

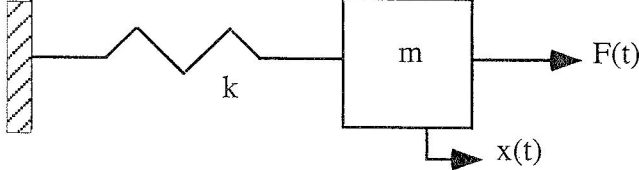
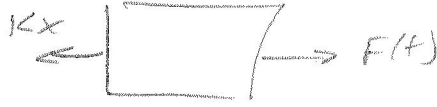
Prerequisites Survey/Test
ME 460/660: Mechanical Vibrations
Instructor - Dr. Joseph C. Slater

Students Name: Solutia Score: _____ points out of 10 points

The purpose of this survey/test is to assess how prepared you are for this course and to see how well the prerequisite courses are covering the material required for this course. Please fill out the general information on each course, check the appropriate box that best describes the level of understanding that you feel you have for the topic, and then work out the test question. This test will constitute 5% of your grade for this quarter. Note that no test points are given or deducted for how you respond to the student assessment portion of the form.

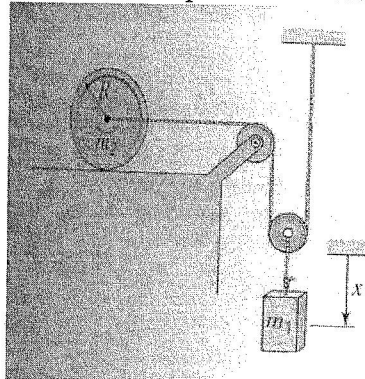
Simple Laplace Transform Table:

$F(s)$	$F(t)$
$sX(s) - x(0)$	$\dot{x}(t)$
$s^2X(s) - sx(0) - v(0)$	$\ddot{x}(t)$
$\frac{a}{s^2+a^2}$	$\sin(at)$
$\frac{s}{s^2+a^2}$	$\cos(at)$
$\frac{1}{s}$	$\delta(t)$
$\frac{1}{s}$	$u(t)$
$\frac{1}{s^2}$	t
$\frac{1}{s-a}$	e^{at}
$\frac{1}{s^n}$	$\frac{t^{n-1}}{(n-1)!}$

General Information on Prerequisite Course				
Course	Where Taken	Term/Year	Instructor	Grade (4.0 scale)
ME 213: Dynamics				
Student Assessment of Their Knowledge of Prerequisite Topic for Course Listed Above				
Topic	ABET Topic Letters	Check box below applicable response		
		Can Explain or Apply Concept	Heard of Topic	Never Heard of Topic
Free Body Diagrams	A			
Test Question Assessment of Student's Prerequisite Knowledge				
<p>Question: Derive the equation of motion of the following system:</p>  <p>Answer:</p>  $\sum F = m\ddot{x}$ $m\ddot{x} + Kx = F(t)$				
Grade: _____ out of 2 points				

General Information on Prerequisite Course				
Course	Where Taken	Term/Year	Instructor	Grade (4.0 scale)
ME 213: Dynamics				
Student Assessment of Their Knowledge of Prerequisite Topic for Course Listed Above				
Topic	ABET Topic Letters	Check box below applicable response		
		Can Explain or Apply Concept	Heard of Topic	Never Heard of Topic
Kinematics and Kinetics	A			
Test Question Assessment of Student's Prerequisite Knowledge				

Question: Derive the equation of motion of the following system:



$$y = 2x$$

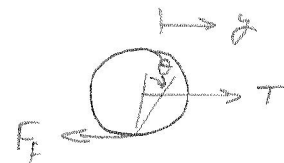
$$y = \theta R, \text{ (Rolling without slipping)}$$

Answer:



$$\Sigma F = m_1 \ddot{x}$$

$$m_1 g - 2T = m_1 \ddot{x} \quad (1)$$



$$\Sigma F = m_2 \ddot{y} = T - F_f \quad (2)$$

$$\Sigma M = J \ddot{\theta} = F_f R \quad (3)$$

$$F_f = \frac{J}{R} \ddot{\theta} \quad (4)$$

$$\text{Sub (4) into (2)}$$

$$m_2 \ddot{y} = T - \frac{J}{R} \ddot{\theta}$$

$$\left(m_2 + \frac{J}{R^2}\right) \ddot{y} = T \quad (5)$$

sub (5) into (1)

$$m_1 g = m_1 \ddot{x} + 2 \left(m_2 + \frac{J}{R^2}\right) \ddot{y}$$

$$m_1 g = \left(m_1 + m_2 + \frac{J}{R^2}\right) \ddot{x}$$

Either

We know there is rolling without slipping because the problem statement asked for a single equation

OR

$y = \theta R$, and we substitute (3) into (1) for the first eqn, and (5) is the second equation. $F_f = \mu_k m_2 g$

Grade: _____ out of 4 points

General Information on Prerequisite Course				
Course	Where Taken	Term/Year	Instructor	Grade (4.0 scale)
EE 321: Linear Systems I				
Student Assessment of Their Knowledge of Prerequisite Topic for Course Listed Above				
Topic	ABET Topic Letters	Check box below applicable response		
		Can Explain or Apply Concept	Heard of Topic	Never Heard of Topic
Laplace transform of differential equation	A			
Test Question Assessment of Student's Prerequisite Knowledge				
<p>Question: Find the <i>Laplace domain</i> solution of $x(t)$, $X(s)$, given the governing equation $\ddot{x} + 0.1\dot{x} + 4x = \sin(3t)$ and $\mathcal{L}(\sin(at)) = \frac{a}{s^2 + a^2}$.</p> <p>Answer:</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> $X(s) = \frac{a}{s^2 + a^2} \cdot \frac{1}{s^2 + .1s + 4}$ </div>				
Grade: _____ out of 2 points				

General Information on Prerequisite Course				
Course	Where Taken	Term/Year	Instructor	Grade (4.0 scale)
EE 321: Linear Systems I				
Student Assessment of Their Knowledge of Prerequisite Topic for Course Listed Above				
Topic	ABET Topic Letters	Check box below applicable response		
		Can Explain or Apply Concept	Heard of Topic	Never Heard of Topic
Fourier series	A			
Test Question Assessment of Student's Prerequisite Knowledge				
<p>Question: Find the first three term of the Fourier series of the repeating function for which $x(t) = 0$ from $t = 0$ to $t = 1$, and $x(t) = -1$ from $t = 1$ to $t = 2$, repeating every 2 seconds.</p> <p>Hint: $F(t) = \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos(n\omega_T t) + b_n \sin(n\omega_T t))$ where $\omega_T = 2\pi/T$, and T is the period of the function $a_0 = \frac{2}{T} \int_0^T F(t) dt$, $a_n = \frac{2}{T} \int_0^T F(t) \cos(n\omega_T t) dt$, and $a_0 = -1$ $b_n = \frac{2}{T} \int_0^T F(t) \sin(n\omega_T t) dt$</p> <p>Answer: You're welcome to do the math, but $a_n = 0$, $n = 1, \dots, \infty$ $b_n = \int_1^2 \sin \frac{2\pi n t}{T} dt$ $= \int_0^1 \sin \pi n t dt = \frac{1}{\pi n} \cos \pi n t \Big _0^1$ $= \frac{1}{\pi n} (-1 + (-1)^n) = \begin{cases} \frac{2}{\pi n} & n \text{ odd} \\ 0 & n \text{ even} \end{cases}$ $F(t) \approx \frac{2}{\pi} \sin \pi t + \frac{2}{3\pi} \sin 3\pi t + \frac{2}{5\pi} \sin 5\pi t + \dots$</p>				
Grade: _____ out of 2 points				