T.E. (Mech.) (Semester – I) Examination, 2010
COMPUTER ORIENTED NUMERICAL METHODS
(Common with Mech.S/W for Semester – II)
(2003 Course)

Time : 3 Hours Max. Marks : 100

Instructions: *1) Answer 3 questions from Section I and 3 questions from Section II.*
2) Answers to the two Sections should be written in separate books.
3) Neat diagrams must be drawn wherever necessary.
4) Black figures to the right indicate full marks.
5) Assume suitable data, if necessary.

SECTION – I

UNIT – 1

1. A) Using Simplex method, maximize the following :

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

subject to, $3x_1 - x_2 + 3x_3 \le 7$

$-2x_1 + 4x_2 \le 12$

$-4x_1 + 3x_2 + 8x_3 \le 10$

$x_1, x_2, x_3 \ge 0$ **12**

B) Define with one example each :

i) Truncation error

ii) Round-off error

iii) Relative error. **6**

OR

2. A) Heat flow rate due to radiation is given by Stefan-Boltzmann's law as follows :

$q_{rad} = \sigma A \in T^4$, where,

$\sigma = 5.67 \times 10^{-8}$ W/m^{2}k^4

$\in = 0.8$

A = Surface area of a rectangular plate with length 'l' m and width 'b' m.

T = Absolute temp. of the plate

Calculate the error caused in calculation of q_{rad} if measurements of l, b and T are made as follows :

$l = (3 \pm 0.0002)$ m

$b = (2 \pm 0.0001)$ m

$T = (800 \pm 0.01)$ k **10**

P.T.O.

B) Define and explain :

i) Basic variables

ii) Slack variables

iii) Objective function

iv) Linear programming model. 8

UNIT – 2

3. A) The deflection of a cantilever beam from its original position at different locations on the beam is as follows :

x (location in 'cm')	0	2	4	6
d (deflection in 'mm')	0	0.1	0.17	0.28

Find out the location (value of x) at which deflection d = 0.15 mm. 8

B) Write a program for fitting a straight line using least square technique, through given points ('n' in no.) as, $(x_1 y_1) \ldots (x_n, y_n)$. 8

OR

4. A) Fit a curve of type $PV^n = C$ to the following data

V (m^3)	0.003	0.005	0.015	0.025
P(bar)	10	7	3	1

8

B) Write a flow-chart for Lagrange's interpolation method to find the value of 'y_k' for given 'x_k' if 'n' no. of data points, viz $(x_1, y_1) \ldots (x_n, y_n)$ are given. 8

UNIT – 3

5. A) The distance travelled by a particle at different time instants is given below. Using Newton's forward difference differentiation method, calculate its velocity at t = 7 sec.

t(sec)	0	5	10	15	20
S(m)	0	10	35	70	120

8

B) Explain the LU. Decomposition method to solve 'n' no. of linear simultaneous equations in 'n' unknowns.

(Only step-by-step procedure is expected. No flow-chart/program is expected). 8

OR

6. A) A slender metal rod subject to temperature variation along its length results in the following equations, indicating the temperature distribution.

$4T_1 + 2T_2 = 80$
$3T_1 + 4T_2 + 2T_3 = 170$
$3T_2 + 4T_3 + 2T_4 = 260$
$3T_3 + 4T_4 = 250$

Calculate the temperatures T_1, T_2, T_3 and T_4 using Gauss-Jordan method. 8

B) Write a flow-chart for backward difference differentiation procedure if 'n' no of data points are given. 8

SECTION – II

UNIT – 4

7. A) Solve by simple iteration (successive approximation) method with accuracy criterion as 0.01 and initial guess as 0.5. $x = \frac{\cos x}{e^x}$. 8

B) The velocity of a car measured at different time instants is as follows :

Time (sec)	0	2	4	6	8	10	12
Velocity (m/s)	0	3	6	15	25	40	60

Using Simpson's $3/8^{th}$ rule, calculate the distance travelled by the car in 12 seconds. Also draw the flow chart for the same. 8

OR

8. A) Calculate $\int_2^4 \frac{dx}{1+x^2}$ using Gauss-Legendre 2 point formula. 8

B) Solve the following equation using Newton Raphson method with initial guess value as 0.8 and accuracy criterion as 0.01

$x^3 - x^2 - x + 1 = 0$

Explain the limitations of Newton-Raphson method with simple sketches. 8

UNIT – 5

9. A) $\frac{dy}{dx} = \frac{(1+x^2)y^2}{2}$

x	y
0	1
0.1	1.06
0.2	1.12
0.3	1.21

Evaluate 'y' at x = 0.4 by Milne's predictor-corrector method. 8

B) Draw a flow-chart for finding solution of a differential equation $y' = f(x,y)$ using modified Euler's method. 8

OR

10. A) Solve the following differential equations simultaneously :

$$\frac{dy}{dx} = 2y + z \qquad \frac{dz}{dx} = y - 3z$$

$y(0) = 0$

$z(0) = 0.5$

Find y (0.1) and z(0.1) using Runge-Kutta method. Take h = 0.1. 8

B) Draw a flow-chart for solution of a differential equation using Taylor's series method. 8

UNIT – 6

11. A) Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ using explicit (Schmidt method).

At x = 0 and x = 0.5, u = 1 for all values of 't'

At t = 0, u = 2x + 1 for $0 \le x \le 0.5$

Take increment in 'x' as 0.1 and increment in 't' as 0.01.

Find all values of 'u' for t = 0 to t = 0.02. 10

B) Draw flowchart for solving hyperbolic partial differential equation $\frac{\partial^2 f}{\partial x^2} = \frac{\partial^2 f}{\partial t^2}$. 8

OR

12. A) Solve the following eq^n :

$$\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$$

At t = 0, u = sin2x $0 \le x \le 0.5$

At x = 0 and x = 0.5, u = 1 for all values of 't'.

Find the values of 'u'

at t = 0.03 for x = 0 to x = 0.5

Take $\Delta x = 0.1$ and $\Delta t = 0.01$ 10

B) Draw flow chart for sol^n of Laplace eq^n, i.e. $\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$. 8