Gokaraju Rangaraju Institute of Engineering and Technology

Department of Civil Engineering

Structural Engineering

NUMERICAL ANALYSIS LAB

(GR20D5021)

I M.Tech - II Semester

(2021-2022)

V Naresh Kumar

Varma/Dr. V Srinivasa

Reddy Assistant

Professor/Professor

Gokaraju Rangaraju Institute of Engineering and Technology
(Autonomous)

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

SYLLABUS

Academic Year : 2021-2022

Name of the Program : M.Tech **Year:** I Year **Semester:** II

Course/Subject :NA LAB **Course Code** : GR20D5021

Name of the Faculty :V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Dept.: Structural Engineering (Civil Engineering)

1. Find the Roots of Non-Linear Equation Using Bisection Method.
2. Find the Roots of Non-Linear Equation Using Newton's Method.
3. Curve Fitting by Least Square Approximations.
4. Solve the System of Linear Equations Using Gauss - Elimination Method.
5. Solve the System of Linear Equations Using Gauss - Seidal Iteration Method.
6. Solve the System of Linear Equations Using Gauss - Jorden Method.
7. Integrate numerically using Trapezoidal Rule.
8. Integrate numerically using Simpson's Rules.
9. Numerical Solution of Ordinary Differential Equations by Euler's Method.
10. Numerical Solution of Ordinary Differential Equations by Runge- Kutta Method.

Signature of HOD Signature of faculty

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

STRUCTURAL ENGINEERING

NA LAB TIME TABLE

M.TECH. I YEAR II SEMESTER **A.YEAR: 2021-22**

	1	2	3	4	5	6	7
	9:00-10:00	10:00-11:00	11:00-12:00	12:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00
Mon							
Tues							
Wed					**NA LAB**	**NA LAB**	**NA LAB**
Thurs							
Fri					**NA LAB**	**NA LAB**	**NA LAB**
Sat							

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M.Tech. Structural Engineering

PEO1: 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.

PEO2: Graduates of the program will be able to design structural components using contemporary softwares and professional tools with quality practices of international standards.

PEO3: 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.

PEO4: Graduates of the program will grow professionally through continuing education, training, research, and adapting to the rapidly changing technological trends globally in structural engineering.

Programme Outcomes(POs)

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 Year : 2021-2022

Name of the Program : M.Tech **Year:** I Year **Semester:** II

Course/Subject :NA LAB **Course Code** : GR20D5021

Name of the Faculty: V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Dept.: Structural Engineering (Civil Engineering)

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

S.No	Objectives
1	Find Roots of non-linear equations by Bisection method and Newton's method.
2	Do curve fitting by least square approximations.
3	Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/Gauss - Jorden Method.
4	Integrate Numerically Using Trapezoidal and Simpson's Rules.
5	Find Numerical Solution of Ordinary Differential Equations by Euler's Method, Runge-Kutta Method.

Signature of HOD Signature of faculty

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 Year : 2021-2022

Name of the Program : M.Tech **Year:** I Year **Semester:** II

Course/Subject : NA LAB **Course Code** : GR20D5021

Name of the Faculty :V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Dept.: Structural Engineering (Civil Engineering)

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

S.No	Outcomes
1	Find Roots of non-linear equations by Bisection method and Newton's method.
2	Do curve fitting by least square approximations.
3	Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/Gauss - Jorden Method.
4	Integrate Numerically Using Trapezoidal and Simpson's Rules.
5	Find Numerical Solution of Ordinary Differential Equations by Euler's Method & Runge-Kutta Method.

Signature of HOD Signature of faculty

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

Gokaraju Rangaraju Institute of Engineering & Technology
M.Tech - Structural Engineering
Academic Year: 2018- 2019
ROLLLIST

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

Gokaraju Rangaraju Institute of Engineering and Technology

(Autonomous)

Structural Engineering

GUIDELINES TO STUDY THE COURSE/SUBJECT

Academic Year : 2021-22

Name of the Program: M.Tech Year: I Semester: II

Course : NA LAB Course Code: GR20D5021

Name of the faculty : V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Dept.: Civil Engineering Designation : Assistant Professor/Professor

Guidelines to study the course Computer-Oriented Numerical Methods in Engineering

This course is a study of mathematical techniques used to model engineering systems. It involves the development of mathematical models and the application of the computer to solve engineering problems using the following computational techniques: Taylor Series approximation, numerical differentiation, root-finding using bracketing and open methods, linear and polynomial curve fitting, solution methods for matrix equations, numerical integration, and the solution of differential equations.

Students should have the following prerequisites

1. Fundamentals of Matrices
2. Basics of Interpolation
3. Basics of Differentiation and
4. Basics of Integration

Where will this subject help?

1. To develop the skill of solving linear algebraic systems by direct and iteration methods.
2. To illustrate advanced matrix techniques in the determination of Eigen values and Eigen vectors of square matrix.

3. To analyze the performance of various interpolation technique and perform error analysis.
4. To compare various numerical differentiation and integration techniques.
5. To explain the various techniques to study Initial and Boundary value problems in ODE.
6. To solve a range of problems on applicable software.
7. To develop the skill of solving linear algebraic systems by direct and iteration methods.

Books/Material

S.No.	Text Books
1	M.K.Jain-S.R.K.Iyengar, R.K.Jain Numerical methods for scientific and engineering computations, Willey Eastern Limited, 1987
2	S.S.Sastry, Numerical methods.
3	Curtis I.Gerala, Applied numerical analysis, Addisson Wasley published campus.

S.No.	Suggested / Reference Books
1	C.Chopra, Raymond P.Canal, Numerical methods for Engineers Stevan, Mc. Graw Hill book Company, 4th edition, 2002.
2	C.Xavier, C Language and Numerical methods, New age international publisher, 2003.
3	Dr. M.Shanta Kumar, Computer based numerical analysis, Khanna Book publishers, New Delhi.

Course Design and Delivery System

1. The course syllabus is written into number of learning objectives and learning outcomes.
2. These learning objectives and outcomes will be achieved through lectures, assessments, assignments, experiments in the laboratory, projects, seminars and presentations, etc.,
3. Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.
4. The learning process will be carried out through assessment of knowledge, skills and attitude by various methods and the student will be given guidance to refer to the textbooks, 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, lesson and unit plan
- Understand different methods of teaching and learning
- Use appropriate teaching and learning aids
- Plan and deliver lectures effectively
- Provide feedback system 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

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SCHEDULE OF INSTRUCTIONS

Academic Year : 2021-2022

Name of the Program : M.Tech **Year:** I Year **Semester:** II

Course/Subject : NA LAB **Course Code** : GR20D5021

Name of the Faculty :V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Dept.: Structural Engineering (Civil Engineering)

Topics/Sub Topics	Date	No. of Periods	Objectives & Outcomes No.	References (Text book, Journal…)	Blooms Taxonomy level
Introduction about C++	13-04-2022 - 20-04-2022	8		Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K1
Bisection Method.	22-04-2022 27-04-2022	8	COb-1, & CO-1	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5
Newton's Method.	29-04-2022 04-05-2022	8	COb-1 & CO-1	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5
Least Square Approximations.	06-05-2022 11-05-2022	8	COb-2 & CO-2	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5

Gauss - Elimination Method.	13-05-2022 18-05-2022	8	COb-3 & CO-3	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5
Gauss - Seidal Iteration Method.	20-05-2022 25-05-2022	8	COb-3 & CO-3	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5
Gauss - Jorden Method.	27-05-2022 01-06-2022	8	COb-3 & CO-3	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5
Trapezoidal Rule.	22-06-2022 24-06-2022	8	COb-4 & CO-4	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5
Simpson's Rule.	29-06-2022 01-07-2022	8	COb-4 & CO-4	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5
Euler's Method.	06-07-2022 08-07-2022	8	COb-5 & CO-5	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5
Runge- Kutta Method.	13-07-2022 15-07-2022	8	COb-5 & CO-5	Numerical methods for scientific & Engg. computations by M. K. Jain & S.R.K Iyengar	K2, K3, K4 & K5

Signature of HOD

Signature of faculty

SESSION PLAN

Subject: **Numerical Analysis Lab (GR20D5021)** I M.Tech - II Sem (2021-22)

Internal Marks: 30 End Exam Marks: 70 Total Marks: 100

S. No.	Exp No.	Date	Topics
1		13-04-2022	General Introduction about subject
2		20-04-2022	Introduction about C++
3	1	22-04-2022	Bisection Method.
4	1	27-04-2022	Bisection Method.
5	2	29-04-2022	Newton's Method.
6	2	04-05-2022	Newton's Method.
7	3	06-05-2022	Least Square Approximations.
8	3	11-05-2022	Least Square Approximations.
9	4	13-05-2022	Gauss - Elimination Method.
10	4	18-05-2022	Gauss - Elimination Method.
11	5	20-05-2022	Gauss - Seidal Iteration Method.
12	5	25-05-2022	Gauss - Seidal Iteration Method.
13	6	27-05-2022	Gauss - Jorden Method.
14	6	01-06-2022	Gauss - Jorden Method.
15		03-06-2022	Revision of 1 to 6 experiments
16		15-06-2022	Revision of 1 to 6 experiments
17		17-06-2022	Revision of 1 to 6 experiments
18	7	22-06-2022	Trapezoidal Rule.
19	7	24-06-2022	Trapezoidal Rule.
20	8	29-06-2022	Simpson's Rule.
21	8	01-07-2022	Simpson's Rule.
22	9	06-07-2022	Euler's Method.
23	9	08-07-2022	Euler's Method.
24	10	13-07-2022	Runge- Kutta Method.
25	10	15-07-2022	Runge- Kutta Method.
26		20-07-2022	Revision of 7 to 10 experiments
27		22-07-2022	Revision of 7 to 10 experiments
28		27-07-2022	Revision of 1 to 10 experiments

29		29-07-2022	Revision of 1 to 10 experiments
30		03-08-2022	Revision of 1 to 10 experiments
31		06-08-2022	Lab - Internal

Gokaraju Rangaraju Institute of Engineering and Technology

Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 13-04-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: **Duration of Lesson:** 1 hr

Lesson Title: General Introduction about subject

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to understand the basic need for Numerical Analysis Lab

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

General Introduction about Laboratory

Assignment / Questions:

Signature of faculty

Gokaraju Rangaraju Institute of Engineering and Technology

Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 20-04-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: **Duration of Lesson:** 1 hr

Lesson Title: Introduction about C++

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to understand algorithm and how to implement it in a computer program

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

Introduction about C++ Algorithm - Syntax

Assignment / Questions:

Signature of faculty

Gokaraju Rangaraju Institute of Engineering and Technology

Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 22-04-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 1 **Duration of Lesson:** 1 hr

Lesson Title: Bisection Method.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Bisection Method with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

Bisection method is based on the repeated application of the intermediate value property. Let the function f(x) be continuous between a and b. For definiteness, let f(a) be negative and f(b) be positive. Then the first approximation to the root is $x_1 = (a+b)*0.5$.

If $f(x_1) = 0$ then x_1 is the root of f(x)=0. Otherwise, the root lies between a and x_1 or x_1 and b according as $f(x_1)$ is positive or negative. Then we bisect the interval as before and continue the process until the root is found to the desired accuracy.
If $f(x_1)$ is positive so that the root lies between a and x_1. Then the second approximation to the root is $x_1 = 0.5*(a+x_1)$. If $f(x_2)$ is negative then the root lies between x_1 and x_2. The third approximation to the root is $x_3 = 0.5*(x_1+x_2)$ and so on.
The error reduces by a factor of ½ each step, the error is linear.

Assignment / Questions:

A fixed beam AB of length 10 m carries a udl of 10kN/m over its entire span. Determine the end moments. Draw Shear Force Diagram and Bending Moment Diagram. Also, write a program in C/C++ to find the points of contraflexure using Bisection method. **Cob1, CO1.**

Signature of faculty

Gokaraju Rangaraju Institute of Engineering and Technology

Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 29-04-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 2 **Duration of Lesson:** 1 hr

Lesson Title: Newton's Method.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Newton's Method with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

x_0 be an approximate root of the equation f(x)=0. If $x_1 = x_0 + h$ be the exact root then $f(x_1)=0$.
Expanding by Taylor's series
Since h is small, neglecting the h^2 and higher powers of x, we have

$$f(x_0 + h) = f(x_0) + hf'(x_0) + \frac{h^2}{2}f''(x_0) + \cdots = 0$$

$$f(x_0) + hf'(x_0) = 0$$

$$h = -\frac{f(x_0)}{f'(x_0)}$$

A closer approximation to the root is given by

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

repeat the iterations until convergence, until two successive values of x are same up to four decimals

Assignment / Questions:

To locate the point(s) where slope is equal to zero for a simply supported beam AB of span 10 m carrying a udl of magnitude 10kN/m over a span of 7m from end A and a concentrated load of 100 kN acting vertically downwards at a distance of 7m from the left end support A. Use Newtons method. **Cob1, CO1.**

Signature of faculty

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Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 06-05-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 3 **Duration of Lesson:** 1 hr

Lesson Title: Least Square Approximations.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Least Square Approximations with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

"The curve of best fit is that for which e's are as small as possible i.e., the sum of the squares of the errors is a minimum"

$$\sum_i y_i = na + b\sum_i x_i + c\sum_i {x_i}^2$$

$$\sum_i x_i y_i = a\sum_i x_i + b\sum_i x_i^2 + c\sum_i {x_i}^3$$

$$\sum_i x_i^2 y_i = a\sum_i x_i^2 + b\sum_i x_i^3 + c\sum_i {x_i}^4$$

Assignment / Questions:

To perform curve fitting and determine the deflected shape of the curve. Find the deflection at a desired section on the deflected curve. **Cob2, CO2.**

Signature of faculty

Gokaraju Rangaraju Institute of Engineering and Technology

Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 13-05-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 4 **Duration of Lesson:** 1 hr

Lesson Title: Gauss - Elimination Method.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Gauss - Elimination Method with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

Gauss - Elimination Method.

Assignment / Questions:

The Axial Stiffness matrix of a bar is given as $K = \frac{AE}{L}\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 1 \end{bmatrix}$ and the Force vector is given by $F = \begin{bmatrix} 1000 \\ 1000 \\ -1000 \end{bmatrix} N$. The length 'L' of the bar is equal to 100 mm. Take AE=1. Find the nodal displacements using the relation KU=F, where the nodal displacement vector is given by U = $[U_1\ U_2\ U_3]^T$. **Cob4, CO4.**

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Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 20-05-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 5 **Duration of Lesson:** 1 hr

Lesson Title: Gauss - Seidal Iteration Method.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Gauss - Seidal Iteration Method with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

Gauss - Seidal Iteration Method.

Assignment / Questions:

The stiffness matrix and the nodal load vector is given below. Solve the simultaneous set of equations and find the nodal displacements. **Cob3, CO3.**

$$\begin{bmatrix} 409.93597 & -135.1495 & -120.3481 \\ -135.1495 & 195.2655 & -176.9319 \\ -120.3481 & -176.9319 & 121.587 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} = \begin{bmatrix} 1000 \\ 1000 \\ -1000 \end{bmatrix} N$$

Signature of faculty

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Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 27-05-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 6 **Duration of Lesson:** 1 hr

Lesson Title: Gauss - Jorden Method.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Gauss - Jorden Method with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

Gauss - Jorden Method.

Assignment / Questions:

The stiffness matrix and the nodal load vector is given below. Solve the simultaneous set of equations and find the nodal displacements. **Cob3, CO3**

$$\begin{bmatrix} 3595.7482 & -1096.608 & -21.8183 \\ -1096.608 & 643.733 & -726.966 \\ -21.8183 & -726.966 & 195.4925 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} = \begin{bmatrix} 1000 \\ 1000 \\ -1000 \end{bmatrix} N$$

Signature of faculty

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Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 22-06-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 7 **Duration of Lesson:** 1 hr

Lesson Title: Trapezoidal Rule.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Trapezoidal Rule Problems with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

Let the curve be denoted by y = f(x) as shown in the Fig.7.1

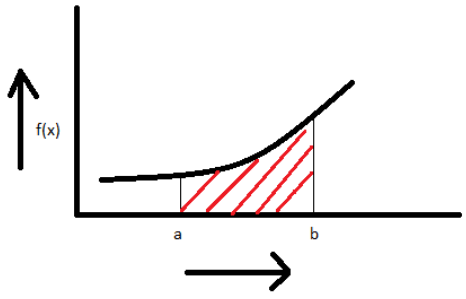

Fig. 7.1 Area under the curve using Trapezoidal rule

Area under the curve = $\frac{h}{2}[f(a)+f(b)]$, $h=(b-a)$

Assignment / Questions:

A cantilever of length 'L' fixed at left end A and free at the right end B. The beam carries a point load 'W' acting vertically downwards at the free end. Using Moment area theorem – I and trapezoidal rule find the slope at the free end of the cantilever at B. Take the flexural rigidity 'EI' as constant. **Cob4, CO4.**

Signature of faculty

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Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 29-06-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 8 **Duration of Lesson:** 1 hr

Lesson Title: Simpson's Rule.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Simpson's Rule problems with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

Area under the curve = $\frac{b-a}{6}[(f_0 + f_n) + 4(\sum f_{odd}) + 2(\sum f_{even})]$

Assignment / Questions:

A cantilever AB is fixed at the left end A and free at the right end B. The beam carries a uniformly distributed load 'w' per unit run over its entire length 'L' as shown in the Fig.8.2. Using Moment area theorem – I and Simpson's rule find the slope at the free end of the cantilever at B. Take the flexural rigidity 'EI' as constant. **Cob4, CO4.**

Signature of faculty

Gokaraju Rangaraju Institute of Engineering and Technology

Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 06-07-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 9 **Duration of Lesson:** 1 hr

Lesson Title: Euler's Method.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Euler's Method with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

Euler's Method.

Assignment / Questions:

A laterally loaded column of steel 50 mm x 50 mm in section and 2m long carries an axial load of 100 kN and a lateral load of W = 3014 N at the centre normal to one of the faces as shown in the Fig.9.2 below. The column is hinged at both the ends. Take E = 2e5 MPa. Find the maximum deflection using Euler's method to solve the linear differential equation as given below. Plot the deflected shape of the curve. Also, find the maximum bending moment. **Cob5, CO5.**

Signature of faculty

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Department of Civil Engineering

LESSON PLAN

Academic Year : 2021-2022 **Date:** 13-07-2022

Name of the Program : M.Tech. **Year :** I **Semester:** II

Course/Subject: NA LAB **Course Code:** GR20D5021

Name of the Faculty: Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Department: Structural Engineering (CIVIL)

Designation: Assistant Professor/Professor

Lesson No: 10 **Duration of Lesson:** 1 hr

Lesson Title: Runge- Kutta Method.

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to solve Runge- Kutta Method with computer programming

TEACHING AIDS : White Board, Marker, Lab Manual.

TEACHING POINTS :

Runge- Kutta Method.

Assignment / Questions:

The differential equation is given by $y'' + xy' + y = 0, y(0) = 1, y'(0) = 0$

Obtain y for x = 0 (0.1) 0.1 by using Runge Kutta method. Take h = 0.1. **Cob5, CO5.**

Signature of faculty

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COURSE COMPLETION STATUS

Academic Year : 2021-22

Name of the Program : M.Tech **Year:** I Year **Semester:** II

Course/Subject : NA Lab **Course Code** : GR20D5021

Name of the Faculty : Mr. V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Dept.: Structural Engineering (Civil Engineering)

Actual Date of Completion & Remarks, if any

Tasks	Remarks	Objectives Achieved	Outcomes Achieved
Task - 1	27-04-2022 Task covered on time	1	1
Task - 2	04-05-2022 Task covered on time	1	1
Task - 3	11-05-2022 Task covered on time	2	2
Task - 4	18-05-2022 Task covered on time	3	3
Task - 5	25-05-2022 Task covered on time	3	3
Task - 6	01-06-2022 Task covered on time	3	3
Task - 7	24-06-2022 Task covered on time	4	4
Task - 8	01-07-2022 Task covered on time	4	4
Task - 9	08-07-2022 Task covered on time	5	5
Task - 10	15-07-2022 Task covered on time	5	5

Signature of HOD Signature of faculty

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

Gokaraju Rangaraju Institute of Engineering and Technology
Department of Civil Engineering
EVALUATION STRATEGY

Academic Year : 2021-2022

Name of the Program : M.Tech **Year:** I Year **Semester:** II

Course/Subject : NA LAB **Course Code** : GR20D5021

Name of the Faculty :V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Dept.: Structural Engineering (Civil Engineering)

1. TARGET:
a) Percentage for pass: 100%
b) Percentage of class:

First class with distinction	21
First class	-
Pass class	-
Total strength	21

2. COURSE PLAN & CONTENT DELIVERY

- 45 to 55 practice classes held for detailed demonstration of Syllabus and for analyzing real time problems in the class.

3. METHOD OF EVALUATION

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

3.2 ☐ Assignments/Seminars

3.3 ☐ Mini Projects

3.4 ☐ Quiz

3.5 ☐ Semester/End Examination

3.6 ☐ Others

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CO-PO-MAPPING

Academic Year : 2021-22 **Year: I** **Semester : II**

Course/Subject: NA LAB **Course Code: GR20D5021**

Dept: Structural Engineering

Name of the Programme: M.Tech

NA LAB / GR20D5021	**Program Outcomes**					
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**
1			M	M	M	
2		M	M	M	M	M
3	M		M		M	
4			M	M		M
5	M		M	M	M	
Actual PO	2.00	2.00	2.00	2.00	2.00	2.00

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RUBRICS FOR COURSE

Academic Year : 2021-2022

Name of the Program : M.Tech **Year:** I Year **Semester:** II

Course/Subject : NA LAB **Course Code**:GR20D5021

Name of the Faculty :V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Dept.: Structural Engineering (Civil Engineering)

		Beginning	Developing	Reflecting Development	Accomplished	Exemplary	Score
Name of the Student	**Performance Criteria**	**1**	**2**	**3**	**4**	**5**	
21241D2001	Level of knowledge on illustrating the fundamental concepts of matrices and its properties	Low Level	Able to understand	Able to understand and explain	Full Knowledge	Analyzing and application of knowledge	
	Level of knowledge on interpolation, differentiation and integration	Low Level	Able to understand	Able to understand and explain	Full Knowledge	Analyzing and application of knowledge	
	Level of knowledge on initial value problems and boundary value problems	Low Level	Able to understand	Able to understand and explain	Full Knowledge	Analyzing and application of knowledge	

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Department of Civil Engineering

Lab Internal Questions

Academic Year : 2021-2022
Name of the Program : M.Tech **Year:** I Year **Semester:** II

Course/Subject : NA LAB **Course Code** : GR20D5021

Name of the Faculty :V Naresh Kumar Varma/Dr. V Srinivasa Reddy

Dept.: Structural Engineering (Civil Engineering)

1. A fixed beam AB of length 10 m carries a udl of 10kN/m over its entire span. Determine the end moments. Draw Shear Force Diagram and Bending Moment Diagram. Also, write a program in C/C++ to find the points of contraflexure using Bisection method. **Cob1, CO1**

2. Determine the point(s) where slope is equal to zero for a simply supported beam AB of span 10 m carrying a concentrated load of 100 kN acting vertically downwards at a distance of 7m from the left end support A. Use Newtons method. **Cob1, CO1**

3. AB is simply supported beam having a length of 10m and flexural rigidity 'EI' as constant. The beam carries a uniformly distributed load of 10kN/m from the support A over a distance of 5m. Using method of least squares determine the equation of the deflected shape of the beam and find the deflection at any desired point on the curve. **Cob2, CO2**

4. The Axial Stiffness matrix of a bar is given as $K = \frac{AE}{L}\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 1 \end{bmatrix}$ and the Force vector is given by $F = \begin{bmatrix} 1000 \\ 1000 \\ -1000 \end{bmatrix} N$. The length 'L' of the bar is equal to 100 mm. Take AE=1. Find the nodal displacements using the relation KU=F, where the nodal displacement vector is given by $U = [U_1\ U_2\ U_3)^T$. using gauss elimination method. **Cob3, CO3**

5. The stiffness matrix and the nodal load vector is given below. Solve the simultaneous set of equations and find the nodal displacements. **Cob3, CO3**

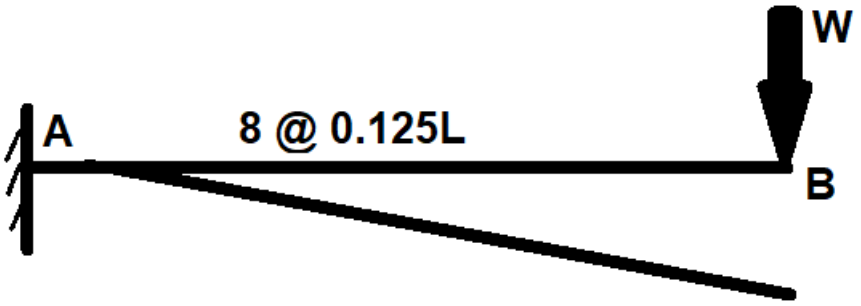
$$\begin{bmatrix} 409.93597 & -135.1495 & -120.3481 \\ -135.1495 & 195.2655 & -176.9319 \\ -120.3481 & -176.9319 & 121.587 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} = \begin{bmatrix} 1000 \\ 1000 \\ -1000 \end{bmatrix} N$$

Using Gauss - Seidal Iteration Method.

6. The flexibility matrix (*f*) and the displacement vector due to the external loading (D_L) for the portal frame is given below. Find the reactions shown as $P = \{P_1, P_2, P_3\}^T$ using Gauss Jorden Iteration Method. The Young's Modulus of Elasticity, E = 200 MPa and the moment of Inertia, $I = 3.5 \times 10^7$ mm^4 EI = 7000 kN-m^4 **Cob3, CO3**

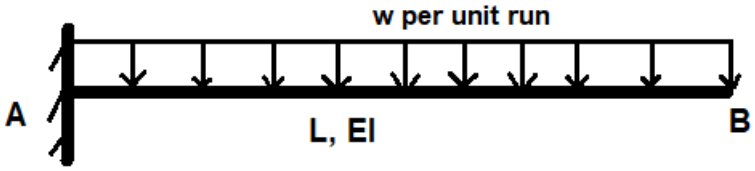
$$fP + D_L = \frac{1}{6EI}\begin{bmatrix} 750 & 375 & -150 \\ 375 & 2000 & -225 \\ -150 & -225 & 60 \end{bmatrix} \begin{bmatrix} P_1 \\ P_2 \\ P_3 \end{bmatrix} + \begin{bmatrix} 695/3EI \\ -1390/EI \\ 139/EI \end{bmatrix} = 0$$

7. A cantilever of length 'L' fixed at left end A and free at the right end B. The beam carries a point load 'W' acting vertically downwards at the free end. Using trapezoidal rule find the slope at the free end of the cantilever at B. Take the flexural rigidity 'EI' as constant. **Cob4, CO4**



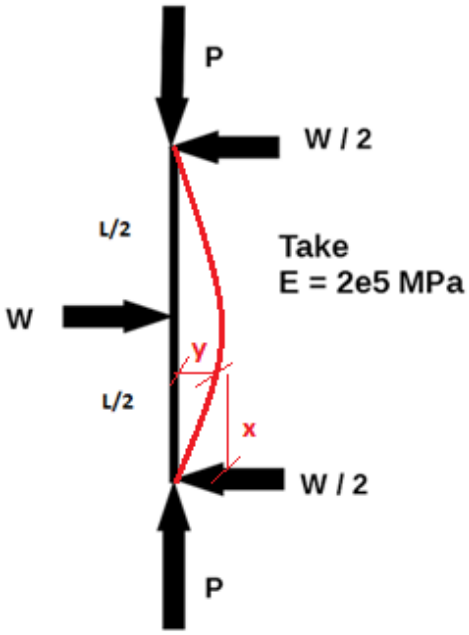
A cantilever beam carrying a point load at the free end

8. A cantilever AB is fixed at the left end A and free at the right end B. The beam carries a uniformly distributed load 'w' per unit run over its entire length 'L' as shown below. Using Simpson's rule find the slope at the free end of the cantilever at B. Take the flexural rigidity 'EI' as constant. **Cob4, CO4**



A Cantilever beam AB carries udl of intensity 'w' per unit run over its entire span

9. Determine the deflection using Euler's Method on the laterally loaded column as shown



Cob5, CO5

Laterally loaded column

10. The differential equation is given by $y' + xy = 0, y(0) = 1$

Obtain y for x = 1 by using Runge Kutta method with h = 0.25 **Cob5, CO5**

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NA LAB INTERNAL MARKS

Roll No	Lab Internals	Assessment Marks	Record Marks	Lab Attendance Marks	Sessional Marks
21241D2001	7	8	5	3	23
21241D2002	10	10	5	5	30
21241D2003	9	10	5	3	27
21241D2004	6	6	2	3	17
21241D2005	10	10	5	5	30
21241D2006	9	9	4	5	27
21241D2007	10	10	5	5	30
21241D2008	8	9	5	3	25
21241D2009	10	10	5	5	30
21241D2010	7	8	5	3	23
21241D2011	10	10	5	5	30
21241D2012	9	10	5	3	27
21241D2013	7	8	5	3	23
21241D2014	8	9	5	5	27
21241D2015	10	10	5	5	30
21241D2016	9	10	5	3	27
21241D2017	8	9	5	5	27
21241D2018	6	6	2	3	17
21241D2019	AB	5	2	3	10
21241D2020	6	6	2	3	17
21241D2021	8	9	5	3	25