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Assignment #5 Mathematics - I (MTH 110)

1. Solve the differential equation $x\,dx + y\,dy = \frac{a^2(x\,dy - y\,dx)}{x^2+y^2}$.

2. Solve the differential equation $sinx\,\frac{dy}{dx} + 3y = cosx$.

3. Solve the differential equation $(x^2 + y^2 + 2x)\,dx + 2y\,dy = 0$.

4. The initial value problem governing the current i, flowing in a series RL circuit when a sinusoidal voltage $v(t) = sin\omega t$ is applied, is given by (R, ω and L are constants)

$$iR + L\frac{di}{dt} = sin\omega t, \qquad t \geq 0, \quad i(0) = 0$$

   Find the current i(t), $t \geq 0$

5. Find the curve y = f(x) through the origin for which $y'' = y'$ and the tangent at the origin is y=x.

6. Reduce the differential equation $y'' + e^{2y}\,y'^3 = 0$ to a lower order equation and hence find the solution of the differential equation.

7. The growth rate of a bacteria population is proportional to its size. Initially, the population is 10,000, while after 10 days its size is 25,000. What will be the population after 20 days?

8. Solve the differential equation:

$$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 3x^2\,e^{2x}\,sin2x$$

9. Identify the type of the following differential equation and find its solution

$$x^2\,\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} + y = \frac{1}{(1-x)^2}$$

10. Apply the method of variation of parameters to solve $\frac{d^2y}{dx^2} + n^2y = sec\,nx$