B.Tech. Civil (Construction Management) /

B.Tech. Civil (Water Resources Engineering)

Term-End Examination

June, 2007

ET-302(A) : COMPUTER PROGRAMMING & NUMERICAL ANALYSIS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks.*

1. (a) Solve the equations :

$$x_1 + x_2 + x_3 = 6$$

$$3x_1 + 3x_2 + 4x_3 = 20$$

$$2x_1 + x_2 + 3x_3 = 13$$

using the Gauss elimination method.

(b) Perform five iterations of the Bisection method to obtain the smallest positive root of the equation

$$f(x) = x^3 - 5x + 1 = 0.$$ 7+7

2. (a) Use Regula – Falsi method to determine the root of the equation $\cos x - xe^x = 0$.

(b) The equation

$$f(x) = x^3 - 7x^2 + 16x - 12 = 0$$

has a double root at $x = 2$. Starting with the initial approximation $x_0 = 1$, find the root correct to 3 decimal places using the Newton – Raphson method. 7+7

3. (a) Find the interpolating polynomial that fits the data given in the following table by using Lagrange's interpolation method :

x	— 1	1	4	7
f(x)	— 2	0	63	342

Using this polynomial, find the approximate value of f(5).

(b) Solve the system of equations

$$4x_1 + x_2 + x_3 = 2$$
$$x_1 + 5x_2 + 2x_3 = -6$$
$$x_1 + 2x_2 + 3x_3 = -4$$

using the Jacobi iteration method.
Take the initial approximation as
$x^{(0)} = [0{\cdot}5, -0{\cdot}5, -0{\cdot}5]^T$. 7+7

4. (a) For the following data, calculate the difference and obtain the forward and backward difference polynomials. Interpolate at x = 0·25 and x = 0·35.

x	0·1	0·2	0·3	0·4	0·5
f(x)	1·40	1·56	1·76	2·00	2·28

(b) Solve the system of equations

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 8 & 22 \\ 3 & 22 & 82 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 5 \\ 6 \\ -10 \end{bmatrix}$$

using the Cholesky method. 7+7

5. (a) The formula

$$y = e^{x^2} \log (1 + |x|)/\sqrt{1+x^2+x^5}$$

is to be evaluated for x = 1·5, 1·55, 1·60, ..., 10·0. Using a DO loop, write a FORTRAN program to compute and print y for each value of x in the given range.

(b) The sum of the squares of the first n natural numbers is given by

$$s = \frac{n(n+1)(2n+1)}{6}$$

Write a program that will compute s for n = 10 (10) 250, i.e. n = 10, 20, 30, ..., 250. 7+7

6. (a) The formulae giving acceleration and position of a particle, assuming that the mass is at rest at time zero, are given by

$$a = \frac{F}{m}; \quad x = \frac{1}{2} at^2.$$

where 'F' is the force (in newton), 'm' the mass (in kg), 'a' the acceleration (in m/sec^2), and 'x' is the distance moved (in metre) since time t = 0. Write a program that reads in the values of F, m, and t, and computes and prints the values of a and x.

(b) Write a FORTRAN program which reads the values of A, B, and C and compute the semi-perimeter and area of the triangle, using the formulae

$$S = (A + B + C)/2$$

$$\text{Area} = \sqrt{S(S - A)(S - B)(S - C)}$$

Also print A, B, and C on one line, and S and area on the next line. 7+7

7. (a) Evaluate $\int_0^6 \frac{1}{1+x^2}\, dx$ by using

(i) Trapezoidal rule, and

(ii) Simpson's $\frac{1}{3^{rd}}$ rule.

(b) Apply Runge – Kutta fourth order method, to find an approximate value of y when $x = 0{\cdot}2$ given that $\frac{dy}{dx} = x + y$ and $y = 1$ when $x = 0$. 7+7

8. (a) Write a FORTRAN program that reads a temperature in Celsius degrees and prints the equivalent in Fahrenheit degrees.

You may use the formula $\frac{C}{5} = \frac{F - 32}{9}$.

(b) Write a FORTRAN program that reads three integers and prints the minimum and maximum. 7+7