**MCA**

**SCM 2006**

# Second Semester Examination – 2008

## NUMERICAL METHODS

### Full Marks – 70

### Time : 3 Hours

*Answer Question No. **1** which is compulsory*
*and any **five** from the rest.*
*The figures in the right-hand margin*
*indicate marks.*

1. Answer the following questions :  $2 \times 10$

   (a) What is an error ? What are the different characteristics and types of error ?

   (b) State the rules of rounding off decimal number correct upto n significant digits.

   (c) Write $-4.268106$ and $0.00518789$ in floating point form with 4 significant digits with round off.

   (d) State the basic difference between Secant method and method of false position in solving an equation.

   (e) What is the geometrical interpretation of Newton-Raphson method to solve an equation ?

   (f) What is ill conditioning of a system of linear equations ? How can you overcome this problem ?

   (g) What is an eigen value of a matrix ? Why are eigen value problems important ?

   (h) Is Euler method to solve a differential equation accurate enough for practical problems ? Can it be improved ?

   (i) What do you mean by single step and multi-step method to find the solution of a

differential equation ? Give one example in each case.

(j)  How to calculate error in Simpson's 1/3 rule in evaluating an integral ?

2.  (a)  Determine a real root of the equation $x^{3.5} = 80$ using method of false position, correct upto three decimal places.          5

(b)  What do you mean by the rate of convergence of an iterative method ? Determine the rate of convergence of Newton-Raphson method to find the solution of an equation.

5

3.  (a)  Solve the following system of linear equations by Gauss elimination using partial pivoting :          5

$$2x + y + z = 1$$
$$5x + 2y + 2z = -4$$
$$3x + y + z = 5$$

(b)  Solve the following system of linear equations by Gauss-Seidel method correct upto two decimal places :          5

$$10x + 2y - z = 27$$
$$-3x - 6y + 2z = -61.5$$
$$x + y + 5z = -21.5$$

4.  (a)  Using least square regression, find a straight line to the following given data :  5

| x : | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-----|---|-----|---|---|---|---|---|----|----|
| y : | 1 | 1.5 | 2 | 3 | 4 | 5 | 8 | 10 | 13 |

(b)  Using centered difference approximation, estimate the first and second order derivative of $y = e^x$ at $x = 2$ for the step size $h = 0.1$.          5

5.  (a)  Derive and estimate the error of Trapezoidal rule for numerical integration of a function f in the range $[a, b]$.          5

(b) Using Simpson's 3/8 rule evaluate the following integral by using 9 sub-intervals of equal width : 5

$$\int_0^{\frac{\lambda}{2}} \sin x\, dx.$$

6. (a) Solve the following differential equation by using modified Euler's method for $y(4.1)$ and $y(4.2)$, taking $h = 01$ 5

$$5x\frac{dy}{dx} + y^2 - 2 = 0.$$

(b) Solve the following differential equation for $y(0.1)$ and $y(0.2)$ using Runge-Kutta method of fourth order. 5

$$\frac{dy}{dx} = \frac{1}{x+y} \quad \text{where } y(0) = 1.$$

7. (a) Find all eigen values and eigen vectors of the matrix 5

$$\begin{bmatrix} 2 & 3 & 1 \\ 3 & 2 & 2 \\ 1 & 2 & 1 \end{bmatrix}.$$

(b) Find the inverse of the following matrix by using LU decomposition. 5

$$\begin{bmatrix} 3.0 & -0.1 & -0.2 \\ 0.1 & 7.0 & -0.3 \\ 0.3 & -0.2 & 10.0 \end{bmatrix}$$

8. (a) Evaluate the polynomial $y = x^3 - 7x^2 + 8x - 0.35$ at $x = 1.37$. Use 3-digit arithmetic with chopping. Also evaluate the percent relative error. 5

(b) Discuss about stability and condition of a mathematical problem. Also compute and interpret the condition number for

$$f(x) = \tan x \quad \text{for } x = \frac{\pi}{2} + 0.1\left(\frac{\pi}{2}\right). \quad 5$$