Roll No: | | | | | | | | | | | | | |

BTECH
(SEM VI) THEORY EXAMINATION 2024-25
COMPUTER BASED NUMERICAL TECHNIQUES

TIME: 3 HRS **M.MARKS: 70**

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt *all* questions in brief. 02 x 7 = 14

<table>
<tr><th>Q no.</th><th>Question</th><th>CO</th><th>Level</th></tr>
<tr><td>a.</td><td>If α number is correct to n significant digits, then what will be the maximum relative error?</td><td>1</td><td>K2</td></tr>
<tr><td>b.</td><td>What is the Laplace-Everett's formula?</td><td>2</td><td>K5</td></tr>
<tr><td>c.</td><td>Evaluate $\int_0^2 e^{x^2}\,dx$ using the Trapezoidal rule ,taking the 10 number of sub-intervals.</td><td>3</td><td>K2</td></tr>
<tr><td>d.</td><td>Write the Divided Difference table for the following values:
<table>
<tr><td>x</td><td>5</td><td>7</td><td>11</td><td>13</td></tr>
<tr><td>f(x)</td><td>150</td><td>392</td><td>1452</td><td>2366</td></tr>
</table></td><td>3</td><td>K5</td></tr>
<tr><td>e.</td><td>Solve $y' = x + y$, $y(0) = 1$by Taylor's series method. Hence find the value of y at x = 0.1.</td><td>4</td><td>K1</td></tr>
<tr><td>f.</td><td>Adams-Bashforth predictor formula to solve $y' = f(x, y)$, given $y_0 = y(x_0)$ is ……</td><td>4</td><td>K1</td></tr>
<tr><td>g.</td><td>Explain the Standard 5-point formula and Diagonal 5-point formula for the boundary value problems of partial differential equation.</td><td>5</td><td>K3</td></tr>
</table>

SECTION B

2. Attempt any *three* of the following: 07 x 3 = 21

<table>
<tr><th>Q no.</th><th>Question</th><th>CO</th><th>Level</th></tr>
<tr><td>a.</td><td>Find the root of the equation $\cos x = xe^x$ using the Regula-Falsi method correct to four decimal places.</td><td>1</td><td>K2</td></tr>
<tr><td>b.</td><td>Using Gauss backward difference formula, find y(8) from the following table:
<table>
<tr><td>x</td><td>0</td><td>5</td><td>10</td><td>15</td><td>20</td><td>25</td></tr>
<tr><td>y</td><td>7</td><td>11</td><td>14</td><td>18</td><td>24</td><td>32</td></tr>
</table></td><td>2</td><td>K4</td></tr>
<tr><td>c.</td><td>Using Bessel's formula, find $f'(7.5)$ from the following table:
<table>
<tr><td>x</td><td>7.47</td><td>7.48</td><td>7.49</td><td>7.50</td><td>7.51</td><td>7.52</td><td>7.53</td></tr>
<tr><td>f(x)</td><td>0.193</td><td>0.195</td><td>0.198</td><td>0.201</td><td>0.203</td><td>0.206</td><td>0.208</td></tr>
</table></td><td>3</td><td>K5</td></tr>
<tr><td>d.</td><td>Using Runge-Kutta method of fourth order, solve for y at x = 1.2 , 1.4 from $\frac{dy}{dx} = \frac{2xy + e^x}{x^2 + xe^x}$ given that $x_0 = 1$, $y_0 = 0$.</td><td>4</td><td>K5</td></tr>
</table>

e.	Obtain by power method, the numerically dominant eigen value correct to two decimal places of the following matrix: $A=\begin{bmatrix}15 & -4 & -3\\ -10 & 12 & -6\\ -20 & 4 & -2\end{bmatrix}$.	5	K3

SECTION C

3. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Using the Newton-Raphson method find the root of $4x-e^x=0$ that lies between 2 and 3.	1	K2
b.	Apply Muller’s method to find the root of the equation $\cos x = x e^x$ which lies between 0 and 1.	1	K5

4. Attempt any *one* part of the following: 07 x 1 = 07

<table>
<tr><th>Q no.</th><th>Question</th><th>CO</th><th>Level</th></tr>
<tr><td>a.</td><td>From the following table, using Stirling’ formula, estimate the value of $\tan 16^0$:
<table>
<tr><td>x</td><td>0^0</td><td>5^0</td><td>10^0</td><td>15^0</td><td>20^0</td><td>25^0</td><td>30^0</td></tr>
<tr><td>$y=\tan x$</td><td>0.0</td><td>0.0875</td><td>0.1763</td><td>0.2679</td><td>0.3640</td><td>0.4663</td><td>0.5774</td></tr>
</table></td><td>2</td><td>K4</td></tr>
<tr><td>b.</td><td>Using Lagrange’s interpolation formula, prove the following: $y_1 = y_3 - 0.3(y_5 - y_{-3}) + 0.2(y_{-3} - y_{-5})$ nearly.</td><td>2</td><td>K6</td></tr>
</table>

5. Attempt any *one* part of the following: 07 x 1 = 07

<table>
<tr><th>Q no.</th><th>Question</th><th>CO</th><th>Level</th></tr>
<tr><td>a.</td><td>Find the first two derivatives of $(x)^{1/3}$ at x = 56 for the given table:
<table>
<tr><td>x</td><td>50</td><td>51</td><td>52</td><td>53</td><td>54</td><td>55</td><td>56</td></tr>
<tr><td>$y=x^{1/3}$</td><td>3.6840</td><td>3.7084</td><td>3.7325</td><td>3.7563</td><td>3.7798</td><td>3.8030</td><td>3.8259</td></tr>
</table></td><td>3</td><td>K2</td></tr>
<tr><td>b.</td><td>Evaluate the integral $I=\int_4^{5.2}\log_e x\,dx$ using Weddle’s rule.</td><td>3</td><td>K5</td></tr>
</table>

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6. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Using Runge-kutta method of fourth order , Compute y (0.3) correct to four decimal places by taking h = 0.1 for the given differential equation: $\frac{dy}{dx} + y + xy^2 = 0$, $y(0) = 1$.	4	K1
b.	Using Milne's method, find y(4.4) for the differential equation $5xy' + y^2 - 2 = 0$, given that $y(4) = 1, y(4.1) = 1.0049, \quad y(4.2) = 1.0097$ $y(4.3) = 1.0143$ correct to five decimal places.	4	K5

7. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Using Bender- Schmidt method, solve the following heat equation: $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ *subject to* $u(0,t) = 0, u(1,t) = 0$ *and* $u(x,0) = \sin \pi x , 0 < x < 1$. (Taking $h = 0.2$)	5	K3
b.	Solve $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}$, $0 < x < 1$, $t > 0$, given that $u(x,0) = u_t(x,0) = 0$, $u(0,t) = 0$ and $u(1,t) = 100 \sin \pi t$. Compute $u(x,t)$ for 4 times steps with $h = 0.25$.	5	K5