

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg. Part-II Even Semester Examination 2022
Course No : MATH2231 (Numerical Methods)
Marks: 35 Time: 2 Hours

(Answer any Four questions taking at least Two from each Section)

Section-A

1. (a) Define inherent error, round-off error and truncation error. Find the relative error of the number 8.6 if both of its digits are correct. 3.75
- (b) What do you mean by exact and approximate number? Give example. 3
- (c) Let \hat{x} be some approximation of an exact value x . State whether "relative error is always smaller than absolute error" is true and justify your answer. 2
2. (a) Describe the Bisection method and derive its formula analytically. 3
- (b) How does accelerate of convergence in iterative method to find real root? Explain. 2.75
- (c) Find a real root of the equation $x^3 + x - 1 = 0$ correct to 3 decimal places using by false position method. 3
3. (a) What is interpolation? Why is it needed? 2
- (b) Derive Newton's forward difference interpolation formula for equidistant data points. 3.75
- (c) From the following table, find value of y when $x=1.45$. 3

x	1.0	1.2	1.4	1.6	1.8	2.0
y	0.0	-0.112	-0.016	0.336	0.992	2.0

Section-B

4. (a) Describe the least square curve fitting procedure for a straight line. 4.75
- (b) Find the values of a, b and c so that $y = a + bx + cx^2$ is the best fit to the data given in the table: 4

x	0	1	2	3	4
y	1	0	3	10	21

5. (a) Is it possible to find solution of a system of linear equation with singular augmented matrix by Gaussian Elimination Method? Justify your answer. 3.75
- (b) How Gauss Jordan method differs from Gauss elimination method? Explain. 2
- (c) Solve the following system by Gauss-Jordan method. 3

$$\begin{aligned} 2x + y + z &= 0 \\ 3x + 2y + 3z &= 18 \\ x + 4y + 9z &= 16 \end{aligned}$$
6. (a) Compute the values of $I = \int_0^1 \frac{1}{1+x^2} dx$ for $h=0.25$ using trapezoidal and simpson's 1/3 rules correct to three decimal places. 3.75
- (b) Derive Euler's method for solution of ordinary differential equations. 3
- (c) Solve by Euler's method the equation 2

$$\frac{dy}{dx} = x + y, \quad y(0) = 0. \text{ Choose } h = 0.2 \text{ and compute } y(0.6).$$

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg. Part-II Even Semester Examination 2021
Course Code: MATH2231 Course Title: (Numerical Methods)
Marks: 35 Time: 2 Hours

(Answer any Four questions taking at least Two from each Section)

Section-A

1. (a) Define significant figures. Write the rules for significant figures. How many significant figures are in the measurement 0.006606? 3
- (b) Discuss briefly the different types of errors encountered in performing numerical calculations. 3
- (c) If $X=0.51$ and correct to 2 decimal places. Find the percentage error. 2.75
2. (a) Differentiate between open and bracketing method to measure root of an equation. 1.75
- (b) Show that the order of convergence of Newton-Raphson method is two. 4
- (c) Find a positive real root of equation $x^3 - 3x + 1 = 0$ by Newton-Raphson's method, correct to 4 decimal places. (with $\epsilon = 0.0001$) 3
3. (a) Derive Newton's General Interpolation Formula using divided difference of data points. 3.75
- (b) Find the polynomial for the following data by Newton's backward difference formula. 3

x	0	1	2	3
y	-3	2	9	18

- (c) State any two properties of divided difference. 2

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Section-B

4. (a) What is meant by interpolation? Derive Lagrange's interpolation formula. 4.75
- (b) Find the form of the function $y(x)$ from the following table. 4

X	0	1	3	4
Y	-12	0	12	24

5. (a) Explain Gauss-Seidel method for solution of linear system and also write the algorithm of it. 3+2
- (b) What is the major drawback of Taylor series method? 0.75
- (c) From the Taylor series for $y(x)$, find $y(0.1)$ correct to four decimal places if $y(x)$ satisfies $y' = x - y^2$ and $y(0) = 1$. 3
6. (a) Derive Trapezoidal rule for numerical integration. 3
- (b) How Simpson's 1/3 rule differs from Trapezoidal rule? Explain. 2
- (c) A solid of revolution is formed by rotating about the x-axis the area between the x-axis, the lines $x = 0$ and $x = 1$, and a curve through the points with the following coordinates: 3.75

x	0.00	0.25	0.50	0.75	1.00
y	1.0000	0.9896	0.9589	0.9089	0.8415

Estimate the volume of the solid formed using Simpson's 1/3 rule, giving the answer to three decimal places.

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg. Part-II Even Semester Examination 2020
Course No : MATH2231 (Numerical Methods)
Marks: 35 Time: 2 Hours

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(Answer any four questions taking at least two from each Section)

Section-A

1. (a) What are accuracy and precision? 1
 (b) Why do occur numerical errors? Explain different types of errors. 3
 (c) How can you measure absolute, relative and percentage errors? 3
 (d) Three approximate values of the number $1/3$ are given as 0.30, 0.33 and 0.34. 1.75
 Which of these three is the best approximation?
2. (a) Describe the Bisection method for finding root of equation $f(x)=0$ with its merits and demerits 4.75
 (b) Find the real root of the equation $x^3-3x-5=0$ correct to three decimal places using Bisection method. 4
3. (a) Explain Shift Operator E, Average Operator μ and Differential Operator D used in interpolation formula. 1.5
 (b) Prove that $E = 1 + \Delta$, symbols have their usual meaning. 2
 (c) Derive Newton's backward interpolation formula for equal spaced data. 3
 (d) Given the table 2.25

x	150	152	154	156
$y = \sqrt{x}$	12.247	12.329	12.410	12.490

Evaluate $\sqrt{155}$ using an interpolation formula.

Section-B

4. (a) What is curve fitting? Explain the purpose of it. 1.75
 (b) Describe the least square curve fitting procedure for power function $f(x) = ax^c$. 4
 (c) By the method of least squares, find a straight line that best fits the following data given in the table 3

x	0	1	2	3	4
y	1.0	2.9	4.8	6.7	8.6

5. (a) Explain Gauss elimination method to solve linear system of equations. 4.75
 (b) Solve the following equations using Gauss-Jordan method 4
 $x + y = 5$
 $-2x - y + 2z = -10$
 $3x + 6y + 7z = 14$

6

6. (a) Derive Euler's method and modified Euler's method for solution of ordinary differential equations. 4.75
 (b) Solve the equation by Euler's method 4
 $\frac{dy}{dx} = y - x, \quad y(0) = \frac{1}{2}$
 Choose $h = 0.1$ and compute $y(0.2)$ and $y(0.4)$.

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. Engg. Part - II, Semester – Even, Examination 2019
Course No.: MATH2231 (Numerical Methods)
Marks: 35 Time: 2 Hours

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(Answer any four questions taking at least two from each Section)

Section-A

1. (a) What is numerical method? Write the reasons to study it. 1.75
 (b) Explain inherent error, round-off error and truncation error. 3
 (c) How numbers are rounded-off? Give the rule. 2
 (d) If $\frac{2}{3}$ is approximated to four significant digits, find absolute, relative and percentage errors. 2

2. (a) Briefly discuss the method to obtain a root using false position method. 1.5
 (b) Use the iterative method to find, correct to four significant figures, a real root of the equation: $1+x^2=x^3$ 3.75

3. (a) Derive Newton's forward difference interpolation formula for equal distance data. 4
 (b) From the following table, find y when $x=301$ using Newton's divided difference formula. 3

x	300	304	305	307
y	2.4771	2.4829	2.4843	2.4871

- (c) Show that the divided differences are symmetrical in their arguments. 1.75

Section-B

4. (a) Define curve fitting. Explain the purpose of it. 1.75
 (b) Describe the least square curve fitting procedure for a straight line. 4
 (c) Find the values of a_0 and a_1 so that $Y = a_0 + a_1x$ fits the data given in the table: 3
- | | | | | | |
|---|-----|-----|-----|-----|-----|
| x | 0 | 1 | 2 | 3 | 4 |
| y | 1.0 | 2.9 | 4.8 | 6.7 | 8.6 |
5. (a) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ for $h = 0.5$ and 0.125 using Trapezoidal rule (correct to three decimal places). 3
 (b) Derive Romberg Integration formula. 4
 (c) State any two differences between direct and iterative methods for solving system of equations. 1.75

 6. (a) From the Taylor series for $y(x)$, find $y(0.1)$ correct to four decimal places if $y(x)$ satisfies $y' = x - y^2$ and $y(0) = 1$. 4
 (b) Determine the value of y using modified Euler's formula when $x = 0.1$ given that $y(0) = 1$ and $y' = x^2 + y$ and $h = 0.05$. 4.75

University of Rajshahi
Department of Computer Science and Engineering
B.Sc. (Engg.) Part-2 Even Semester Examination-2018
Course: MATH2231 (Numerical Methods)
Marks: 35 Time: 2 Hours

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 University of Rajshahi

[N.B. Answer any FOUR questions taking TWO from each section.]

Section-A

1. a) What is numerical method? Write the reasons to study it. 2
 b) Define the terms 'accuracy', 'precision' and 'bias'. 1.50
 c) What do you mean by significant figures? Write the rules for identifying significant figures with examples. 3.25
 d) What is the difference between algebraic and transcendental equations? 2
2. a) Define Bisection method. Find the real root of the equation $x^3 - 2x - 5 = 0$, using bisection method. 5.75
 b) Explain the advantages and disadvantages of bisection method. 3
3. a) Derive Newton's forward difference interpolation formula for equal distance data. 3
 b) Define the divided differences $f[x_i; x_{i+1}; \dots; x_{i+k}]$ for a function $f(x)$. 3
 c) Use divided differences to construct the Newton interpolation polynomial $p_2(x)$ of degree 2 that passes through according to following table or the points (0.1, 0.1248), (0.2, 0.2562), and (0.4, 0.6108). 2.75

x	0.1	0.2	0.4
f(x)	0.1248	0.2562	0.6108

Section-B

4. a) Define curve fitting. Explain the purpose of it. 1.75
 b) Describe the least square curve fitting procedure for a polynomial of degree n. 4
 c) Derive a polynomial of degree 2 to the data points given in the table: 3

x	0	1	2
y	1.0	6.0	17.0

5. a) Solve the following system using Jacobi iterative technique: 3.5
 $3x_1 + x_2 - 2x_3 = 9$
 $-x_1 + 4x_2 - 3x_3 = -8$
 $x_1 - x_2 + 4x_3 = 1$
 b) Solve the following differential equation using Euler's method for $1 \leq x \leq 2$ with a step size of $h = 0.1$: $\frac{dy}{dx} = 3x^2y$ such that $y=1$ at $x=1$. 5.25

6. For the following set of data:

x	0	1	2	3	4
f(x)	0	0.5	0.75	0.79	0.99

- a) Construct a finite-difference table and numerically evaluate the first, second, third derivative at $x=1$ using forward differences. 4.5
- b) Use the Simpson's 1/3-Rule to numerically evaluate the integral $\int_0^4 f(x) dx$. 3
- c) How can you reduce the error in your estimate of the integral? 1.25