

The University of Texas at Austin
Mechanical Engineering Department
MODELING OF PHYSICAL SYSTEMS

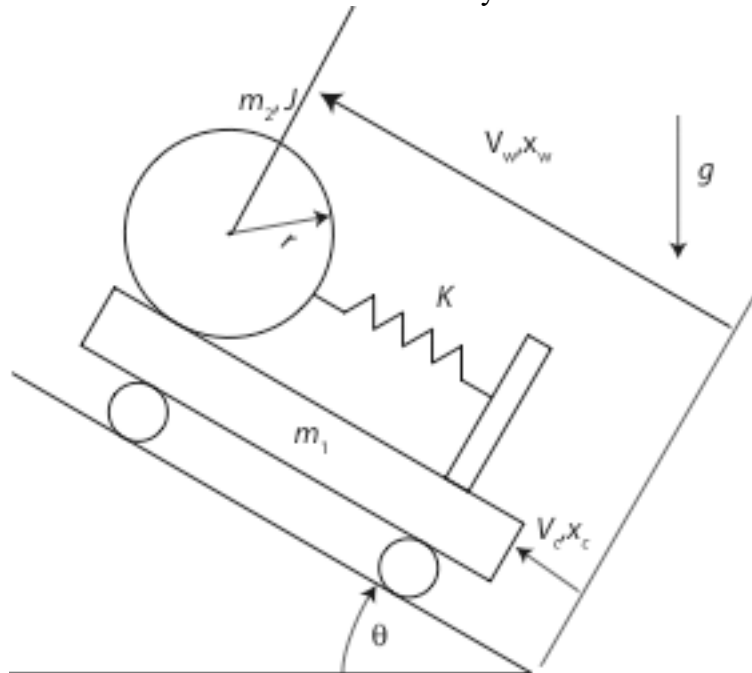
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Assigned 4/14/2022

ME 383Q.4
Assignment 6

Spring 2022
Due 4/21/2022

Read Chapter 9 and 10

1. Shown below is a schematic of mechanical system.



- Draw a Lagrangian bond graph for this system with independent coordinates of cart position x_c and wheel center position x_w .
 - Write a consistent set of state equations that could be simulated in MATLAB with states of cart position and generalized momentum and wheel position and generalized momentum. You do not need to perform the simulation.
2. Shown below is a simple pump driven by a piston and a crankshaft. The poppet valves of the pump have constitutive relation shown in fig. b below.
- Formulate a detailed bond graph model of this system if the inertia of the crank links can be neglected and the mass of the piston is m_p .
 - With $\tau(t)$ given, write a consistent set of state equations that could be simulated in MATLAB for (a) above using direct methods.
 - Neglect the pump portion of the system and formulate a detailed bond graph model of just the slider crank assuming that the drive link has moment of inertia J_d about its fixed pivot, the floating link has moment of inertia J_f about its center of gravity and mass m_f , and the piston has mass m_p .

- d. Formulate a Lagrangian bond graph model of this system (c).
- e. With $\tau(t)$ given, write a consistent set of state equations that could be simulated in MATLAB for (d) above

