23U503 (Pages: 2) Name: ....

Reg.No: ....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2025

(CBCSS - UG)

(Regular/Supplementary/Improvement)

CC20UMTS5B07 - NUMERICAL ANALYSIS

(Mathematics - Core Course)

(2020 Admission onwards)

Time : 2.00 Hours Maximum : 60 Marks

Credit : 3

Part A (Short answer questions)

Answer ***all*** questions. Each question carries 2 marks.

1. Let $f(x) = 3(x+1)(x-\frac{1}{2})(x-1) = 0$. Use the Bisection method on the interval $[-2, 1.5]$ to find p_3.
2. Use algebraic manipulations to show that the function $g(x) = \left(\dfrac{3+x-x^4}{2}\right)^{1/2}$ has a fixed point at p precisely when $f(p) = 0$ where $f(x) = x^4 + 2x^2 - x - 3$
3. Let $f(x) = x^2 - 6 = 0$ and $p_0 = 1$. Use Newton's method to find p_2.
4. What do you meant by polynomial interpolation?
5. Using the forward-difference formula approximate the derivative of $f(x) = \ln x$ at $x_0 = 1.8$ by considering $h = 0.01$. Also determine the bound for the approximation error.
6. Given $f(x) = xe^x$. By taking $h = 0.1$ and using three-point midpoint formula find $f'(2.0)$ correct to four decimal places.
7. Let $f(x) = \cos \pi x$. Use the midpoint formula and the values of $f(x)$ at $x = 0.25$, 0.5 and 0.75 to approximate $f''(0.5)$. Compare the result to the exact value.
8. Determine the values of h that will ensure an approximation error of less than *0.00002* when approximating $\displaystyle\int_0^{\pi} \sin x \, dx$ using composite trapezoidal rule.
9. Does the function $f(t,y) = t|y|$ satisfy a Lipschitz condition on $D = \{(t,y) : 1 \le t \le 2;\ -3 \le y \le 4\}$?
10. Solve the initial value problem $y' = \frac{2}{t}y + t^2 e^t,\ 1 \le t \le 2,\ y(1) = 0$.
11. Use Euler's method to approximate the solution of the initial value problem $y' = 1 + \frac{y}{t},\ 1 \le t \le 2,\ y(1) = 2$ with $h = 1$.
12. Write a short note on predictor-corrector methods.

(Ceiling: 20 Marks)

Part B (Short essay questions - Paragraph)

Answer ***all*** questions. Each question carries 5 marks.

13. Use method of false position to find solution of $\sin x - e^{-x} = 0$ for $0 \leq x \leq 1$ accurate to within 10^{-2}.

14. Using Newton's divided difference formula construct interpolating polynomials of degree one, two and three for the data given in the table,

x	8.1	8.3	8.6	8.7
$f(x)$	16.94	17.56	18.51	18.82

15. Using Stirling's formula approximate $f(1.5)$ by taking $x_0 = 1.6$ corresponding to the data given in the table,

x	1	1.3	1.6	1.9	2.2
$f(x)$	0.7652	0.6201	0.4554	0.2818	0.1104

16. Approximate $\int_{1}^{1.5} \frac{2x}{x^2-4}\, dx$ using Trapezoidal rule. Find the actual error of the approximation.

17. Approximate $\int_{0}^{\pi/4} e^{3x} \sin 2x\, dx$ using Simpson's rule. Find the actual error of approximation.

18. Use Taylor's method of orders two and four to approximate the solution of the initial value problem $y' = 1 + (t-y)^2,\ 2 \leq t \leq 3,\ y(2) = 1$, with $h = 0.5$.

19. Use modified Euler's method to approximate the solution of the initial value problem $y' = \frac{2-y^2}{5t},\ 4 \leq t \leq 4.4,\ y(4) = 1$, with $h = 0.2$.

(Ceiling: 30 Marks)

Part C (Essay questions)

Answer any ***one*** question. The question carries 10 marks.

20. Use secant method to find solution of $x^3 + 3x^2 - 1 = 0$ for $[-3, -2]$ accurate to within 10^{-3}.

21. Use Runge-Kutta method of order four to approximate the solution of the initial value problem $y' = \sin t + e^{-t},\ 0 \leq t \leq 1,\ y(1) = 0$,with $h = 0.5$. Compare the results to the actual values.

(1 × 10 = 10 Marks)

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