

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE –**RAIGAD -402 103****Semester Examination – May - 2019****Branch: Mechanical Engineering****Sem.:- IV****Subject with Subject Code:- Numerical Method in Mechanical Engineering (BTMEC404)****Marks: 60****Date:- 22/5/2019****Time:- 3 Hr.****Instructions to the Students**

1. Each question carries 12 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately assume it and should mention it clearly

Q.1. a) Round off the following to four significant digits 04

3.26425, 35.46735, 0.00032217, 6.248359

b) The measuring length of bridge and rivet are 9999 and 9 cm respectively, whereas the true value are 10,000 and 10 cm respectively, Compute true error and true percent relative error for each case. 04

c) A body travels uniformly a distance of (13.8 ± 0.2) in a time (4.0 ± 0.3) find velocity of body with in error limits. 04

Q.2. a) Explain the concept of bisection method graphically and write the necessary conditions to find out the real root by bisection method. 06

b) The volume V of liquid in a spherical tank of radius r is related to the depth h of the liquid by $V = \frac{\pi h^2(3r-h)}{3}$. Determine h using Newton-Raphson Method, given r = 1 m, and V = 0.5 m³ 06

Q.3. a) Use Cramer's rule to solve system of equation 04

$$-x + 3y - 2z = 5; \quad 4x - y - 3z = -8; \quad 2x + 2y - 5z = 7.$$

b) Solve the system of equation with pivoting with pivoting 04

$$0.0003120x + 0.006032y = 0.003328; \quad 0.5000x + 0.894y = 0.9471$$

c) Monthly Faculty salary in three departments of an institute is given below, Assuming that salary for particular category is same in all the departments calculate the salary of each category of faculty **04**

| Department | Number of Faculty | | | Total Salary(Thousands) |
|------------|-------------------|---------------------|---------------------|-------------------------|
| | Professor | Associate professor | Assistant Professor | |
| A | 2 | 2 | 4 | 60 |
| B | 3 | 1 | 2 | 50 |
| C | 1 | 4 | 3 | 60 |

Q.4.) a) A solid of revolution is formed by rotating about x-axis the area between the x-axis, the line $x=0$ and $x=l$ and curve through the points with the following co-ordinates: **06**

| | | | | | |
|---|-------|--------|--------|--------|--------|
| X | 0.00 | 0.25 | 0.50 | 0.75 | 1.00 |
| Y | 1.000 | 0.9896 | 0.9589 | 0.9089 | 0.8415 |

Estimate the volume of the solid formed, giving answer to three decimal place by using Trapezoidal rule.

b) Velocity of car running on straight road at interval of 2 minutes are given below. **06**

| | | | | | | | |
|------------------------|---|----|----|----|----|----|----|
| Time (T) (min) | 0 | 2 | 4 | 6 | 8 | 10 | 12 |
| Velocity(V) (km/hr) | 0 | 22 | 30 | 27 | 18 | 7 | 0 |

Find the distance covered by car using Simpson's 1/3 rule

Q.5a) Given the equation $\frac{dy}{dx} = \frac{2y}{x}$ with $y(1) = 2$, estimate $y(2)$ using Euler's method using $h=0.25$. **04**

b) The experimental values relating centripetal force and radius, for a mass travelling at constant velocity in a circle, are as shown:

| | | | | | | | | |
|----------------|----|----|----|----|----|----|----|----|
| Force(N) | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
| Radius (cm) | 55 | 30 | 16 | 12 | 11 | 9 | 7 | 5 |

Determine the equations of the regression line of force on radius. **04**

c) Given that $\frac{dy}{dx} = y - x$ where $y(0) = 2$, find $y(0.1)$ with $h=0.1$ correct to four decimal place by using Range-Kutta fourth order method **04**

Q.6. a) Write the algorithm for finding the real root single root of an equation by Bisection Method **04**

b) Write the algorithm for to find the integration using Simpson's 1/3 rule **04**

c) Write the algorithm for to solve ordinary differential equation using Euler's Method. **04**

**DR. BABASAHEB AMBEDKAR TECHNOLOGICAL
UNIVERSITY, LONERE - RAIGAD -402 103
Winter Semester Examination - Dec - 2019**

Branch: Mechanical Engineering

Subject:- Numerical Methods in Mechanical Engineering (BTMEC404)

Date:- 02/12/2019

Sem.:- IV

Marks: 60

Time:- 3 Hr.

Instructions to the Students

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(Marks)

- Q.1. (a)** Explain the following; Approximate error, Precision and accuracy with suitable example? **(6)**
- (b) (i)** The length and breadth of a rectangle are A body travels uniformly a distance of (5.7 ± 0.1) cm and (3.4 ± 0.2) cm. Find the area of the rectangle with in error limit. **(4)**
- (ii)** Round off the following to four significant digits. **(2)**
 $0.0063945, 0.090038$
- Q.2.** Find the positive root of the equation $xe^{-x} = 1$ using bisection method which lies between 0 and 1 till approximate error becomes 10%. Show lower limit, upper limit and approximate error in each iteration. **(12)**
- Q.3.** Use Gauss elimination to solve **(12)**
$$\begin{aligned} 3x_1 - 0.1x_2 - 0.2x_3 &= 7.85 \\ 0.1x_1 + 7x_2 - 0.3x_3 &= -19.3 \\ 0.3x_1 - 0.2x_2 + 10x_3 &= 71.4 \end{aligned}$$
- Q.4. (a)** The work done on an object is equal to the force times the distance moved in the direction of the force. The velocity of an object in the direction of a force is given by
$$v = 4t \quad 0 \leq t \leq 6$$

where v is in m/s. Employ the multiple application trapezoidal rule to determine the work if a constant force of 200 N is applied for all t . **(8)**
- (b)** Obtain the forward Difference expression for first derivatives. **(4)**
- Q.5. (a)** Solve the following ODE using Euler's method from $t = 0$ to 3 taking step size of 1.
$$\frac{dy}{dt} = -y + t \quad \text{given } y(0) = 1$$
 (6)

- (b) The table below gives the temperature T ($^{\circ}\text{C}$) and length l (mm) of a heated rod. Find the values of length at 55°C using quadric interpolation. (6)

| | | | |
|-----|-------|-------|-------|
| T | 40 | 50 | 60 |
| l | 600.5 | 600.6 | 600.8 |

- Q.6.** Draw the algorithm of the following Numerical Methods (Any Two). (12)
- (i) NR Method
 - (ii) Simple Trapezoidal Rule
 - (iii) $1/3^{\text{rd}}$ Simpson Rule

Paper End

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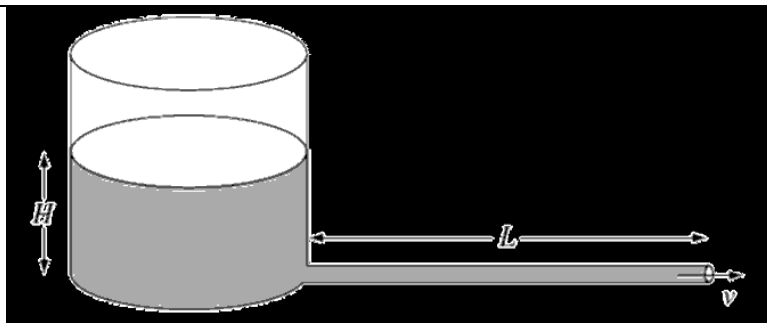
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Paper End

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE**Supplementary Semester Examination – Summer 2022****Course: B. Tech.****Branch : Mechanical Engg.****Semester : IV****Subject Code & Name: BTMEC404 – Numerical Methods in Mechanical Engineering****Max Marks: 60****Date:****Duration: 3.00 Hrs.**

| | | | |
|-------------|---|------------|-------|
| | Instructions to the Students: <ol style="list-style-type: none"> 1. All the questions are compulsory. 2. The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question. 3. Use of non-programmable scientific calculators is allowed. 4. Assume suitable data wherever necessary and mention it clearly. | | |
| | | (Level/CO) | Marks |
| Q. 1 | Solve Any Two of the following. | | |
| A) | Explain the terms with the help of suitable examples: <ol style="list-style-type: none"> 1. True error 2. Approximate error 3. Truncation error 4. Round-off error | CO-1 | 06 |
| B) | Write short note on 'Total numerical error' | CO-1 | 06 |
| C) | Explain the terms: <ol style="list-style-type: none"> 1. Blunders 2. Formulation errors 3. Data uncertainty | CO-1 | 06 |
| Q.2 | Solve Any Two of the following. | | |
| A) | Using bisection method find the roots of the equation $f(x) = x^{10} - 1$ Calculate the roots till the approximate error falls below 5%. Note that the root lies between 0 to 1.3. | CO-2 | 06 |
| B) | Using Newton-Raphson method, find the root of the equation using initial guess as 0. $f(x) = e^{-x} - x$ Carry out minimum four iterations. | CO-2 | 06 |
| C) | The velocity of water v (m/s), during the discharge from a cylindrical tank through a long pipe can be calculated as $v = \sqrt{2gH} \tanh\left(\frac{\sqrt{2gH}}{2L} t\right)$ | CO-4 | 06 |



If $g = 9.81 \text{ m/s}^2$, H = initial head (m), L = Length of pipe (m), and t = elapsed time (s). Determine the head needed to achieve $v=5 \text{ m/s}$ in 2.5 sec for a 4 m long pipe. Use bisection method with initial guesses as 0 m and 2 m. carry out minimum three iterations.

Q. 3 Solve Any Two of the following.

A) Solve the following system of equations using Cramer's rule.

$$2x_1 + x_2 + x_3 = 9$$

$$3x_1 + x_2 = 10$$

$$2x_2 + 5x_3 = 9$$

CO-2

06

B) Solve the following system of equations using Gauss elimination method.

$$10x_1 + 2x_2 - x_3 = 27$$

$$-3x_1 - 6x_2 + 2x_3 = -61.5$$

$$x_1 + x_2 + 5x_3 = -21.5$$

CO-2

06

C) Solve the following system of equations using Gauss elimination method with partial pivoting.

$$8x_1 + 2x_2 - 2x_3 = -2$$

$$10x_1 + 2x_2 + 4x_3 = 4$$

$$12x_1 + 2x_2 + 2x_3 = 6$$

CO-2

06

Q.4 Solve Any Two of the following.

A) Evaluate the following integral using Simpson's 1/3rd Rule.

$$\int_0^{\pi/2} (6 + 3 \cos x) dx$$

CO-2

06

B) Evaluate the integral of the following tabulated data using trapezoidal rule.

| | | | | | | |
|------|---|-----|-----|-----|-----|-----|
| x | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 |
| F(x) | 1 | 8 | 4 | 3.5 | 5 | 1 |

Also comment on how the accuracy of trapezoidal rule be increased?

CO-2

06

C) Write algorithm for evaluating an integration using Trapezoidal rule.

CO-4

06

Q. 5 Solve Any Two of the following.

A) Fit a straight line with zero intercept to the following data using least-square regression method.

CO-2

06

| | | | | | | | | | | | | | | | | | | | | | | | |
|----|---|-------|-----|-----|------|------|-----|-----|----|----|----|-----|-------|-----|-----|------|------|-----|-----|------|----|--|--|
| | <table><tr><td>X</td><td>2</td><td>4</td><td>6</td><td>7</td><td>10</td><td>11</td><td>14</td><td>17</td><td>20</td></tr><tr><td>Y</td><td>1</td><td>2</td><td>5</td><td>2</td><td>8</td><td>7</td><td>6</td><td>9</td><td>12</td></tr></table> | X | 2 | 4 | 6 | 7 | 10 | 11 | 14 | 17 | 20 | Y | 1 | 2 | 5 | 2 | 8 | 7 | 6 | 9 | 12 | | |
| X | 2 | 4 | 6 | 7 | 10 | 11 | 14 | 17 | 20 | | | | | | | | | | | | | | |
| Y | 1 | 2 | 5 | 2 | 8 | 7 | 6 | 9 | 12 | | | | | | | | | | | | | | |
| B) | <p>Use Newton’s interpolating polynomial to determine y at x =8 to the best of accuracy using the following data.</p> <table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>5.5</td><td>11</td><td>13</td><td>16</td><td>18</td></tr><tr><td>Y</td><td>0.5</td><td>3.134</td><td>5.3</td><td>9.9</td><td>10.2</td><td>9.35</td><td>7.2</td><td>6.2</td></tr></table> | X | 0 | 1 | 2 | 5.5 | 11 | 13 | 16 | 18 | Y | 0.5 | 3.134 | 5.3 | 9.9 | 10.2 | 9.35 | 7.2 | 6.2 | CO-2 | 06 | | |
| X | 0 | 1 | 2 | 5.5 | 11 | 13 | 16 | 18 | | | | | | | | | | | | | | | |
| Y | 0.5 | 3.134 | 5.3 | 9.9 | 10.2 | 9.35 | 7.2 | 6.2 | | | | | | | | | | | | | | | |
| C) | <p>Solve the following from $t = 1.5$ to $t = 2.5$ using fourth-order Runge-Kutta method.</p> $\frac{dy}{dx} = \frac{-2y}{1 + t}$ <p>If $y(0) = 2$</p> | CO-2 | 06 | | | | | | | | | | | | | | | | | | | | |
| | *** End *** | | | | | | | | | | | | | | | | | | | | | | |