

ODE - Test 2

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Each problem carries 3 marks. Problem 1 is compulsory.
Solve any one of the remaining two.

1. **(Compulsory)** Show that it is impossible to construct a homogeneous linear differential equation of the form $y'' + P(x)y' + Q(x)y = 0$ with continuous coefficients $P(x)$ and $Q(x)$ on the interval $[2\pi/3, 5\pi/3]$ such that $y_1 = \sin x$ and $y_2 = x \sin x$ are both solutions.
2. Is it possible that the differential equation

$$y'' + 2y' + y = e^{-x}x^2$$

has a thrice differentiable solution $y = f(x)$ such that $f(0) = f'(0) = f''(0) = f'''(0)$?

3. Find the general solution of the differential equation:

$$(x^2 - 1)y'' - 2xy' + 2y = (x^2 - 1)^2.$$