Roll No. Total No. of Pages : 03

Total No. of Questions : 09

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 :

1. 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.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt ANY TWO questions.

SECTION-A

1. Write briefly :

i) 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.

iv) 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 $x_0 = 1.8$ using $h = 0.1$.

xi) What is the order of convergence when Newton Raphson's method is applied to the equation $x^2 - 6x + 9 = 0$ to find its multiple root.

x) Out of chopping of numbers and rounding off of numbers, which one introduce less error?

SECTION-B

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

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

with boundary conditions

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

and initial condition

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

3. Apply Taylor's method of order 2 with N = 10 to initial value problem

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

4. The following data is given

1.0	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 $f\,(x) = e^x$.

6. Find the largest interval in which p^* must lie to approximate p with relative error at most 10^{-4} for $p = (17)^{\frac{1}{3}}$.

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.

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

$$ex_1 - x_2 + x_3 + 2x_4 = 1,$$

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

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

9. Determine the values of h that will ensure an approximation error of less than 10^{-4} when 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.