\frac{1}{2}$=5 Marks

Name : _____ Roll No. | | | | | | D | | | | |

1. What is N_2, when N_1 is 0.3 [ ]
   a) 0 b) -1 c) 0.8 d) 0.7

2. The potential energy is equal to _____ as per Rayleigh method [ ]
   a) Minimum b) Maximum c) 0 d) $\propto$

3. As per stiffness matrix the co-efficient of k_{ij} = [ ]
   a) k_{ij} b) k_{ji} c) f_{ij} d) f_{ji}

4. The size of stiffness matrix depends on _____ [ ]
   a) Support reactions b) dof c) type of loading d) Geometric properties of structure

5. Stiffness of truss element is equals to [ ]
   a) $\frac{EI}{l^2}$ b) $\frac{EI}{l^3}$ c) $\frac{P}{\delta}$ d) $\frac{AE}{l}$

6. The beam element belongs to _____ [ ]
   a) 1-D element b) 2-D element c) 3-D element d) Either A or B

7. Stiffness of beam element is equals to_____
   a) $\frac{EI}{l^2}$ b) $\frac{EI}{l^3}$ c) $\frac{12\,EI}{l^3}$ d) $\frac{4\,EI}{l}$

8. What is dof for each node in a beam element [ ]
   a) 0 b) 1 c) 2 d) 3

9. In Point collocation method the residual is equals to _____ [ ]
   a) 0 b) 1 c) 2 d) $\propto$

10. The size of stiffness matrix for CST element is equals to_____ [ ]
    a) 2 X 2 b) 3 X 3 c) 6 X 6 d) 12 X 12

Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)

Department of Civil Engineering

I M.Tech. II Semester MID II EXAMINATIONAugust 2022

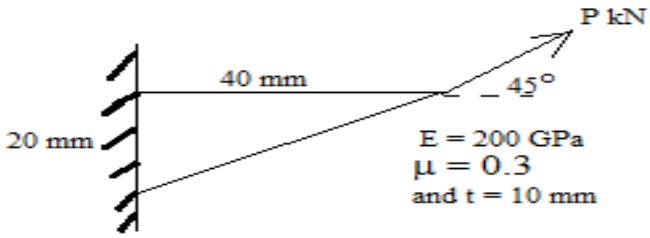
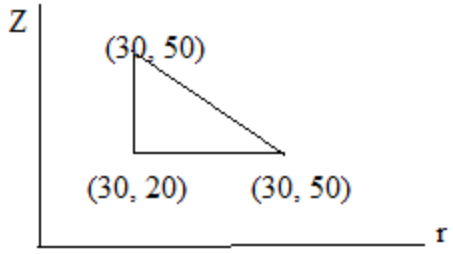
FEM in Structural Engineering (GR20D5012)

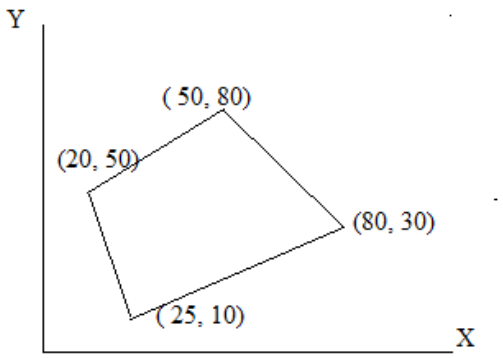
Time: 75 Minutes **Date of examination 16-08-2022** **Max.Marks: 15 Marks**

Answer all questions **3x5=15 Marks**

Name : _____ Roll No. | | | | | | D | | | | |

Part-B

		M	COs	BLs	PIs
1.	**a) Evaluate Stiffness matrix for the two dimensional plate as shown below:** 	**5**	**3**	**5**	**3.2.1**
	OR				
	c) Calculate the element stresses for the Axisymmetric element as shown in figure. The Nodal displacements are as follows: u_1 = 0.01 mm; v_1 = 0.02 mm; u_2 = 0.03 mm; v_2 = 0.05 mm; u_3 = -0.01 mm; v_3 = 0.03 mm; 	**5**	**3**	**5**	**3.2.1**
2	a) Compare between different Isoparametric elements.	**2**	**4**	**5**	**3.2.1**
	b) For the four noded quadrilateral element shown in figure. Determine the Jacobian matrix and evaluate the point (0.5, 0.5)	**3**	**4**	**5**	**3.2.1**

					
	OR				
	c) Evaluate the Integral given below: I = $\int_{-1}^{1}(3\,e^{x} + x^{2} + \frac{1}{(x+2)})\,dx$ Using onne and two point Gauss Quadrature method. Also compar ths with exact solution.	**5**	**4**	**5**	**5.1.2**
3	a) Distinguish between the various methods of non-linearity.	**5**	**5**	**4**	**5.3.2**
	OR				
	b) Explain different method in non-linear analysis.	**5**	**5**	**4**	**5.3.2**

Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)

Department of Civil Engineering

I M.Tech. II Semester MID II EXAMINATION August 2022

FEM in Structural Engineering (GR20D5012)

Time: 15 Minutes **Date of examination 16-08-2022** **Max.Marks: 15 Marks**

Answer all questions **10 X $\frac{1}{2}$ = 5 Marks**

Name : _____ Roll No. | | | | | | D | | | | |

Part-A

Choose the correct answers.

1. The size of stiffness matrix for a LST element is _____ [ ]
   A) 3 X3 B) 6 X 6 C) 9 X 9 D) 12 X 12

2. The value of 2A in a CST element equals to _____ [ ]
   A) $|C|$ B) $|B|$ C) $|D|$ D) $|K|$

3. Strain-displacement matrix also known as _____ [ ]
   A) B Matrix B) C Matrix C) D Matrix D) G Matrix

4. The value γ_3 equals to [ ]
   $A)\ x_{31}$ B) x_{21} $C)\ x_{23}$ D) y_{31}

5. In Axi-symmetric element the Circumferential strain also known as [ ]
   A) Tangential strain B) Radial strain C) Axial Strain D) Shear strain

6 In master element the sides are [ ]
   A) Curved and straight B) Straight and Sharp C) Curved only D) straight only

7. In Jacobian matrix J_{21} = [ ]
   A) $\frac{\partial u}{\partial \xi}$ B) $\frac{\partial v}{\partial \xi}$ C) $\frac{\partial u}{\partial \eta}$ D) $\frac{\partial v}{\partial \eta}$

8. The B-matrix in a four noded rectangular element is [ ]
   A) G X H B) D X H C) K X H D) C X H

9. In Linear Analysis the materials obey's _____ law [ ]
   A) Pascal B) Newton C) Hooks D) Bernoulli

10. In case two point problems the Gaussian weights are ___ , _____ [ ]
   A) 1.0, 2.0 B) 1.0, 1.0 C) 2.0, 1.0 D) 1.0 or 2.0

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 11-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 1 Duration of Lesson: 1hr

Lesson Title: Introduction about FEM and concepts of FEM

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the concepts of FEM.
2. List out steps involved in FEM.
3. Discretization of structure

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Definition of FEM
- Differentiate between FEM and analytical methods.
- Different types of analysis methods

Assignment / Questions: (1 & 1) 1. What is basic concept of FEM?
(1 & 1) 2. Explain steps involved in FEM with suitable example.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 11-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 2 Duration of Lesson: 1hr

Lesson Title: History and applications of FEM

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand about back ground or History of FEM
2. Understand the applications of FEM in various fields

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the History of FEM
- List out various uses of FEM

Assignment / Questions: (1 & 1) 1. What is basic history of FEM?
(1 & 1) 2. Explain the usage of FEM in various fields.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 14-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 3 Duration of Lesson: 1hr

Lesson Title: Minimum Potential energy principle

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the Minimum Potential energy principles in FEM
2. Understand various Minimum Potential energy principle in FEM

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Role of Minimum Potential energy principle in FEM
- Discuss on Rayleigh Ritz theorem

Assignment / Questions: (1 & 1) 1. What is minimum energy principle in FEM?
(1 & 1) 2. Explain in detail Rayleigh Ritz theorem

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 14-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech(Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty:.Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 4 Duration of Lesson: 1hr

Lesson Title: Discuss on bar and spring element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand about stiffness of a spring.

2. Understand the concept of equivalent stiffness when springs are parallel and series.

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Role of stiffness in FEM.
- Determine equivalent stiffness when springs are parallel and series.

Assignment / Questions: (1 & 1) 1. What is usage stiffness concept in FEM?.
(1 & 1) 2. Evaluate the equivalent stiffness when springs are parallel and series.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 18-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 5 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for bar element using minimum potential energy method

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. How to evaluate the stiffness matrix for bar element using minimum potential energy method

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- How to derive the stiffness matrix for bar element using minimum potential energy method

Assignment / Questions: (1 & 1) 1. Explain the procedure in evaluation of stiffness matrix for bar element using minimum potential energy method.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 18-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 6 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for bar element using minimum direct stiffness method

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in Evaluation of stiffness matrix for bar element using minimum direct stiffness method

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the procedure in evaluation of stiffness matrix for bar element using minimum direct stiffness method

Assignment / Questions: (1 & 1) 1. How to evaluate the stiffness matrix for bar element using minimum direct stiffness method

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 21-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: II

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 7 Duration of Lesson: 1hr

Lesson Title: Evaluation of stresses and strains in bar element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of individual matrices.
2. Understand the procedure in assembly of global stiffness matrices.

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS

- Explain the procedure in evaluation of individual matrices.
- Explain the procedure in evaluation of assembly of global stiffness matrices from individual matrices.

Assignment / Questions: (1 & 1) 1. How to evaluate individual and global stiffness matrices.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date:

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: II

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 8 Duration of Lesson: 1hr

Lesson Title: Evaluation of stresses and strains in bar element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of stresses and strains in bar element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS

- Ex[lain the procedure in evaluation of stresses and strains in bar element

Assignment / Questions: (1 & 1) 1. How to evaluate the stresses and strains in bar element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 25-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject:**FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty:Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 9 Duration of Lesson: 1hr

Lesson Title: Discuss on nodal equilibrium equations

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand how to solve the nodal equilibrium equations

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Derive the nodal equilibrium equations using general stiffness relationship
- Stiffness matrix for a one dimensional element.
- Explain the methodology to evaluate the stiffness matrix in another method to a one dimensional element.

Assignment / Questions: (1 & 1) 1. What is the procedure to prepare stiffness matrix for one dimensional Element?
(1 & 1) 2. What are the properties of stiffness matrix?

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 25-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 10 Duration of Lesson: 1hr

Lesson Title: Introduction about Method of weighted Residual method

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INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understood the importance of weighted Residual methods in FEM.

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Introduction on Method of weighted Residual methods used in FEM

Assignment / Questions: (1 & 1) 1. Explain the role of weight residual methods in FEM.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 28-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: **FEM in Structural Engineering** Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 11 Duration of Lesson: 1hr

Lesson Title: Explain the various weighted Residual method
.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understood the various weighted Residual methods in FEM.

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Various methods of weighted Residual methods used in FEM

Assignment / Questions: (1 & 1) 1. Explain the various weight residual methods in FEM.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 28-04-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 12 Duration of Lesson: 1hr

Lesson Title: Explain compatibility & completeness requirements

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understood the compatibility conditions used in FEM.
2. Understood completeness requirements for FEM

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Discuss on various compatibility conditions used in FEM.
- Explain on completeness requirements for FEM

Assignment / Questions:(1 & 1) 1. What are the different compatibility conditions used in FEM?
(1 & 1) 2. Explain briefly on completeness requirements for FEM

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Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 02-05-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 13 Duration of Lesson: 1hr

Lesson Title: Polynomial forms and their applications

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understood different Polynomial forms and their applications in FEM

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Discuss on different polynomial forms and their applications used in FEM.

Assignment / Questions: (1 & 1) 1. Explain the different Polynomial forms and their applications used FEM

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 02-05-2022

Semester : II **Unit – I Introduction to Finite Element methods**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 14 Duration of Lesson: 1hr

Lesson Title: One dimensional FEM Introduction about 1-D element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understood various one dimensional 1-D elements in FEM

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Analyse various one dimensional 1-D elements in FEM.

Assignment / Questions: (1 & 1) 1. Explain the various one dimensional 1-D elements in FEM used FE

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 05-05-2022

Semester : II **Unit- II Beam and Truss Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 15 Duration of Lesson: 1hr

Lesson Title: Derivation of stiffness matrix for flexure element using minimum potential energy method

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Evaluate the stiffness matrix for flexure element using minimum potential energy method

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the procedure in derivation of stiffness matrix for flexure element using minimum potential energy method

Assignment / Questions: (2 & 2) 1. Evaluate the stiffness matrix for flexure element using minimum potential energy method

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 05-05-2022

Semester : II **Unit- II Beam and Truss Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 16 Duration of Lesson: 1hr

Lesson Title: Derivation of stiffness matrix for flexure element using direct stiffness approach method

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Evaluate Derivation of stiffness matrix for flexure element using direct stiffness approach method

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Derivation of stiffness matrix for flexure element using direct stiffness approach method

Assignment / Questions: (2& 2) 1. Evaluate Derivation of stiffness matrix for flexure element using direct stiffness approach method

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 09-05-2022

Semester : II **Unit- II Beam and Truss Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 17 Duration of Lesson: 1hr

Lesson Title: Evaluation of stresses in a flexure element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in calculation of stresses in a flexure element

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the procedure in evaluation of stresses in a flexure element

Assignment / Questions: (2 & 2) 1. Evaluate the stresses in a flexure element.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 09-05-2022

Semester : II **Unit- II Beam and Truss Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 18 Duration of Lesson: 1hr

Lesson Title: Evaluation of strains in a flexure element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the steps used in calculation of Evaluation of strains in a flexure element

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the procedure in evaluation of strains in a flexure element

Assignment / Questions: (2 & 2) 1. Determine the strains in a flexure element.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 12-05-2022

Semester : II **Unit- II Beam and Truss Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 19 Duration of Lesson: 1hr

Lesson Title: Derivation of stiffness matrix for truss element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand in evaluation in derivation of stiffness matrix for truss element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Derivation of stiffness matrix for truss element

Questions: (2 & 2) 1. Derive stiffness matrix for truss element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 12-05-2022

Semester : II **Unit- II Beam and Truss Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 20 Duration of Lesson: 1hr

Lesson Title: Derivation of stresses and strains matrix for truss element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of stresses and strains matrix for truss element

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the procedure in evaluation of stresses and strains matrix for truss element

Assignment / Questions: (2 & 2) 1. Derive the stresses and strains matrix for truss element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 16-05-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**
Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 21 Duration of Lesson: 1hr

Lesson Title: Introduction to Triangular element using in FEM's

INSTRUCTIONAL/LESSON OBJECTIVES:
On completion of this lesson the student shall be able to:

1. Know about the CST and LST elements
2. Applications of Triangular element using in FEM's

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the definition of CST and LST elements.
- State the applications of triangular elements FEM's
- Difference between CST and LST elements.

Assignment / Questions: (3 & 3) 1. Write the applications of triangular elements FEM's
2. State the Difference between CST and LST elements.
3. Define the terms CST and LST elements.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 16-05-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 22 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for a triangular element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

- Know about the B-matrix of a triangular element.
- Understand the procedure in evaluation of stiffness matrix for a triangular element

.

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the B-matrix of a triangular element
- Explain the procedure in evaluation of stiffness matrix for a triangular element

Assignment / Questions: (3 & 3) 1. Evaluate B-Matrix for a triangular element
2. Determine stiffness matrix for given triangular element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

LESSON PLAN

Academic **Y**ear : 2021-22 Date: 19-05-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 23 Duration of Lesson: 1hr

Lesson Title: Evaluate the stresses and strains induced in triangular element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of stresses and strains induced in triangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluation of stresses and strains induced in triangular element

Assignment / Questions: (3 & 3) 1. Evaluate the stresses and strains induced in triangular element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 19-05-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 24 Duration of Lesson: 1hr

Lesson Title: Evaluate the forces, stresses and strains induced in triangular element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of the forces, stresses and strains induced in triangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluate the forces, stresses and strains induced in triangular element

Assignment / Questions: (3 & 3) 1. Evaluate the forces, stresses and strains induced in triangular element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 23-05-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 25 Duration of Lesson: 1hr

Lesson Title: Evaluate the forces, stresses and strains induced in triangular element

INSTRUCTIONAL/LESSON OBJECTIVES:
On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of the forces, stresses and strains induced in triangular element

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the procedure in evaluate the forces, stresses and strains induced in triangular element

Assignment / Questions: (3 & 3) 1. Evaluate the forces, stresses and strains induced in triangular element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 23-05-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 26 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for a CST element

INSTRUCTIONAL/LESSON OBJECTIVES:
On completion of this lesson the student shall be able to:

1. Understand the procedure Evaluation of stiffness matrix for a CST element

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the procedure in evaluation stiffness matrix for a CST element

Assignment / Questions: (3 & 3) 1. Evaluate the of stiffness matrix for a CST element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 26-05-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 27 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for a Axisymmetric element

INSTRUCTIONAL/LESSON OBJECTIVES:
On completion of this lesson the student shall be able to:

2. Understand the procedure Evaluation of stiffness matrix for a CST element

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the procedure in evaluation stiffness matrix for a Axisymmetric element

Assignment / Questions: (3 & 3) 1. Evaluate the of stiffness matrix for a Axisymmetric element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 26-05-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 28 Duration of Lesson: 1hr

Lesson Title: Evaluate the stresses and strains induced in axisymmetric element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Understand the procedure in evaluation of the stresses and strains induced in triangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluate the stresses and strains induced in axisymmetric element

Assignment / Questions: (3 & 3) 1. Evaluate the stresses and strains induced in axisymmetric element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 02-06-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 29 Duration of Lesson: 1hr

Lesson Title: Evaluate the stresses and strains induced in axisymmetric element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of the stresses and strains induced in triangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluate the stresses and strains induced in axisymmetric element

Assignment / Questions: (3 & 3) 1. Evaluate the stresses and strains induced in axisymmetric element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 02-06-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 30 Duration of Lesson: 1hr

Lesson Title: Exercise problems in triangular and axisymmetric elements.

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of stiffness matrix for a rectangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Exercise problems in triangular and axisymmetric elements

Assignment / Questions: (3 & 3) 1. Determine or slove the Exercise problems in triangular and axisymmetric elements.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 13-06-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 31 Duration of Lesson: 1hr

Lesson Title: Solve old question paper problems in triangular and axisymmetric elements.

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Understand the procedure in evaluation of stiffness matrix for a rectangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Solve old question paper problems in triangular and axisymmetric elements.

Assignment / Questions: (3 & 3) 1. Solve old question paper problems in triangular and axisymmetric elements.

.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 13-06-2022

Semester : II **Unit-III Triangular & Axisymmetric Elements**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 32 Duration of Lesson: 1hr

Lesson Title: Solve old question paper problems in triangular and axisymmetric elements.

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Understand the procedure in evaluation of stiffness matrix for a rectangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Solve old question paper problems in triangular and axisymmetric elements.

Assignment / Questions: (3 & 3) 1. Solve old question paper problems in triangular and axisymmetric elements.

.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 16-06-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 33 Duration of Lesson: 1hr

Lesson Title: Explain Interpolation elements

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the importance and properties of Isoparametric elements
2. Understand different types of Isoparametric elements

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain various types of Interpolation elements and properties of Isopatrametric elements.

Assignment / Questions: (4 & 4) 1. Explain properties of various types of Isoparametric elements

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 16-06-2022

Semester : I **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 34 Duration of Lesson: 1hr

Lesson Title: Evaluate the stresses and strains induced in rectangular element

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of the stresses and strains induced in rectangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluation of stresses and strains induced in rectangular element

Assignment / Questions: (4 & 4) 1. Derive the stresses and strains induced in a given rectangular element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 20-06-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 35 Duration of Lesson: 1hr

Lesson Title: Evaluate the forces, stresses and strains induced in rectangular element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

3. Understand the procedure in evaluation of the forces, stresses and strains induced in rectangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluation of the forces, stresses and strains induced in rectangular element

Assignment / Questions: (4 & 4) 1. Determine the forces, stresses and strains induced in a given rectangular element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 20-06-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 36 Duration of Lesson: 1hr

Lesson Title: Evaluate the forces, stresses and strains induced in rectangular element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

4. Understand the procedure in evaluation of the forces, stresses and strains induced in rectangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluation of the forces, stresses and strains induced in rectangular element

Assignment / Questions: (4 & 4) 1. Determine the forces, stresses and strains induced in a given rectangular element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 23-06-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 37 Duration of Lesson: 1hr

Lesson Title: Evaluate the forces, stresses and strains induced in three dimensional element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of the forces, stresses and strains induced in three dimensional element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluation of the forces, stresses and strains induced in three dimensional element

Assignment / Questions: (4 & 4) 1. Determine the forces, stresses and strains induced in a given three dimensional element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous)

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 23-06-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 38 Duration of Lesson: 1hr

Lesson Title: Evaluate the forces, stresses and strains induced in rectangular element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

5. Understand the procedure in evaluation of the forces, stresses and strains induced in rectangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluation of the forces, stresses and strains induced in rectangular element

Assignment / Questions: (4 & 4) 1. Determine the forces, stresses and strains induced in a given rectangular element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 27-06-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 39 Duration of Lesson: 1hr

Lesson Title: Evaluate the forces, stresses and strains induced in rectangular element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Understand the procedure in evaluation of the forces, stresses and strains induced in rectangular element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluation of the forces, stresses and strains induced in rectangular element

Assignment / Questions: (4 & 4) 1. Determine the forces, stresses and strains induced in a given rectangular element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 27-06-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 40 Duration of Lesson: 1hr

Lesson Title: Evaluate the forces, stresses and strains induced in three dimensional element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand the procedure in evaluation of the forces, stresses and strains induced in three dimensional element

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain the procedure in evaluation of the forces, stresses and strains induced in three dimensional element

Assignment / Questions: (4 & 4) 1. Determine the forces, stresses and strains induced in a given three dimensional element

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 30-06-2022

Semester : I **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 41 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for an axisymmetric element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Exercise problems in unit-4

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain exercise problems in unit-4

Assignment / Questions: (4 & 4) 1. Exercise problems in rectangular elements..

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 30-06-2022

Semester : I **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 42 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for an axisymmetric element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Exercise problems in unit-4

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain exercise problems in unit-4

Assignment / Questions: (4 & 4) 1. Exercise problems in rectangular elements..

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 04-07-2022

Semester : I **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 43 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for an axisymmetric element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Exercise problems in unit-4

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain exercise problems in unit-4

Assignment / Questions: (4 & 4) 1. Exercise problems in rectangular elements..

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 04-07-2022

Semester : I **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 44 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for an axisymmetric element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Solve old question paper problems

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Solve old question paper problems

Assignment / Questions: (4 & 4) 1. Solve old question paper problems in unit -4

..

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 07-07-2022

Semester : I **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 45 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for an axisymmetric element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Solve old question paper problems

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Solve old question paper problems

Assignment / Questions: (4 & 4) 1. Solve old question paper problems in unit -4

..

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 16-07-2022

Semester : I **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 46 Duration of Lesson: 1hr

Lesson Title: Evaluation of stiffness matrix for an axisymmetric element

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Solve old question paper problems

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Solve old question paper problems

Assignment / Questions: (4 & 4) 1. Solve old question paper problems in unit -4

..

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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Bachupally, Kukatpally, Hyderabad – 500 090. (040) 6686 4440

LESSON PLAN

Academic **Y**ear : 2021-22 Date: 11-07-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 47 Duration of Lesson: 1hr

Lesson Title: Explain Numerical integration method used in FEM

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Understand about Explain Numerical integration method used in FEM

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain about the Numerical integration method used in FEM

Assignment / Questions: (4 & 4) 1. What is Numerical integration? And state its importance.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

Gokaraju Rangaraju Institute of Engineering and Technology
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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 11-07-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 48 Duration of Lesson: 1hr

Lesson Title: Explain Gauss quadrature method

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Know about Gauss quadrature method in error calculations.

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain Gauss quadrature method with one, two and three point methods

Assignment / Questions: (4 & 4) 1. Evaluate exact solutions for given mathematical expressions.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 14-07-2022

Semester : II **Unit-IV Isoparametric Formulation**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR20D5012**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 49 Duration of Lesson: 1hr

Lesson Title: Estimate the error calculations using Gauss quadrature method

.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Know about Gauss quadrature method in error calculations.

TEACHING AIDS : white board, Different colour markers

TEACHING POINTS :

- Explain Gauss quadrature method with one, two and three point methods

Assignment / Questions: (4 & 4) 1. Evaluate exact solutions and errors for given mathematical Expressions using Gauss quadrature method.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 14-07-2022

Semester : II **Unit-V Introduction in Non-linear analysis**
Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR17D5162**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 50 Duration of Lesson: 1hr

Lesson Title: Introduction in Non-linear analysis

INSTRUCTIONAL/LESSON OBJECTIVES:
On completion of this lesson the student shall be able to:

1. The difference between linear and non-linear material properties

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the difference between linear and non-linear material properties

.

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

Assignment / Questions: (5 & 5) 1. List out difference between linear and non-linear material properties

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 18-07-2022

Semester : II **Unit-V Introduction in Non-linear analysis**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR17D5162**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 51 Duration of Lesson: 1hr

Lesson Title: Differentiate between various non-linear analysis

INSTRUCTIONAL/LESSON OBJECTIVES:
On completion of this lesson the student shall be able to:
1. Discuss the differences between various non-linear analysis method

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the differences between various non-linear analysis

Assignment / Questions: (5 & 5) 1. Discuss the differences between various non-linear analysis methods.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 18-07-2022

Semester : II **Unit-V Introduction in Non-linear analysis**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR17D5162**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 52 Duration of Lesson: 1hr

Lesson Title: Differentiate between various non-linear analysis

INSTRUCTIONAL/LESSON OBJECTIVES:
On completion of this lesson the student shall be able to:

1. Discuss the differences between various non-linear analysis method

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the differences between various non-linear analysis

Assignment / Questions: (5 & 5) 1. Discuss the differences between various non-linear analysis methods.

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

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LESSON PLAN

Academic **Y**ear : 2021-22 Date: 21-07-2022

Semester : II **Unit-V Introduction in Non-linear analysis**

Name of the Program: M.Tech (Structural Engineering) Year: I

Course/Subject: FEM in Structural Engineering Course Code: **GR17D5162**

Name of the Faculty: Dr.GVV Satyanarayana. Dept.: Civil Engineering

Designation: PROFESSOR

Lesson No: 54 Duration of Lesson: 1hr

Lesson Title: Explain the importance of non-linear analysis

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

- Know the importance of non-linear analysis

.

TEACHING AIDS : white board, Different colour markers
TEACHING POINTS :

- Explain the importance of non-linear analysis

Assignment / Questions: (5 & 5) 1. Explain the importance of non-linear analysis

Signature of faculty

Note: Mention for each question the relevant Objectives and Outcomes Nos.

MAPPING

GR20D5012- FEM in Structural Engineering	Course Outcomes				
Course Objectives	1	2	3	4	5
1	X				
2		X			
3			X	X	X
4					
5					

GR20D5012- FEM in Structural Engineering	Course Outcomes				
Assessment	1	2	3	4	5
1	X				
2		X			
3			X	X	X
4					

GR20D5012- FEM in Structural Engineering	Course Objectives				
Assessments	1	2	3	4	5
1	X				
2		X			
3			X		
4			X		
5				X	

Course	Program Outcomes					
	1	2	3	4	5	6
GR20D5012- FEM in Structural Engineering	X	X	X	X	X	X

GR20D5012- FEM in Structural Engineering	**Program Outcomes**					
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**
Use minimum potential energy principle in Finite Element Method	H				M	M
Analyse one dimensional elements like beam element using FEM approach	M		M	M	M	M
Formulate interpolation functions and evaluation of structural deformation using Galerkin approach.	H	M	M		M	M
Evaluation of stress and strains in 2D, 3D elements using iso-parametric and axi- symmetric element approach.	M		M	M		M
Predict the error using Gauss quadrature method	M	M	M	M	M	M
Use minimum potential energy principle in Finite Element Method	H				M	M
Analyse one dimensional elements like beam element using FEM approach	M		M	M	M	M

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Department of Civil Engineering

I M.Tech II (Semester Structural Engineering)

FEM IN STRUCTURAL ENGINEERING (GR20D5012)

COURSE FILE CHECK LIST

S.No.	Name of the Format	Page
1.	Syllabus	
2.	Time Table	
3.	Program educational Objectives	
4.	Program objectives	
5.	Course Objectives	
6.	Course Outcomes	
7.	Students Roll List	
8.	Guide lines to study the course books & references, course design & delivery	
9.	Course schedule	
10.	Unit plan/Course Plan	
11.	Evaluation Strategy	
12.	Assessment in relation to COB's and Co's	
13.	Tutorial Sheets	
14.	Assignment Sheets	
15.	Rubric for Course	
16.	Mappings of CO's and Po's	
17.	Model question papers	
18.	Mid-I and Mid-II question papers	
19.	Mid –I marks	
20.	Mid –II marks	
21.	Sample answer scripts and Assignments	
22.	Course materials like notes, PPT's, Videos etc.,	

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(GR20D5012) FEM IN STRUCTURAL ENGINEERING

I M.Tech (Structural Engineering) – II Semester (2021-22)

Dr. G.V.V.Satyanarayana

Professor

Department of Civil Engineering

Gokaraju Rangaraju Institute of Engineering and Technology,

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Gokaraju Rangaraju Institute of Engineering and Technology Department of Civil Engineering

Structural Analysis

Course File Check List

S.No.	Name of the Format	Page No.
1	Syllabus	
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GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING (2021-22)

Subject: FEM in Structural Engineering **Class: M.Tech., I/II (Section - A)**

Name : Dr.G V V SATYANARAYANA **Sub Code: GR20D5012**

S.No	Date`	Unit No	Session Duration	Topics
1.	11-04-2022	I		Introduction about FEM and concepts of FEM
2.	11-04-2022			History and applications of FEM
3.	14-04-2022			Minimum Potential energy principle
4.	14-04-2022			Discuss on bar and spring element
5.	18-04-2022			Evaluation of stiffness matrix for bar element using minimum potential energy method
6.	18-04-2022			Evaluation of stiffness matrix for bar element using direct stiffness method
7.	21-04-2022			Assembly of global stiffness matrices. Element strain & stress
8.	21-04-2022			Evaluation of stresses and strains in bar element
9.	25-04-2022			Discuss on nodal equilibrium equations
10.	25-04-2022			Introduction about Method of weighted Residual method
11.	28-04-2022			Explain the various Method of weighted Residual method
12.	28-04-2022			Explain compatibility & completeness requirements
13.	02-05-2022			Polynomial forms and their applications
14.	02-05-2022			One dimensional FEM Introduction about 1-D element
15.	05-05-2022	II		Derivation of stiffness matrix for flexure element using minimum potential energy method
16.	05-05-2022			Derivation of stiffness matrix for flexure element using direct stiffness approach method
17.	09-05-2022			Evaluation of stresses in a flexure element
18.	09-05-2022			Evaluation of strains in a flexure element
19.	12-05-2022			Derivation of stiffness matrix for truss element Derivation of stresses and strains matrix for truss element
20.	12-05-2022			Derivation of stresses and strains matrix for truss element
21.	16-05-2022	III		Introduction to Triangular element using in FEM's
22.	16-05-2022			Evaluation of stiffness matrix for a triangular element
23.	19-05-2022			Evaluate the stresses and strains induced in triangular element
24.	19-05-2022			Evaluate the forces, stresses and strains induced in triangular element
25.	23-05-2022			Evaluate the forces, stresses and strains induced in triangular element
26.	23-05-2022			Evaluation of stiffness matrix for a cSt ement
27.	26-05-2022			Evaluation of stiffness matrix for a Axi-Symmetric element
28.	26-05-2022			Evaluate the stresses and strains induced in Axi-Symmetric element
29.	02-06-2022			Evaluate the stresses and strains induced in Axi-

				Symmetric element
30.	02-06-2022			Exercise problems
31.	13-06-2022			Solve old question paper problems
32.	13-06-2022			Solve old question paper problems
33.	16-06-2022			Unit-4 Explain Interpolation elements
34.	16-06-2022			Evaluate the stresses and strains induced in rectangular element
35.	20-06-2022			Evaluate the stresses and strains induced in rectangular element
36.	20-06-2022			Evaluate the forces, stresses and strains induced in rectangular element
37.	23-06-2022			Evaluate the stresses and strains induced in rectangular element
38.	23-06-2022			Evaluate the forces, stresses and strains induced in rectangular element
39.	27-06-2022			Evaluate the forces, stresses and strains induced in three dimensional element
40.	26706-2022	**IV**		Evaluation of stiffness matrix for a three dimensional element
41.	30-06-2022			Exercise problems
42.	30-06-2022			Exercise problems
43	04-07-2022			Exercise problems
44.	04-07-2022			Solve old question paper problems
45.	07-07-2022			Solve old question paper problems
46.	16-06-2022			Solve old question paper problems
47.	11-07-2022			Explain Numerical integration method used in FEM
48.	11-07-2022			Explain Gauss quadrature method
49.	14-07-2022			Estimate the error calculations using Gauss quadrature method
50.	14-07-2022			Unit-5 Introduction in Non-linear analysis used in FEM
51.	18-07-2022			Differentiate between various non-linear analysis
52.	18-07-2022	**V**		Differentiate between various non-linear analysis
53.	21-07-2022			Explain the importance of non-linear analysis
54.	21-07-2022			Explain the importance of non-linear analysis
55.	25-07-2022			Explain Numerical integration method used in FEM
56.	25-07-2022			Revision in unit-1
57.	28-07-2022			Revision in unit-2
58.	28-07-2022			Revision in unit-3
59.	01-08-2022			Revision in unit-4
60.	01-08-2022			Revision in unit-5