DECA Cumulative I

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Derivations

1. Find the general solution for the equation

$$\frac{dy}{dt} = ay + b$$

State initial value solution for $y(0) = y_0$

2. Find the general solution for the equation

$$ay'' + by' + cy = 0$$

3. Find the general solution for the equation

$$ay'' + by' + cy = 0$$

when the roots are complex of the form $\lambda + \mu i$

4. Find a series solution of the equation

$$y(x)'' + y(x) = 0, \qquad -\infty < x < \infty$$

Follow the steps to receive partial credit

1. Find y'', y', y for the power series of the form $\sum_{n=0}^{\infty} a_n x^n$
2. Express the sum of the two power series as one
3. Solve a recursive expression
4. Find a separate power series for even and odd
5. Combine the two for the final answer
6. Express sin and cos as an initial value condition for the final answer

5. State the Laplace Transform of the first and second derivative in terms of the original function

Questions

6. Solve the initial value problem

$$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{3x^2 + 4x + 2}{2(y-1)}, \qquad y(0) = -1$$

7. Find the solution of the initial value problem

$$4y'' - 8y' + 3y = 0, \qquad y(0) = 2, \qquad y'(0) = 1/2$$

8. Find a particular solution of

$$y'' - 3y' - 4y = 2\sin t$$

9. Find the general solution for

$$y'' + 4y' + 4y = 0$$

show all steps

10. Find the particular solution for

$$y'' + y' - \frac{1}{4} = 0$$

11. Find the general solution for

$$y'' + y' + y = 0$$

12. Find the general solution of

$$y^{iv} - y = 0$$

Also find the solution that satisfies the initial conditions

$$y(0) = 7/2 \quad y'(0) = -4 \quad y''(0) = 5/2 \quad y'''(0) = -2$$

you can use a calculator to put it in reduced row-echelon form

13. Find $\mathcal{L}\{\sin at\}$

14. Use the property of derivative transforms to find $\mathcal{L}\{\cos at\}$

15. Find the solution of the differential equation using the Laplace Transform

$$y'' - y' - 2y = 0$$

satisfying the initial condition

$$y(0) = 1, \qquad y'(0) = 0$$

16. Use Newton's Laws and Hooke's Law to show

1. position of an oscillating spring is given by

$$x(t) = A\cos(\omega t)$$

2. period is given by

$$T = 2\pi\sqrt{\frac{m}{k}}$$