Course: Linear and Quadratic Spirals - Mass-Damper Systems

Course (HW+4), Sections 1-5

50 minutes or less

Bring pen/pencil, paper

Closed book, closed notes

Wed Feb 9

Exam I

University of Idaho
5) If functions > evaluations, generate kernel contributions.

Step 4: Identify unknowns. If unknowns = equations, then

3) Write Newton's Law for each OF

(c) Examine forces

Direction for each candidate
(b) Candidate system, especially individual particles
(a) Body

2) Use body diagram for each OF (usually a mass)

1) Sketch in different conditions

Procedure

Fundamental Systems

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Example

Newton's Laws

\[ F = \frac{d}{dt} (x(t) - x_0) \]

\[ \frac{d}{dt} (x(t) - x_0) = m \cdot \frac{d^2 x}{dt^2} \]

Coordinate of body center of mass

\[ \sum \mathbf{F} = m \cdot \frac{d^2 \mathbf{x}}{dt^2} \]

F10 specified, \( m_1, m_2 \), \( k, c \) known

Positive direction for \( x, x_2 \) both to the right
Zero Mass at "Pof"

\[-k(x-y) - c(x-y) = mx\]

In this example, the system is modeled as a spring and damper. The position \( y(t) \) is specified as the position at the end of the spring and damper.
System Hanging in a Gravitational Field

Equations:

\[ -k_1(x_i-x_0) - k_2(x_i-x_0) = m_i \ddot{x}_i \]

\[ F(\ddot{x}_i) - k_1(\ddot{x}_i-x_0) - k_2(\ddot{x}_i-x_0) = m_i \ddot{x}_i \]

\[ \ddot{x}_i = 0 \]

\[ \dot{x}_i = 0 \]

\[ x_i = x_0 \]

Unknowns: \( x_1, x_2, x_0 \)

Newton's Laws

F(t) - k1(x_i-x_0) - k2(x_i-x_0) = m_i \ddot{x}_i
Applied angular displacement at input

\[ \phi(t) = (0-t) \cdot k_1 \]

\[ -k_3(\theta_2 - \theta) - k_2(\theta - \phi) = I_i \cdot \theta \]

Applied torque as input

\[ T_i = I_i \cdot \theta \]

The system is described by:

\[ T_i = k_3 \cdot \theta_2 - k_2 \cdot \theta + k_1 \cdot \phi(t) \]

The specified applied torque

\[ k_4, I_i \text{ are considered known} \]

Unsure
Let $\theta_1 = \theta_2$ [unknown: $\theta_1$, $\theta_2$, $\theta_3$, $F$]

Let $-k\mu (\theta_3 - \theta_2) - q(\theta_3 - 0) = 5\theta_3$

$-F_1 - k(\theta_2 - \theta_2) = 10\theta_2 = 0$

$TH + FN = 1\theta_1$

$n = \frac{m}{I}$ or $\frac{1}{I}$

Kinematic Constants and Joint Velocities