NAME **MATH 227 DIFFERENTIAL EQUATIONS** **Final Exam**
Part I

6 Problems- 16 2/3 points each **Show all work for full credit!**

1 An airplane takes off on a runway that is 3 kilometers long. The plane starts off with an initial velocity of 15 meters/sec and moves with constant acceleration for 50 seconds and then lifts off at the end of the runway. How fast was the plane traveling (in meters/sec) on lift off? Model and solve using differential equations. Show all differential equations and all work.

2 Solve using the method of undetermined coefficients:

$$y'' - 3y' - y = e^{4x}\cos 2x$$

3 Use the Laplace transform and partial fractions (show all steps) to solve the differential equation with initial conditions:

$$y'' + 2y' + 10y = 10 \qquad y(0) = 0, y'(0) = 1$$

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4 Use the Frobenius method to solve: $xy''-2y'+y=0$. Find index *r* and recurrence relation. Compute the first 5 terms $(a_0 - a_4)$ using the recurrence relation for each solution and index *r*.

$$X'(t)=\begin{bmatrix} -7 & 0 & 0 & 0 \\ 8 & -3 & 4 & 0 \\ 1 & 0 & -5 & 0 \\ 2 & 1 & 4 & -1 \end{bmatrix} X(t)$$

5. Find the eigenvalues and eigenvectors for the above system of equations.

6. Apply the Runge-Kutta method to approximate the solution on the interval [0,1] with step size h=0.25 Construct a table showing five-decimal-place values of the approximate solution for y'=sinh(x)+1, y(0)=1.