

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

**CLASS: IMSC
BRANCH: MATHEMATICS**

**SEMESTER : V
SESSION : MO/2025**

SUBJECT: MA311R1 NUMERICAL TECHNIQUES

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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|--|--------|--------|--------|--------|------|------|--------|--------|--------|--------|---|------|--|--|--|
| Q.1(a) Use Regula-Falsi method to find a real root between 0.5 and 1 of $xe^x - 2 = 0$. (upto 4 iteration.) | [5] | 1 | 1 | | | | | | | | | | | | |
| Q.1(b) Solve by Newton Raphson method $x^2 + y^2 = 1$ and $xy = x + y$ with $x_0 = 0.5$ and $y_0 = -1$. Do one iteration and all numbers are approximated up to 4 decimal places. | [5] | 1 | 1 | | | | | | | | | | | | |
| Q.2(a) Solve the following system of equations by the Gauss-Seidel iteration method (Do three iterations; consider the initial guess of all variables as zero). $27x + 6y - z = 85$, $6x + 15y + 2z = 72$ and $x + y + 54z = 110$ | [5] | 2 | 1 | | | | | | | | | | | | |
| Q.2(b) Solve the following system of equations using Gauss elimination method:
$2x + y + z = 10$
$3x + 2y + 3z = 18$
$x + 4y + 9z = 16$ | [5] | 2 | 2 | | | | | | | | | | | | |
| Q.3(a) Using Lagrange's interpolation formula, find $f(3)$ from the following data. Find the polynomial in simplest form. | [5] | 3 | 2 | | | | | | | | | | | | |
| <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 2px;">x</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">2</td> <td style="padding: 2px;">5</td> </tr> <tr> <td style="padding: 2px;">f(x)</td> <td style="padding: 2px;">2</td> <td style="padding: 2px;">3</td> <td style="padding: 2px;">12</td> <td style="padding: 2px;">147</td> </tr> </table> | x | 0 | 1 | 2 | 5 | f(x) | 2 | 3 | 12 | 147 | | | | | |
| x | 0 | 1 | 2 | 5 | | | | | | | | | | | |
| f(x) | 2 | 3 | 12 | 147 | | | | | | | | | | | |
| Q.3(b) Given the values. Find an interpolating polynomial by the Newton Divided Difference formula in the simplest form and find $f(3)$. | [5] | 3 | 2 | | | | | | | | | | | | |
| <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 2px;">x</td> <td style="padding: 2px;">-4</td> <td style="padding: 2px;">-1</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">2</td> <td style="padding: 2px;">5</td> </tr> <tr> <td style="padding: 2px;">f(x)</td> <td style="padding: 2px;">1245</td> <td style="padding: 2px;">33</td> <td style="padding: 2px;">5</td> <td style="padding: 2px;">9</td> <td style="padding: 2px;">1335</td> </tr> </table> | x | -4 | -1 | 0 | 2 | 5 | f(x) | 1245 | 33 | 5 | 9 | 1335 | | | |
| x | -4 | -1 | 0 | 2 | 5 | | | | | | | | | | |
| f(x) | 1245 | 33 | 5 | 9 | 1335 | | | | | | | | | | |
| Q.4(a) Compute the value of $\int_{0.2}^{1.4} (\sin x - \ln x + e^x) dx$ using Simpson's 3/8 rule . (All the calculation correct upto four decimal place) | [5] | 4 | 1 | | | | | | | | | | | | |
| Q.4(b) Find the derivative of y at $x = 0.65$ | [5] | 4 | 1 | | | | | | | | | | | | |
| <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 2px;">x</td> <td style="padding: 2px;">0.6</td> <td style="padding: 2px;">0.65</td> <td style="padding: 2px;">0.7</td> <td style="padding: 2px;">0.75</td> </tr> <tr> <td style="padding: 2px;">y</td> <td style="padding: 2px;">0.6221</td> <td style="padding: 2px;">0.6155</td> <td style="padding: 2px;">0.6138</td> <td style="padding: 2px;">0.6170</td> </tr> </table> | x | 0.6 | 0.65 | 0.7 | 0.75 | y | 0.6221 | 0.6155 | 0.6138 | 0.6170 | | | | | |
| x | 0.6 | 0.65 | 0.7 | 0.75 | | | | | | | | | | | |
| y | 0.6221 | 0.6155 | 0.6138 | 0.6170 | | | | | | | | | | | |
| Q.5(a) Compute $y(0.1)$ using R-K method of order fourth, given that $y' = xy + y^2$ and $y(0) = 1$. $h = 0.1$. (All calculations are approximated upto 4 th decimal place). | [5] | 5 | 2 | | | | | | | | | | | | |
| Q.5(b) Using the finite difference method, solve the boundary value problems: $y'' + y = 0$, $y(0) = 0$, $y(1) = 1$, taking $h = 0.25$. | [5] | 5 | 1 | | | | | | | | | | | | |