Mathematics 352
Exam 3

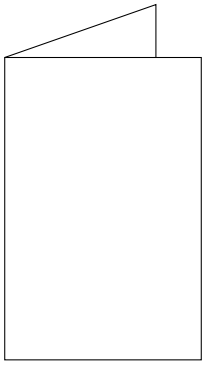
April 29, 2013; 60 minutes Name: _____

This exam is closed book; you can use a calculator (*not* a mobile phone) but no other electronic aids or printed references. *If the wording or intent of any question is unclear, please ask me to clarify.* I am not trying to confuse you with the problem statements.

You can use your own paper or the provided blank copy paper. DO NOT WRITE ANYTHING YOU WANT GRADED ON THE EXAM PAPER. Please write your name on each page you hand in. Show all your reasoning and all pertinent calculations. *Give all answers in exact form. Decimal approximations of any accuracy will not receive full credit.*

When you have finished the exam, place this cover sheet on top of it and fold the packet in half *the long way, with your name facing out.*

YOU ARE STRONGLY ENCOURAGED TO READ ALL THE PROBLEMS BEFORE BEGINNING.



Question	Points	Score
1	0	
2	0	
3	0	
4	0	
Total:	0	

Good luck!

NO WORK ON THIS PAGE
ALL WORK ON SEPARATE PAGES

1. Consider a mass-spring system. Suppose it is perturbed and released in such a way that the displacement function for the mass is the solution of the initial value problem

$$2u'' + 0.6u' + 0.45u = 0, \quad u(0) = 3, \quad u'(0) = 0.$$

Solve the initial value problem to find $u(t)$.

2. *In this problem, assume that the acceleration g due to gravity is exactly* $10\,\text{m/s}^2$.

   (a) Consider a spring-mass system with a mass of 6 kg that stretches the spring a length of $5/3$ m when first attached. Suppose this system operates in a viscous medium that provides 60 N of resistive force to a mass moving at 2 m/s.

   Find the position function for the motion that results if the mass is moved 2 m below its equilibrium position and then released. Show all work. Classify the motion as overdamped, underdamped, or critically damped.

   (b) How should the damping constant γ be changed to obtain a critically damped system, if the mass and spring constant are left unchanged? (Give an explicit value for γ.)

3. Use whatever method you like to find the general solution to the equation

$$y'' - 10y' + 25y = e^{5t}.$$

4. Find the general solution of the equation

$$ty'' - (t+1)y' + y = t^2$$

given that $y_1 = e^t$ and $y_2 = t + 1$ are solutions of the associated homogeneous equation. *Hint.* Use the method of variation of parameters.