2\textsuperscript{nd} Midterm - Problems

- 2.1 Electrical Circuit
- 2.2 Mechanical System
- 2.3 Hydraulic System

2.1 Electrical Circuit I

- Create a bond graph for the electrical circuit to the left. Choose the same direction for the harpoons as for the currents.
- Add causality strokes, and determine whether or not this circuit contains any algebraic loops and/or structural singularities.
- Draw the dual bond graph.
- Read a horizontally sorted set of simulation equations out of the dual bond graph.
Electrical Circuit II

- The dual bond graph is not the same as a dual circuit. It represents the same circuit as before.
- You get sort of a dual circuit by starting out with the dual bond graph, then interpreting each current as a voltage (or potential), and each voltage (or potential) as a current.
- Draw a circuit diagram for the so-obtained dual circuit.

2.2 Cervical Syndrome

- Create a bond graph for the human upper body shown on the left.
- Use the diamond property to simplify the bond graph.
- Add causality strokes to the modified bond graph.
- Read a horizontally sorted set of simulation equations out of the modified bond graph.
2.3 Hydraulic System I

- Create a bond graph for the hydraulic motor with servo valve shown on the left.
- The hydraulic motor is here a hydraulic cylinder, i.e., it generates a translational rather than rotational motion. Both the internal and external leakage flows are ignored.
- The servo valve is also different from the one shown in the lecture notes.

Hydraulic System II

- You may assume that the \( m_{\text{GHydro-element}} \) is available.
- You don’t need to model the control of the tongue of the servo valve. Assume \( x \) to be the input signal, and \( y \) the output signal.
- Use appropriate modulated sources and sensor elements to convert the input signal to the bond graph, and to sense the output signal from the bond graph.