University of Mumbai
Examinations Summer 2022
Program: Mechanical Engineering
Curriculum Scheme: Rev2019
Examination: TE Semester V
Course Code: MEDLO5013 and Course Name: Computational Methods

Time: 2 hour 30 minutes   Max. Marks: 80

Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	In 5 experiments with the same objective, the values obtained are very near to each other. These values can be called _____ .
Option A:	Precise
Option B:	Accuracy
Option C:	Average
Option D:	Error
2.	Truncation error is the difference between
Option A:	the exact solution of the partial differential equation and the discretized equations
Option B:	the exact partial differential equation and the discretized equations
Option C:	the exact solution and the numerical solution of the partial differential equations
Option D:	the exact partial differential equation and its solution
3.	Cramer's Rule fails for _____
Option A:	Determinant > 0
Option B:	Determinant < 0
Option C:	Determinant = 0
Option D:	Determinant = non-real
4.	One of the Eigen vectors of the matrix $\begin{bmatrix} -5 & 2 \\ -9 & 6 \end{bmatrix}$ is?
Option A:	$\begin{bmatrix} -1 \\ 1 \end{bmatrix}$
Option B:	$\begin{bmatrix} -2 \\ 9 \end{bmatrix}$
Option C:	$\begin{bmatrix} 2 \\ -1 \end{bmatrix}$
Option D:	$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$
5.	Rate of convergence of the Newton- Raphson method is generally?
Option A:	Super linear
Option B:	Linear
Option C:	Quadratic
Option D:	Cubic
6.	Number of iterations depends on the _____ ?
Option A:	Initial value taken to start the iteration
Option B:	Type of linear equations
Option C:	Number of unknowns
Option D:	Approximation to be done
7.	The numerical method for solving the differential equations by approximating them with difference equations is called?
Option A:	Euler's method

Option B:	Finite Volume method
Option C:	Finite Element method
Option D:	Finite Difference method

8.	The predictor-corrector method is a combination of _____
Option A:	Midpoint and trapezoidal rules
Option B:	Backward Euler method and Trapezoidal rule
Option C:	Implicit and explicit methods
Option D:	Forward and backward Euler methods

9.	Numerical techniques more commonly involve _____
Option A:	Iterative method
Option B:	Direct method
Option C:	Elimination method
Option D:	Reduction method

10.	For which of these problems is the Crank-Nicolson scheme unconditionally stable?
Option A:	Compressible flows
Option B:	Advection problems
Option C:	Diffusion problems
Option D:	Convection-Diffusion problems

Q2.	Solve any Two Questions out of Three 10 marks each
A	Solve the following system of equations using Gauss Elimination method- $2x_1 + x_2 + x_3 = 10$ $3x_1 + 2x_2 + 3x_3 = 18$ $x_1 + 4x_2 + 9x_3 = 16$
B	Use Secant method to determine the root of following equation $f(x) = x^3 - 5x - 7 = 0$ Find the root correct up to '3' places of decimal point.
C	Fit a straight line for the following data: <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></tr><tr><td>y</td><td>0.5</td><td>2.3</td><td>2.1</td><td>4.2</td><td>3.6</td><td>5.8</td><td>5.5</td></tr></table> And evaluate value of y at x = 4.5

Q3.	
A	Solve any Two 5 marks each
i.	Explain Error Propagation.
ii.	What is Fuzzy Logic? Explain Fuzzy logic Systems Architecture.
iii.	Use Regula- Falsi method to determine the roots of the equation $e^{-x} - x = 0$. Two initial guess values being $x_0 = 0$ and $x_1 = 1$. Compute the root at the end of 4th iteration.
B	Solve any One 10 marks each
i.	Solve the following differential equation using Adams method. $\frac{dy}{dx} = 1+y^2$ with y = 0 when x = 0 Take h = 0.2 and find y at x = 0.8 The following values were obtained previously <table><tr><td>x</td><td>0</td><td>0.2</td><td>0.4</td><td>0.6</td></tr><tr><td>y</td><td>0</td><td>0.2027</td><td>0.4228</td><td>0.6841</td></tr></table>
ii.	Obtain the numerical solution of 1-Dimensional wave equation using Crank Nicolson method.

Q4.	
A	**Solve any Two** **5 marks each**
i.	Solve the heat conduction problem $$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$$ Subject to the conditions $u(x, 0) = \sin \pi x$, $0 \le x \le 1$, and $u(0, t) = u(1, t) = 0$. Use Crank- Nicolson formulae to compute the value of $u(0.6, 0.04)$ and compare the results with exact value of $u(0.6, 0.04) = 0.6408$. Take $h = 0.2$, $l = 0.04$, $\lambda = 1$
ii.	For the matrix $\begin{bmatrix} 1 & 2 & -2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$ Find all the Eigen values and corresponding Eigen vectors.
iii.	Using Euler's method, obtain the solution of $y' = x - y$, given $x_0 = 0$, $y_0 = 1$ at $x = 0.6$ taking $h = 0.2$
B	**Solve any One** **10 marks each**
i.	Explain Truncation errors and Rounding errors. Round the following numbers to two decimal places. (i) 24.5431 (ii) 7.4679 (iii) 102.6554 What would be the effect of truncating the above numbers?
ii.	Given the points $(0\ 0)$, $(\pi/2, 1)$ and $(\pi, 0)$ satisfying the function $y = \sin x$ $(0 \le x \le \pi)$, determine the value of $y(\pi/6)$ using the cubic spline approximation. Take $n = 2$ and $h = \pi/2$