An Assignment Manual for

Mathematics-III
(BE03000211)

B.E. Semester3
(Mechanical Engineering
Automobile Engineering)

Directorate of Technical
Education,Gandhinagar,Gujarat

Mathematics-III
(BE03000211)

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“College Name”

Certificate

This is to certify that Mr./Ms. ____ _________ Enrollment No. _________________ of B.E. Semester ______Branch ___________ Engineering of this Institute (GTU Code: ______) has satisfactorily completed the Assignment / Tutorial work for the subject **Mathematics –III** for the academic year 2025-26.

Place: ___________

Date: ___________

Name and Sign of Faculty member

Preface

Main objectives of assignment work of any subject are for pleasing to the eye on required skills as well as creating ability amongst students to solve real time problem by developing relevant competencies in psychomotor domain. By keeping in view, GTU has designed competency focused outcome-based curriculum for engineering degree programs where sufficient time given to Assignment or Tutorial work. It shows importance of enhancement of skills amongst the students, and it pays attention to utilize every second of time allotted for Assignment or Tutorial work amongst students, faculty members to achieve relevant outcomes by solving the Assignment or Tutorial rather than having simply study type classroom learning. It is must for effective implementation of competency focused outcome-based curriculum that every Assignment or Tutorial work is keenly designed to serve as a tool to develop and enhance relevant competency required by the various branch of engineering among every student. These psychomotor skills are exceedingly difficult to develop through traditional chalk and board content delivery method in the classroom. Accordingly, this lab manual is designed to focus on the Programme and Course Outcome defined relevant programme, rather than old practice of conducting Assignment or Tutorial to prove concept and theory.

By using this Assignment or Tutorial manual students can go through the relevant theory and numerical in advance which creates an interest and students can have basic practice prior to exam. This in turn enhances pre-determined outcomes amongst students. Each Assignment or Tutorial in this manual begins with understanding, utility, modeling, analytic and creativity other relevant skills, course outcomes as well as practical outcomes (objectives).

This Assignment or Tutorial also provides guidelines to faculty members to facilitate student centric Assignment or Tutorial activities through each Assignment or Tutorial by arranging and managing necessary resources in order that the students follow the procedures with required skill to achieve the outcomes. It also gives an idea that how students will be assessed by process of continuous evaluation system.

This course covers a broad spectrum of applied mathematics topics essential for engineering and scientific applications. It begins with an introduction to **Fourier series**, focusing on periodic functions, expansion of functions with period 2π2\pi2π or any arbitrary period, and the **Dirichlet conditions** for the convergence of Fourier series. It also explores Fourier series representations for **even and odd functions**, including **half-range expansions**. The section on **Partial Differential Equations (PDEs)** includes the formation of PDEs, solutions of first-order linear and non-linear PDEs using methods such as **Charpit's method**, and solutions of second and higher-order PDEs through the **complementary function and particular integral method**. It also includes the **classification of second-order PDEs** and the **method of separation of variables**, with applications to the **one-dimensional wave and heat equations**. The course further explores **finite differences and interpolation**, introducing difference operators and their interrelations, and methods such as **Newton's forward and backward formulas**, **Lagrange's interpolation**, **inverse interpolation**, and **Newton's divided difference method**. In **numerical differentiation and integration**, students learn to approximate derivatives using forward and backward difference formulas and apply integration techniques such as the **Newton-Cotes quadrature**, **Trapezoidal rule**, **Simpson's rules**, and **Gaussian quadrature**, supported by case studies. The module on **numerical solutions of ordinary differential equations** includes **Picard's method**, **Euler's method**, and **Runge-Kutta methods** (2nd and 4th order), with practical applications. Lastly, the course covers **Laplace transforms**, including direct and inverse transforms, **linearity**, **first and second shifting theorems**, transformations of derivatives and integrals, handling of **ODEs**, the **unit step and Dirac delta functions**, **convolution theorem**, and application to **integral equations**, **ODEs with variable coefficients**, and **systems of ODEs**.

Mathematics III (BE03000211)

CO-PO Matrices

Table

Sr. No.	COs	Statement
1	1	Establish the Fourier series expansion of periodic functions and perform its applications.
2	2	Apply suitable methods to solve partial differential equations. Model and solve some engineering problems related to heat and wave equations.
3	3	Estimate the intermediate values of the function from its tabulated values using appropriate interpolation formulas.
4	4	Perform numerical differentiation and integration and also solve ODEs using numerical methods.
5	5	Compute Laplace and inverse Laplace transforms of the various functions using its properties and apply them to solve ordinary differential equations

Table CO – PO Matrix

Sr. No.		PO1 Engineering knowledge	PO2 Problem analysis	PO3 Design/ development of solutions	PO4 Conduct investigations of complex problems	PO5 Modern tool usage	PO6 The engineer and society	PO7 Environment and sustainability	PO8 Ethics	PO9 Individual and team work	PO10 Communication	PO11 Project management and finance	PO12 Life-long learning
1	CO1												
2	CO2												
3	CO3												
4	CO4												
5	CO5												

Guidelines for Faculty members

1. Teacher should provide the guideline with demonstration some problems to the students.
2. Teacher shall explain in shortly, basic concepts/theory related to the Assignment or Tutorial to the students before starting of each Assignment or Tutorial
3. Involve all the students in Assignment or Tutorial.
4. Teacher is expected to share the skills and competencies to be developed in the students and ensure that the respective skills and competencies are developed in the students after the completion of the Assignment or Tutorial.
5. Teachers should give opportunity to students for hands-on experience after the demonstration.
6. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected from the students.

7. Give assignment and assess the performance of students based on task assigned to check whether it is as per the instructions or not.

8. Teacher is expected to refer complete curriculum of the course and follow the guidelines for implementation.

Instructions for Students

1. Students are expected to carefully listen to all the theory classes delivered by the faculty members and understand the COs, content of the course, teaching and examination scheme, skill set to be developed etc.
2. Students shall organize the work in the group and make record of all work.
3. Students shall develop maintenance skill as expected by course.
4. Student shall attempt to develop related hand-on skills and build confidence.
5. Student shall develop the habits of evolving more ideas, innovations, skills etc. apart from those included in scope of manual.
6. Student shall refer bookand resources.
7. Student should develop a habit of submitting the Assignment or Tutorial work as per the schedule and s/he should be well preparedfor the same.

Index
(Progressive Assessment Sheet)

Sr. No.	Objective(s) of Experiment	Page No.	Date of starting	Date of submission	Marks	Sign	Remarks
Total							

Date:	
Assignment No: 01	
Topic:	Fourier series
Sub Topics:	Periodic functions, Fourier series of functions of 2π or any other period, Dirichlet's condition for convergence of Fourier series, Fourier series of even and odd functions, Half-range Fourier series
Relevant CO:	Establish the Fourier series expansion of periodic functions and perform its applications.
Objectives:	1. To express any periodic function (with period 2π or T) as a sum of sine and cosine functions. 2. To represent a function defined only on a half-interval [0,L] using either only sine (odd extension) or cosine (even extension) terms.

Sr. No.	**Question**	**CO**	**PI**	**B.T. level**
1	**Find** the fundamental period p of (i) $\cos\frac{2\pi x}{k}$ (ii) $\cos\frac{2\pi n x}{k}$	CO1	2.1.1	U, A
2	**Find** the Fourier series of the function $f(x)$ which is assumed to have the period 2π, where $f(x)$ is as follows (i) $f(x)=x, \quad -\pi<x<\pi$ (ii) $f(x)=x^2, \quad 0<x<2\pi$ (iii) $f(x)=x+\lvert x\rvert, \quad -\pi<x<\pi$	CO1	2.1.2	U, A
3	**Find** the Fourier series of the function $f(x)$ which is assumed to have the period 2π, where $f(x)$ is as follows (i) $f(x)=\begin{cases}1 & if \quad -\pi<x<0\\ -1 & if \quad 0<x<\pi\end{cases}$ (ii) $f(x)=\begin{cases}x & if \quad -\pi/2<x<\pi/2\\ 0 & if \quad \pi/2<x<3\pi/2\end{cases}$	CO1	2.1.3	U, A
4	**Find** the Fourier series of the periodic function $f(x)$ of period $p=2l$, (i) $f(x)=\begin{cases}-1 & if \quad -1<x<0\\ 1 & if \quad 0<x<1\end{cases}$ (ii) $f(x)=\begin{cases}(1/2)+x & -(1/2)<x<0\\ (1/2)-x & 0<x<(1/2)\end{cases}$	CO1	1.1.1	U, A
5	**Check** whether the following functions are odd or even. (i) $\lvert x^3\rvert$ (ii) $x^2\cos nx$ (iii) $x\lvert x\rvert$ (iv) e^x (v) $\ln x$	CO1	2.1.2	U, A
6	**Obtain** the Fourier Series of the function $f(x)=cosx, \quad for \ -\pi<x<0$; $= sinx, \quad for \ 0<x<\pi$	CO1	1.2.1	U, A
7	**Find** the Fourier Series of $f(x)=x+\lvert x\rvert$, $\quad -\pi<x<\pi$	CO1	2.1.2	U, A
8	**Find** Fourier Cosine Series of $f(x)=e^x$, $\quad 0<x<L$	CO1	1.1.1	U, A
9	**Find** Half range sine series of $f(x)=\{2x \quad , \ 0<x<1$ 4 $\quad -2x \quad , \ 1<x<2$	CO1	1.1.2	U, A
10	**Find** Fourier Series for the function $f(x)=x-\lvert x\rvert \ , \ -\pi<x<0$; $=x+\lvert x\rvert \ , \ 0<x<\pi$. Also show that $1-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+\cdots=\frac{\pi}{4}$	CO1	2.1.1	U, A

B.T.Level: R: Remembering,U: Understanding,A: Applying,N: Analyzing,E: Evaluating, C: Creating

Date:	
Assignment No: 2	
Topic:	Partial Differential Equations
Sub Topics:	Formation of partial differential equations, solution of first order linear and non-linear partial differential equations, Charpit's method.
Relevant CO:	Apply suitable methods to solve partial differential equations. Model and solve Some engineering problems related to heat and wave equations.
Objectives:	1. Explains formation of PDEs by eliminating arbitrary constants. 2. Explains formation of PDEs by eliminating arbitrary functions. 3. Explain Direct integration method 4. Use of langrage's method to solve first order linear PDE 5. Explain solutions of non linear PDEs of first order 6. Use of Charpit's method to solve first order non linear PDEs

Sr. No.	Question	CO	PI	B.T. level
Form PDE from following (1 & 2) equations by eliminating arbitrary constants				
1	$z=(x-a)^2+(y-b)^2$	CO2	1.2.1	U
2	$z=(x^2+a)(y^2+b)$	CO2	1.2.1	U
Form PDE from following (3 & 4) equations by eliminating arbitrary Functions				
3	$z = y^2 + 2f\left(\frac{1}{x} + lny\right)$	CO2	1.2.1	U
4	$F\left(\frac{x-y}{xy}, \frac{x-y}{z}\right) = 0$	CO2	1.2.1	U
Solve following (5 to 16) Linear Partial Differential Equations (Lagrange's equations).				
5	$(y-z)p + (x-y)q = (z-x)$	CO2	2.4.1	U
6	$z(xp - yq) = y^2 - x^2$	CO2	2.4.1	U
7	$y^2p - xyq = x(z-2y)$	CO2	2.4.1	U
8	$x(y-z)p + y(z-x)q = z(x-y)$	CO2	2.4.1	U
9	$y^2zp - x^2zq = x^2y$	CO2	2.4.1	U
10	$pz - qz = z^2 + (x+y)^2$	CO2	2.4.1	U
11	$(mz-ny)p + (nx-lz)q = ly - mx$	CO2	2.4.1	U
12	$pz + qz = z^2 + (x-y)^2$	CO2	2.4.1	U
13	$(x^2+y^2+z^2)p + zxyq = 2xz$	CO2	2.4.1	U
14	$(x^2-yz)p + (y^2-zx)q = (z^2-xy)$	CO2	2.4.1	U
Solve following (17 to 11) Non- linear partial differential equations.				
15	$p^2 + q^2 = 1$			
16	$p(1+q^2) = q(z-1)$	CO2	2.4.1	U
17	$p(1+q) = qz$	CO2	2.4.1	U
18	$p^2 - q^2 = x - y$	CO2	2.4.1	U
19	$p^2 - q^2 = x^2 + y^2$	CO2	2.4.1	U
20	$z = px + qy + \frac{p}{q-p}$	CO2	2.4.1	U
Solve following (17 to 11) Non- linear partial differential equations using Charpit's Method.				
21	$px + qy = pq$	CO2	2.4.1	U
22	$(p^2+q^2)y = qz$	CO2	2.4.1	U
23	$z^2 = pqxy$	CO2	2.4.1	U

B.T.Level: R: Remembering,U: Understanding,A: Applying,N: Analyzing,E: Evaluating, C: Creating

Date:	
Assignment No: 3	
Topic:	Partial Differential Equations
Sub Topics:	Solution of homogeneous and non homogeneous linear partial differential equations of second and higher order by complementary function and particular integral method, method of separation of variables, One-dimensional wave equation and heat equation.
Relevant CO:	Apply suitable methods to solve partial differential equations. Model and solve Some engineering problems related to heat and wave equations.
Objectives:	1. Explain solutions of Higher order linear PDE 2. Explain separation of variables method 3. Understand modeling of real-world problems using concept of PDE 4. Explain modeling of Heat equation and Wave equation s with initial and boundary value conditions and derive their solutions.

Sr. No.	**Question**	**CO**	**PI**	**B.T. level**
Solve following (1 to 3) second order homogeneous PDEs.				
1	$\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial x \partial y} - 12\frac{\partial^2 z}{\partial y^2} = 3e^{2x-3y}$	CO2	2.4.1	U
2	$\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial x \partial y} = \cos(2x-3y)$	CO2	2.4.1	U
3	$\frac{\partial^2 z}{\partial x \partial y} - \frac{\partial^2 z}{\partial y^2} = x^2 y^3$	CO2	2.4.1	U
4	Using method of separation of variables solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$ given that $u(x,0) = 6e^{-3x}$.	CO2	2.4.1	U, A
5	Using method of separation of variables solve $\frac{\partial u}{\partial t} = 4\frac{\partial^2 u}{\partial x^2}$given that $u(x,0) = 4x - \frac{1}{2}x^2$.	CO2	2.4.1	U,A
6	**Discuss** all possible solutions for a heat conduction problem in a rod of length *l* whose ends are held at zero temperature and *f(x)* is initial temperature distribution.	CO2	2.1.1	R,U
7	**Find** the temperature in the thin metal rod of length l with both ends insulated and initial temperature is $sin\frac{\pi x}{l}$. Use one-dimensional heat equation$\frac{\partial u}{\partial t} = c^2\frac{\partial^2 u}{\partial x^2}$.	CO2	2.4.1	U,A
8	**Derive** one dimensional wave equation that governs small vibration of an elastic string of length *l* whose both ends are fixed. Also state physical assumptions that you make for the system.	CO2	2.1.1	R, U
9	A string is streched between two fixed points and the points of the string are given initial velocity$g(x)$, where $g(x) = \begin{cases} \frac{2x}{l} & , 0 < x < \frac{l}{2} \\ \frac{2(l-x)}{l} & , \frac{l}{2} < x < l \end{cases}$, *x* being the distance from the first end point. **Find** the displacement of the string at any time. Use wave equation$\frac{\partial^2 y}{\partial t^2} = c^2\frac{\partial^2 y}{\partial x^2}$.	CO2	2.4.1	U,A
10	A string of length $l = \pi$ has its ends fixed at $x = 0$ and $x = \pi$. At any time $t = 0$, the string is given a shape defined by $f(x) = 50x(\pi - x)$, then it is realesd. **Find** the deflection of string at any time t.	CO2	2.4.1	U,A

B.T.Level: R: Remembering,U: Understanding,A: Applying,N: Analyzing,E: Evaluating, C: Creating

Date:	
Assignment No: 04	
Topic:	Interpolation
Sub Topics:	Finite difference operators and their relations, Newton’s forward and backward difference methods
Relevant CO:	Estimate the intermediate values of the function from its tabulated values using appropriate interpolation formulas.
Objectives:	1. To estimate the value of a function near the **beginning** of a data table. 2. Uses **forward differences** of known data points. 3. To estimate the value of a function near the **end** of a data table. 4. Uses **backward differences**.

<table>
<tr><th>Sr. No.</th><th>Question</th><th>CO</th><th>PI</th><th>B.T. level</th></tr>
<tr><td>1</td><td>Define the operators, Δ, ∇, δ and E, E^{-1} and show that

(i) $\Delta \equiv E\nabla$ (ii) $E = 1 + \Delta$ (iii) $\nabla = E^{-1}\Delta$ (iv) $E^{-1} \equiv 1 - \nabla$</td><td>CO3</td><td>2.4.1</td><td>R, U</td></tr>
<tr><td>2</td><td>Obtain the estimate of missing terms in the following table:
<table>
<tr><td>X</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td>Y</td><td>2</td><td>4</td><td>8</td><td>-</td><td>32</td><td>-</td><td>128</td><td>256</td></tr>
</table></td><td>CO3</td><td>2.4.2</td><td>U, A</td></tr>
<tr><td>3</td><td>Express $f(x) = 2x^3 - 3x^2 + 3x - 10$ in factorial polynomial and ,hence, show that $\Delta^3 f(x) = 12$.</td><td>CO3</td><td>2.4.4</td><td>U, A</td></tr>
<tr><td>4</td><td>Find cosh 0.56 from Newton’s forward difference interpolation formula and Estimate the error for the following data.
<table>
<tr><td>x</td><td>0.5</td><td>0.6</td><td>0.7</td><td>0.8</td></tr>
<tr><td>Cos hx</td><td>1.127626</td><td>1.185465</td><td>1.255169</td><td>1.337435</td></tr>
</table></td><td>CO3</td><td>1.1.1</td><td>U, A</td></tr>
<tr><td>5</td><td>Using Newton’s forward interpolation formula, find the value of $f(5)$ if
<table>
<tr><td>x</td><td>4</td><td>6</td><td>8</td><td>10</td><td>12</td></tr>
<tr><td>f(x)</td><td>1</td><td>3</td><td>8</td><td>16</td><td>20</td></tr>
</table></td><td>CO3</td><td>1.1.2</td><td>U, A</td></tr>
<tr><td>6</td><td>Using Newton’s forward interpolation formula, Find $\sin 52^\circ$ from following data
<table>
<tr><td>$\sin 45^\circ$</td><td>$\sin 50^\circ$</td><td>$\sin 55^\circ$</td><td>$\sin 60^\circ$</td></tr>
<tr><td>0.7071</td><td>0.7660</td><td>0.8192</td><td>0.8660</td></tr>
</table></td><td>CO3</td><td>1.2.1</td><td>U, A</td></tr>
<tr><td>7</td><td>Find $y(300)$ from the given values using Newton’s backward Interpolation formula.
<table>
<tr><td>x</td><td>50</td><td>100</td><td>150</td><td>200</td><td>250</td></tr>
<tr><td>y</td><td>618</td><td>724</td><td>805</td><td>906</td><td>1032</td></tr>
</table></td><td>CO3</td><td>1.3.1</td><td>U, A</td></tr>
<tr><td>8</td><td>The area A of a circle of diameter d is given for the following values:
<table>
<tr><td>d</td><td>80</td><td>85</td><td>90</td><td>95</td><td>100</td></tr>
<tr><td>A</td><td>5026</td><td>5674</td><td>6362</td><td>7088</td><td>7854</td></tr>
</table>
Find the area of a circle of a diameter of 105 units using Newton’s backward Interpolation formula.</td><td>CO3</td><td>1.4.1</td><td>U, A</td></tr>
<tr><td>9</td><td>From the following data, Find the profit in the year 1925.
<table>
<tr><td>Year</td><td>1891</td><td>1901</td><td>1911</td><td>1921</td><td>1931</td></tr>
<tr><td>Profit in the lakhs</td><td>46</td><td>66</td><td>81</td><td>93</td><td>101</td></tr>
</table></td><td>CO3</td><td>1.2.1</td><td>U, A</td></tr>
<tr><td>10</td><td>Find P when t = 175^0C from the given table, using Newton’s backward Interpolation formula
<table>
<tr><td>Temperature t^0 C</td><td>140</td><td>150</td><td>160</td><td>170</td><td>180</td></tr>
<tr><td>Pressure P</td><td>3685</td><td>4845</td><td>6302</td><td>8076</td><td>10225</td></tr>
</table></td><td>CO3</td><td>1.4.1</td><td>U, A</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Date:	
Assignment No: 05	
Topic:	Interpolation
Sub Topics:	Lagrange’s interpolation method, Inverse interpolation, Newton’s divided difference method
Relevant CO:	Estimate the intermediate values of the function from its tabulated values using appropriate interpolation formulas.
Objectives:	1. Understand the concept of unequal interval interpolation formula. 2. Determine missing value for unequal intervals. 3. To interpolate data using a **polynomial with unequally spaced x-values**.

<table>
<tr><th>Sr. No.</th><th>Question</th><th>CO</th><th>PI</th><th>B.T. level</th></tr>
<tr><td>1</td><td>Find $f(6)$ from the following data, by using Newton's divided difference interpolation formula:
<table><tr><td>x</td><td>1</td><td>2</td><td>7</td><td>8</td></tr><tr><td>f(x)</td><td>1</td><td>5</td><td>5</td><td>4</td></tr></table></td><td>CO3</td><td>1.2.1</td><td>R, U</td></tr>
<tr><td>2</td><td>Compute $f(4)$, from the tabular values given:
<table><tr><td>x</td><td>2</td><td>3</td><td>5</td><td>7</td></tr><tr><td>$f(x)$</td><td>0.1506</td><td>0.3001</td><td>0.4517</td><td>0.6259</td></tr></table>
using Lagrange's interpolation formula.</td><td>CO3</td><td>2.1.2</td><td>U, A</td></tr>
<tr><td>3</td><td>Find the polynomial which takes the values $f(1) = 1,\ f(2) = 9,\ f(3) = 5,\ \ f(4) = 55,\ f(5) = 105$.</td><td>CO3</td><td>1.1.2</td><td>U, A</td></tr>
<tr><td>4</td><td>Calculate $e^{1.85}$ from the following table:
<table><tr><td>x</td><td>1.7</td><td>1.8</td><td>1.9</td><td>2</td><td>2.1</td><td>2.2</td><td>2.3</td></tr><tr><td>e^x</td><td>5.474</td><td>6.050</td><td>6.686</td><td>7.389</td><td>8.166</td><td>9.025</td><td>9.974</td></tr></table></td><td>CO3</td><td>2.1.2</td><td>U, A</td></tr>
<tr><td>5</td><td>The values of specific heat (C_p) at constant pressure of a gas are tabulated below for various temperatures. Find the specific heat at $900^{\circ}C$.
<table><tr><td>Temperature °C</td><td>500</td><td>1000</td><td>1500</td><td>2000</td></tr><tr><td>C_p</td><td>31.23</td><td>35.01</td><td>39.18</td><td>43.75</td></tr></table></td><td>CO3</td><td>1.4.1</td><td>U, A</td></tr>
<tr><td>6</td><td>Compute $f(10.5)$, from the given values by using Newton's divided difference Interpolation formula
<table><tr><td>x</td><td>10</td><td>11</td><td>13</td><td>17</td></tr><tr><td>$f(x)$</td><td>2.3026</td><td>2.3979</td><td>2.5649</td><td>2.8332</td></tr></table></td><td>CO3</td><td>2.1.2</td><td>U, A</td></tr>
<tr><td>7</td><td>Find x corresponding to $y = 85$ from the following table:
<table><tr><td>x</td><td>2</td><td>5</td><td>8</td><td>14</td></tr><tr><td>y</td><td>94.8</td><td>87.9</td><td>81.3</td><td>68.7</td></tr></table></td><td>CO3</td><td>1.3.1</td><td>U, A</td></tr>
<tr><td>8</td><td>Develop Newton's divided difference polynomial for the following data.
ln 9.0 = 2.1972, ln 9.5 = 2.2513, ln 11.0 = 2.3979.</td><td>CO3</td><td>2.4.2</td><td>U, A</td></tr>
<tr><td>9</td><td>Find $f(9.2)$ from the given values using Newton's divided difference Interpolation formula.
<table><tr><td>x</td><td>8.0</td><td>9.0</td><td>9.5</td><td>11.0</td></tr><tr><td>$f(x)$</td><td>2.079442</td><td>2.197225</td><td>2.251292</td><td>2.397895</td></tr></table></td><td>CO3</td><td>1.3.1</td><td>U, A</td></tr>
<tr><td>10</td><td>Find x given y = 0.3887 from the following data:
<table><tr><td>x</td><td>21</td><td>23</td><td>25</td></tr><tr><td>y</td><td>0.3706</td><td>0.4068</td><td>0.4433</td></tr></table></td><td>CO3</td><td>2.1.1</td><td>U, A</td></tr>
</table>

B.T. Level: R: Remembering, U: Understanding, A: Applying, N: Analyzing, E: Evaluating, C: Creating

Date:	
Assignment No: 06	
Topic:	Numerical Differentiation
Sub Topics:	Derivatives using forward difference and backward difference formulae
Relevant CO:	Perform numerical differentiation and integration and also solve ODEs using numerical methods.
Objectives:	1. **Newton's Forward Difference Formula** is used when the point of interest is near the **beginning** of the data set. 2. **Newton's Backward Difference Formula** is used when the point of interest is near the **end** of the data set.

Sr. No.	Question	CO	PI	B.T. level
1	Write derivatives formulae using forward difference and backward difference.	CO4	1.1.1	R
2	Given that x: 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 y: 7.989, 8.403, 8.781, 9.129, 9.451, 9.750, 10.031 **Find** $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at x = 1.1 .	CO4	1.1.2	U
3	Given that x: 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 y: 7.989, 8.403, 8.781, 9.129, 9.451, 9.750, 10.031 **Find** $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at x = 1.6 .	CO4	1.1.2	U
4	**Compute** $f'(2.2)$,using appropriate method from the following data: x: 1.4, 1.6, 1.8, 2.0, 2.2 f(x): 4.0552, 4.9530, 6.0496, 7.3981, 9.0250	CO4	1.1.2	U
5	Given that x: 0, 5, 10, 15, 20 y: 1.5708, 1.5738, 1.5828, 1.5981, 1.62 **Find** $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at x = 3.	CO4	1.4.1	U, A
6	Using the backward differences, **compute** the derivative of the tabulated function given below at x = 0.4. x: 0.1, 0.2, 0.3, 0.4 y: 1.10517, 1.22140, 1.34986, 1.49182	CO4	2.1.2	U, A

B.T.Level: R: Remembering,U: Understanding,A: Applying,N: Analyzing,E: Evaluating, C: Creating

Date:	
Assignment No: 07	
Topic:	Numerical Integration
Sub Topics:	Newton-Cotes quadrature formulae, Trapezoidal rule, Simpson's rules, Gaussian integration, Case studies
Relevant CO:	Perform numerical differentiation and integration and also solve ODEs using numerical methods.
Objectives:	1. **Newton's Forward Difference Formula** is used when the point of interest is near the **beginning** of the data set. 2. **Newton's Backward Difference Formula** is used when the point of interest is near the **end** of the data set.

B.T.Level: R: Remembering,U: Understanding,A: Applying,N: Analyzing,E: Evaluating, C: Creating

Sr. No.	Question	CO	PI	B.T. level
1	**Evaluate** $\int_0^{\frac{\pi}{2}} e^{\sin\theta}\, d\theta$ by **using** Simpson's 3/8 rule, dividing the interval $\left[0,\frac{\pi}{2}\right]$ into six equal parts.	CO4	2.1.1	U, A
2	**Evaluate** $\int_1^2 \frac{dx}{1+x^2} dx$ taking $h = 0.2$,**using** trapezoidal rule.	CO4	2.1.2	U, A
3	**Evaluate**$\int_0^6 \frac{dx}{1+x^2} dx$ by **using** (i) trapezoidal rule, (ii) Simpson's 1/3 rule, (iii) Simpson's 3/8 rule.	CO4	2.1.3	U, A
4	**Evaluate**$\int_4^{5.2} logx\, dx$ **using** the trapezoidal rule and Simpson's 3/8 rule take h=0.2.	CO4	1.1.1	U, A
5	**Evaluate**$\int_0^1 (1+\frac{sinx}{x}) dx$ correct to three decimal places, by **using** (i) trapezoidal rule, (ii) Simpson's 1/3 rule, (iii) Simpson's 3/8 rule.	CO4	2.1.2	U, A
6	**Compute** the value of $\int_{0.2}^{1.4} (sin\, sinx - log\, logx + e^x) dx$ taking $h = 0.2$ and **using** the trapezoidal rule and Simpson's rule.	CO4	1.2.1	U, A
7	**Evaluate**$\int_{0.5}^{0.7} \sqrt{x}\, e^{-x} dx$ **using** Simpson's 3/8 rule.	CO4	2.1.2	U, A
8	**Evaluate** $\int_0^{\frac{\pi}{2}} sinxdx$ by the two-point Gaussian formula.	CO4	1.1.1	U, A
9	**Evaluate** $\int_0^1 e^{-x^2}\, dx$ by using the Gaussian quadrature formula with $n = 3$.	CO4	1.1.2	U, A
10	**Evaluate**$\int_0^{\frac{\pi}{2}} log(1+x) dx$ by the two-point Gaussian formula.	CO4	2.1.1	U, A

Date:	
Assignment No: 08	
Topic:	Numerical Solution of Ordinary Differential Equations
Sub Topics:	Picard’s method, Euler’s method, Runge-Kutta 2nd and 4th order method, Case studies
Relevant CO:	Perform numerical differentiation and integration and also solve ODEs using numerical methods.
Objectives:	1. Understand the concept of numerical solution of differential equations. 2. Apply Picard's method to solve the differential equation with the initial value problem. 3. To provide a simple numerical approach for solving **first-order ordinary differential equations (ODEs)** with initial values. 4. To improve the accuracy over Euler’s method while keeping the computational cost relatively low.

Sr. No.	**Question**	**CO**	**PI**	**B.T. level**
1	**Using** the Picard’s method , **find** $y(1.1)$ correct to four decimal places given that $\frac{dy}{dx} = xy^{\frac{1}{3}}, y(1) = 1, h = o.1.$	CO4	2.1.1	U, A
2	**Solve** $\frac{dy}{dx} = x + y$ by Picard's method. Start from $x = 1, y = 0$ and carry to $x = 1.2$ with $h = o.1.$	CO4	2.1.2	U, A
3	**Solve** $\frac{dy}{dx} = x^2 + y^2$ by the Picard’s method, with $y(0) = 0$ at $x = 0.4.$	CO4	2.2.1	U, A
4	**Solve** $\frac{dy}{dx} = xy$ by **using** Euler’s method, with $y(0) = 2, h = 0.2$ at $x = 1.$	CO4	2.1.1	U, A
5	**Solve** $\frac{dy}{dx} = x + y + xy$ by **using** Euler’s method, with $y(0) = 1, h = 0.025$ at $x = 1.$	CO4	2.1.2	U, A
6	**Solve** $\frac{dy}{dx} = x + \sqrt{y}$ by **using** Euler’s method, with $y(2) = 4, h = 0.2$ at $x = 3.$	CO4	2.2.1	U, A
7	**Solve** $\frac{dy}{dx} = \frac{y-x}{y+x}$ by **using** Runge Kutta method, with $y(0) = 1, h = 0.2$ at $x = 2.2.$	CO4	2.2.4	U, A
8	**Solve** $\frac{dy}{dx} = xy^2$ by **using** Runge Kutta method with $y(2) = 1$ for $x = 2.2$ taking $h = 0.2.$	CO4	1.3.1	U, A
9	**Solve** $\frac{dy}{dx} = x - y^2$ by **using** Runge Kutta method with $y(0) = 1$for $x = 0.2$ taking $h = 0.1.$	CO4	1.2.1	U, A
10	**Solve** $\frac{dy}{dx} = x + y$ by **using** Runge Kutta method with $y(0) = 1$ for $x = 2.2$ taking $h = 0.2.$	CO4	1.2.1	U, A

B.T.Level: R: Remembering,U: Understanding,A: Applying,N: Analyzing,E: Evaluating, C: Creating

Date:	
Assignment No: 09	
Topic:	Laplace Transforms:
Sub Topics:	Laplace transform and Inverse Laplace transform, linearity, first shifting theorem (s-shifting), transforms of derivatives and integrals, unit step function (Heaviside function), second shifting theorem (t-Shifting), integral equations, differentiation and integration of transforms,
Relevant CO:	Compute Laplace and inverse Laplace transforms of the various functions using its properties and apply them to solve ordinary differential equations
Objectives:	1. Define LT and use of definition to derive LT of standard functions. 2. Explain Linearity of LT and LT of product of functions 3. Explain Inverse Laplace transforms. 4. Explains LT of derivatives and of integral functions. 5. Explains first shifting theorem for LT and ILT 7. Explain Unit step functions and second shifting theorem 8. Explain LT of functions division by t and ILT of functions division by s

Sr. No.	Question	CO	PI	B.T. level
	Using Appropriate rule **find** Laplace Transforms of folllowing functions (1 to 6)			
1	$f(t)=\begin{cases}0 & if\ 0\le t<3\\ 4 & if\ t\ge 3\end{cases}$	CO5	2.1.1	R,U
2	(i) e^{2t+3} (ii) $\cos^2 t$ (iii) $t^5+\cos 5t+e^{-100t}$ (iv) $e^{4t}\sin 2t\cos t$	CO5	2.4.1	U
3	(i) $\int_0^t e^{-u}\cos u\,du$ (ii) $\int_0^t\int_0^t \sin au\,du\,du$	CO5	2.4.1	U
4	(i) $t^2\cos^2 2t$ (ii) $t\sin 3t\cos 2t$ (iii) $te^t sint$	CO5	2.4.1	U, A
5	(i) $\frac{1-\cos 2t}{t}$ (ii) $\frac{e^{-bt}-e^{-at}}{t}$	CO5	2.4.1	U, A
6	(i) $e^{-3t}u(t-2)$ (ii) $t^2u(t-2)$	CO5	2.4.1	U,A
	Using Appropriate rule **find** Inverse Laplace Transforms of following functions (7 to 11)			
7	(i) $\frac{s+7}{s^2+8s+25}$ (ii) $\frac{s}{(s+1)^2+9}$ (iii) $\frac{s}{s^2-3s+2}$	CO5	2.4.1	U
8	(i) $\frac{1}{s(s^2-3s+3)}$ (ii) $\frac{1}{s(s^2+4)}$	CO5	2.4.1	U,A
9	(i) $\ln\left(\frac{s^2+a^2}{s^2+b^2}\right)$ (ii) $\tan^{-1}\left(\frac{2}{s}\right)$	CO5	2.4.1	U,A
10	$\frac{s+2}{(s^2+4s+5)^2}$	CO5	2.4.1	U, A
11	(i) $\frac{e^{-2\pi s}-e^{-8\pi s}}{s^2+1}$ (ii) $\frac{e^{-3s}}{s^2+8s+25}$	CO5	2.4.1	U, A
12	**Define** Unit step function and **Find** Laplace transform of $f(t)=\begin{cases}2, & 0<t<1\\ t^2/2, & 1<t<\pi/2\\ \cos t, & t>\pi/2\end{cases}$	CO5	2.4.1	R, A

B.T.Level: R: Remembering,U: Understanding,A: Applying,N: Analyzing,E: Evaluating, C: Creating

Date:	
Assignment No: 10	
Topic:	Laplace Transforms:
Sub Topics:	Laplace transform of periodic functions, short impulses, Dirac’s delta function, convolution, ODEs with variable coefficients, systems of ODEs
Relevant CO:	Compute Laplace and inverse Laplace transforms of the various functions using its properties and apply them to solve ordinary differential equations
Objectives:	1. Explain LT of periodic functions] 2. Understand convolution and statement of convolution theorem 3. Understand ILT using convolution theorem 4. Explain IVP and solution of ODE using LT 5. Explain Dirac’s delta function and use it 6. Use of LT to solve ODE, OPE with variable coefficient and Simultaneous ODES.

Sr. No.	Question	CO	PI	B.T. level
1	**Find** Laplace transform of periodic function $f(t)=\frac{2t}{3};0\le t\le 3; f(t+3)=f(t)$.	CO5	2.4.1	R,U
2	**Find** convolution of t and e^t.	CO5	2.4.1	U
3	**Find** $L^{-1}\left(\frac{2\pi s}{(s^2+\pi^2)^2}\right)$ using Convolution theorem.	CO5	2.4.1	U
4	Find Inverse Laplace Transform of following using Convolution theorem $(i)\frac{3s^2+2}{(s+1)(s+2)(s+3)}$ $(ii)\frac{4s+5}{(s-1)^2(s+2)}$ $(iii)\frac{s^2}{(s^2+25)(s^2+49)}$	CO5	2.4.1	U, A
5	**Solve** the initial value problem $y''-y'-2y=0, y(0)=1, y'(0)=0$ using Laplace transform.	CO5	2.4.1	U,A
6	**Using** the Laplace transforms, **find** the solution of the initial value problem $y''+25y=10\cos 5t, \quad y(0)=2, y'(0)=0$.	CO5	2.4.1	U,A
7	**Solve** $\frac{dy}{dt}-4y=2e^{2t}+e^{4t}$ by Laplace transformation	CO5	2.4.1	U,A
8	**Solve** the IVP $y''+2y'+y=e^{-t}, y(0)=-1, y'(0)=1$ using Laplace transform	CO5	2.4.1	U
9	Define Dirac's delta function and find the solution of $\frac{d^2x}{dt^2}+3\frac{dx}{dt}+2x=1+\delta(t-4), x(0)=x(0)^{\cdot}=0$	CO5	2.4.1	R,A
10	**Solve** the system of ODEs $\frac{dx}{dt}+y=1, x+\frac{dy}{dt}=2$ where $x(0)=1, y(0)=1.$	CO5	2.4.1	U,A
11	**Solve** $y''-ty'+y=1, y(0)=1, y'(0)=2$ by Laplace transformation	CO5	2.4.1	U,A
12	**Solve** $ty''+(1-2t)y'-2y=0, y(0)=1, y'(0)=2$ by Laplace transformation	CO5	2.4.1	U,A

B.T.Level: R: Remembering,U: Understanding,A: Applying,N: Analyzing,E: Evaluating, C: Creating