Name_____ ID_____ Sec_____

MATH 308 Exam 2 Summer 2003

Section 301-302 Version B P. Yasskin

1	/20	5	/10
2	/30	6	/10
3	/10	7	/10
4	/10		

1. (20 points) Consider the homogenous differential equation $\frac{d^2x}{dt^2} + 7\frac{dx}{dt} + 10x = 0$

a. (10) Find the general solution.

b. (8) Find the specific solution satisfying the initial conditions $x(0) = 3, \quad x'(0) = 0.$

c. (2) If you regard this equation as describing a free, damped harmonic oscillator, it is

Circle one: i) underdamped ii) critically damped iii) overdamped

2. (30 points) Consider the inhomogenous differential equation $\frac{d^2x}{dt^2} + 7\frac{dx}{dt} + 10x = 442\cos(3t)$

HINT: The related homogenous differential equation was analyzed in problem 1.

a. (10) Find a particular solution.

b. (5) Find the general solution. (Use your result from 1a.)

c. (10) Find the specific solution satisfying the initial conditions $x(0) = 1, \quad x'(0) = 0.$

d. (5) What is the phase shift? What is the gain?
HINT: Write the steady state solution as $A\cos(3t - \varphi)$

3. (10 points) Consider the inhomogenous differential equation $\frac{d^2x}{dt^2} + 7\frac{dx}{dt} + 10x = 6e^{-2t}$

Find a particular solution.

HINT: The related homogenous differential equation was analyzed in problem 1.

4. (10 points) Consider the homogenous differential equation $\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 25x = 0$

a. (8) Find the general solution.

b. (2) If you regard this equation as describing a free, damped harmonic oscillator, it is

Circle one: i) underdamped ii) critically damped iii) overdamped

5. (10 points) Consider the homogenous differential equation $\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 9x = 0$

a. (8) Find the general solution.

b. (2) If you regard this equation as describing a free, damped harmonic oscillator, it is

Circle one: i) underdamped ii) critically damped iii) overdamped

6. (10 points) Consider the inhomogenous differential equation $\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 9x = 27t^2 - 18$

Find a particular solution.

HINT: The related homogenous differential equation was analyzed in problem 5.

7. (10 points) A 3 kg mass is attached to a spring with spring constant of 6 N/m and feels air resistance proportional to the velocity with drag coefficient of 0.4 N-sec/m. The mass also has an electric charge and there is an electric field which applies an external force of $F_e = 5\cos(2t)$. If you hold the mass at .8 m from its rest position and let go at $t = 0$, write the differential equation and initial conditions which determine the motion of the mass.

Scratch or Continuation: