

AIML

Reg. No. :

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Question Paper Code : 60875

B.E/B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026

Fourth/Fifth/Sixth Semester

Civil Engineering

MA8491 – NUMERICAL METHODS

(Common to : Aeronautical Engineering/Aerospace Engineering/Agriculture Engineering/Electrical and Electronics Engineering/Electronics and Instrumentation Engineering/Instrumentation and Control Engineering/Manufacturing Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Biotechnology and Biochemical Engineering/Chemical Engineering/Chemical and Electrochemical Engineering/Plastic Technology/Polymer Technology/Textile Technology)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine the fixed points of the function $g(x) = x^2 - 2$.
2. Show that $g(x) = \frac{(x^2 - 1)}{3}$ has a unique fixed point on the interval $[-1, 1]$.
3. Use the polynomial $f(x) = \frac{1}{22}x^2 - \frac{35}{88}x + \frac{49}{44}$ to approximate $f(3) = 1/3$.
4. Write down the Newton forward-difference formula.
5. Present the formula for the Trapezoidal rule.
6. Compare the Trapezoidal rule and Simpson's rule approximations to $\int_0^2 f(x)dx$ when $f(x) = (x+1)^{-1}$.
7. Write the difference between single step and multistep method.
8. State the formula for the Modified Euler Method.

9. Provide the three-dimensional heat equation.
 10. Write the Crank-Nicolson formula.

PART B — ($5 \times 16 = 80$ marks)

11. (a) Solve $x^3 + 4x^2 - 10 = 0$ with accuracy 10^{-3} using Newton Raphson method.

Or

- (b) Write the linear system

$$E_1 : x_1 - x_2 + 2x_3 - x_4 = -8,$$

$$E_2 : 2x_1 - 2x_2 + 3x_3 - 3x_4 = -20,$$

$$E_3 : x_1 + x_2 + x_3 = -2,$$

$E_4 : x_1 - x_2 + 4x_3 + 3x_4 = 4$, as an augmented matrix and use Gaussian Elimination to find its solution.

12. (a) Determine the linear Lagrange interpolating polynomial that passes through the points (2, 4) and (5, 1).

Or

- (b) Construct the interpolating polynomial for

x	1.0	1.3	1.6	1.9	2.2
$f(x)$	0.7651977	0.6200860	0.4554022	0.2818186	0.1103623

13. (a) Use Trapezoidal rule to find approximations $\int_0^\pi \sin x \, dx$ with $n = 1, 2, 4, 8$ and 16. Then perform Romberg extrapolation on the results.

Or

- (b) Use Gaussian quadrature with $n = 3$ to evaluate $\int_0^1 e^{-x^2} \, dx$.

14. (a) Find the approximate solution to the initial-value problem $y' = y - t^2 + 1$, $0 \leq t \leq 2$, $y(0) = 0.5$ using the Euler's method taking $h = 0.5$ at $t = 1$ and compare these with the exact values given by $y(t) = (t+1)^2 - 0.5e^t$.

Or

- (b) Using Taylors method, first calculate four starting values and then apply Adams-Bashforth predictor corrector method to find $y(0.5)$ given

$$\frac{dy}{dx} = x + y, y(0) = 1, h = 0.1.$$

15. (a) Using finite difference method, solve the boundary value problem

$$\frac{d^2y}{dx^2} - y = x, 0 \leq x \leq 1; y(0) = 0, y(1) = 0 \text{ with } h = 0.25$$

Or

- (b) Determine the steady-state heat distribution in a thin square metal plate with dimensions 0.5 m by 0.5 m using $n = m = 4$. Two adjacent boundaries are held at 0°C , and the heat on the other boundaries increases linearly from 0°C at one corner to 100°C where the sides meet.
-

