

**Exam #3 objectives**

For Exam #3, a well-prepared student should be able to

- use the trace and determinant of a  $2 \times 2$  matrix to determine the qualitative nature of the corresponding linear system of differential equations
- determine how the qualitative nature of a  $2 \times 2$  linear system depends on one or more parameters
- find the general solution for a  $3 \times 3$  linear system of differential equations
- broadly describe the qualitative nature of the phase space for a  $3 \times 3$  linear system of differential equations
- describe the structure of the general solution to a second-order linear differential equation
- use a direct approach to find the general solution for a homogeneous linear second-order differential equation
- relate the direct approach and the system approach to a homogeneous linear second-order differential equation
- use judicious guessing (aka the method of undetermining coefficients) to find a particular solution to a suitable nonhomogeneous linear second-order differential equation
- understand the “complexification” approach to working with sinusoidal nonhomogeneous terms
- find the general solution for a nonhomogeneous linear second-order differential equation
- use a general solution for a nonhomogeneous linear second-order differential equation to find the specific solution for given initial conditions
- classify a given damped spring system as underdamped, critically damped, or overdamped
- analyze a model for a spring system with external forcing
- determine and describe the beat structure of a solution for an undamped spring model with sinusoidal forcing