Assignment 1: Ordinary Differential Equations (ODE A2023)

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Instructions

Please solve the following differential equations. Show all steps clearly and provide explanations where necessary. Submit your solutions by June 4, 2024. This assignment counts towards your final marks in the ODE course.

Question 1: Verification of Solutions (4 marks)

Verify that the indicated function is a solution of the given differential equation.

1. $y'' - 4y' + 4y = 0; \quad y = 2xe^{2x}$ [2 Marks]
2. $u''(t) + 2u'(t) + 2u(t) = 0; \quad u(t) = e^{-t}\sin t$ [2 Marks]

Question 2: General Solutions (12 marks)

Solve the given differential equations for their general solutions using appropriate methods. Clearly indicate the method used. If the question is not solvable using the methods that we learned, please indicate as well.

1. $\frac{d^2x}{dt^2} - 9x = 0$ [3 Marks]
2. $\dot{x} - 4x = 12$ [3 Marks]
3. $y\frac{dy}{dx} = \cos(4x)$ [3 Marks]
4. $(2 + x)\frac{dy}{dx} - y = 0$ [3 Marks]

Question 3: Initial Value Problems (14 marks)

Find the particular solution of the following differential equations that satisfy the given initial conditions.

1. $y' + 3y = 6, \quad y(0) = 2$ [4 Marks]
2. $\frac{dx}{dt} + 2tx = t, \quad x(1) = 0$ [5 Marks]
3. $y' - 2xy = x^2, \quad y(0) = 1$ [5 Marks]

Question 5: Exact Differential Equations (10 marks)

Test each of the following equations for exactness, and then solve the equation.

1. (5 marks) $(2x + y)dx + (x + 3y)dy = 0$ [5 Marks]
2. (5 marks) $(y + \sin x)dx + (x + \cos y)dy = 0$ [5 Marks]

Submission Guidelines

- Clearly write your name and student ID on the first page of your submission.
- Submit your assignment in PDF format via the course portal by June 4, 2024.

Good luck!