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Invigilator's Signature :	•••••

CS/B.TECH (AUE)/SEM-4/AUE-401/2010 2010

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:

 $10 \times 1 = 10$

- Newton-Raphson method used for finding the real roots of a numerical equation is
 - a) analytical method
 - b) graphical method
 - c) iterative method
 - d) none of these.

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ii) If the interval of differencing is unity and $f(x) = ax^2$, find which one of the following choices is wrong.

a)
$$\Delta f(x) = a(2x + 1)$$

b)
$$\Delta^3 f(x) = 2$$

c)
$$\Delta^4 f(x) = 0$$

- d) None of these.
- iii) The accuracy attainable with Newton-Raphson method depends upon the value of the derivative $f^{\,\prime}(\,x\,)$. It is
 - a) True

- b) False.
- iv) In evaluating $\int_{a}^{b} f(x) dx$, the error in Trapezoidal rule

is of the order

a) h^{3}

b) h⁴

c) h^5

- d) none of these.
- v) The rate of convergence of Newton-Raphson method is
 - a) 1

b) 2

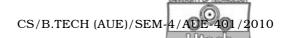
c) 3

- d) none of these.
- vi) The shift operator E is equal to
 - a) $1 + \Delta$

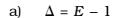
b) $(1 + \Delta)^{-1}$

c) $1-\Delta$

d) $1 - \Delta^2$.



vii) Which of the following is not true?



b)
$$\Delta \cdot \nabla = \Delta - \nabla$$

c)
$$\frac{\Delta}{\nabla} = \Delta + \nabla$$

d)
$$\Delta = 1 - E^{-1}$$
.

viii) One of the iterative methods by which we can find the solution of simultaneous linear equation is

a) Gauss Elimination method

- b) Gauss-Seidel method
- c) Matrix Inversion method
- d) none of these.
- ix) For the differential equation $\frac{dy}{dx} = 1 y$; y (0) = 0, the value of y (0.2) is

a) 0·1

b) 0.01

c) 0·2

- d) none of these.
- x) The error in 4th order Runge-Kutta method is of order

a) h^3

b) h⁴

c) h⁵

d) none of these.

GROUP - B



(Short Answer Type Questions)

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

2. Evaluate $\int \frac{dx}{1+x^2}$, using Simpson's $\frac{1}{3}$ rule taking $h = \frac{1}{6}$.

Hence compute an approximate value of π .

- 3. Find a real root of the equation $x^3 2x 5 = 0$ by Newton-Raphson method, correct up to three decimal places.
- 4. Solve the differential equation $\frac{dy}{dx} = x + y$, y (0) = 1,

 $x \in [0, 1]$, by Taylor's series method to obtain y for x = 0.1.

5. Compute y (0.3) by Euler's method

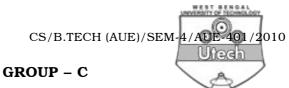
$$\frac{dy}{dx} = y^2 - x^2$$
 with $y(0) = 1$

and correct up to three decimal places.

6. Using Stirling's formula, find f (2.9) from the following table :

x :	1	2	3	4	5
f(x):	1	- 1	1	- 1	1

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(Long Answer Type Questions)

Answer any three of the following.

 $3 \times 15 = 45$

7. a) Using the Trapezoidal rule evaluate

$$\int_{1}^{2} \int_{1}^{2} \frac{\mathrm{d}x \, \mathrm{d}y}{x+y}$$

with the length of subinterval h = 0.25 (along x-axis) and k = 0.25 (along y-axis). Compare the exact solution.

- Find a real root of the equation $x^2 y^2 = 4$ and b) $x^2 + y^2 = 16$ by Newton-Raphson method correct up to two decimal places. Take $x_0 = y_0 = 2\sqrt{2}$. 7 + 8
- 8. a) Find all eigenvalues and eigenvectors of the matrix

$$A = \begin{bmatrix} 1 & \sqrt{2} & 2 \\ \sqrt{2} & 3 & \sqrt{2} \\ 2 & \sqrt{2} & 1 \end{bmatrix}$$

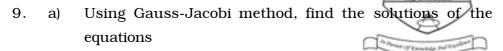
by Jacobi method.

Determine the largest eigenvalue and the corresponding b) eigenvector of the matrix

$$A = \begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$$

by Power method.

8 + 7



$$8x - 3y + 2z = 20$$

 $6x + 3y + 12z = 35$
 $4x + 11y - z = 33$

correct up to three decimal places.

b) Find the inverse of the matrix

$$A = \begin{bmatrix} 2 & 2 & -3 \\ -3 & 2 & 2 \\ 2 & -3 & 2 \end{bmatrix}$$

by Gauss-Jordon method.

c) Show that
$$\Delta \log f(x) = \log \left[1 + \frac{\Delta f(x)}{f(x)} \right]$$

$$6 + 6 + 3$$

10. a) Find $f'(1\cdot 1)$ and $f''(1\cdot 1)$ from the following table :

<i>x</i> :	1.0	1.2	1.4	1.6	1.8	2.0
f(x):	0.0	0.1280	0.5540	1.2960	2.4320	4.0000

b) Solve the following system of equations of Gauss-Seidel method :

$$x + 5y - z = 10$$
$$4x + 2y + z = 14$$

$$x + y + 8z = 20$$

correct up to three significant figures.

11. a) Compute y (0.1), y (0.2), y (0.3) from the following differential equation :

$$\frac{\mathrm{d}y}{\mathrm{d}x} = x + y \; ; \; y \; (\; 0\;) = 1 \; \text{ takeing } h = 0.1.$$

b) Given the initial value problem

$$\frac{\mathrm{d}y}{\mathrm{d}x} = 1 + y \; ; \; y \; (0) = 0$$

Find y (0.6) by Runge-Kutta 4th order method taking h = 0.2. 8 + 7

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