Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B. Tech (AUE)OLD/SEM-4/AUE-401/2012

2012

ENGINEERING ANALYSIS & NUMERICAL METHODS

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 the following : $10 \times 1 = 10$

   i) $(\Delta - \nabla)x^2$ is equal to

   a) h^2 b) $-2h^2$

   c) $2h^2$ d) none of these.

   ii) The error in composite Simpon's $\frac{1}{3}$rd rule is of ..... order.

   a) h^3 b) h^4

   c) h^5 d) none of these.

iii) Newton's interpolation formula can be used only for equal intervals.

a) True

b) False.

iv) Lagrange's interpolation formula can be used only for equal intervals.

a) True

b) False.

v) The partial differential equation $u_{xx} + u_{yy} = f(x, y)$ is called

a) Heat equation

b) Wave equation

c) Laplace equation

d) Poisson's equation.

vi) The shift operator E is equal to

a) $1 + \Delta$ b) $(1+\Delta)^{-1}$

c) $1 - \Delta$ d) $1-\Delta^2$.

vii) Which of the following is not true (the notation have their usual meaning) ?

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

c) $\frac{\Delta}{\nabla} = \Delta + \nabla$ d) $\Delta = 1 - E^{-1}$.

viii) The error in 4th order Runge-Kutta method is of order

a) h^3 b) h^4

c) h^5 d) none of these.

ix) For the differential equation $\frac{dy}{dx} = 1 - y,\ y(0) = 0$ the value of y (0·2) =

a) 0·1 b) 0·2

c) 0·01 d) none of these.

x) The error in the trapezoidal rule for $\int_{10}^{20} f(x)\,dx$ (where the number of sub-interval is 10) is

a) $-\frac{h^3}{12} f''(\xi)$

b) $-\frac{h^3}{12} f'(\xi)$

c) $-\frac{h}{12} f''(\xi)$

d) $-\frac{h^2}{12} f''(\xi)$

where h is the length of each sub-intervals and $a < \xi < b$.

GROUP – B

(Short Answer Type Questions)

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

2. Use Stirling's formula to find $f(35)$ from the following table :

x :	20	30	40	50
$f(x)$:	512	439	346	243

3. Compute $f^{I}(1{\cdot}2)$ and $f^{II}(1{\cdot}2)$ from the following table :

x :	1	2	3	4	5
$f(x)$:	0	1	5	6	8

4. Compute the values of the unknown in the system of equations by Matrix-Inversion method :

$$x_1 + 3x_2 + 2x_3 = 17$$

$$x_1 + 2x_2 + 3x_3 = 16$$

$$2x_1 - x_2 + 4x_3 = 13.$$

5. Evaluate $\int_0^5 \frac{dx}{3+x^2}$, by trapezoidal rule, taking $h = 1$.

6. Find the root of the equation $3x - \cos x - 1 = 0$, by the iteration method, correct to four significant figures.

GROUP – C

(Long Answer Type Questions)

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

7. a) Evaluate the integral $I = \int_0^1 \frac{dx}{1+x}$ using Gaussian two and three point integration rule. Compare with the exact solution.

b) Evaluate the following integral $I = \int_{y=1}^{2} \int_{x=1}^{3} (x^2 + y^2)\, dx\, dy$, using Simpson's $\frac{1}{3}$rd rule with the length of sub-interval h = 0·5 (along x-axis) and K = 0·5 (along y-axis). (7 + 1) + 7

8. a) Establish Newton's interpolation formula using forward differences when the functional values of $y = f(x)$ are known at (n + 1) equispaced points.

b) Compute f (0·5) and f (2·8) from the following table :

x :	0	1	2	3
$f(x)$:	1	2	11	34

7 + 8

9. a) Using Euler's method find the solution of the differential equation $\frac{dy}{dx} = x^2 - y, y(0) = 1$ for x = 0·3 taking h = 0·05 and compare with its exact solution.

b) Compute y (0·1), y (0·2), y (0·3) from the following differential equation : $\frac{dy}{dx} = x + y, y(0) = 1$ taking h = 0·1.

8 + 7

10. a) Explain Gauss elimination process for solving a system of three linear equations with three unknowns.

b) What do you mean by a system $n \times n$ strictly diagonally dominant equations ?

c) Solve, by Gauss-Seidel iteration method, the system,

$3x_1 + 9x_2 - 2x_3 = 11$

$4x_1 + 2x_2 + 13x_3 = 24$

$4x_1 - 2x_2 + x_3 = -8$.

6 + 2 + 7

11. a) Solve the equation $y'' = x + y$ with boundary conditions $y(0) = y(1) = 0$.

b) Use Newton-Raphson method to solve the system of equations $x^2 + y^2 + xy = 7$ and $x^3 + y^3 = 9$.

Take the initial approximation as $x_0 = 1{\cdot}5$ and $y_0 = 0{\cdot}5$.

6 + 9