Roll No. Total No. of Pages : 02

Total No. of Questions : 18

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

Answer the following :

1. Define a cubic spline interpolant with natural boundary.
2. What do we mean by unconditionally stable method?
3. Find the condition number of the function $f(x) = \cos x$.
4. Determine the Lagrange interpolating polynomial passing through the points (2,4) and (5,3).
5. Out of chopping of numbers and rounding off of numbers, which one introduce less error? Explain suitably.
6. Find the l_2 norm of the vector $(1,\sqrt{6},3)^t$.
7. 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.
8. Use the forward-difference formula to approximate the derivative of $f(x) = \ln x$ at $x_0 = 1.8$ using h = 0.01.
9. Compute $\int_0^{\pi} x \sin x dx$ using Simpson's rule.
10. Explain Lagrange's interpolation.

SECTION-B

11. Use Euler's method to approximate the solution of the following initial value problem

$y' = y/t - (y/t)^2, \quad 1 \le t \le 2, y(1) = 1, h = 0.1.$

12. Construct a clamped spline S(x) which passes through the points (1,2), (2,3) and (3,5) that has $S'(1) = 2$ and $S'(3) = 1$.

13. 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 $f(1.5)$.

14. Let $f(x) = (x \cos x - \sin)/(x - \sin x)$. Use four digit rounding arithmetic to evaluate $f(0.1)$. The actual value is $f(0.1) = -1.99899998$, using this value find the relative error.

15. Use backward-difference method with steps sizes h = 0.1 and k = 0.01 to approximate the solution to the heat equation

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

with boundary conditions $u(0,t) = c(1,t) = 0, \ t > 0,$

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

SECTION-C

16. Determine the values of h that will ensure an approximation error of less than 0.00002 when approximating $\int_0^{\pi} \sin x dx$ and employing.

a) Composite trapezoidal rule.

b) Composite Simpson's rule.

17. Draw the graph of $4x = \tan x$. Use Newton's method to find the first two positive roots of $4x = \tan x$ (Note: You can use the graph drawn for selecting your initial guesses.).

18. Use Gauss elimination method with scaled partial pivoting to solve the following linear system of equations

$2.11x_1 - 4.21x_2 + 0.921x_3 = 2.01,$

$4.01x_1 + 10.2x_3 - 1.12x_3 = -3.09,$

$1.09x_1 + 0.987x_2 + 0.832x_3 = 4.21.$

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.