63/1 (SEM–4) CC8/MATHC4086

2025

MATHEMATICS

Paper : MATHC4086

(Numerical Methods)

Full Marks : 60

Pass Marks : 24

Time : Three hours

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

1. Choose the correct answer from the following : ***(any five)*** 1×5=5

   (a) For the operators E and ∇, $E\nabla$ is equal to

   (i) 1

   (ii) Δ

   (iii) ∇

   (iv) E

(b) Which of the following rule is generally more accurate than any other ?

(i) Simpson's one-third rule

(ii) Simpson's three-eighth rule

(iii) Weddle's rule

(iv) Trapezoidal rule

(c) Euler's modified method has an error of order

(i) 1

(ii) h

(iii) h^2

(iv) h^3

(d) Truncation errors is due to

(i) human mistake

(ii) limitation of computing aids

(iii) infinite process is approximate by a finite one

(iv) round off the number

(e) The value E_R after rounding off the number 37·46235 to four significant figure, where the symbols have its usual meaning is

(i) 37·46

(ii) 0·00235

(iii) $6{\cdot}27 \times 10^{-5}$

(iv) $6{\cdot}27 \times 10^{-3}$

(f) Bisection method always converges with a rate of

(i) 1

(ii) 1·5

(iii) 1·26

(iv) 2

(g) The third divided difference $f(x_0, x_0, x_0)$ is

(i) $f'(x_0)$

(ii) $\frac{1}{\lfloor 2} f'(x_0)$

(iii) $f''(x_0)$

(iv) $\frac{1}{\lfloor 2} f''(x_0)$

(h) Simpson's rule can be applied when the interval of integration is divided into a number of sub-intervals, which must be a multiple of

(i) 2

(ii) 3

(iii) 6

(iv) 10

(i) For the operators Δ and ∇, $(1+\Delta)(1-\nabla)$ is equal to

(i) 0

(ii) $1-\Delta^2$

(iii) $1-\nabla^2$

(iv) 1

(j) Newton-Raphson's method is applicable only when $f'(x)$ is

(i) 0

(ii) small

(iii) large

(iv) any value

2. Answer the following questions : ***(any five)*** 2×5=10

(a) What do you mean by interpolation and extrapolation ?

(b) Under what assumption the process of interpolation based upon ?

(c) If $f(x)=(1-x)(1-2x)(1-3x)$, then find $\Delta^3 f(x)$.

(d) Write the remainder term in Newton's formula for forward interpolation.

(e) Evaluate $\sqrt{12}$ by applying Newton's formula.

(f) Define the operators E and Δ.

(g) Show that the operators E and Δ are commutative.

3. Answer the following questions : ***(any five)*** 5×5=25

(a) Determine the function whose first difference is $9x^2+11x+5$.

(b) Obtain Lagrange's interpolation formula with unequal intervals in the form

$$f(x)=\sum_{r=1}^{n}\frac{\phi(x)\,f(x_r)}{(x-x_r)\,\phi(x_r)}$$

where $\phi(x)=(x-x_0)(x-x_1)\ldots.(x-x_n)$

and $\phi'(x)=\left[\frac{d\phi}{dx}\right]_{x=x_r}$.

(c) From the following table, find the number of students who obtained less than 45 marks

Marks	No. of students
30–40	31
40–50	42
50–60	51
60–70	35
70–80	31

(d) If U_x is a function whose fifth differences are constant and $\int_{-1}^{1} U_x\,dx$ can be expressed in the form $pU_{-\alpha}+qU_{\beta}+pU_{\alpha}$ then find p, q and α.

(e) A curve is drawn to pass through the points given by the following table :

x	:	1	1·5	2	2·5	3	3·5	4
y	:	2	2·4	2·7	2·8	3	2·6	2·1

Find the area bounded by the curve, the x-axis and the line $x=1$, $x=4$.

(f) Find the real root up to four decimal places of the equation

$$x^3-x-1=0$$

(g) Solve :

$$\begin{aligned} x+2y+z&=8\\ 2x+3y+4z&=20\\ 4x+3y+2z&=16 \end{aligned}$$

by Gauss's Elimination method.

(h) Find the third divided differences with the arguments a, b, c, d of the function $\frac{1}{x^2}$.

(i) State and prove Newton's Backward interpolation formula.

4. Answer the following : ***(any two)*** 10×2=20

(a) Given, $\frac{dy}{dx} = \frac{y-x}{y+x}$

with boundary conditions $y = 1$ for $x = 0$, find approximately for $x = 0{\cdot}1$ by Euler's method upto five steps.

(b) Using the following table, find $f(x)$ as a polynomial in power of $(x-5)$:

x	:	0	2	3	4	7	9
$f(x)$	:	4	26	58	112	466	922

Also, find $f'(5)$, $f''(5)$ and $f'''(5)$.

(c) Derive a general quadrature formula for equidistant ordinates. Deduce from it Simpson's three-eighth rule.

(d) The following table gives the population of a town during last six censuses. Estimate using any suitable interpolation formula, the increase in the population during the period from 1946 to 1948.

Year	:	1911	1921	1931	1941	1951	1961
Population (in thousand)	:	12	15	20	27	39	52