Total No. of Printed Pages—4

# 4 SEM TDC MTMH (CBCS) C 8

## 2023

( May/June )

## MATHEMATICS

( Core )

Paper : C–8

**( Numerical Methods )**

*Full Marks* : 60

*Pass Marks* : 24

*Time* : 3 hours

*The figures in the margin indicate full marks for the questions*

*Use of scientific calculator is allowed*

**1.** *(a)* Define an algorithm and write one important feature of an algorithm. 1+1=2

*(b)* Define error and relative error. 1+1=2

*(c)* Write the convergence of numerical methods. 1

**2.** *(a)* State true or false : 1

Iteration method is always convergent.

*(b)* Describe bisection method for solving an algebraic equation. 4

*Or*

Find a real root of the equation

$$x^3 - 2x - 5 = 0$$

by secant method correct up to three decimal places.

*(c)* Give the geometrical interpretation of Newton-Raphson method. 5

*Or*

Determine the real root of $\cos x = 2x$ by Newton-Raphson method correct up to three decimal places.

**3.** *(a)* Describe Gauss elimination method for the solution of the system of linear equations. 5

*Or*

Solve the following by Gauss-Jordan method :

$$x + y + z = 5,\ 2x + 3y + 5z = 8,\ 4x + 5z = 2$$

*(b)* Solve the following by Gauss-Jordan method : 5

$$5x - 2y + 3z = -1,\ -3x + 9y + z = 2,$$
$$2x - y - 7z = 3$$

*Or*

Find the solution of the system of equations

$$5x + 2y + z = 12,\ x + 4y + 2z = 15,$$
$$x + 2y + 5z = 20$$

by Gauss-Seidel method up to three iterations.





**4.** *(a)* Define interpolation. 1

*(b)* Find the relation between $D$ and $\Delta$, where $D$ = differential operator and $\Delta$ = forward difference operator. 2

*(c)* Construct forward difference table for the following values : 2

| | | | | | | |
|---|---|---|---|---|---|---|
| $x$ | : | 0 | 5 | 10 | 15 | 20 |
| $y$ | : | 7 | 11 | 14 | 18 | 24 |

*(d)* Deduce Newton's forward interpolation formula. 5

*Or*

Find the missing term in the following table using Lagrange's interpolation formula :

| | | | | | | |
|---|---|---|---|---|---|---|
| $x$ | : | 0 | 1 | 2 | 3 | 4 |
| $y$ | : | 1 | 3 | 9 | ? | 81 |

**5.** *(a)* Deduce composite Simpson's $\frac{1}{3}$rd rule for numerical integration. 5

*(b)* Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by trapezoidal rule. 5

*Or*

Evaluate $\int_0^1 \frac{dx}{1+x}$ using Simpson's $\frac{1}{3}$rd rule.

(c) Evaluate $\int_1^2 \frac{dx}{x}$ by Simpson's $\frac{3}{8}$th rule. 5

*Or*

Evaluate $\int_{0.2}^{0.6} \frac{dx}{1+x}$ by Bool's rule correct to three decimal places, using $n = 4$.

**6.** (a) Find $y(0 \cdot 10)$ and $y(0 \cdot 15)$ by Euler's method from the equation

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

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

(b) Derive the actual computational formulae for Runge-Kutta method of order two. 6

*Or*

Using Runge-Kutta method of fourth order, find the numerical solution at $x = 0 \cdot 2$ for

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

taking $h = 0 \cdot 2$.

★ ★ ★