

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech (EE-NEW)/SEM-3/CS-312/2010-11****2010-11****NUMERICAL METHODS AND PROGRAMMING**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.***GROUP - A****( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any ten of the following : 10 × 1 = 10

i) The Newton-Raphson method is used to find the root of the equation  $x^2 - 2 = 0$ . If the iteration started from  $-1$ , the iteration will

- a) converges to  $-1$                       b) converges to  $\sqrt{2}$   
 c) converges to  $-\sqrt{2}$                     d) not convergent.

ii) Consider the sequence  $x_{n+1} = \frac{x_n}{2} + \frac{9}{8x_n}$  ( $n \geq 0$ ),  $x_0 = 0.2$  obtained from Newton-Raphson method. The sequence converges to

- a) 1.5                                              b)  $\sqrt{2}$  /  
 c) 1.6                                              d) 1.4.

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iii) In iteration method  $[x = \varphi(x)]$  for the equation  $\pi x = \sin x$ , the appropriate choice of  $\varphi(x)$  such that sequence  $x_0, x_1, x_2, \dots, x_n$  convergence to the root is

- a)  $\frac{\sin x}{\pi}$                       b)  $\cos x$   
c)  $\frac{\cos x}{\pi}$                       d) none of these.

iv) What is the output of the following code ?

```
#include<stdio.h>

void main ( )
{
    int x = 2;
    x = x <<5; printf("%d",x);
}
```

- a) 5                                  b) 2  
c) 32                                d) none of these.
- v) When Gauss elimination method is used to solve  $AX = B$ ,  $A$  is transformed to a/an
- a) null matrix  
b) upper triangular matrix  
c) identity matrix  
d) diagonally dominant matrix.
- vi) The kind of error occurs when  $\pi$  approximated by 3.14 is
- a) truncation error              b) round off error  
c) inherent error                d) relative error.

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- vii) The convergence condition for Gauss-Seidel iterative method for solving a system of linear equation is
- a) the coefficient matrix is singular
  - b) the coefficient matrix has rank zero
  - c) the coefficient matrix must be strictly diagonally dominant
  - d) none of these.
- viii) Recursive function may call
- a) another function
  - b) itself
  - c) both (a) & (b)
  - d) none of these.
- ix) Which of the following is a multistep method ?
- a) Euler's method
  - b) Predictor-corrector method
  - c) Taylor's series method
  - d) None of these.
- x) The rate of convergence of the Fixed point iteration method for solving  $f(x) = 0$  is
- a) quadratic
  - b) biquadratic
  - c) cubic
  - d) linear.
- xi) The value of  $x$  after execution of the following statements :
- ```
int x, y = 12;  
x = (y < 14) ? (y + 1) : (y - 1);
```
- is
- a) 10
  - b) 15
  - c) 12
  - d) 13.

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xii) Output of the following programme code

```
{
int a = 5, b = 3;
    a = a + b;
    b = a - b;
    a = a - b;

printf ("a=%d, b=%d", a, b);
}
```

is

- a)  $a = 5, b = 3$                       b)  $a = 0, b = 5$   
c)  $a = 3, b = 5$                       d) none of these.

### GROUP - B

( Short Answer Type Questions )

Answer any *three* of the following.                       $3 \times 5 = 15$

2. Find the inverse of the following matrix by Gauss elimination method :

$$\begin{bmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 1 & 4 & 9 \end{bmatrix}$$

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3. Prove that  $\Delta \log f(x) = \log \left[ 1 + \frac{\Delta f(x)}{f(x)} \right]$ .                      5

4. a) Explain "closing a file" with the help of small programme segment in C.

- b) Write a user defined recursive function to calculate factorial of  $n$ , where  $n$  is any integer number.                       $2 + 3$

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5. From the following table find the polynomial  $f(x)$  by Newton's divided difference interpolation formula :

|         |    |    |    |     |      |
|---------|----|----|----|-----|------|
| $x:$    | -1 | 0  | 3  | 6   | 7    |
| $f(x):$ | 3  | -6 | 39 | 822 | 1611 |

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6. Using Runge-Kutta method to fourth order solve  $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$  with  $y(0) = 1$  at  $x = 0.2$ .

**GROUP - C****( Long Answer Type Questions )**Answer any *three* of the following.  $3 \times 15 = 45$ 

7. a) Find a real root of the equation  $f(x) = x^3 - 2x - 5 = 0$  using Regula falsi method correct to 3 decimal places.
- b) Prove that  $\mu^2 = 1/4(\delta^2 + 4)$ , where  $\mu$  = mean operator and  $\delta$  = central difference operator. 7 + 8
8. a) Find the value of  $y$  at  $x = 6$  from the following data, using Newton's divided difference formula. 7

|      |     |     |    |    |
|------|-----|-----|----|----|
| $x:$ | 3   | 7   | 9  | 10 |
| $y:$ | 168 | 120 | 72 | 63 |

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- b) Find the values of  $y$  at  $x = 0.1$  using Taylor's series method of the third order, given that  $dy/dx = 1/(x+y)$ ,  $y(0) = 2$ . 5
- c) Write difference between Euler's method and R.K. method. 3
9. a) Prove that Newton-Raphson method has a quadratic convergence.
- b) Use Gauss elimination method to solve the following equations :
- $$2x + y + z = 10$$
- $$3x + 2y + 3z = 18$$
- $$x + 4y + 9z = 16 \quad 6 + 9$$
10. a) Evaluate  $\int_3^7 x^2 \log x \, dx$  by using Trapezoidal rule taking  $n = 4$ .
- b) Find the missing term in the following table :
- |       |   |   |   |   |    |
|-------|---|---|---|---|----|
| $x :$ | 0 | 1 | 2 | 3 | 4  |
| $y :$ | 1 | 3 | 9 | — | 81 |
- Explain why the result differs from  $3^3 = 27$ .
- c) Write a program in C to solve the equation  $x^3 + x^2 + x + 7 = 0$  within  $(-3, -2)$  by Bisection method. 4 + 4 + 7

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11. a) Derive Simpson's one-third rule from Newton-Cote's quadrature formula.
- b) Solve the equation  $dy/dx = x + y$  with initial condition  $y(0) = 1.0$  and  $h = 0.1$ , using predictor-corrector method, to find  $y(0.2)$ .
- c) Write a program using recursive function to calculate the sum of all digits of any number. 6 + 5 + 4
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