SE – Chemical – Sem-III – CBSGS → CPNM

02 DEC 2014

QP Code :14617

(3 hours) Sub: Computer Programming & Numerical Methods (27)

80 marks

N.B. : 1) Question No.1 is compulsory
2) Answer any three questions from remaining questions
3) Assume data if necessary and specify assumptions clearly

Q.1 a) Solve following system of equations by using Gauss-Elimination Method 5 marks

$x+y+z=7 \quad x+2y+3z=16 \quad x+3y+4z=22$

b) Use Crank-Nicholson Scheme to solve, $u_{xx}=u_t, 0<x<1,\ t>0\ ,\ h=\frac{1}{4}\ ,\ k=\frac{1}{8}$ 5 marks

Given $u(x,0)=0\ ,\ u(0,t)=0\ ,u(1,t)=50t$ Compute u for 1-step in t-direction

c) Explain the use of 'If-else ' in SciLab with appropriate example 5 marks

d) A chemical reaction is carried out in a batch of reactor and the change in concentration of 5 marks

reactant is given by $\frac{dC_A}{dt}=\frac{C_A}{0.6+2C_A}$, initially at $t=0$, $C_A=1$. Find C_A at $t=1$ by using

Runge Kutta Method of second order with $h=0.5$

Q.2

A volume and level in gravity flow tank system is given by following equations, [20]

$$\frac{dV}{dt}=0.0107h-0.00205V^2$$

$$\frac{dh}{dt}=0.311-0.0624V$$

where, V in cu. ft. and h in ft and time in sec.
The parameters and variables are as given below.

V = tank volume, (at t = 0, 3.4 cu. ft.)
h = level in tank, (at t = 0, 2.05 ft)

Find the level and volume after one minute using Runge-Kutta second order method.
Use 20 sec as step size.

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GN-Con.:

Q.3 a) Use Bender Schmidt Method to solve, $\frac{\partial^2 u}{\partial x^2} = \frac{1}{4}\frac{\partial u}{\partial t}$ given $u(0,t) = 0 = u(8,t)$, 10 marks

$u(x,0) = 4x - \frac{x^2}{2}$ Find u in the range taking $h = 1$ upto $t = 1$

b) Find the root of the equation $3x - \sqrt{1+\sin x} = 0$ upto four decimal places using Bisection Method 10 marks

Q.4 a) Friction factor in commercial pipe for turbulent flow can be calculated using Colebrook equation. 12 marks

If roughness factor(k) for carbon steel pipe is 0.00015 m for a pipe with ID (D) 0.315 m, using any numerical method calculate friction factor (f) if Reynolds number(Re) is 125,000.

Colebrook equation,

$$\frac{1}{\sqrt{f}} = -2.0\log\left(\frac{k/D}{3.7} + \frac{2.51}{Re\sqrt{f}}\right)$$

b) Solve the following system of equation by Gauss- Jordan Method and LU-Decomposition 08 marks

$x + y + z = 3 \qquad x + 4y + 9z = 6 \qquad x + 2y + 3z = 4$

Q.5 a) Use Regula Falsi Method to find the root of the equation $x\log x = 2$ correct to three decimal places 7 marks

b) Discuss the convergence of Newton Raphson Method 6 marks

c) Solve $\frac{\partial^2 p}{\partial x^2} + \frac{\partial^2 p}{\partial y^2} = 0$, if $p(0,y) = 0$, $p(x,0) = 0$, $p(4,y) = y$, $p(x,4) = x$ 7 marks

where $0 \le x \le 4$, $0 \le y \le 4$ by draw the mesh for given data

Q.6 a) Calculate the volume of superheated steam at $100atm$ and $350^0 C$ using the equation 10 marks

$\left(P + \frac{a}{v^2}\right)(v - b) = RT$, Newton-Raphson Method, for initial value of v use Ideal gas equation

where $a = \frac{27R^2T_c^2}{64P_c}$, $b = \frac{RT_c}{8P_c}$, $Tc = 647.11K$, $Pc = 220.76atm$

b) Solve $\frac{dy}{dx} = x^2(1+y)$, $y(1) = 1$, $h = 0.1$ Find the value of $y(1.4)_P$ and $y(1.4)_C$ by Adam-Bashforth 10 marks

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