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:II
Class:FY	Program:B.Tech
Branch Code:FYE	Pattern:2023
Name of Course:Differential Equations and Integral Calculus	Course Code:2300102A
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. Use of non-programmable pocket calculator is allowed.
5. Draw the neat labelled diagrams, wherever necessary.
6. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

Marks CO

Question No. 1

1 Solve the differential equation $\cos x \ \frac{dy}{dx} + y\sin x \ = \sqrt{ysecx}$ (6) CO2

Question No. 2

2 A long hollow pipe has an inner diameter of 10 cm and an outer diameter of 20cm. The inner surface is kept at 200^0C and the outer surface at 50^0C. The thermal conductivity is 0.12. Find the temperature at a distance x=7.5 from the centre of the pipe under the steady state conditions. (6) CO5

Question No. 3

3.a) The following table gives the interpolation of a town during the last five censuses. Estimate the population for the year 1948, using Newton's Backward interpolation formula (5) CO3

Year	1911	1921	1931	1941	1951
Population (in thousands)	12	15	20	27	39

OR

3.b) The table gives the distances in nautical miles of the visible horizon for the given heights in feet above the Earth's surface: (5) CO3

x (height)	100	150	200	250	300
y(distance)	10.63	13.03	15.04	16.81	18.420

Find the values of y when x=140 ft by Newton's Forward interpolation formula.

3.c) i) Find (E+2)(E-1)($e^x + x$), h=1. (5) CO1

ii) Find Ef(x), if f(x)=x^3, h=1.

OR

3.d) i) Find $\Delta^n e^x$, h=1 (5) CO1

ii) Prove that $\delta E^{\frac{1}{2}} = \Delta$

3.e) Estimate Lagrange's polynomial passing through the set of points (0,1), (1,3) and (2,5). Hence, find $\frac{dy}{dx}$ at x=2 (6) CO3

OR

3.f) Apply Stirling's formula to find f (0.41) if f (0.30) =0.1179, f (0.35) =0.1368, f (0.40) =0.1554, f (0.45) =0.1736, f (0.50) =0.1915. (6) CO3

Question No. 4

4.a) Use Euler's method to solve the equation $\frac{dy}{dx} = \frac{y - x}{y + x}$, subject to the condition y (0) =1, with step size 0.02 and find y at x=0.1. Give the answer correct up to 4 decimal places. (5) CO3

OR

4.b) Using Modified Euler's method to solve the equation $\frac{dy}{dx} = -xy^2$, subject to the condition y (0)= 2, with step size 0.1, and find y at x=0.1. Give the answer correct up to 4 decimal places. (5) CO3

4.c) Using the fourth-order Runge-Kutta method to solve the equation $\frac{dy}{dx} = \frac{1}{x + y}$, subject to the condition y(0) =1 and find y (0.2), taking h=0.2. Give the answer correct up to 4 decimal places. (6) CO3

OR

4.d) Numerical solution of the differential equation $\frac{dy}{dx} = 1 + y^2$ is tabulated as (6) CO3

x	0	0.2	0.4	0.6
y	0	0.2027	0.4228	0.6841

Find y at x= 0.8 by Milne's predictor-corrector method.

4.e) In a drug study, the concentration of a medicine in the bloodstream is recorded every hour for 9 hours (5) CO3

Time(hr.)	0	1	2	3	4	5	6	7	8	9
Concentration (mg/L)	0	1.5	3.2	4.1	4.0	3.2	2.1	1.2	0.6	0.2

Estimate the total drug exposure using the trapezoidal rule.

OR

4.f) The rate of water flow F (litres/min) from a tank is recorded every 1 minute as follows: (5) CO3

Time (min)	0	1	2	3	4	5	6	7	8	9	10
Flow (L/min)	0	6	14	20	25	30	26	18	10	4	0

Estimate the total volume of water drained in 10 minutes using Simpson's $\frac{1}{3}$ rule

Question No. 5

5.a) Evaluate $\iint e^{2x + 3y} dxdy$ over the triangle bounded by x=0, y=0, x=y=1. (6) CO2

OR

5.b) Evaluate $\int_0^1 \int_{e^x}^{e} \frac{1}{\log y}$ d y dx (6) CO2

5.c) Determine the area bounded by the parabola $y^2 = 4x$ and the line y = x-8. (5) CO5

OR

5.d) Determine the center of gravity of the area bounded by the curve y=x, y=-x, x=1. (5) CO5

5.e) Evaluate $\int \int \int \frac{dx\ dy\ dz}{x^2+y^2+z^2}$ over the volume of the positive octant $x^2 + y^2 + z^2 = 1$ (5) CO3

OR

5.f) Calculate the volume enclosed between the cone z=$\sqrt{x^2 + y^2}$ and the paraboloid z=$x^2 + y^2$ (5) CO3

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