(6 pages)

MAY 2016 **P/ID 37459/PMAE**

Time : Three hours Maximum : 60 marks

SECTION A — (10 × 1 = 10 marks)

Answer ALL questions.

1. Write down the content and purpose of the header file $\langle$utility$\rangle$.

2. What are the two ways for creating a symbolic constants in C++?

3. What does inheritance mean in C++?

4. What is the difference between the input stream and the output stream?

5. Write down the general term, obtained by the two-point iteration formula in secant method.

6. Using back substitution method, solve $4x_1 - x_2 + 2x_3 = 20; -2x_2 + 7x_3 = -7; 6x_3 = 4$.

7. Define the terms :

   (a) interpolated value and

   (b) extrapolated value.

8. Find the value of h, that minimizes $f(h) = \frac{3 \in}{2h} + \frac{Mh^4}{30}$.

9. Write down the composite Simpson's rule to evaluate $\int_{x_0}^{x_4} f(x)dx$.

10. State the first derivative test.

SECTION B — (5 × 3 = 15 marks)

Answer ALL questions.

11. (a) List out the striking feature of object-oriented program.

Or

(b) What are the advantages offered by the new operator over the function malloc ( )?

12. (a) Write down the steps in the process of overloading operation.

Or

(b) What is a stream? How does a C++ program handle input and output data?

13. (a) Let $g \in C[a, b]$. If the range of the mapping $y = g(x)$ satisfies $y \in [a, b]$ for all $x \in [a, b]$, then prove that g has a fixed point in $[a, b]$.

Or

(b) Using Gaussian elimination method, construct the triangular factorization of the matrix

$$A = \begin{bmatrix} 4 & 3 & -1 \\ -2 & 4 & 5 \\ 1 & 2 & 6 \end{bmatrix}.$$

14. (a) Write down the nested multi-form of $f(x) = (x-1)^8$.

Or

(b) Let $f(x) = \cos(x)$. Obtain the approximation of $f'(0.8)$, using the linear combination $\frac{1}{3}(4D_0(h) - D_0(2h))$, where $D_0(h)$ and $D_0(2h)$ are Pichardson's extrapolation with step sizes h and $2h$ respectively. Take $h = 0.01$.

15. (a) Using the two-point Gauss-Legendre rule approximate $\int_{-1}^{+1} \frac{dx}{x+2}$. Compare the result with the trapezoidal rule $T(t, h)$ with $h = 2$.

Or

(b) Given that $y' = \frac{1}{2}(t - y)$ on $[0, 3]$ with $y(0) = 1$. Using Heun's method for the step size $h = \frac{1}{4}$, find $y(0.5)$.

SECTION C — (5 × 7 = 35 marks)

Answer ALL questions.

16. (a) What are the principal advantages of OOP?

Or

(b) Write a program to read a matrix of order (3 × 4) using class type objects.

17. (a) Discuss hierarchical inheritance and hybrid inheritance.

Or

(b) List out the rules for creating virtual functions.

18. (a) State and prove the fixed point theorem.

Or

(b) Using triangularization method, solve the following system :

$x + 5y + 2 = 14; 2x + y + 3z = 13;$

$3x + y + 4z = 17$.

19. (a) State and derive the error bounds for Lagrange interpolation for equally spaced nodes.

Or

(b) Derive the second-order forward difference formula and second-order backward difference formula for approximating $f'(x)$, from Newton polynomial $p(t)$ of degree 2.

20. (a) Obtain the minimum of the function $f(x) = x^2 - \sin(x)$ defined on $[0, 1]$ using the Fibonacci search method. Use a tolerance $\in = 10^{-4}$ and distinguishability constant $e = 0.01$.

Or

(b) Using Runge-Kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$, $y(0) = 1$, at $x = 0.2, 0.4$.

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