MODEL QUESTION PAPER

SIXTH SEMESTER B.TECH DEGREE EXAMINATION

(2013 Scheme)

BRANCH: BIOTECHNOLOGY AND BIOCHEMICAL ENGINEERING

13.605 NUMERICAL METHODS FOR PROCESS ENGINEERS (B)

Time: 3 hours Max. Marks: 100

PART-A

(Answer all questions. Each question carries 2 marks)

1. Write down the importance of Numerical Techniques in bioprocess engineering.
2. State the criterion for the convergence in Newton Raphson method.
3. What are the two types of errors involving in the numerical computations?
4. State Schmidt's explicit formula for solving heat flow equation?
5. Find the divided differences of $f(x) = x^2+x+2$ for the arguments 1,3,6,11.
6. How many prior values are required to predict the next value in Milne's method?
7. State the conditions required for a natural cubic spline.
8. Find the values of k1 and l1 to solve y"+xy'+y=0, y(0)=1, y'(0)=0 by fourth order Runge-Kutta method.
9. Obtain the Lagrange's interpolating polynomial for the observed data of points (1,1),(2,1) and (3,-2).
10. Write down the general and simplest forms of the difference equation corresponding to the hyperbolic equation $u_{tt}=a^2u_{xx}$.

PART-B

(Answer one full question from each module. Each question carries 20 marks)

MODULE I

6. (a). Obtain the solution of

$4x^2+ y^2+ 2xy- y^2 = 0$

$2x^2+ y^2+ 3xy- 3 = 0$ near (0.4,0.9)

using Modified Newton Raphson method.

(b). Using Gauss-Jordan method, solve the following system of equations

$$3x+4y-7z=23,\ 7x-y+2z=-14,\ x+10y-2z=33.$$

7. (a) Solve the following system of equations using Gauss elimination method

$$8x_1+4x_2+2x_3 = 24$$
$$4x_1+10x_2+5x_3+4x_4 = 32$$
$$2x_1+5x_2+6.5x_3+4x_4 = 26$$
$$4x_2+4x_3+9x_4 = 21$$

(b) Solve the equation $3x + \sin x - e^x = 0$ by Regula falsi method

MODULE II

8. (a) The following data are taken from a steam table.

Temperature, °C	140	150	160	170	180
Pressure, Kgf/cm²	3.685	4.854	6.302	8.076	10.225

Find the pressure at 142 °C'

(b) Using the following table, apply the gauss forward formula to get f(3.75)

X	2.5	3	3.5	4	4.5	5
F(X)	24.145	22.043	20.225	18.644	17.262	16.047

9. (a) Evaluate $\int_0^1 \left(1+\frac{\sin x}{x}\right)dx$ correct to three decimal places,

(i) Using trapezoidal rule and Romberg integration.

(ii) Using simpson's rule and Romberg integration.

Assume f(0) as the limiting value.

(b) Evaluate the integral $I = \int_0^1 \frac{dx}{1+dx}$ with composite trapezoidal rule

MODULE III

10. (a) Solve the initial value problem

$$u' = -2tu^2 \, , \; u(0) = 1$$

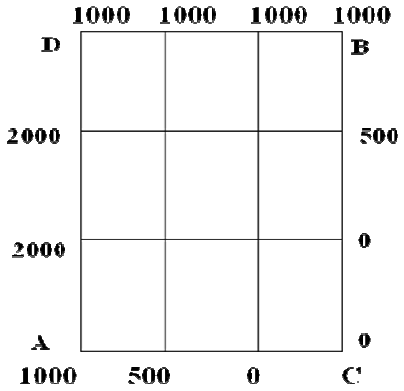
With $h = 0.2$ on the interval [0, 0.4]. Use the fourth order classical Runge- Kutta method. Compare with exact solution.

11. Consider the initial value problem $y' = x(y + x) - 2 \, , \; y(0) = 2$.

(a) Use Euler method with step sizes $h = 0.3, \; h = 0.2, \; h = 0.15$ to compute approximations to $y(0.6)$ (5 decimals).

MODULE IV

12. Evaluate the function $u(x, y)$ satisfying $\nabla^2 u = 0$ at the lattice points given the boundary values as follows.



13. Solve the boundary value problem $u'' = \frac{3}{2}u^2 \, , \; u(0) = 4 \, , \; u(1) = 1$

With h = 1/3. Use a second order finite difference method for its solution.