ESE 406/505 & MEAM 513 – 2013-Jan-23 – Quiz – Name:_____

- Choose only one answer (A through D) for each question by circling the letter.
- A correct answer is worth 2 points.
- No answer is worth 0 points.
- An incorrect answer is worth -1 point. Random guessing will lower your grade on average.

1. Which of the following is MOST CORRECT about the equation we derived in class (shown at right) governing the behavior of a mass-spring-damper system?

$$m\frac{d^2y}{dt^2} + c\frac{dy}{dt} + ky = ku$$

   A. The equation is a non-linear equation.
   B. The term involving "c" represents the effect of the damper.
   C. The term involving "u" represents gravity.
   D. All of the above.

2. Which of the following is MOST CORRECT about the equation we derived in class (shown at right) governing the behavior of a robot arm actuated by a DC motor?

$$\left(I_P + J\right)\frac{d\Omega}{dt} = Ki - mgl\sin\theta$$

   A. "K" is the motor torque constant.
   B. "g" is the acceleration due to gravity.
   C. the equation is nonlinear.
   D. All of the above.

3. Which of the following is MOST CORRECT finding the "trim" condition of a system?
   A. Finding trim requires us to solve a system of coupled ODEs.
   B. Finding trim requires us to solve a Fredholm Equation of the 2nd Kind.
   C. Finding trim requires us to solve "n" generally nonlinear algebraic equations.
   D. None of the above.

4. Which of the following is a trim (or equilibrium) condition for the system $\frac{dx}{dt} = -\sqrt{x} + \cos u$ with $u_o = 0$?
   A. $x_o = 0$
   B. $x_o = 1$
   C. $x_o = \frac{\pi}{2}$
   D. $x_o = \pi$

5. Which of the following statements is NOT correct concerning the linearization $\Delta\dot{\underline{x}} \approx A\Delta\underline{x} + B\Delta u$ of the non-linear system $\dot{\underline{x}} = \underline{f}\left(\underline{x}, u\right)$:
   A. A is a row (1-by-n) vector.
   B. B is a column (n-by-1) vector (because we are considering only one control input).
   C. A and B depend on the trim (equilibrium) condition.
   D. $\Delta\underline{x}$ and Δu are small perturbations, measured relative to the trim condition.