

1T00525 - T.E.(CHEMICAL)(Sem V) (Choice Based) Computer Programming &amp; Numerical Methods

(3 hours)

Total Marks: 80

- N. B. (i) Question number **one is compulsory**.  
 (ii) Answer any **three** questions from the rest.  
 (iii) Assume suitable data wherever necessary.

Q.1.a) How to use Loops in python? Explain with examples. (05)

b) Solve the following system of equations using Gauss elimination method: (05)

$$3x + y - 2z = 9$$

$$-x + 4y - 3z = -8$$

$$x - y + 4z = 1$$

c) Give graphical representation of Newton Raphson and Bisection method and comment on their convergence. (05)

d) Calculate the value of y (0.2) for the equation (05)

$$\frac{dy}{dx} = y^2 - x \text{ if } y(0)=1.0 \text{ take step size } h=0.1. \text{ Use Euler's method.}$$

Q.2.a) Find the positive root of  $xe^x = 2$  by False position method correct up to 3 decimal places. (10)

b) Using Newton's method find the root between 0 and 1 of  $x^3 = 6x - 4$  correct up to 4 decimal places. (10)

Q.3.a) A ball at 1200K is allowed to cool down in air at an ambient temperature of 300K. Assuming heat is lost only due to radiation of the ball is given by, (15)

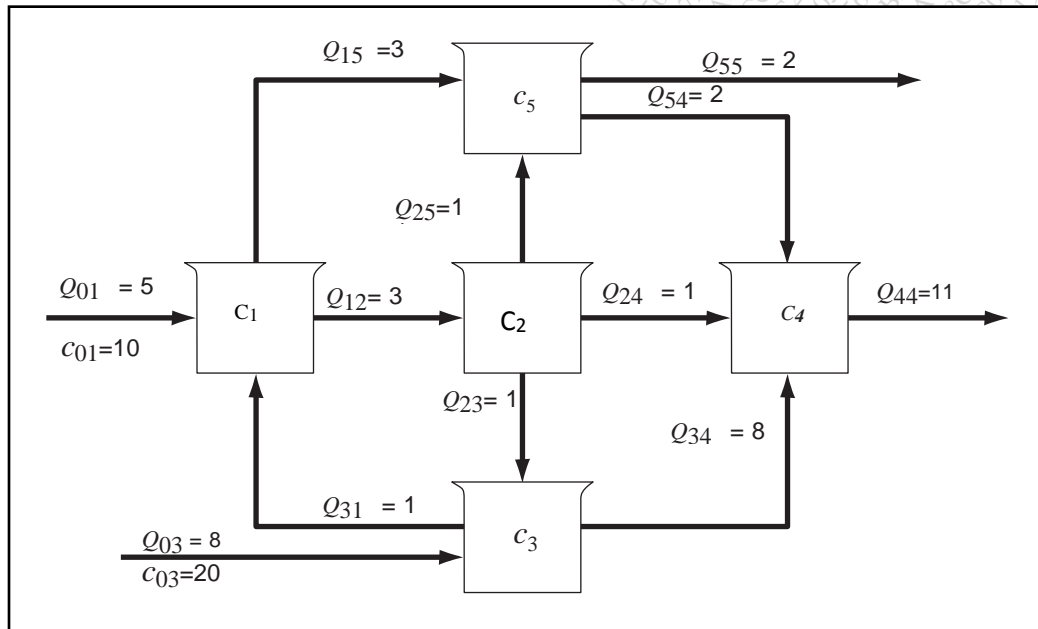
$$\frac{d\theta}{dt} = -2.2067 \times 10^{-12} (\theta^4 - 81 \times 10^8), \theta(0) = 1200K$$

where  $\theta$  is in K and t is in seconds. Find temperature at  $t=480$  s. Using Runge Kutta 4<sup>th</sup> order method. Assume a step size of  $h = 240$ s.

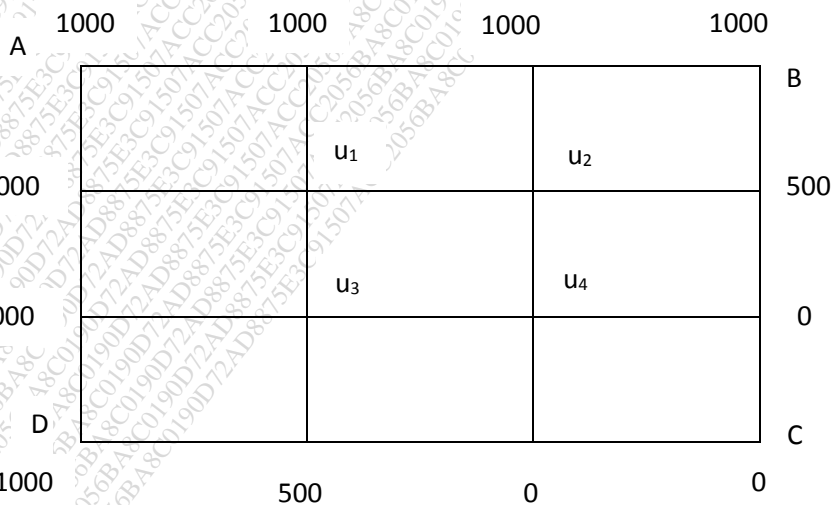
b) Solve  $u_{xx} = 32 u_t$  taking  $h=0.25$  for  $t > 0$ ,  $0 < x < 1$  and  $u(x,0) = 0$ ,  $u(0, t) = 0$ ,  $u(1, t) = t$  upto  $t=5$ . Use Bender-Schmidt method. (05)

Q.4) Use Gauss-Jordan method to determine the steady state concentrations  $C_1, C_2, C_3,$  (20)

$C_4$  and  $C_5$  of a system of coupled reactors. Flowrate  $Q$  in  $\text{m}^3/\text{min}$  and concentration in  $\text{mg}/\text{m}^3$  are as shown in following figure.



Q.5.a) Evaluate the function  $u(x,y)$  satisfying  $\nabla^2 u = 0$  at the lattice points given the boundary value as follows (10)



b) Using Adam-Bashforth predictor-corrector method find  $y(2)$  given (10)

$$\frac{dy}{dx} = \frac{1}{2}(x + y), y(0) = 2, y(0.5) = 2.636, y(1) = 3.595, y(1.5) = 4.968.$$

Q.6a) Form the difference equation given (05)

$$y_n = (An + B)3^n$$

b) Solve by Crank Nicholson method the equation  $u_{xx} = u_t$  subject to the (08)  
condition  $u(x, 0) = 0, u(0, t) = 0$  and  $u(1, t) = t$  taking  $h=0.25$  for one-time  
steps.

c) Solve the equation  $x^3 - x - 4 = 0$  by secant method correct upto 4 decimal (07)  
places.

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