Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH(EE-OLD)/SEM-3/CS-312/2011-12

2011

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 : $10 \times 1 = 10$

   i) The number of significant digits in 0·04505910 is

      a) 8 b) 7

      c) 6 d) 5

   ii) Overflow occurs due to

      a) division by a very large number

      b) division by a very small number

      c) both (a) and (b)

      d) none of these.

iii) The rate of convergence of secant method is

a) 2 b) 1

c) 0·62 d) 1·62

iv) If $f(x)$ be a polynomial of degree n, then

a) $(n+1)^{\text{th}}$ order forward difference exists

b) $(n-1)^{\text{th}}$ order forward difference exists

c) n^{th} order forward difference exists

d) none of these.

v) Which of the following does not always guarantee convergence ?

a) Bijection method

b) Newton-Raphson method

c) Regula-falsi method

d) none of these.

vi) If $f(x)=\frac{1}{x}$ then divided difference [a , b, c] is

a) $\frac{1}{a}-\frac{1}{b}-\frac{1}{c}$ b) $\left(\frac{1}{a}-\frac{1}{b}\right)-\left(\frac{1}{b}-\frac{1}{c}\right)$

c) $\frac{1}{abc}$ d) $\left(\frac{1}{a}-\frac{1}{b}\right)+\left(\frac{1}{b}-\frac{1}{c}\right)$

vii) Which of the following relations is true ?

a) $\Delta=E-1$ b) $\Delta,\nabla=\Delta-\nabla$

c) $\Delta,\nabla=\Delta+\nabla$ d) $\Delta=1-E$

viii) In Simpson's $\frac{1}{3}$rd rule the portion of the curve in the interval $[x_{i-1}, x_{i+1}]$ is replaced by

a) straight line
b) parabola
c) hyperbola
d) a cubic polynomial.

ix) What will be the output of the following program segment ?

```
main ( )
 {
    int x, y, z;
       x = 7;
       y = x + + ;
       z = + + ;
       prinf (“%d, %d”, y, z)
  }
```

a) 7, 8
b) 7, 9
c) 8, 9
d) none of these.

x) Which of the following statements is / are false ?

A. Gaussian elimination method is a direct method

B. Gaussian elimination method has a computational complexity O (n^3)

C. Gaussian elimination method solves any system of linear simultaneous equations

D. Gaussian elimination method reduces the co-efficient matrix in upper triangular form.

a) (C) only b) both (B) and (C)

c) (B) only d) all are true.

xi) Consider the following program segment :

```
for (i = 1, sum = 0; i ≤ 10; i + +)
{
 scanf ("%d", & x) ;
if (x < 0) continue ;
sum + = x ;
}
```

The value of "sum" with input 1,–2, –3, 2, 4,–3,5,1,3, –1 is

a) 5 b) 1

c) 16 d) 7

xii) Truncation error associated with Runge-Kutta 4th order formula is of the order of

a) h^2 b) h^3

c) h^4 d) h^5

GROUP – B

(Short Answer Type Questions)

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

2. Solve the following system of linear simultaneous equations by Gaussian elimination method.

   $2x + y + 4z = 16$

   $3x + 2y + z = 10$

   $x + 3y + 3z = 16.$

3. Find a root of the following non-linear equation corrected up to 3 decimal places.

   $x^3 - 2x - 5 = 0$

   Take $x_0 = 1$ and $x_1 = 2$

4. Evaluate $\int_0^1 \frac{1}{1+x}\,dx$ using Simpson's $\frac{1}{3}^{\text{rd}}$ rule.

   Take $h = 0 \cdot 1$.

5. What do you mean by "Entry Control Loop" and "Exit Control Loop" ? What is a void pointer ?

6. Given the following table of values :

x	4	5	7	10
$f(x)$	48	100	294	900

Calculate $f(8)$ using Lagrange's formula.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Derive the condition of convergence of Gauss-Seidel iterative method for solution of linear simultaneous equations.

   b) Write a *C* program to implement Trapezoidal method. Result is required to be corrected up to n decimal places. The limits of integration and the value of n (precision) are to be taken as input. 7 + 8

8. a) Solve the following system of equation by *LU*-factorization method.

   $x + 3y + 8z = 4$

   $x + 4y + 3z = -2$

   $x + 3y + 4z = 1$

   b) Given the following differential equation $\frac{dy}{dx} = x + y + xy, \quad y(0) = 1$

   Calculate y at $x = 0{\cdot}1$ taking $h = 0{\cdot}02$. 8 + 7

9. a) Define Δ, ∇ and E. Hence derive Newton's forward difference formula.

   b) Derive the order of convergence for Newton-Raphson method

   c) Evaluate $\sqrt{5}$ corrected up to 4 decimal places using Newton-Raphson method. 5 + 5 + 5

10. a) Write a *C* program to create the divided difference table.

b) Prove that $\Delta , \nabla = \frac{\Delta}{\nabla} - \frac{\nabla}{\Delta}$ 10 + 5

11. a) Derive the truncation error associated with Trapezoidal method.

b) Find y (0·26) from the following tabular values using Newton's Backward difference formula :

x	0·10	0·15	0·20	0·25	0·30
y	0·1003	0·1511	0·2027	0·2553	0·3093

c) Compute the absolute error and relative error associated with division of two approximate numbers *A* and *B*. 5 + 5 + 5