

Name :
Roll No. :
Invigilator's Signature :

**CS/B.TECH/NEW/APM/CSE/IT/AUE/CHE/BT/ ME/
PE/CE/CT/LT/TT/FT/SEM-4/M(CS)-401/2013
2013**

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.*

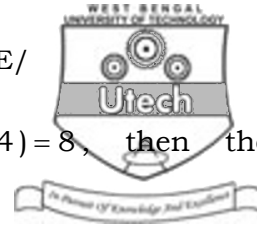
GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

- i) The number of significant figures in 0.03409 is
- | | |
|----------|----------|
| a) five | b) six |
| c) seven | d) four. |
- ii) The kind of error occurs when π approximated by 3.14 is
- | | |
|---------------------|--------------------|
| a) truncation error | b) round-off error |
| c) inherent error | d) relative error. |



iii) If $f(0) = 12$, $f(3) = 6$ and $f(4) = 8$, then the interpolation function $f(x)$ is

- a) $x^2 - 3x + 12$ b) $x^2 - 5x$
c) $x^3 - x^2 - 5x$ d) $x^2 - 5x + 12$.

iv) Newton-Raphson method for solution of the equation $f(x) = 0$ fails when

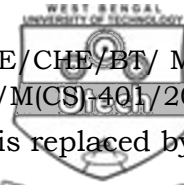
- a) $f'(x) = 1$ b) $f'(x) = 0$
c) $f'(x) = -1$ d) none of these.

v) In Gaussian elimination method, the given system of equation represented by $Ax = B$ is converted to another system $Ux = Y$ where U is

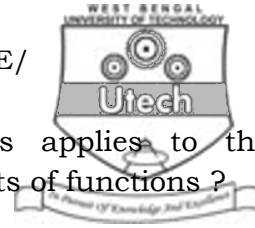
- a) diagonal matrix
b) null matrix
c) identity matrix
d) upper triangular matrix.

vi) Error in Weddle method of integration is

- a) 0 b) $-\frac{h^4}{180}(b-a)M_4$
c) $-\frac{h^2}{12}(b-a)M_2$ d) $-\frac{h^6}{840}(b-a)M_6$.



- vii) In Trapezoidal rule, the portion of curve is replaced by
- a) straight line b) circular path
- c) parabolic path d) none of these.
- viii) Which of the following is an iterative method ?
- a) Gauss Elimination Method
- b) Gauss Jordan Method
- c) LU decomposition Method
- d) Gauss-Seidel Method.
- ix) The number 9.6506531 when rounded-off to 4 places of decimal will give
- a) 9.6506 b) 9.6507
- c) 9.6505 d) none of these.
- x) $\Delta^3 y_0$ may be expressed as
- a) $y_3 - 3y_2 + 3y_1 - y_0$ b) $y_2 - 2y_1 + y_0$
- c) $y_3 - 3y_2 + 3y_1 + y_0$ d) none of these.



- xi) Which of the following statements applies to the bisection method used for finding roots of functions ?
- a) Convergence within a few iteration
 - b) Guaranteed to work for all continuous functions
 - c) Is faster than the Newton-Raphson method
 - d) Requires that there be no error in determining the sign of the function.
- xii) Runge-Kutta formula has a truncation error, which is of the order
- a) h^2
 - b) h^4
 - c) h^5
 - d) none of these.
- xiii) In finite difference method, $\frac{d^2y}{dx^2}$ is replaced by
- a) $\frac{y_{n+1} - 2y_{n-1} + y_n}{2h^2}$
 - b) $\frac{y_{n+1} - 2y_n + y_{n-1}}{h^2}$
 - c) $\frac{y_{n+1} - 2y_{n-1} + y_n}{2h}$
 - d) $\frac{y_{n+1} - 2y_{n-1} + y_n}{4h^2}$.

GROUP - B

(Short Answer Type Questions)

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

2. a) Show that $\Delta \log f(x) = \log \left[1 + \frac{\Delta f(x)}{f(x)} \right]$.
- b) Define forward difference operator Δ and shift operator E . Prove that $E \cdot \Delta = \Delta \cdot E$.



3. Find the missing terms in the following table :

| | | | | | | |
|-----|---|----|----|----|----|----|
| x | 0 | 5 | 10 | 15 | 20 | 25 |
| y | 6 | 10 | ? | 17 | ? | 31 |

4. Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Simpson's $\frac{1}{3}$ rd rule taking $n = 6$.

Hence find the value of π .

5. Using Runge-Kutta method of 4th order solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$

with $y(0) = 1$ at $x = 0.2$.

6. Solve the following system of linear equations by Gaussian Elimination method :

$$3x + 4y + 5z = 18, \quad 2x - y + 8z = 13, \quad 5x - 2y + 7z = 20.$$

GROUP - C

(Long Answer Type Questions)

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

7. a) What do you mean by interpolation ? Derive Newton's backward interpolation formula. Can you apply this formula for unequispaced interpolating points ? 7

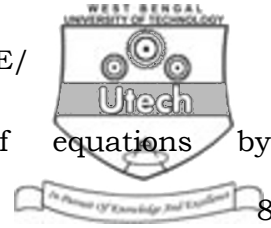
- b) Using Trapezoidal and Simpson's $\frac{1}{3}$ rd rule compute

$$\int_4^{5.2} \log_e x \, dx \text{ by taking seven ordinates correct up to four}$$

decimal places. 8

8. a) Find the value of $\sqrt{2}$ from the following table : 7

| | | | | | |
|-------------------|--------|--------|--------|--------|--------|
| x | 1.9 | 2.1 | 2.3 | 2.5 | 2.7 |
| $f(x) = \sqrt{x}$ | 1.3784 | 1.4491 | 1.5166 | 1.5811 | 1.6432 |



- b) Solve the following system of equations by LU-factorization method : 8

$$3x + 4y + 2z = 15$$

$$5x + 2y + z = 18$$

$$2x + 3y + 2z = 10$$

9. a) Find a root of the equation $x \log_{10} x = 1.2$ by the method of false position correct to three decimal places.

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- b) Find the inverse of the matrix $A = \begin{bmatrix} 3 & 2 & 1 \\ 2 & 3 & 2 \\ 1 & 2 & 2 \end{bmatrix}$ by using

Gaussian elimination method. 8

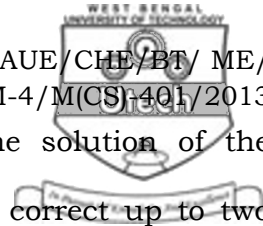
10. a) Apply Milne's method to find $y(0.8)$ for the equation

$$\frac{dy}{dx} = x + y^2, \text{ given that } y(0) = 0, \quad y(0.2) = 0.02,$$

$$y(0.4) = 0.0805, \quad y(0.6) = 0.1839. \quad 8$$

- b) Evaluate $\int_0^{0.6} \frac{dx}{\sqrt{1-x^2}}$, using Weddle's rule taking

12 equal subintervals. 7



11. a) Using Gauss-Seidel method find the solution of the following system of linear equations correct up to two decimal places :

$$3x + y + 5z = 13$$

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

$$x + 6y - 2z = -1 \qquad \qquad \qquad 7$$

- b) Using finite difference method solve the boundary value problem :

$$\frac{d^2y}{dx^2} + y + 1 = 0 \text{ with } y(0) = 0, y(1) = 0. \qquad \qquad \qquad 8$$

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