S.E (Chem)(REV) CBGS.

(CPNM)

Computer Programming &   QP Code : NP-18693

Numerical methods (3 Hours)(Lab) 28   [Total Marks : 80

26/5/14

N.B. : (1) Question No. 1 is **compulsory**, Answer any **three** questions from **remaining**.

(2) Assume data if **necessary** and specify the assumptions **clearly**.

(3) Answer to the **sub-questions** of an individual question should be **grouped** and **written together** i.e. **one** below the other.

1. (a) Explain how to use 'do–while' loop in Sci-Lab with appropriate example. 5

   (b) Using finite difference method obtain the discrete formula for the second order derivative, 5

   $$\frac{d^2x}{dt^2}$$

   (c) Solve following equations using successive substitution method. 5

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

   (d) Calculate the value of y (0·2) for the equation $dy/dx = y^2 - x$ if y (0) = 1·0, take step size of 0·1 and use Euler's method. 5

2. A dynamic model for flow through cylindrical tank, 20

   $$\frac{dh}{dt} = \frac{F_o - F}{\frac{\pi}{4} D^2}$$

   where, D is diameter of tank, Fo is inlet flowrate, F is outlet flowrate and h is level in the tank. If tank dimensions are as given below, find the liquid level in the tank with respect to time. Take step size of 5 seconds and show calculations till 20 seconds. Use modified Euler's Method, or second order Runge – Kutta Method.

   Data :
   Diameter of tank = 1m
   Height of tank = 2m
   $F = 0·04 \sqrt{h}$ in m^3/s where h is in m,
   $F_0 = 0·06 \ m^3/s$
   At t = 0 sec, h = 1 m.

3. (a) Solve following set of equations using Gauss–seidel and Gauss–Jordon method :— 12

   $$x + 2y + 3z = 14$$
   $$x + y - z = 0$$
   $$2x + y - z =$$

   (b) Write Laplace equatio   ss it in difference form using Taylor's series expansion. 8

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4. (a) Chemical equilibria for a reaction $A + B \rightleftharpoons 3C$ is represented by following   15
equation.

$$K = \frac{C_A C_B}{C_c^3}$$

where, k = equilibrium constant = 2

$C_A = (1 - X_A)$

$C_B = C_{BO}(1 - X_B) \approx C_{AO}(1 - X_A)$

$C_C = C_{CO} + 3C_{AO} X_A \approx 3 C_{AO} X_A$

$C_{AO} = 1$.

Find the conversion X_A using Newton – Raphson method. Take $X_A = 0.5$ as initial guess.

(b) Show that the following system does not have a solution :—   5

$$3x_1 + 2x_2 - x_3 - 4x_4 = 10$$
$$x_1 - x_2 + 3x_3 - x_4 = -4$$
$$2x_1 + x_2 - 3x_3 = 16$$
$$-x_2 + 8x_3 - 5x_4 = 3$$

5. (a) Solve the following system by Gaussian Elimination with and without partial   12
pivoting and comment on the result.

$$2.51x + 1.48y + 4.53z = 0.05$$
$$1.48x + 0.93y - 1.30z = 1.03$$
$$2.68x + 3.04y - 1.48z = -0.53$$

(b) Solve the following system by LU decomposition :—   8

$$A = \begin{bmatrix} 4 & 0 & -1 & 3 \\ 2 & 1 & -2 & 0 \\ 0 & 3 & 2 & -2 \\ 1 & 1 & 0 & 5 \end{bmatrix} \quad x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} \quad b = \begin{bmatrix} 0 \\ 1 \\ 4 \\ -2 \end{bmatrix}$$

$$Ax = b$$

6. (a) Find the root of $f = 4(x - 1)^3$ via secant method with $0.4 \le x \le 1.3$. Required   10
accuracy is 0.02. Show the progress of method on graph.

(b) Apply Regula-Falci method to find root in the interval [0.5, 1.5] for the function.   10

$$f = 30x^5 - 180x^4 + 330x^3 - 180x^2 = 0$$

accurate upto third decimal place.