# MA 2051 B2013 — Quiz 2

**Name:** Solutions

**Section (circle):** 9 a.m. (Nathan) 10 a.m. (Ruofan) 11 a.m. (Alex) noon (Tuan) noon (Hector) 3 p.m. (Jesus)

**Instructions:** Work neatly. Show your work. Do your work on this paper. Use the back if needed. **Justify your answers.**

5.1.6/1(a)

1. (4 pts) When a mass of 3 kg is suspended from a spring, the end of the spring moves 0.24 m. Suppose a mass of **2** kg is suspended vertically from that spring and that the **2**-kg mass is set in motion by pulling it down 4 cm and releasing it from rest. Write an initial-value problem whose solution will describe the position of the mass at any time $t$.

$3\text{ kg} \oplus z = 0.24\text{ m} \Rightarrow$ spring const. $k = \frac{3\cdot 9.8}{0.24} = \frac{9.8}{0.08}$ N/m

$mx'' + kx = 0,\ x(0) = x_i,\ v(0) = v_i \Rightarrow \boxed{2x'' + \left(\frac{9.8}{0.08}\right)x = 0,\quad x(0) = 0.04\text{ m},\ x'(0) = 0\text{ m/s}}$

similar to 6.1.5/14

2. (3 pts) Identify a particular physical situation of which the initial-value problem $y''(t) + 2y'(t) + 5y(t) = 0$, $y(0) = 0$, $y'(0) = 0.04$, might be a model. Be sure to specify units.

$mx'' + px' + kx = 0,\ x(0) = x_i,\ x'(0) = v_i \Rightarrow$ mass of 1 kg on spring w/const. $k = 5$ N/m, damping coeff. of $p = 5$ N/m/s. Mass started from equilibrium $(x=0)$ w/ vel. up of 0.04 m/s

5.1.6/4(b)

3. (3 pts) Show that $C_1 \sin\sqrt{k/m}t + C_2 \cos\sqrt{k/m}t$ is a solution of $mx'' + kx = 0$ for any constants $C_1, C_2$. (**Hint:** *show* means *check*.) Use the back of this page if necessary.

$x = C_1 \sin\sqrt{k/m}\,t + C_2 \cos\sqrt{\ }\,t$

$\Rightarrow x' = \sqrt{\frac{k}{m}}\left(C_1 \cos\sqrt{\ }\,t - C_2 \sin\sqrt{\ }\,t\right)$

$x'' = \frac{k}{m}\left(-C_1 \sin\sqrt{\ }\,t - C_2 \cos\sqrt{\ }\,t\right)$

$mx'' + kx = \cancel{m}\frac{k}{\cancel{m}}\left(-C_1 \sin\sqrt{\ }\,t - C_2 \cos\sqrt{\ }\,t\right)$

$+\ k\left(C_1 \sin\sqrt{\ }\,t + C_2 \cos\sqrt{\ }\,t\right)$

$= kC_1\cdot 0 + kC_2\cdot 0 = 0$ ✓