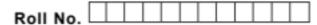


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B.Tech (Automation & Robotics) (2011 & Onwards) (Sem.-5)

NUMERICAL METHODS IN ENGINEERING

Subject Code : ME-309

M.Code: 70482

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

- SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
- 2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt ANY FOUR questions.
- SECTION-C contains THREE questions carrying TEN marks each and students have to attempt ANY TWO questions.

SECTION-A

1. Write briefly :

- Write Newton's formula for interpolation.
- ii) Find the condition number of the function $f(x) = \sin x$.
- iii) Define a cubic spline interpolant with clampled boundary.
- Determine the Lagrange interpolating polynomial passing through the points (1, 1), (2, 4) and (3, 9).
- v) Find the l_∞ norm of the vector (1, -5, 9)^t.
- vi) Explain least square curve fitting.
- vii) Compute $\int_{0}^{2} xe^{x} dx$ using Simpson's rule.
- viii) Use the forward-difference formula to approximate the derivative of f(x) = ln x at x₀ = 1.8 using h = 0.1.

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- What is the order of convergence when Newton Raphson's method is applied to the equation x² - 6x + 9 = 0 to find its multiple root.
- x) Out of chopping of numbers and rounding off of numbers, which one introduce less error?

SECTION-B

 Use forward-difference method with steps sizes h = 0.1 and k = 0.01 to approximate the solution to the heat equation :

$$\frac{\partial u}{\partial t}(x,t) - \frac{\partial^2 u}{\partial x^2}(x,t) = 0, \quad 0 < x < 1, t \ge 0,$$

with boundary conditions

$$u(0, t) = v(1, t) = 0, t > 0,$$

and initial condition

$$u(x, 0) = \sin(\pi x), 0 \le x \le 1.$$

3. Apply Taylor's method of order 2 with N 710 to initial value problem

$$y^1 = y - t^2 + 0, 0 \le t \le 2, y(0) = 0.5$$

The following data is given.

1.0	J 1.3	1.6	1.9	2.2
0.7651977	0.6200860	0.4554022	0.2818186	0.1103623

Use Lagrange's formula to approximate f(1,5).

- 5. Use the data points (0, 1), (1, e), (2, e^2) and (3, e^3) to form a natural spline S(x) that approximates $f(x) = e^x$.
- Find the largest interval in which p* must lie to approximate p with relative error at most 10⁻⁴ for p = (17)^{1/2}.



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SECTION-C

- 7. Derive Secant's formula for solving the equation f(x) = 0 (specifying the assumptions made). Use the secant method to solve the equation $x = \cos x$ starting with an initial guesses 0.5 and $\frac{\pi}{4}$.
- 8 Use Gauss elimination method with partial pivoting to solve the following linear system of equations.

$$\pi x_1 + \sqrt{2}x_2 - x_3 + x_4 = 0,$$

$$e x_1 - x_2 + x_3 + 2x_4 = 1,$$

$$x_1 + x_2 - \sqrt{3}x_3 + x_4 = 2,$$

$$-x_1 - x_2 + x_3 - \sqrt{5}x_4 = 3.$$

- Determine the values of h that will ensure an approximation error of less than 10⁻⁴ when 9. Determine the values of *h* that will ensure an ap approximating $\int_{0}^{2} e^{2x} \sin 3x \, dx$ and employing : a) Composite trapezoidal rule. b) Composite Simpson's rule.

NOTE : Disclosure of identity by writing mobile number or making passing request on any page of Answer sheet will lead to UMC case against the Student.

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