

Module 2: Assignments

Course Code: 25MT105

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Course: Calculus and Ordinary Differential Equations

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Assignment 1

1. Compute $\iiint_E (x + y + z) dV$ where E is the box $[0, 1] \times [0, 2] \times [0, 3]$.
 2. Evaluate the double integral $\int_0^2 \int_0^3 (x^2 + y) dy dx$.
 3. Find $\iint_D e^{x+y} dA$ where D is the region bounded by $y = 0$, $y = x$, and $x = 1$.
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Assignment 2

1. Solve $\frac{dy}{dx} = \frac{x - 2y}{x}$. Verify it is homogeneous, and determine the solution in terms of x and y .
 2. Solve $(x^2 + y^2) dx - xy dy = 0$. Confirm homogeneity. Identify the family of curves represented by the solution.
 3. Solve $\frac{dy}{dx} = \frac{y^2 - x^2}{2xy}$ with initial condition $y(1) = 2$. Verify that the particular solution satisfies the ODE.
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Assignment 3

1. Solve $\frac{dy}{dx} = y(2y + 1)$.
 2. Solve $\frac{dy}{dx} - \frac{y}{x} = x^2$.
 3. Solve $\frac{dx}{dy} + \frac{x}{5y} = 2y^2$.
 4. A metal rod is heated to 100°C . It is placed in a room where the temperature is 15°C . After 5 minutes, the rod cools to 60°C .
 1. Find the cooling constant k .
 2. What is the temperature after 30 minutes?
 3. When will the temperature reach 4°C ?
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Assignment 4

1. Evaluate the triple integral:

$$\int_0^1 \int_0^{1-x} \int_0^{1-x-y} (x + 2y + 3z) dz dy dx.$$

2. Find the general solution of:

$$y'' + y = \sin x.$$

Note that $\sin x$ is part of the complementary function. Show the modification required for the particular integral.

3. Explain the significance of the auxiliary equation in determining the nature of the general solution to a second-order linear homogeneous ODE. How do the discriminant values relate to oscillatory vs. non-oscillatory behavior?
 4. Consider the equation $y'' + by' + cy = 0$ with characteristic roots $r_1 = -1 + 3i$ and $r_2 = -1 - 3i$. Without solving fully, analyze the long-term behavior of $y(t)$ and determine whether the solution is oscillatory, decaying, or growing. Justify your answer in terms of the real and imaginary parts of the roots.
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Assignment 5

1. Solve the initial value problem:

$$y'' - 6y' + 9y = 0, \quad y(0) = 2, \quad y'(0) = 7.$$

2. Solve:

$$y'' + 6y' + 8y = 4e^{-2x}.$$

Identify whether the particular integral requires modification and find the complete solution.

3. Evaluate the solution of $y'' + 4y = e^{-2x} + \sin(2x) + \cos(x)$. Explain the physical phenomenon represented by the growth of this solution over time and identify the condition under which this occurs.
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