A 221TME100022301 Pages: 2

Reg No.:_______________ Name:_______________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

First Semester M.Tech Degree Examination December 2022 (2022 Scheme)

MECHANICAL ENGINEERING

221TME100: COMPUTATIONAL METHODS FOR ENGINEERS

Max. Marks: 60 Duration: 2.5 Hours

PART A

Answer all questions. Each question carries 5 marks Marks

1 Use Gauss elimination to solve: (5)
$-2x - y - z = -11$
$3x + 4y + z = 19$
$3x + 6y + 5z = 43$

2 Use Newton-Raphson method to solve $x^3-37=0$.Correct to three decimal places. (5)

3 Evaluate $\int_0^6 \frac{1}{1+x^2}dx$ using Simpson's one by third rule by dividing the range into six equal parts.. Estimate the error. (5)

4 Use Euler's method to solve the following IVP from x=0 to x=0.3 (5)

$$y' + 2y = x^3e^{-2x}, \quad y(0) = 1$$

(Take h=0.1)

5 Explain how partial differential equations are classified with suitable examples. (5)

PART B

Answer any 5 questions. Each question carries 7 marks

6 Solve the following system of equations using LU decomposition. (7)

$x_1-x_2+2x_3 = -8$

$x_1+x_2+x_3= -2$

$2x_1-2x_2+3x_3= -20$

7 Fit a least-squares quadratic polynomial to the following data, (7)

X	0	1	2	3	4	5
Y	2.1	7.7	13.6	27.2	40.9	61.1

8 Solve the IVP given below by Runge-Kutta 4th order method. (7)

$$\frac{d^2y}{dt^2} - t^2\frac{dy}{dt} - 2yt = 1$$

Given, y (0) =1, $\frac{dy}{dt}(0) = 0$. Find the values of y and $\frac{dy}{dt}$ at t=0.1.

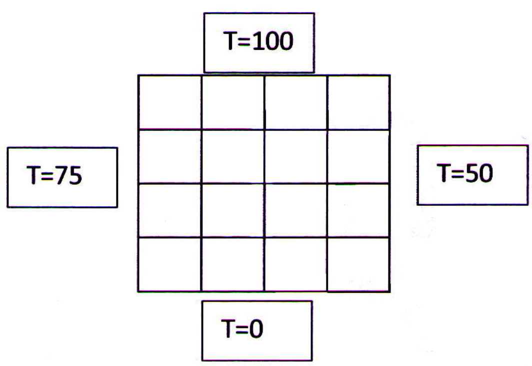
9 Evaluate $\int_0^1 \frac{1}{1+x^2}dx$ using 3-point Gaussian Quadrature method. Weights and abscissae for three point are {0.55555, 0.88889, 0.55555} and {-0.77460, 0.00000, 0.77460} respectively. (7)

10 Employ numerical differentiation to estimate the first and second derivatives at x =1 (i.e f'(1) and f''(1)) for the data in the following table. (7)

X	1.0	1.5	2.0	2.5	3.0
Y	27.00	106.75	324.00	783.75	1621.00

11 Solve Laplace's equation $\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$ over the domain given below. Boundary conditions are given in the figure. Find the values of T at interior nodes. Use Liebmann's method (perform 2 iterations). Employ overrelaxation with a value of 1.5 for the weighting factor. (7)

$\Delta x = \Delta y = 1$; Length = 4 and width = 4



12 Given the parabolic equation (transient 1D heat conduction) $k' \frac{\partial^2 T}{\partial x^2} = \frac{\partial T}{\partial t}$ (7)

T(x,0) = 0, x≠0 & x≠10,

T(0,t)=100°C,

T(10,t)=50°C

With Δx = 2 units and Δt = 0.2 units, use a convenient scheme to estimate temperatures at the interior nodes at time t=0.2 units and also at time t= 0.4 units. Use k'= 0.8348 units.

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