BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
M.E. 1ST SEMESTER (CE) FINAL EXAMINATIONS, 2012
Advanced Numerical Methods and Computer Programming (CE 920)

Full Marks: 70 **Time: 3 hrs**

Answer any five questions.

1. What are eigenvalue problems? Explain the Fadeev-Leverrier Method and use it to find the characteristic polynomial of the following system of equations. Also determine the eigenvalues of the system.

$$\begin{aligned} 16x_1 - 24x_2 + 18x_3 &= \lambda x_1 \\ 3x_1 - 2x_2 - 2x_3 &= \lambda x_2 \\ -9x_1 + 18x_2 - 17x_3 &= \lambda x_3 \end{aligned}$$

(14)

2. (a) Explain the advantage of Gaussian integration over the Newton Cotes Methods. Write an algorithm for implementing the Gauss Legendre formula to evaluate $\int_a^b f(x)dx$, assuming that the weights and abscissae are available in an input file.

(b) Use the fourth-order Runge-Kutta Method to estimate $y(0.5)$ of the following equation with $h = 0.25$

$$\frac{dy}{dx} = y + \sin x; \quad y(0) = 2$$

(7 +7 =14)

3. (a) A set of data is given in the table below.

x	2	4	6	8
y	1.4	2.0	2.4	2.6

Fit the saturation growth rate model $y = \frac{ax}{b+x}$ to this data.

(b) Discuss on the different cases of convergence or divergence that may be obtained depending on the form of the iteration function *g(x)* in the Fixed Point Method for the solution of a nonlinear equation.

(7 +7 =14)

4. (a) Write a program that constructs Newton's interpolating polynomial for a given set of data points and then computes the interpolated value at a specified value of the independent variable.

(b) Derive the Newton-Raphson iterative formula for solving *f(x) = 0*. Explain the limitations of using this method.

(8+6 = 14)

5. (a) Write a program, which solves a system of *'n'* linear equations using the Jacobi iteration method. The solution algorithm should be implemented through a subroutine, which should test for both accuracy and convergence.

(b) Write a short note on Monte Carlo simulation technique.

(8+6 = 14)

6. (a) Factorize the following matrix into LU form, where L is lower triangular matrix and U is upper triangular matrix.

$$[A]=\begin{bmatrix} 3 & -2 & 1 \\ -2 & 3 & 2 \\ 1 & 2 & 2 \end{bmatrix}$$

Hence, solve the system of equations: -

$$\begin{aligned} 3x - 2y + z &= 3 \\ -2x + 3y + 2z &= -3 \\ x + 2y + 2z &= 2 \end{aligned}$$

(b) Write a program to solve a system of linear equations by Basic Gauss Elimination Method.

(8+6 = 14)

7. (a) Discuss and compare the following pairs of methods:

(i) Bisection Method and False Position Method
(ii) Lagrange interpolation polynomial and Newton interpolation polynomial
(iii) Jacobi iteration method and Gauss-Seidal method

(b) What is meant by an *r-order* Runge–Kutta Method ?

(4x3 + 2 =14)