



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:CIV	Pattern:2022
Name of Course:Applied Mathematics-III	Course Code:SMH222301
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 3 page(s).
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 programmable scientific calculator is allowed.
6. The last columns indicates the Course Outcome of the Question/sub-question.

Marks CO

Question No. 1

- 1a) Solve the following linear differential equation by the method of variation of parameters. (6) CO2

$$\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = xe^{3x}$$

Question No. 2

- 2a) A string is stretched and fastened to two points l apart. Motion is started by displacing the string in the form $u(x,0) = a \sin \frac{\pi x}{l}$ from which it is released at time $t=0$. Find the displacement $u(x,t)$ at any distance x from one end at any time t using wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$. (6) CO4

Question No. 3

- 3a) Find the directional derivative of $\phi = x^2 - y^2 + 2z^2$ at the point (1,2,3) in the direction of the line PQ where Q is the point (5,0,4). (5) CO2

OR

- 3b) Find the directional derivative of $\phi = e^{2x} \cos(yz)$ at the point (0,0,0) in the direction of the tangent to the curve $x = a \sin t, y = a \cos t, z = at$ at $t = \frac{\pi}{4}$. (5) CO2

- 3c) Prove that $\vec{F} = (2x + yz)\hat{i} + (4y + zx)\hat{j} - (6z - xy)\hat{k}$ is solenoidal as well as irrotational vector field. (5) CO2

OR

- 3d) Show that the vector field $\vec{F} = (2xy + z)\hat{i} + (x^2 + 2yz^3)\hat{j} + (3y^2z^2 + x)\hat{k}$ is irrotational. (5) CO2
Also find the scalar potential ϕ such that $\vec{F} = \nabla\phi$.

- 3e) Evaluate the total work done in moving a particle under the curve $x = 2t^2, y = t, z = 4t^2 - t$ from $t=0$ to $t=1$ under the field of force given by $\vec{F} = 3x\hat{i} + (2xz - y)\hat{j} + z\hat{k}$. (6) CO5

OR

- 3f) Evaluate $\int_C xy dx + xy^2 dy$ by Stoke's theorem where C is a square in XY plane with vertices (0,0), (1,0), (1,1) and (0,1). (6) CO5

Question No. 4

- 4a) A construction company is evaluating the quality of concrete for a new building. Two different mix designs mix X and mix Y are prepared and 28=days compressive strength tests are performed on cubes from each mix. The measured concrete cube strengths (N/mm²)are (5) CO5

Mix X	28.5	30.2	29.8	31.0	30.5	29.7	30.8	29.9	30.1	30.4
Mix Y	25.0	35.0	28.0	32.0	27.5	33.5	26.0	34.0	29.0	31.0

Based on CV, determine which mix demonstrates more consistent quality for structural application.

OR

- 4b) Calculate the first four central moments of the following data. (5) CO5

X	0	1	2	3	4	5	6	7	8
f	1	8	28	56	70	56	28	8	1

Also find the coefficient of skewness and kurtosis. And comment upon the nature of distribution.

- 4c) The deflection (mm) of beams under a standard load is recorded for varying percentages of steel reinforcement. (5) CO4

Steel% (X)	0.8	1.0	1.2	1.4	1.6
Deflection (Y)	12	11	7	5	4

Determine the correlation coefficient between steel percentage and beam deflection.

OR

- 4d) For a certain X and Y series which are correlated, the two lines of regression are $5X - 6Y + 90 = 0$, $15X - 8Y - 130 = 0$. The value of variance X is 9. On the basis of above information, evaluate (5) CO4

- The mean value of X and Y.
- Coefficient of correlation between X and Y.
- Standard deviation of Y.

- 4e) In a survey of 25 construction sites the probability that a site fully complies with safety norms is 0.7. Using Binomial distribution find the probability that (6) CO5

- Exactly 20 sites comply with safety norms.
- At most 2 sites comply with safety norms.
- At least 22 sites comply with safety norms.

OR

- 4f) The time required by a construction worker to lay a concrete slab is normally distributed with a mean of 79 minutes and a standard deviation of 5 minutes. Find (6) CO5

- How many slabs out of 200 are completed between 75 and 82 min.
- how many slabs are completed in less than 89 minutes. [Given $A(z=0.8)=0.2881$, $A(z=0.6)=0.2257$, $A(z=2)=0.4772$].

Question No. 5

- 5a) Using Bisection method, find the root of the equation $e^x = 4\sin x$ till the end of sixth iteration. (5) CO3

OR

- 5b) Find the real root of the equation $x^3 - 4x - 9 = 0$ by applying Newton Raphson method correct to three decimal places. (5) CO3
- 5c) Solve the following system of equation using Gauss elimination method: (5) CO3
 $2x + 2y + 4z = 18; x + 3y + 2z = 13; 3x + y + 3z = 14$

OR

- 5d) Solve the following system of equations using Cholesky method: (5) CO3
 $x + 2y + 3z = 5; 2x + 8y + 22z = 6; 3x + 22y + 82z = -10$
- 5e) Solve the following system of equations using Gauss Seidel method: (6) CO3
 $28x + 4y - z = 32; 2x + 17y + 4z = 35; x + 3y + 10z = 24$

OR

- 5f) Solve the following system of equations using Jacobi's iteration method: (6) CO3
 $10x + y + 2z = 13; 3x + 10y + z = 14; 2x + 3y + 10z = 15$

..... End of question paper.....