KUMARAGURU
college of technology
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B.E. DEGREE EXAMINATIONS: NOV/DEC 2022

(Regulation 2018)

Third Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

U18MAT3104: Numerical Methods and Probability

(Statistical Tables required)

COURSE OUTCOMES

CO1:	Apply various numerical techniques for solving non-linear equations and systems of linear equations.
CO2:	Analyze and apply the knowledge of interpolation and determine the integration and differentiation of the functions by using the numerical data.
CO3:	Predict the dynamic behavior of the system through solution of ordinary differential equations by using numerical methods.
CO4:	Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.
CO5:	Apply the concepts of probability to random variables.
CO6:	Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

<table>
<tr><td>1.</td><td>Find an iteration formula of $\sqrt{N}$ where N is the positive number using Newton’s method.</td><td>CO1</td><td>[K₂]</td></tr>
<tr><td>2.</td><td>Write the sufficient condition for a Gauss Seidel method.</td><td>CO1</td><td>[K₁]</td></tr>
<tr><td>3.</td><td>Write the Newton’s backward difference formula for first and second order derivatives for equal intervals.</td><td>CO2</td><td>[K₁]</td></tr>
<tr><td>4.</td><td>Form the divided difference table from the given data:
<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>CO2</td><td>[K₂]</td></tr>
<tr><td>5.</td><td>Write the Milne’s Predictor-Corrector formula.</td><td>CO3</td><td>[K₁]</td></tr>
<tr><td>6.</td><td>Given $y' = -y$ and $y(0) = 1$, determine the value of y at$x = 0.01$by Euler’s method.</td><td>CO3</td><td>[K₃]</td></tr>
<tr><td>7.</td><td>Write the explicit formula for the one-dimensional heat equation.</td><td>CO4</td><td>[K₁]</td></tr>
<tr><td>8.</td><td>Write the formula of standard five-point formula and diagonal five-point formula.</td><td>CO4</td><td>[K₁]</td></tr>
</table>

9.	If X and Y are independent random variables with variances 2 and 3 respectively, find the variance of $3X + 4Y$.	CO5	[K$_3$]
10.	If the sum of mean and variance of a Poisson distribution is 4.8, find the corresponding probability distribution.	CO6	[K$_2$]

Answer any FIVE Questions:-

PART B (5 x 16 = 80 Marks)

(Answer not more than 400 words)

<table>
<tr><td>11.</td><td>a)</td><td>Solve the equation $x^3 + x^2 - 1 = 0$, for positive roots by iteration method.</td><td>(8)</td><td>CO1</td><td>[K$_5$]</td></tr>
<tr><td></td><td>b)</td><td>Find the numerically largest Eigen value of $A = \begin{pmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{pmatrix}$ and the corresponding Eigen vector by power method. Assume initial vector as $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$</td><td>(8)</td><td>CO1</td><td>[K$_5$]</td></tr>
<tr><td>12.</td><td>a)</td><td>Find the age corresponding to the annuity value 13.6 given the table.
<table>
<tr><td>Age (x) :</td><td>30</td><td>35</td><td>40</td><td>45</td><td>50</td></tr>
<tr><td>Annuity value (y):</td><td>15.9</td><td>14.9</td><td>14.1</td><td>13.3</td><td>12.5</td></tr>
</table></td><td>(8)</td><td>CO2</td><td>[K$_5$]</td></tr>
<tr><td></td><td>b)</td><td>Dividing the range into 10 equal parts, find the approximate value of $\int_0^{\pi} sin\, x\, dx$ by trapezoidal rule and Simpson's 1/3rd rule. Verify the answers by actual integration.</td><td>(8)</td><td>CO2</td><td>[K$_5$]</td></tr>
<tr><td>13.</td><td>a)</td><td>Using Taylor's series method, compute $y(0.2)$ and $y(0.4)$, correct to 4 decimal places given $\frac{dy}{dx} = 1 - 2xy, y(0) = 0$.</td><td>(8)</td><td>CO3</td><td>[K$_5$]</td></tr>
<tr><td></td><td>b)</td><td>Using Runge Kutta method of fourth order, find $y(0.8)$ correct to 4 decimal places if $y' = y - x^2, y(0.6) = 1.7379$, taking $h = 0.2$.</td><td>(8)</td><td>CO3</td><td>[K$_5$]</td></tr>
<tr><td>14.</td><td>a)</td><td>Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to $u(x,0) = sin\, \pi\, x, 0 \le x \le 1, u(0,t) = u(1,t) = 0$, using Bender Schmidt method.</td><td>(8)</td><td>CO4</td><td>[K$_5$]</td></tr>
<tr><td></td><td>b)</td><td>Solve $25u_{xx} - u_{tt} = 0$ for u at the pivotal positions, given $u(0,t) = u(5,t) = 0, u_t(x,0) = 0, u(x,0) = \begin{cases} 2x & \text{for } 0 \le x \le 2.5 \\ 10 - 2x & \text{for } 2.5 \le x \le 5 \end{cases}$ for one-half period of vibration</td><td>(8)</td><td>CO4</td><td>[K$_5$]</td></tr>
<tr><td>15.</td><td>a)</td><td>The contents of urns I, II, III are as follows: 1 white, 2 black and 3 red balls; 2</td><td>(8)</td><td>CO5</td><td>[K$_5$]</td></tr>
</table>

		white, 1 black and 1 red balls; 4 white, 5 black and 3 red balls respectively. One urn is chosen at random and two balls are drawn from it. They happen to be white and red. What is the probability that they come from urns I, II, or III?			
	b)	In a certain factory manufacturing razor blades, there is small chance of 1/500 for any blade to be defective. The blade is in packets of 10. Use Poisson distribution to calculate the approximate number of packets containing (i) no defective (ii) one defective (iii) 2 defective blades respectively in a consignment of 10,000 packets.	(8)	CO6	[K_5]
16.	a)	Solve using Gauss Seidel method: $8x - 3y + 2z = 20$ $6x + 3y + 12z = 35$ $4x + 11y - z = 33$	(8)	CO1	[K_5]
	b)	Solve the Poisson equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over the square mesh with sides $x = 0, y = 0, x = 3, y = 3$ with $u = 0$ on the boundary, and mesh length 1unit.	(8)	CO4	[K_5]

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