



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

SUMMER-2024	
Exam Seat No.:	
Academic Year:2023-2024	Semester:III
Class:SY	Program:B.Tech
Branch Code:CHE	Pattern:2022
Name of Course:Applied Mathematics-III	Course Code:SMH222201
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 _____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. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

Question No. 1 Attempt following Question

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

$$\frac{d^2y}{dx^2} + 4y = \tan 2x$$

Question No. 2 Attempt following Question

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

Question No. 3 Attempt following Question

- 3a) Express the following function as Heaviside's Unit Step function and hence evaluate its Laplace transform (5) CO3

$$f(t) = \begin{cases} \cos t, & 0 < t < \pi \\ \sin t, & t > \pi \end{cases}$$

OR

- 3b) Find the Laplace transform of the following periodic function with period 3 where (5) CO3

$$f(t) = \begin{cases} 1, & 0 < t < 1 \\ 0, & 1 < t < 2 \\ -1, & 2 < t < 3 \end{cases}$$

3c) Show that $L\left\{\frac{1}{2a^3}(\sin at - at \cos at)\right\} = \frac{1}{(s^2 + a^2)^2}$ (5) CO3

OR

3d) Find $L\{t^2 \cos at\}$ (5) CO3

3e) Use convolution theorem to find the inverse Laplace transform of $\frac{1}{s^2(s^2 + 1)}$ (6) CO3

OR

3f) Solve the following differential equation using Laplace transform (6) CO3

$$y'' + 2y' + y = te^{-t}, \quad y(0) = 1, \quad y'(0) = -2$$

Question No. 4 Attempt following Question

4a) Solve the following system of equations using Gauss Seidel method: (5) CO5

$$28x + 4y - z = 32, x + 3y + 10z = 24, 2x + 17y + 4z = 35.$$

OR

4b) Solve the following system of equations using Gauss elimination method (5) CO5

$$4x + y + z = 4, x + 4y - 2z = 4, 3x + 2y - 4z = 6.$$

4c) Use the method of bisection to find a positive real root of the equation $f(x) = x^3 - 2x - 5$ lying in the interval (2,3) at the end of fifth iteration. (5) CO2

OR

4d) Find a real root of the equation $x^3 + 2x - 5 = 0$ lying in the interval (1,2) by applying Newton Raphson method at the end of fifth iteration. (5) CO2

4e) Use bisection method to find the real root of the equation $x^3 - 4x + 1 = 0$ lying in the interval (0,1) at the end of fifth iteration. (6) CO2

OR

4f) Find a real root of the equation $x^3 - 3x + 1 = 0$ lying in the interval (0,1) correct up to four decimal places by using Newton Raphson method. (6) CO2

Question No. 5 Attempt following Question

5a) Evaluate $\iint_S \text{Curl } \vec{f} \cdot \hat{n} ds$ for the surface of the paraboloid $z = 9 - (x^2 + y^2)$ where $\vec{f} = (x^2 + y - 4)\vec{i} + 3xy\vec{j} + (2xz + z^2)\vec{k}$ above XOY plane. (5) CO5

OR

5b) Find the work done in moving a particle once round the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1, z = 0$ under the field of force given by $\vec{f} = (2x - y + z)\vec{i} + (x + y - z)\vec{j} + (3x - 2y + 4z)\vec{k}$. (5) CO5

5c) Find the directional derivative of $\phi = xy^2 + yz^3$ at the point $P(1, -1, 1)$ in the direction of $\vec{i} + 2\vec{j} + 2\vec{k}$. (5) CO2

OR

5d) Find the directional derivative of the function $\vec{f} = 4e^{2x-y+z}$ at the point $P(1, 1, -1)$ in the direction (5) CO2 towards the point $Q(-3, 5, 6)$.

5e) Show that the vector field $\vec{f} = (x^2 - yz)\vec{i} + (y^2 - xz)\vec{j} + (z^2 - xy)\vec{k}$ is irrotational. Find the corresponding scalar ϕ such that $\vec{f} = \nabla\phi$ (6) CO2

OR

5f) Prove that $\vec{A} = (6xy + z^3)\vec{i} + (3x^2 - z)\vec{j} + (3xz^2 - y)\vec{k}$ is irrotational. Find the corresponding scalar f such that $\vec{A} = \nabla f$. (6) CO2

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