

**BACHELOR IN COMPUTER  
APPLICATIONS****Term-End Examination****June, 2006****CS-71 : COMPUTER ORIENTED  
NUMERICAL TECHNIQUES**

Time : 3 hours

Maximum Marks : 75

**Note :** Question number 1 is **compulsory**. Attempt any **three** questions from Q 2 to Q 5. Calculators are **not** to be used. Unless otherwise mentioned, calculations should be done upto 3 decimal places.

- 
- 
1. (a) The equation  $9x^3 + 3x^2 - 5x + 1 = 0$  has a double root near 0.3. Obtain one approximation to the root using the Newton-Raphson method, upto three decimal places. 4
- (b) Find the relative error in the computation of  $x - y$ , where  $x = 0.572133869$ ,  $y = 0.572021437$  with five decimal digit accuracy. 3
- (c) If  $f(x) = \frac{1}{x}$ , find the third divided difference  $f[x_0, x_1, x_2]$ . 3

- (d) Using the Newton's backward difference formula, obtain an approximation to  $f(4.5)$  from the data of values.

x	1	2	3	4	5
f(x)	8	21	46	89	156

- (e) Evaluate  $\int_0^1 x e^{-x^2} dx$  using the Simpson's rule with  $n = 4$  sub-intervals. Compare the result with the exact solution.

(Given :  $e^{-1/16} = 0.9394$ ,  $e^{-1/4} = 0.7788$ ,  
 $e^{-9/16} = 0.5698$ ,  $e^{-1} = 0.3679$ )

- (f) Obtain the truncation error of the Heun's method for the solution of the initial value problem  $y' = f(t, y)$ ,  $y(t_0) = y_0$ .
- (g) Explain what 'instability of an algorithm' is. Support your explanation with appropriate examples.

2. (a) Derive the regula-falsi method for finding a simple root of the equation  $f(x) = 0$ .
- (b) State the Lipschitz condition. Further, check whether the IVP

$$y' = 1 + y^2, y(0) = 1$$

can be solved using this condition.

- (c) From the following data, approximate  $f(2.5)$  using Newton's difference formula :

x	2	3	4	5
f(x)	0.693	1.098	1.386	1.609

3. (a) For  $f(x) = x^2 - 3x + 1 = 0$ , find the smallest positive root by the fixed point iteration method, using three iterations. Find the minimum number of iterations required so that the error in the approximation is  $\leq 5 \times 10^{-1}$ . 9

- (b) Solve the following system of equations by Gauss elimination with partial pivoting. 6

$$x_1 + x_2 + 2x_3 = 1$$

$$4x_1 + 2x_2 + x_3 = 2.5$$

$$2x_1 + 3x_2 + 4x_3 = 1$$

4. (a) If  $f''(x_0)$  is approximated by

$$f''(x_0) = \frac{1}{12h^2} [-f(x_0 - 2h) + 16f(x_0 - h) + cf(x_0) + 16f(x_0 + h) - f(x_0 + 2h)],$$

find the value of c. 5

- (b) Solve the initial value problem

$$y' = \frac{2y - x}{2y + x}, y(0) = 1$$

using Euler's method in  $[0, 0.3]$  with  $h = 0.1$ . 5

- (c) Find the interpolation polynomial that fits the data  $f(0) = 1$ ,  $f(2) = 25$ ,  $f(3) = 82$ ,  $f(4) = 193$ . Hence, find an approximation to  $f(1)$ . 5

5. (a) Use the Runge - Kutta method of order 4 to evaluate  $y(1.1)$  for the IVP  $\frac{dy}{dx} = x^2 + y^2$ ,  $y(1) = 0$ . 6

(b) Which of the following statements is true ? Give reasons for your answer. 6

(i) 2.145 is the floating point representation of 21.45.

(ii) The round-off of 4.50936 to 4 significant digits is 4.5094.

(iii) Numbers in 3-digit decimal arithmetic with rounding satisfy the distributive property of multiplication over addition.

(c) Using inverse interpolation, find the value of  $x$  for  $y = 1$ , given the following data : 3

x	1	3	4
y	-3	0	3