K. K. Wagh Institute of Engineering Education & Research, Nashik
(An Autonomous Institute From A.Y. 2022-23)

WINTER-2025	
Exam Seat No.:	
Academic Year:2025-2026	Semester:III
Class:SY	Program:B.Tech
Branch Code:CHE	Pattern:2023
Name of Course:Applied Mathematics and Numerical Methods	Course Code:2300201B
Max. Marks:60	Duration:2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 02 pages.
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. Use of non programable calculator is allowed.

Marks CO

Question No. 1

1a) Solve: $x^2\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 4x^3$ (6) CO2

Question No. 2

2a) Solve the wave equation: $\frac{\partial^2 u}{\partial t^2} = c^2\frac{\partial^2 u}{\partial x^2}$ with condition (i)$u(0,t) = 0, \forall t$ (ii) $u(\pi,t) = 0, \forall t$ (iii) $\frac{\partial u}{\partial t}_{t=0} = 0, \quad \forall x$ (iv) $u(x,0) = a, \quad 0 < x < \pi$ (6) CO5

Question No. 3

3a) Find Laplace transform of: $f(t) = t\sin^2 2t$ (5) CO2

OR

3b) Find inverse Laplace transform of: $\tan^{-1}\left(\frac{s+1}{25}\right)$ (5) CO2

3c) Find Fourier sine transform of $f(x) = \begin{cases} \cos x & 0 \le x \le a \\ 0 & x > a \end{cases}$ (5) CO2

OR

3d) Solve the integral equation: $\int_0^\infty f(x)\cos\lambda x dx = \begin{cases} 2025 - \lambda, & 0 < \lambda \le 2025 \\ 0, & \lambda > 2025 \end{cases}$ (5) CO2

3e) Find the solution of differential equation using Laplace transform method: $y' + y = 3, \quad y(0) = -3$ (6) CO2

OR

3f) Find the solution of differential equation using Laplace transform method: $y' + 4y + 29\int_0^t y(t)dt = \frac{t}{2}, \quad y(0) = -3$ (6) CO2

Question No. 4

4a) Use bisection method to find positive root of $x^3 - 70 = 0$ at the end of sixth iteration. (5) CO5

OR

4b) Evaluate the positive root of $x - e^{-3x} = 0$ using Newton's Raphson method. (5) CO5

4c) Solve the system of equation by Gauss elimination method: (5) CO4

$x - 3y - z = 3; \quad 5x - y - 2z = 4; \quad 2x - y - 3z = 0$

OR

4d) Solve the system of equation by Cholesk's method: (5) CO4

$x - y + z = 2; \quad -x + 26y - z = 48; \quad x - y + 82z = 83$

4e) Solve the system of equation by Jacobi's method: (6) CO4

$x + 38y - 9z = 56 \quad ; \quad 38x - 4y + 2z = -80; \quad 3x + 4y + 38z = 78$

OR

4f) Solve the system of equation by Gauss seidel method: (6) CO4

$5x - 9y - 4z = 5; \quad 3x + 2y + 9z = -5; \quad 9x - 2y - 3z = 29$

Question No. 5

5a) Find directional derivative of $\emptyset = 2xz^4 - x^2y$ at (2,-2,1) in the direction parallel to line $\frac{x-2}{2} = \frac{y+2}{-2} = \frac{z-1}{1}$ (5) CO1

OR

5b) Show that: $\nabla^2 f\left(r\right) = f''\left(r\right) + \frac{2}{r} f'\left(r\right)$ (5) CO1

5c) Show that $\vec{F} = \left(2x - 3yz\right)\vec{i} + \left(2y - 3xz\right)\vec{j} - 3xy\vec{k}$ is irrotational. Find scalar $\emptyset$ such that $\vec{F} = \nabla \emptyset$. (5) CO3

OR

5d) Evaluate $\int_C \vec{F} . d\vec{r}$ for $\vec{F} = x^2\vec{i} - y\vec{j} - yz\vec{k}$ along the curve $x = -t, \quad y = 2t, \quad z = t$ from t=0 to t=1. (5) CO3

5e) A vector field is given by $\vec{F} = y^4\vec{i} + x\left(1 + 4y^3\right)\vec{j}$, Evaluate the integral using Green's theorem $\int_C \vec{F} . d\vec{r}$ where C is the circle $x^2 + y^2 = 7, \quad z = 0$ (6) CO3

OR

5f) Using Stoke's theorem find $\int_S \int \left(\nabla \times \overrightarrow{F}\right) . d\vec{S}$ for $\vec{F} = y\vec{i} + z\vec{j} + x\vec{k}$ and S is the surface of paraboloid $z = 1 - x^2 - y^2, \quad z \geq 0$. (6) CO3

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