M.Tech. 1st Semester (ME)

Examination, December–2018

MACHINE DESIGN

Paper– M–801– A

Numerical Analysis and Optimization

Time allowed : 3 hours] *[Maximum marks : 100*

Note: *Attempt any **five** questions. All questions carry equal marks.*

1. (a) Solve the system

$2x + 4y + z = 3$

$3x + 2y - 2z = -2$

$x - y + z = 6$

by using Gauss Jordan method.

(b) Determine Eigen value and the corresponding Eigen vector of the matrix by Jacobi Method.

$$A = \begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$$

2. (a) Fit a second degree parabola to the following data:

x :	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y :	1.1	1.3	1.6	2.0	2.7	3.4	4.1

(b) Given the values

x :	300	304	305	307
$\log_{10}x$:	2.4771	2.4829	2.4843	2.4871

Evaluate $\log_{10} 310$ by using

(i) Lagrange's formula

(ii) Newton's divided difference formula.

3. Describe Newton's cotes formula. Also derive Trapezoidal rule and Simpson's rule and hence evaluate $\int_0^6 \frac{1}{1+x^2} dx$ using (i) Trapezoidal rule (ii) Simpson's rule.

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4. Apply Milne's Method to find a solution of the differential equation $\frac{dy}{dx} = x - y^2$ in the range $0 \le x \le 1$ for the boundary condition $y = 0$ at $x = 0$ taking $h = 0.2$ Starting solutions required are to be obtained by using Taylor's series methods.

5. (a) Transform the matrix to tri-diagonal form by using Householder's method

$$A = \begin{bmatrix} 1 & 4 & 3 \\ 4 & 1 & 2 \\ 3 & 2 & 1 \end{bmatrix}$$

(b) Using modified Euler's method, find y for $x = 0.1$

and 0.2 Given that $\frac{dy}{dx} = xy + y^2, y(0) = 1.$

6. (a) Discuss direct search method. Also write the characteristics of direct search method.

   (b) State the necessary and sufficient conditions for the unconstrained minimum of the function.

7. Find the minimum value of the function $f(x_1,x_2) = x_1^2 + x_2^2 - 10x_1 - 10x_2$

   Subject to $x_1 + x_2 \leq 9$

   $x_1 - x_2 \geq 6,$

   $x_1, x_2 \geq 0.$

8. A manufacturing firm producing small refrigerators has entered into a contract to supply 50 refrigerators at the end of the first month, 50 at the end of second month and 50 at the end of the third. The cost of producing X refrigerators in any month is given by Rs $(x^2 + 1000)$. The firm can produce more refrigerators in any month and carry them to a subsequent month. However it cost Rs 20 per unit for any refrigerator carried over from one month to the next. Assuming that there is no initial inventory, determine the number of refrigerators to be produced in each month to minimize the total cost.