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# CS/BCA/SEM-4/BM-401/09

1. .....
*Signature of Invigilator*

2. ..... **Reg. No.**
*Signature of the Officer-in-Charge*

***Roll No. of the Candidate***

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## CS/BCA/SEM-4/BM-401/09

### ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

## STATISTICS, NUMERICAL METHODS & ALGORITHMS ( SEMESTER - 4 )

Time : 3 Hours ] [ Full Marks : 70

***INSTRUCTIONS TO THE CANDIDATES :***

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

**No additional sheets are to be used and no loose paper will be provided**

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**FOR OFFICE USE / EVALUATION ONLY**

Marks Obtained

| | Group – A | | | | | | | | | | Group – B | | | Group – C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Question Number*** | | | | | | | | | | | | | | | | | ***Total Marks*** | ***Examiner's Signature*** |
| ***Marks Obtained*** | | | | | | | | | | | | | | | | | | |

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**Head-Examiner/Co-Ordinator/Scrutineer**

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**ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009**

# STATISTICS, NUMERICAL METHODS & ALGORITHMS

**SEMESTER - 4**

Time : 3 Hours ] [ Full Marks : 70

## GROUP – A

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Inverse of a matrix $A$ is given by

a) $A^{-1}$ = Adj. of $A$ / Det. $A$ b) $A^{-1}$ = Det. $A$ / Adj. $A$

c) $A^{-1}$ = Det. $A$ d) none of these.

ii) Newton's forward interpolation formula is used for

a) equispaced values b) unequispaced values

c) both (a) and (b) d) none of these.

iii) A matrix is said to be lower triangular, if and only if,

a) all the elements in the principal diagonal are zero

b) all the elements above the principal diagonal are zero

c) all the elements below the principal diagonal are zero

d) none of these.

iv) Which of the following relations is true ?

a) $1 + \Delta = E$ b) $3 + E = \Delta$

c) $2 + \Delta = E$ d) None of these.

v) For $\frac{dy}{dx} = f(x, y)$ with $y(x_0) = y_0$

$$y(x) = y(x_0) + h / y'(x_0) + h^2 y''(x_0) / 2! + \ldots$$

is given by

a) Euler's series method b) Taylor's series method

c) Runge-Kutta method d) None of these.

vi) If $f(x) = 2x^3 - 3x^2 + 4x + 5$, then $\Delta^3 f(x)$ is

a) 8 b) 10

c) 200 d) 100.

vii) One of the roots of the equation $x^2 + 2x - 2 = 0$ lies in between

a) 1 and 2 b) 0 and 0·5

c) 0·5 and 1 d) none of these.

viii) The first order forward difference of a constant function is

a) 0 b) 3

c) 1 d) 4.

ix) The order of convergence of Newton-Raphson method is

a) 3 b) 2

c) 1 d) 4.

x) By evaluating $\int_0^1 \frac{dx}{1 + x^2}$ by numerical integration method we can approximate the value by

a) $e$ b) $\log_{10} 2$

c) $\log_e 2$ d) $\frac{\pi}{4}$ .

xi) If $f(x) = 99$ and $h = 1$, then $\Delta f(x)$ is equal to

a) 100 b) 1

c) 0 d) 98.

xii) Newton's forward interpolation formula uses

a) the front part of the table b) the end part of the table

c) any part of the table d) precisely the middle of the table.

xiii) When rounded off after 4 decimal places 0·003256 becomes

a) 0·0032 b) 0·0033

c) 0·0326 d) none of these.

xiv) If $y_0 = 3$, $y_1 = 5$, $y_2 = 6$ and $y_4 = 28$, then $y_3$ is

a) 10 b) 11·75

c) 12·62 d) = 10·38

## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following questions. 3 × 5 = 15

2. Use Lagrange's interpolation to express $y$ as a function of $x$ from the following table :

| $x$ | 0 | 1 | 3 | 4 |
|---|---|---|---|---|
| $y$ | – 12 | 0 | 6 | 12 |

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

4. Evaluate $\int_0^5 \frac{dx}{1+x}$ by Trapezoidal rule taking $h = 1$.

5. If $D$ stands for the differential operator $\left(\frac{d}{dx}\right)^6$, prove that

$$D \equiv \frac{1}{h}\left(\Delta - \frac{\Delta^2}{2} + \frac{\Delta^3}{3} - \ldots\ldots\right) .$$

6. Solve by Gauss elimination method the following system of equations :

$$2x + y + 4z = 16$$

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

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

## GROUP – C

### ( Long Answer Type Questions )

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

7. a) For few values of $x$, the corresponding values of $f(x)$ are as follows :

| $x$ | 4 | 5 | 6 | 7 |
|---|---|---|---|---|
| $f(x)$ | 3·11 | 2·96 | 2·85 | 2·70 |

Using appropriate interpolation formula find the value of $f(6{\cdot}5)$.

b) Find the missing figure in the following :

| $x$ | 5·1 | 5·2 | 5·3 | 5·4 | 5·5 |
|---|---|---|---|---|---|
| $y$ | — | 0·110 | 0·100 | 0·090 | 0·082 |

c) Find the real root of $xe^x - 2 = 0$ correct upto three places of decimals using Newton-Raphson method. 5 + 5 + 5

8. a) Find the inverse of the following matrix by Gauss Elimination method :

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

b) Find $\frac{dy}{dx}$ at $x = 0{\cdot}5$ from the following data :

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $y$ | 1 | 1 | 15 | 40 | 85 |

8 + 7

9. a) Find the cubic function $f(x)$ from the following data :

| $x$ | 0 | 1 | 2 | 4 |
|---|---|---|---|---|
| $f(x)$ | 1 | 4 | 14 | 85 |

b) Find the values of $y$ at $x = 21$ and $x = 28$ from the following data :

| $x$ | 20 | 23 | 26 | 29 |
|---|---|---|---|---|
| $f(x)$ | 0·3420 | 0·3907 | 0·4384 | 0·4848 |

7 + 8

10. a) Evaluate $\int_0^{10} \frac{dx}{1 + x^2}$ by dividing the range into 10 equal parts and applying Simpson's one-third rule.

b) Compute $y(0{\cdot}1)$ by Runge-Kutta method of fourth order for the differential equation

$$\frac{dy}{dx} = xy + y^2, \quad y(0) = 1.$$

8 + 7

11. a) Find a root of the equation $\sin x + \cos x = 1$, by Regula Falsi method up to 4 places of decimal.

b) From the following table compute $y$ for $x = 1{\cdot}25$ by using Newton's divided difference formula correct up to 4 decimal places :

| $x$ | 1·0 | 1·1 | 1·3 | 1·5 | 1·6 |
|---|---|---|---|---|---|
| $y$ | 0·3639 | 0·3258 | 0·2612 | 0·2095 | 0·1876 |

7 + 8

END

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**CS/BCA/SEM-4/BM-401/2010**

# 2010

# STATISTICS, NUMERICAL & METHODS & ALGORITHMS

*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) If $f(x)$ is a polynomial of degree $n$, then ..... is a constant.

      a) $(n+1)$th order difference

      b) $n$th order difference

      c) $(n-1)$th order difference

      d) $(n-2)$th order difference.

   ii) One of the roots of the equation $x^2+2x-2=0$ lies in between

      a) 1 & 2 b) 0 & 0·5

      c) 0·5 & 1·0 d) none of these.

iii) First order forward difference of a constant function is

a) 0 b) 4

c) 3 d) 1.

iv) Inverse of a matrix $A$ is given by

a) $A^{-1} = \frac{adj\ A}{det\ A}$ b) $A^{-1} = \frac{det\ A}{adj\ A}$

c) $A^{-1} = (det\ A)^T$ d) $A^{-1} = (adj\ A)^T$.

v) $\delta E^{\frac{1}{2}}$ is equal to

a) $\nabla$ b) $\Delta$

c) $E$ d) none of these.

vi) The inherent error in the Runge-Kutta method is of order

a) $h^2$ b) $h^4$

c) $h^5$ d) $h^6$.

vii) The value of $\left(\frac{\Delta^2}{E}\right)x^4$ is

a) $6x$ b) $6x^2$

c) $6x^3$ d) $6x^0$.

viii) If $E$ is the shift operator and $\Delta$ is the forward difference operator, then relationship between them is

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

c) $E + 1 = \Delta$ d) none of these.

ix) Let $f(x) = 0$ be the equation of a curve. Then the condition that one of the roots of $f(x)$ lies between $x = a$ and $x = b$ is

a) $f(a) > 0$ b) $f(a)\, f(b) < 0$

c) $f(a)\, f(b) > 0$ d) none of these.

x) Simpson's $\frac{1}{3}$rd rule gives us exact result for a polynomial of degree

a) less than 3

b) less than equal to 3

c) greater than 3

d) greater than equal to 3.

xi) If $u_0 = 1$, $u_1 = 1$ and $u_2 = 21$, then $\Delta^2 u_0$ is

a) 10 b) 11

c) 0 d) 20.

xii) By evaluating $\int_0^{\infty} \frac{dx}{1+x^2}$ by numerical integration method, we can obtain the approximate value of

a) $log_e 2$ b) $\frac{\pi}{2}$

c) $e$ d) $log_{10} 2$.

xiii) For a system of equation $Ax = b$, a solution exists if and only if $A$ is

a) symmetric b) singular

c) orthogonal d) diagonal.

xiv) Equation $AX = B$ has unique solution if

a) Rank ( $A$ ) ≠ Rank ( $A\ B$ )

b) Rank ( $A$ ) < Rank ( $A\ B$ )

c) Rank ( $A$ ) = Rank ( $A\ B$ ) = No. of unknowns

d) Rank ( $A$ ) = Rank ( $A\ B$ ) ≠ No. of unknowns.

## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following. 3 × 5 = 15

2. Prove that $D = \frac{1}{h} log \frac{1}{(1-\nabla)}$, where $D$ is differential operator and $\nabla$ is backward difference operator.

3. Find the value of $\frac{dy}{dx}$ for $x$ = 1·0 from the following table :

| $x$ : | 1·0 | 1·2 | 1·4 | 1·6 | 1·8 | 2·0 |
|---|---|---|---|---|---|---|
| $y$ : | 2·7183 | 3·3201 | 4·0552 | 4·9530 | 6·0496 | 7·3891 |

4. Find a root of the equation $x^3 - 3x - 5 = 0$ by the method of false position correct to 2 decimal places.

5. Using Taylor's method obtain an approximate value of $y$ at $x$ = 0·2 for the differential equation $\frac{dy}{dx} = 2y + 3e^x$, $y$ ( 0 ) = 0.

6. Solve the system of equations by Gauss elimination method :

$2x + 3y + z = 9$

$x + 2y + 3z = 6$

$3x + y + 2z = 8$

correct upto three significant figures.

## GROUP – C

### ( Long Answer Type Questions )

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

7. a) Evaluate $y$ ( 1·1 ) using Runge-Kutta method of order 4 for the problem

$$\frac{dy}{dx} = x^2 + y^2, \quad y(1) = 0$$

b) Find the inverse of the matrix $\begin{bmatrix} 1 & 2 & 6 \\ 2 & 5 & 15 \\ 6 & 15 & 46 \end{bmatrix}$ by Gauss elimination method.

8. a) Compute $f$ ( 0·29 ) from the following table by using Newton's backward interpolation formula :

| $x$ : | 0·20 | 0·22 | 0·24 | 0·26 | 0·28 | 0·30 |
|---|---|---|---|---|---|---|
| $y$ : | 1·6596 | 1·6698 | 1·6804 | 1·6912 | 1·7024 | 1·7139 |

b) The following are the mean temperature ( Fahrenheit ) on the three days, 30 days apart round the periods of summer and winter. Estimate the approximate dates and the values of the maximum dates and the values of the maximum and minimum temperature.

| Day | Summer | | Winter | |
|---|---|---|---|---|
| | Date | Temperature | Date | Temperature |
| 0 | 15th June | 58·8 | 16th December | 40·7 |
| 30 | 15th July | 63·4 | 15th January | 38·1 |
| 60 | 14th August | 62·5 | 14th February | 39·3 |

9. a) Using Newton's divided difference formula, construct the interpolation polynomial and hence compute $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at $x = 5$ by using the following data :

| $x$ : | 0 | 2 | 3 | 4 | 7 | 9 |
|---|---|---|---|---|---|---|
| $y$ : | 4 | 26 | 58 | 112 | 466 | 922 |

b) Evaluate $\int_0^1 x^3 \, dx$ by Trapezoidal rule with $n = 5$.

10. a) Evaluate one root of the following equation, by Newton – Raphson method :

$e^x - 3x = 0$

correct up to 3 decimal places.

b) Use Euler's method to find the numerical solution of the following differential equation :

$f'(x) = 1 + x - x^2$, $y$ ( 0 ) = 1, $h$ = 0·02;

find $y$ ( 0·1 ).

11. a) Find the missing term in the following table :

| $x$ : | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| $y$ : | 0 | — | 8 | 15 | — | 35 |

b) What is the lowest degree polynomial which takes the following values :

| $x$ : | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| $f(x)$ : | 1 | 4 | 9 | 16 | 25 | 36 |

Hence calculate $f(x)$ and also find $f(6)$.

*Name : .....*

*Roll No. : .....*

*Invigilator's Signature : .....*

**CS/BCA/SEM-4/BM-401/2011**

# 2011
# STATISTICS, NUMERICAL METHODS AND ALGORITHMS

*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 digit in 0·00303 is

      a) 6 b) 5

      c) 3 d) none of these.

   ii) When rounded off after 4 decimal places 0·003256 becomes

      a) 0·0032 b) 0·0033

      c) 0·0326 d) none of these.

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iii) Divided difference formula is used for

a) equispaced point

b) unequally spaced points

c) both (a) & (b)

d) none of these.

iv) Newton's forward formula is used for interpolating the value of $y$ near the

a) beginning of a set

b) end of a set

c) central of the set

d) none of these.

v) In backward difference $\nabla^2 f(x)$ is

a) $\nabla f(x) - \nabla f(x+h)$ b) $\nabla^2 f(x) - \nabla^2 f(x-h)$

c) $\Delta f(x) - \Delta f(x+h)$ d) none of these.

vi) The iterative method to solve a system of equation is

a) Gauss-elimination b) Gauss-Jordan

c) Gauss-Seidel d) None of these.

vii) The error in the Simpson's $\frac{1}{3}$rd method is of order

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

c) $h^3$ d) $h^4$.



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viii) Newton-Raphson method fails when

a) $f^{I}(x) = 0$ b) $f^{I}(x) > 0$

c) $f^{I}(x) < 0$ d) none of these.

ix) Diagonal dominance is must for

a) Gauss-Seidel method

b) Gauss-Jordan's matrix inversion method

c) Gauss elimination method

d) none of these.

x) The second order Runge-Kutta formula has a truncation error which is of order of

a) $h^2$ b) $h^3$

c) $h^4$ d) none of these.

xi) The order of $h$ in the error expression of trapezoidal rule is

a) 1 b) 2

c) 3 d) 4.

xii) Relative error in numerical method where $x_{\Gamma}$ = true value of solution $\neq 0$, $x_A$ = Approximate value of solution is

a) $|x_{\Gamma} - x_A|$ b) $\frac{|x_{\Gamma} - x_A|}{x_{\Gamma}}$

c) $\frac{|x_{\Gamma} - x_A|}{x_{\Gamma}} \times 100$ d) none of these.

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xiii) Which is the direct method ?

a) Gauss-elimination method

b) Gauss-Jacobi method

c) Gauss-Seidel method

d) none of these.

xiv) Newton-Raphson method is also known as

a) chord method b) tangent method

c) secant method d) none of these.

## GROUP – B

### ( Short Answer Type Questions )

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

2. By means of Newton's divided differential interpolation formula find the value of $f(8)$ from the following table :

| $x =$ | 4 | 5 | 7 | 10 | 11 | 13 |
|---|---|---|---|---|---|---|
| $f(x) =$ | 48 | 100 | 294 | 900 | 1210 | 2028 |

3. Prove that for small values of '$h$' $\Delta^{n+1} f(x_0) \approx h^{n+1} f^{n+1}(x_0)$.

4. Evaluate $\int_0^1 \cos x \, dx$ taking five equal intervals. Explain the reason behind your choice of integration formula used.

5. Compute $f(1{\cdot}42)$ from the following data :

| $x$ | 1·1 | 1·2 | 1·3 | 1·4 |
|---|---|---|---|---|
| $f(x)$ | 7·831 | 8·728 | 9·697 | 10·744 |

6. Solve $\frac{dy}{dx} = x^2y - 1$, where $y\ (\ 0\ ) = 1$ by Taylor's series method. Also find $y\ (\ 0{\cdot}1\ )$ correct to seven significant digits.

7. How many digits are to be taken in computing $\sqrt{13}$ so that error does not exceed 0·1% ?

## GROUP – C

### ( Long Answer Type Questions )

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

8. a) Compute $f\ (\ 1{\cdot}16\ )$ from the following table :

| $x$ | 1·11 | 1·12 | 1·13 | 1·14 | 1·15 | 1·16 |
|---|---|---|---|---|---|---|
| $f\ (\ x\ )$ | 6·2321 | 6·2544 | 6·2769 | 6·2996 | 6·3225 | 6·3456 |

b) Find the positive root of the equation $x^2 + 2x - 2 = 0$, correct up to 2 significant figures by Newton-Raphson method.

c) Estimate the missing term from the table :

| $x$ | 2 | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| $y$ | 5 | 13 | $*$ | 53 | 85 |

9. a) Solve the following system of linear equations by Gauss-Seidel method :

$6x + 15y + 2z = 72$

$27x + 6y - z = 85$

$x + y + 54z = 110.$

b) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Simpson's one-third rule taking $h = \frac{1}{6}$ correct up to 3 decimal places.

c) Find the root of the equation $x \log_{10} x = 1 \cdot 2$, correct to 2 decimal places by Bisection method. 6 + 4 + 5

10. a) Solve by Gauss elimination method :

$x + 2y + 3z = 10$

$x + 3y - 2z = 7$

$2x - y + z = 5$.

b) Evaluate $\int_0^1 \left(4x - 3x^2\right) dx$ taking 10 intervals by Trapezoidal rule and then find the absolute error.

c) Prove that $E = e^{hD}$, $D = \frac{d}{dx}$ and $E$ is the shift operator. 7 + 5 + 3

11. a) Use Euler's method to find the solution of $\frac{dy}{dx} = x - y$ with $y(0) = 1$, $h = 0{\cdot}2$ at $x = 0{\cdot}4$.

b) Find the value of $y(0{\cdot}2)$ by 4th order Runge-Kutta method which is correct to *four* decimal places, where $\frac{dy}{dx} = y^2 - x^2, y(0) = 1$ taking $h = 0{\cdot}1$. 7 + 8



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12. a) Compute a root of the equation $x^2 e^{-x/2} = 1$ in the interval [ 0, 2 ] by secant method correct to 3 decimal places.

b) Find the inverse of the matrix $\begin{bmatrix} 2 & 0 & 1 \\ 2 & 1 & 3 \\ 1 & -1 & 0 \end{bmatrix}$ by Gauss' method. 7 + 8

13. a) Solve the following equation by Jacobi's iteration method :

$10x - 2y - z - w = 3$

$-2x + 10y - z - w = 15$

$-x - y + 10z - 2w = 27$

$-x - y - 2z + 10w = -9$

b) Solve by *LV* factorization method :

$2x - 3y + z = -1$

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

$x - 4y + z = -6$ 7 + 8

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*Name* : .....

*Roll No.* : .....

*Invigilator's Signature* : .....

**CS/BCA/SEM-4/BM-401/2012**

**2012**

# STATISTICS, NUMERICAL METHODS & ALGORITHMS

*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.*

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## 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 1·00234 is

a) 3 b) 4

c) 5 d) 6.

ii) The relation between shift operator $E$ and forward difference operator $\Delta$ is given by

a) $\Delta = 1 + E$ b) $E = 1 + \Delta$

c) $E = \Delta$ d) $E = \Delta + 2$.

iii) When the number 1·004355 is rounded to 5 decimal places, then it becomes

a) 1·00436 b) 1·00435

c) 1·00434 d) none of these.

iv) The order of convergence of Newton-Raphson method is

a) 3 b) 2

c) 1 d) 4.

v) Lagrange's interpolation formula is usd for

a) only equispaced values

b) only unequispaced values

c) both equispaced & unequispaced values

d) none of these.

vi) The number of sub-intervals required for Simpson's $\frac{1}{3}$ rule of numerical integration is

a) even b) odd

c) even or odd d) none of these.

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

a) $0(h^2)$ b) $0(h^3)$

c) $0(h^4)$ d) $0(h^5)$.

viii) The sum of the approximate numbers 2·56, 4·56273, 1·253, 1·05342 is

a) 9·4291 b) 9·429

c) 9·43 d) 9·5.



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ix) Under the condition that $f(a)$, $f(b)$ have opposite signs and $a < b$, the first approximation of one of the roots of $f(x) = 0$ by Regula-Falsi method is given by

a) $\dfrac{bf(a) + af(b)}{f(a) + f(b)}$

b) $\dfrac{a\,f(a) - b\,f(b)}{f(a) - f(b)}$

c) $\dfrac{a\,f(b) - b\,f(a)}{f(b) - f(a)}$

d) $\dfrac{a\,f(a) + b\,f(b)}{f(a) + f(b)}$ .

x) Which of the following methods is an iterative method ?

a) Gauss elimination b) Gauss-Jordan

c) Gauss-Jacobi d) Gauss-Seidel.

xi) A system of equations $AX = b$ where $A = (a_{ij})_{n \times n}$ is said to be diagonally dominant if

a) $|a_{ii}| > \sum_{\substack{j=1 \\ j \neq i}}^{n} |a_{ij}|$ for all $i$

b) $|a_{ii}| < \sum_{\substack{j=1 \\ j \neq i}}^{n} |a_{ij}|$ for all $i$

c) $|a_{ii}| > \sum_{j=1}^{n} |a_{ij}|$ for all $i$

d) $|a_{ii}| < \sum_{j=1}^{n} |a_{ij}|$ for all $i$ .

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xii) If $E_a$ is the absolute error in a quantity whose tree and approximated values are given by $x_t$ and $x_a$, then the relative error is given by

a) $\left| \frac{E_a}{x_a} \right|$ b) $\left| \frac{E_a}{x_t} \right|$

c) $\left| \frac{E_a}{x_t - x_a} \right|$ d) $| E_a |$.

xiii) When the Gauss elimination method is used to solve $BX = A$, $B$ is transformed into

a) a lower triangular matrix

b) a unit matrix

c) a singular matrix

d) an upper triangular matrix.

xiv) When $x = \phi(x)$ admits a real root in $[a, b]$, then

a) $|\phi'(x)| < 1$

b) $|\phi'(x)| > 1$

c) $|\phi'(x)| = 1$

d) none of these.

xv) The degree of precision of Simpson's $\frac{1}{3}$ rd rule is

a) 1 b) 2

c) 3 d) none of these.

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## GROUP – B

### ( Short Answer Type Questions )

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

2. Compute $f(b)$ from he following table using Newton's Divided Difference Formula :

| $x$ | 4 | 5 | 7 | 10 | 11 | 13 |
|---|---|---|---|---|---|---|
| $f(x)$ | 48 | 100 | 294 | 900 | 1210 | 2028 |

3. Find the missing term in the following table :

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $f(x)$ | 1 | 3 | 9 | — | 81 |

4. Compute $y(0{\cdot}2)$ from the equation $\frac{dy}{dx} = x - y$ ; $y(0) = 1$, taking $h = 0{\cdot}1$, by Runge-Kutta method of fourth order, correct to five decimal places.

5. Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Weddle's rule, taking $n = 6$ correct to 4 decimal places.

6. Find a root of $e^{-x} - 3x = 0$ correct to two decimal places, using the method of fixed point iteration.

7. Find a real root of the equation $x^3 - 2x = 5$ by Regula-Falsi method correct up to 2 significant digits.

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## GROUP – C

### ( Long Answer Type Questions )

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

8. a) Find the inverse of the matrix $\begin{pmatrix} 2 & -2 & 4 \\ 2 & 3 & 2 \\ -1 & 4 & -1 \end{pmatrix}$ by Gauss-elimination method.

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

$$5x + 2y + z = -12$$

$$-x + 4y + 2z = 20$$

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

7 + 8

9. a) Given the table of $y = \log_{10}(x + 2)$ with spacing $h = 1$, find the value of $y^{I}(0)$ and $y^{II}(4)$.

| ***x :*** | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| ***y :*** | 0·3010 | 0·4771 | 0·6020 | 0·6990 | 0·7782 |

b) Find a real root of $x^3 - 4x = 9$ correct up to 3 decimal places by bisection method. 8 + 7

10. a) Find $y(0{\cdot}10)$ and $y(0{\cdot}15)$ by Euler's method from the differential equation :

$$\frac{dy}{dx} = x^2 + y^2, \quad y(0) = 0$$

correct up to 4 decimal places, taking $h = 0{\cdot}05$.

b) The value of $x$ and $y$ are given below :

| ***x :*** | 5 | 6 | 9 | 11 |
|---|---|---|---|---|
| ***y :*** | 12 | 13 | 14 | 16 |

Find the value of $y$ when $x = 10$ using Lagrange's interpolation formula. 8 + 7

11. a) From the following table of values of $x$ and $f(x)$ determine $f(0{\cdot}29)$ :

| | $x$ | 0·22 | 0·24 | 0·26 | 0·28 | 0·30 |
|---|---|---|---|---|---|---|
| | $f(x)$ | 1·6698 | 1·6804 | 1·6912 | 1·7024 | 1·7139 |

b) Using Taylor's series method find $y$ at $x = 1{\cdot}1, 1{\cdot}2$ by solving $\frac{dy}{dx} = (x^2 + y^2)$ given by $y(1) = 2{\cdot}3$.

7 + 8

12. a) Solve the following system of linear equations by Gauss-Seidel method of iteration ( correct up to 3 decimal places ) :

$$10x + y + z = 12$$

$$2x + 10y + z = 13$$

$$2x + 2y + 10z = 14.$$

b) Write Algorithm for finding the equation by Newton-Raphson method. 8 + 7

13. a) Solve by Euler's modified method, the following differential equation for $x = 0{\cdot}02$ taking $h = 0{\cdot}01$ :

$$\frac{dy}{dx} = x^2 + y, \quad y(0) = 1.$$

b) Solve the equation

$$\frac{dy}{dx} = x + y, \quad y(0) = 1 \text{ at } x = 0{\cdot}2,$$

by Picard's method ( take only three integrations ). 8 + 7

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*Name : .....*

*Roll No. : .....*

*Invigilator's Signature : .....*

**CS/BCA/SEM-4/BM-401/2013**

# 2013

# STATISTICS, NUMERICAL METHODS & ALGORITHMS

*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) Newton-Raphson method is also known as method of

   a) straight line b) tangent

   c) normal d) none of these.

   ii) Order of the term $h$ in the error term of trapezoidal rule is of order

   a) 1 b) 2

   c) 3 d) 4.



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iii) The value of $\Delta^2 \left( ax^2 + bx + c \right)$ is

a) $2\,an + b$ b) $2\,an$

c) $2\,an^2$ d) none of these.

iv) The number of significant digits in 1·00234 is

a) 3 b) 4

c) 5 d) 6.

v) If $y_0 = 2$, $y_1 = 4$, $y_2 = 8$, $y_4 = 32$, then $y_3$ is equal to

a) 5 b) 6

c) 15 d) none of these.

vi) Which of the following methods is an iterative method ?

a) Gauss Elimination method

b) Gauss-Jordan method

c) Gauss-Jacobi method

d) Crout's method.

vii) The order of convergence of Newton-Raphson methods is

a) 1 b) 2

c) 2 d) 4.

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viii) The relation between shift operator $E$ and forward difference operator $\Delta$ is given by

a) $\Delta = 1 + E$ b) $E = 1 + \Delta$

c) $E = \Delta$ d) $E = \Delta + 2$.

ix) The first order of forward difference of a constant function is

a) 0 b) 1

c) 4 d) 3.

x) Lagrange's interpolation formula is used for

a) Equally space point b) Unequally space point

c) Both (a) & (b) d) None of these.

xi) The equation $x^x + x - 1 = 0$ is a

a) algebraic equation

b) transcendental equation

c) both (a) & (b)

d) none of these.

xii) Order of $h$ in the error expression of Simpson's 1/3rd rule is

a) 2 b) 4

c) 3 d) 5

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xiii) The degree of interpolation polynomial of a function whose values are known at 8 points is

a) 5 b) 6

c) 7 d) 8.

xiv) The number of significant digits in 0·00303 is

a) 6 b) 5

c) 3 d) 2.

**GROUP – B**

**( Short Answer Type Questions )**

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

2. Find the missing terms of the following table :

| | | | | | |
|---|---|---|---|---|---|
| $X$ : | 45 | 50 | 55 | 60 | 65 |
| $f(X)$ : | 3 | ? | 2 | ? | 4 |

3. Solve the system of equation by LU method :

$3x + 4y + 7z = 8$

$x + 2y + 3z = 6$

$x + 5y + 9z = 9$

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4. Find the real root of equation $x^3 - x - 1 = 0$ by the method of bisection.

5. Compute by Newton-Raphson method the positive root of equation $3x^2 + 2x = 9$ correct to four significant figures.

6. Compute the value of $y$ at $x = 1{\cdot}3$ using Runge-Kutta method of fourth order by solving the differential equation.

$\frac{dy}{dx} = x^2 + y^2$, with $x_0 = 1$, $y_0 = 0$ and step size $h = 0{\cdot}3$.

## GROUP – C

**( Long Answer Type Questions )**

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

7. a) Use Newton's divided difference formula to find $f(8)$ and $f(15)$ from the following table :

| $x$ : | 4 | 5 | 7 | 10 | 11 | 13 |
|---|---|---|---|---|---|---|
| $f(x)$ : | 48 | 100 | 294 | 900 | 1210 | 2028 |

b) Find the value of fifth root of 255. 7 + 8



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8. a) From Gauss-Legendre quadrature formula establish trapezoidal rule of integration.

b) By using Simpson's one third rule calculate

$\int_0^1 \left( x^3 - x \right) dx$. Compute relative error. 7 + 8

9. a) Solve the system of equation by Inverse Matrix method :

$x + y + z = 3$

$2x - y + 3z = 16$

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

b) Find by Taylor's series method the value of $y$ at $x = 0{\cdot}1$ and $x = 0{\cdot}2$ to 5 places of decimal from $\frac{dy}{dx} = x^2 y - 1,\ y(0) = 1$. 7 + 8

10. a) Compute $y(0{\cdot}2)$ from the equation $\frac{dy}{dx} = x - y,\ y(0) = 1$ taking $h = 0{\cdot}1$ by Rune-Kutta method correct to four decimal places.

b) Solve by Gauss elimination method.

$x - y - z = 1$

$2x - 3y + z = 1$

$3x + y - z = 2$. 7 + 8



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11. a) Find a real root of the equation $f(x) = \log x - \cos x$ using bisection method up to 3 decimal places.

b) Solve the system of equation by Gauss elimination method :

$x + 3y + 2z = 5$

$2x - y + z = -1$

$x + 2y + 3z = 2$ 7 + 8

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# 2014

## Statistics, Numerical Methods & Algorithms

*Time Alloted : 3 Hours* *Full Marks : 70*

***The figure 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:** 10x1=10

i) **The relative percentage error in approximate representation of 4/3 as 1.33 is**

a) 25%
b) 2.5%
c) .25%
d) 0.025%

ii) **First order forward difference of a constant function is**

a) 0
b) 4
c) 3
d) 1



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iii) When the no 1.004355 is rounded to 5 decimal places then it becomes

a) 1.00436
b) 1.00435
c) 1.00434
d) None of these

iv) For Trapezoidal rule of numerical integration, the number of sub-intervals should be

a) Even
b) Odd
c) Even or odd
d) Multiple of three

v) When the Guass elimination method is used to solve BX= A, B is transformed into

a) A lower triangular matrix
b) Zero matrix
c) An upper triangular matrix
d) None of these

vi) The order of convergence of Regula-falsi method is

a) 1
b) 1.52
c) 1.62
d) 2

vii) Which of the following methods give faster convergence?

a) Gauss-Jacobi Method
b) Gauss- Seidel Method
c) Gauss-Elimination Method
d) Gauss-Jordan Elimination Method



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viii) The condition of convergence for the method of fixed point iteration is

a) $|\varphi'(x)|<1$
b) $|\varphi'(x)|>1$
c) $|\varphi'(x)|\leq 1$
d) $|\varphi'(x)|\geq 1$

ix) The truncation error in 4th order Runge-Kutta Method is of the

a) $O(h^2)$
b) $O(h^3)$
c) $O(h^4)$
d) $O(h^5)$

x) A system of linear equations is said to be diagonally dominant if its coefficient matrix satisfy

a) $|a_{ii}|\leq\sum|a_{ij}|$
b) $|a_{ii}|\geq\sum|a_{ij}|$
c) $|a_{ii}|>\sum|a_{ij}|$
d) $|a_{ii}|<\sum|a_{ij}|$

xi) If a number be rounded off to m decimal places, then the absolute error

a) $E_a \leq \frac{1}{2}10^{-m}$
b) $E_a \leq \frac{1}{2}10^{m}$
c) $E_a \geq \frac{1}{2}10^{-m}$
d) $E_a \geq \frac{1}{2}10^{m}$

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xii) Weddle's rule gives exact result for a polynomial of degree

a) ≤5

b) =6

c) ≤7

d) =8

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## GROUP - B
## ( Short Answer Type Questions )

**Answer any *three* of the following. 3x5=15**

2. When h=1, prove that

$$\Delta\left\{\frac{1}{f(x)}\right\} = -\frac{\Delta f(x)}{f(x).f(x+1)}$$

and hence or otherwise find the value of $\Delta^n\left(\frac{1}{x}\right)$

3. Find the value of f(12) from the following table correct up to 4 decimal places:

| x: | 10 | 15 | 20 | 25 | 30 | 35 |
|---|---|---|---|---|---|---|
| f(x): | 35.3 | 32.4 | 29.2 | 26.1 | 23.2 | 20.5 |

4. Using regular falsi method find a real root of $x^3 + 2x - 2 = 0$, correct upto four significant figures.

5. Evaluate

$$\int_1^5 log_{10}\, x dx$$

taking 8 sub- intervals, correct upto four decimal places by simpson's 1/3rd rule.

6 Compute y(0.2), from the equation

$$\frac{dy}{dx} = x - y, y(0) = 1$$

taking h=0.1, by Runge-kutta method of fourth order, correct to five decimal places.



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## GROUP - C
## ( Long Answer Type Questions )
**Answer any *three* of the following. 3x15=45**

7. (a) Derive Newton's Forward Interpolation Formula.

   (b) The following table gives the distance in nautical miles of the visible horizon for the given heights in feet above the earth's surface:

| Height (x): | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
|---|---|---|---|---|---|---|---|
| Distance (d): | 10.66 | 13.06 | 15.07 | 16.84 | 18.45 | 19.93 | 21.30 |

   Find the value of d when x=390 feet.

8. (a) Show that Newton- Raphson method has second order convergence.

   (b) Solve the following system of equations by Gauss-Jacobi iteration method.

   8x-y+z=18

   2x+5y-2z=3

   x+y-3z=-6

   [7+8]

9. (a) Evaluate $\int_0^1 \frac{dx}{1+x^2}$, by using simpson's 1/3 rule taking n=4 and hence find the value of π.

   (b) Solve by Gauss-seidel iteration method, the system

   x+y+4z=9

   8x-3y+2z=20

   4x+11y-z=33

   [8+7]

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10. (a) Apply Euler's method to find the value of y at x=0.02 for the initial value problem

$$dy/dx = y + e^x$$ with y(0)=0, taking h=0.01.

(b) Find the real root of the equation cos x=3x-1 correct to 4 decimal places using successive approximation method.

[8+7]

11. (a) Evaluate

$$\int_0^{\pi/2} \sqrt{1 - 0.162\,Sin^2\theta}\, d\theta$$

correct upto 4 decimal places by Trapezoidal rule, taking n=10.

(b) Compute the value of y at x=0.01 using Runge-kutta method of order 4 from the differential equation $dy/dx=x^2+y$ with y(0)=1 and hence compare your result with the exact solution.

[7+8]

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# WEST BENGAL UNIVERSITY OF TECHNOLOGY

## BM-401

### STATISTICS, NUMERICAL METHODS & ALGORITHMS

Time Allotted: 3 Hours | Full Marks: 70

*The questions are of equal value.*
*The figures in the margin indicate full marks.*
*Candidates are required to give their answers in their own words as far as practicable.*
*All symbols are of usual significance.*

## GROUP A
## (Multiple Choice Type Questions)

1. Answer any *ten* questions. $10\times1 = 10$

(i) The degree of precision of Simpson's $1/3^{rd}$ rule is

(A) 1 (B) 2 (C) 3 (D) 4

(ii) The rate of convergence of bisection method is

(A) linear (B) quadratic (C) cubic (D) none of these

(iii) If $f(x)=\frac{1}{x^2}$, then divided difference $f(a, b)$ is

(A) $\frac{a+b}{(ab)^2}$ (B) $-\frac{a+b}{(ab)^2}$ (C) $\frac{1}{a^2-b^2}$ (D) $\frac{1}{a^2}-\frac{1}{b^2}$

(iv) Which of the following relation is true?

(A) $\Delta = E-1$ (B) $\Delta\cdot\nabla = \Delta-\nabla$ (C) $\Delta\cdot\nabla = \Delta+\nabla$ (D) $\Delta = 1-E$

(v) If $\frac{5}{3}$ is approximated to 1.6667, then absolute error is

(A) 0.000033 (B) 0.000043 (C) 0.000045 (D) 0.000051

(vi) When the Guass elimination method is used to solve **BX = A**, **B** is transformed into

(A) a lower triangular matrix (B) an upper triangular matrix
(C) zero matrix (D) none of these

(vii) Order of $h$ in the error expression of Simpson's $1/3^{rd}$ rule is

(A) 2 (B) 4 (C) 3 (D) 5

(viii) If $f(x) = b.e^{ax}$, then $\Delta f(x)$ is

(A) $be^{ax}(e^{ah}-1)$ (B) $be^{ax}(a-1)$
(C) $be^{ax}(1-e^{ah})$ (D) none of these

(ix) The number of significant digits in 0.00303 is

(A) 6 (B) 5 (C) 3 (D) done of these

(x) Newton's forward interpolation formula uses

(A) the front part of the table (B) the end part of the table
(C) any part of the table (D) middle of the table

(xi) Diagonal Dominance is must for

(A) Gauss Seidal method of iteration
(B) Gauss Jordan matrix inversion method
(C) Gauss elimination method
(D) None of these

(xii) If $f(x) = 101$ and $h = 3$, then $\Delta f(x)$ is equal to

(A) 100 (B) 99 (C) 1 (D) 0

## GROUP B
## (Short Answer Type Questions)

Answer any *three* questions. $3\times5 = 15$

2. Evaluate $\Delta^2 \cos 2x$.

3. Evaluate $\sqrt{12}$ to three places of decimals by Newton–Raphson method.

4. Evaluate $\int_0^1 \frac{dx}{1+x}$ by Simpson's 1/3rd rule taking 11 ordinates and hence find the value of $\ln 2$. Correct up to five significant figures.

5. Use Euler's Method to solve the differential equation $\frac{dy}{dx} = xy$, for $x = 1$. Given that when $x = 0$, $y = 1$. Take $h = 0.2$.

6. Find by Lagrange's interpolation formula for the polynomial which corresponds to the following data.

| $x$ : | −1 | 0 | 2 | 5 |
|---|---|---|---|---|
| $F(x)$ : | 9 | 5 | 3 | 15 |

## GROUP C
## (Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) Evaluate $\int_0^2 \frac{dx}{1+x^2}$ correct up to 4 places of decimal by using Weddle's rule, taking 12 intervals. 8+7

(b) Estimate the missing term

| $x$ : | 2 | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| $F(x)$ : | 5 | 13 | * | 53 | 85 |

8. (a) Find the roots of the equation $x^2 - 3x - 2 = 0$ by using Newton-Raphson Method. 7+8

(b) Solve the following system of equations by using Jacobi Iteration Method:

$8x + 2y - 2z = 08$
$x - 8y + 3z = -4$
$2x + y + 9z = 12.$

9. (a) Starting from Gauss–Legendre Quadrature formulas establish the trapezoidal rule of integration. 8+7

(b) Evaluate $\int_0^1 (4x+3x^2)dx$, by using the trapezoidal rule taking 10 intervals. Compute the exact value and the absolute and relative errors in your results.

10.(a) Find the smallest positive root of the equation $3x^3 - 9x^2 + 8 = 0$, correct up to four places of decimal, using Newton-Raphson method. 5+5+5

(b) Find $y(1.1)$ using Runge-Kutta method of fourth order, given that $\frac{dy}{dx} = y^2 + xy,\ y(1) = 1$.

(c) Use the method of bisection to compute a root of the equation $x^3 - 4x - 1 = 0$ lying between 2 and 3 up to four significant figures.

11.(a) Solve $\frac{dy}{dx} = x^2y - 1, y(0) = 1$ by Taylor's series. Also find $y(0.1)$ correct up to seven significant digits. 5+5+5

(b) Solve the equation $\frac{dy}{dx} = x + y, y(0) = 1$ at $x = 0.2$ by Picard's method (take only three integrations).

(c) Use Euler's method to find the numerical solution of the following differential equation. $\frac{dy}{dx} = 1 + x - x^2, y(0) = 1$. Taking $h = 0.02$ find $y(0.1)$.

12(a) Use Regula-Falsi method to evaluate the smallest real root of the equation $x^3 + x^2 - 1 = 0$. 6+4+5

(b) Solve the following system of equations by LU method.

$$3x + 4y + 7z = 8$$
$$x + 2y + 3z = 6$$
$$x + 5y + 9z = 9.$$

(c) Use Newton's divided difference formula to find $f(8)$ and $f(15)$ from the following table :

| $x$ : | 1 | 5 | 7 | 9 |
|---|---|---|---|---|
| $f(x)$ : | 89 | 178 | 278 | 321 |

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# MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

**Paper Code : BM-401**

# STATISTICS, NUMERICAL METHODS AND ALGORITHM

*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) $(I + \Delta)(I - \nabla)$ is equal to

   a) 1 b) $\Delta^2$

   c) $\nabla^2$ d) none of these.

   ii) Lagrange's interpolation formula is used for

   a) equally spaced arguments

   b) unequally spaced arguments

   c) unequally or equally spaced arguments

   d) none of these.



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iii) The number of significant digits in 1·00234 is

a) 3 b) 4

c) 5 d) 6.

iv) First order forward difference of a constant function is

a) 0 b) 1

c) 3 d) 4.

v) Newton-Raphson method can be used to solve the equation $f(x) = 0$ when

a) $f'(x) > 0$ b) $f'(x) < 0$

c) $f'(x) = 0$ d) none of these.

vi) Trapezoidal rule will not produce any error if $f(x)$ is

a) Parabolic b) Linear

c) Logarithmic d) None of these.

vii) Which of the following methods is an iterative method ?

a) Gauss Elimination Method

b) Gauss-Jordan Method

c) Gauss-Jacobi Method

d) Crout's Method.



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viii) The error in Runge-Kutta method of $4^{th}$ order is

a) $0\ (h^2)$ b) $0\ (h^3)$

c) $0\ (h^4)$ d) $0\ (h^5)$.

ix) If the $n$th order forward difference of a polynomial is 0, then the degree of the polynomial will be

a) $n$ b) $(n-1)$

c) $(n+1)$ d) None of these.

x) Regula-Falsi method is

a) conditionally convergent

b) linearly convergent

c) divergent

d) none of these.

xi) Modified Euler's method has a truncation error of the order of

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

c) $h^3$ d) $h^4$.

xii) The rate of convergence of secant method is

a) 2 b) 1

c) 0·62 d) 1·62

e) None of these.



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## GROUP – B

### ( Short Answer Type Questions )

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

2. Solve the following equations using Gauss-Seidel Method ;

   $3x + y + 5z = 13$, $5x - 2y + z = 4$, $x + 6y - 2z = -1$ continue up to 3 successive approximation.

3. Find $f$ (5) using Newton's divide difference formula, for the following data :

| $X$ | 0 | 2 | 3 | 4 | 7 | 8 |
|---|---|---|---|---|---|---|
| $f(x)$ | 4 | 26 | 58 | 112 | 466 | 668 |

4. Find a negative root of the equation $x^3 - 3x - 5 = 0$ using Bisection method correct up to three decimal places.

5. Evaluate $\int_1^3 \frac{x dx}{x^2 + 3}$ by Simpson's $\frac{1}{3}$ rule taking 7 ordinates and find the value of $\log_e \sqrt{3}$.

6. Using Taylor's series method find $y$ (0·2) correct up to three decimal places from $\frac{dy}{dx} = 2x + 3y^2$ given $y(0) = 0$ taking $h = 0{\cdot}1$.



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## GROUP – C

### ( Long Answer Type Questions )

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

7. a) Apply Lagrange's interpolation formula to find $f(x)$ if $f(1) = 2$, $f(2) = 4$, $f(3) = 8$, $f(4) = 16$ and $f(7) = 128$.

   b) Solve the equation $x^3 - 3x - 5 = 0$ within ( 1, 2 ) by Bisection method correct to three decimal places.

   c) Deduce Newton's Backward Interpolation formula.

   5 + 5 + 5

8. a) Solve by Euler's method the following differential equation $\frac{dy}{dx} = x^2 - y$, $y(0) = 1$, for $x = 0{\cdot}3$ taking $h = 0{\cdot}1$, correct up to four decimal places. 8

   b) Use Regula-Falsi method to evaluate the smallest real root of the equation $3x - \cos x - 1 = 0$, correct to three decimal places. 7

9. a) Solve the following system of equations by LU Factorization method. 6

   $2x - 3y + 4z = 8$

   $x + y + 4z = 15$

   $3x + 4y - z = 8$



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b) Obtain the order of convergence of Newton-Raphson method. 4

c) Solve the following system of equations by Gauss-Jacobi iteration method correct up to 3 significant figures. 5

$20x + 5y - 2z = 14$

$3x + 10y + z = 17$

$x - 4y + 10z = 23$

10. a) Use Runge-Kutta method of order 2 to calculate $y$ (0·1) for the equation correct up to 4 decimal places. 4

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

b) Given $\frac{dy}{dx} = x^2 + y^2$, $y(1) = 2 \cdot 3$, calculate $y$ (1·1) by modified Taylor Series method correct up to 4 decimal places. 6

c) Find a real root of the equation $x = 2x - 3$ correct up to 3 decimal places by iteration method. 5

11. a) Solve the system of eqation by Gauss elimination method : 7

$x + 3y + 2z = 5$

$2x - y + z = -1$

$x + 2y + 3z = 2$



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b) The following table gives the distance in nautical miles of the visible horizon for the given heights in feet above the earth's surface :

| Height ($x$) | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
|---|---|---|---|---|---|---|---|
| Distance ($y$) : | 10·66 | 13·06 | 15·07 | 16·84 | 18·45 | 19·93 | 21·3 |

Find the value of $y$ when $x = 120$ ft and $x = 390$ ft. 8



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# MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

**Paper Code : BM-401**

# STATISTICS, NUMERICAL METHODS AND ALGORITHMS

*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 figures in 0.002560 is

a) 6 b) 5

c) 4 d) none of these.

ii) Which of the following relations is true ?

a) $E = 1 + \Delta$ b) $E = 1 - \Delta$

c) $E = 1/\Delta$ d) None of these.



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iii) If $f(3) = 4$, $f(4) = 13$ and $f(6) = 43$, then $f(5) =$

a) 20 b) 26

c) 25 d) none of these.

iv) In Simpson's 1/3 rd rule for finding $\int_a^b f(x)dx$, $f(x)$ is approximated by

a) Line segment

b) Parabola

c) Circular sector

d) None of these.

v) In Guass elimination method, the given system of equations represented by AX=B is converted to another system UX=Y where U is

a) Diagonal matrix

b) Identity matrix

c) Upper triangular matrix

d) none of these.

vi) The Newton-Raphson's method fails when

a) $f'(x) = 1$ b) $f'(x) = 0$

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

vii) One of the roots of $x^3 - 17x + 5 = 0$ lies in between

a) 1 and 2 b) 0 and 1

c) −1 and 0 d) none of these.

viii) Runge-Kutta formula has a truncation error, which is of the order of

a) $h^2$ b) $h^4$

c) $h^5$ d) none of these.

ix) The percentage error in approximating $\frac{4}{3}$ to 1.3333 is

a) 0.0025% b) 25%

c) 0.00025% d) none of these.

x) Find the value of $\Delta^3 y$ from the following table.

| $x$ : | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| $y$ : | 3 | 6 | 11 | 18 |

a) 0 b) 3

c) 5 d) none of these.

xi) The degree of precision of Simpson's 1/3 rd rule is

a) 1 b) 3

c) 5 d) none of these.

xii) The Lagrange's interpolation polynomial of $f(x)$ is

| $x$ : | 1 | 3 | 4 |
|---|---|---|---|
| $y$ : | 4 | 12 | 19 |

a) $3x^2 - 12$ b) $x^2 - 12$

c) $x^2 - 4$ d) none of these.

## GROUP – B

### ( Short Answer Type Questions )

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

2. Evaluate $\int_0^{\frac{\pi}{2}} \sqrt{1 - 0.162 \sin^2 \varphi}\, d\varphi$, by Simpson's one-third rule, correct up to two places of decimal, taking three points.

3. Find the root of $x^2 + 2x - 2 = 0$, by Newton-Raphson method, correct up to two significant figures.

4. Find the value of $f(2)$ from the following table :

| $x$ : | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| $f(x)$ : | 7 | -- | 13 | 21 | 37. |

5. Compute $f(0.23)$ and $f(0.29)$ using suitable formula from the table below :

| $x$ : | 0.20 | 0.22 | 0.24 | 0.26 | 0.28 | 0.30 |
|---|---|---|---|---|---|---|
| $f(x)$ : | 1.6596 | 1.6698 | 1.6804 | 1.6912 | 1.7024 | 1.7139 |

6. Given $\frac{dy}{dx}+\frac{y}{x}=\frac{1}{x^2}, y(1)=1$. Evaluate $y$ (1.2) by modified Euler's method correct up to 4 decimal places.

## GROUP – C

### ( Long Answer Type Questions )

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

7. (a) Solve the system of linear equations by Guass Elimination method :

$$5x_1 - x_2 = 9$$
$$-x_1 + 5x_2 - x_3 = 4$$
$$-x_2 + 5x_3 = -6$$

b) Evaluate $\int_0^1 \frac{1}{x^2+1}$ using Simpson's 1/3 rd rule taking $n = 6$, hence find the value of $\pi$.

c) Prove that : $E^{-1} \equiv 1 - D$. 5 + 5 + 5

8. a) Find the value of $\sqrt{2}$ correct up to four significant figures from the following table :

| $x$ : | 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) Find the roots of the equation $x^3 - 4x + 1 = 0$ using Regula Falsi method.

c) $\int_0^1 e^x dx$ by Trapezoidal rule taking h=0.1. 5 + 5 + 5

9. a) Solve the following system of equations by L-U Factorization method :

$$x_1 + x_2 - x_3 = 2$$
$$2x_1 + 3x_2 + 5x_3 = -3$$
$$3x_1 + 2x_2 - 3x_3 = 6$$

b) Find the polynomial of the least degree which attains the prescribed values of the given points :

| $x$ : | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| $y$ : | 3 | 6 | 11 | 18 |

Hence find $y$ for $x = 1.1$.

c) Using Newton-Raphson method, find a real root of the following equation correct to three decimal places $x^4 - x - 1 = 0$. 5 + 5 + 5

10. a) Using Runge-Kutta method of fourth order with $h$=0.1 find $y(1.1)$. Given $\frac{dy}{dx} = y^2 + xy, y(1) = 1$.

b) Using divided difference formula, evaluate $f(8)$.

| $x$ : | 4 | 5 | 7 | 10 | 11 | 13 |
|---|---|---|---|---|---|---|
| $f(x)$ : | 48 | 100 | 294 | 900 | 1210 | 2028 |

c) Solve the following system of equations by Gauss-Seidel iterative method :

$$x + y + 54z = 110$$
$$27x + 6y - z = 85$$
$$6x + 15y + 2z = 72.$$

5 + 5 + 5

11. a) Find $A^{-1}$ where $A = \begin{pmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{pmatrix}$.

b) Using Taylor's series method find $y$ at $x = 1.1, 1.2$ solving $\frac{dy}{dx} = (x^2 + y^2)$ given by $y(1) = 2.3$.

c) Write down the general rules for rounding off a number to $n$ significant figures. 6 + 6 + 3