03.8 ss.exe Exercises for Chapter **03**

Exercise 03.1 metroid

Draw necessary sign coordinate arrows, a *linear graph*, a *normal tree*, and identify *state variables* and *system order* for each of the following schematics.

a. Electrical system, current source



b. Rotational mechanical system, torque source



c. Translational mechanical system, velocity source



Exercise 03.2 megaman

Draw necessary sign coordinate arrows, a *linear graph*, a *normal tree*, and identify *state variables* and *system order* for each of the following schematics.

a. Electrical system, voltage source



b. Rotational mechanical system, angular velocity source



c. Translational mechanical system, force source



Exercise 03.3 sonic

Draw necessary sign coordinate arrows, a *linear graph*, a *normal tree*, and identify *state variables* and *system order* for each of the following schematics.

a. Electrical system, voltage source



b. Rotational mechanical system, torque source



c. Translational mechanical system, force source



Exercise 03.4 nintendo

Use the following linear graph for a circuit to answer the questions below, which are the steps to determining a state-space model of the circuit. Use the sign convention from the diagram. V_s is a voltage source.



- a. Determine the *normal tree, state variables, system order, state vector, input vector,* and *output vector* for the outputs i_R and v_C .
- b. Write the required *elemental*, *continuity*, and *compatibility equations*.
- c. Solve for the *state equation* in standard form.
- d. Solve for the *output equation* in standard form.

Exercise 03.5 supernintendo

Use the following linear graph for a mechanical translational system to answer the questions below, which are the steps to determining a state-space model from the linear graph. Use the sign convention from the diagram. F_S is a force source. Let the outputs be v_m and f_k .



- a. Determine the *normal tree, state variables, system order, state vector, input vector, and output vector.*
- b. Write the required *elemental*, *continuity*, and *compatibility equations*.
- c. Solve for the *state equation* in standard form.
- d. Solve for the *output equation* in standard form.

Exercise 03.6 gameboy

Use the following linear graph for a mechanical rotational system to answer the questions below, which are the steps to determining a state-space model from the linear graph.

Use the sign convention from the diagram. T_S is a torque source. Let the outputs be Ω_I and T_B .



- a. Determine the *normal tree, state variables, system order, state vector, input vector, and output vector.*
- b. Write the required *elemental*, *continuity*, and *compatibility equations*.
- c. Solve for the *state equation* in standard form.
- d. Solve for the *output equation* in standard form.

Exercise 03.7 blowhard

Use the following linear graph for a mechanical rotational system to answer the questions below, which are the steps to determining a state-space model from the linear graph.

Use the sign convention from the diagram. Ω_S is an angular velocity source. Let the outputs be the angular velocity Ω_J of the inertia and the angular *displacement* θ_k across the spring.



- 1. Determine the *normal tree, state variables, system order, state vector, input vector, and output vector.*
- 2. Write the required *elemental*, *continuity*, and *compatibility equations*.
- 3. Solve for the *state equation* in standard form.
- 4. Solve for the *output equation* in standard form.

Exercise 03.8 blinken

Use the following linear graph for an electrical system to answer the questions below, which are the steps to determining a state-space model from the linear graph.

Use the sign assignments from the diagram. I_S is a current source. Let the outputs be the voltage across the capacitor v_C and the current through the resistor i_R .



- 1. Determine the *normal tree, state variables, system order, state vector, input vector, and output vector.*
- 2. Write the required *elemental*, *continuity*, and *compatibility equations*.
- 3. Solve for the *state equation* in standard form.
- 4. Solve for the *output equation* in standard form.

Exercise 03.9 chunker

Use the assigned coordinate arrows to draw a *linear graph*, a *normal tree*, and identify *state variables* and *system order* for each of the following schematics.

1. Electrical system, voltage and current source



2. Rotational mechanical system, torque source, coordinate arrow



3. Translational mechanical system, force sources (2)



Exercise 03.10 stevenuniverse

Use the assigned coordinate arrows to draw a *linear graph*, a *normal tree*, and identify *state variables*, *system order*, and *dependent energy storage elements* for each of the following schematics.



1. Electrical system, voltage and current source



2. Rotational mechanical system, angular velocity source



3. Translational mechanical system, force sources (2)



Exercise 03.11 winken

Use the assigned coordinate arrows to draw a *linear graph*, a *normal tree*, and identify *state variables* and *system order* for each of the following schematics.

1. Electrical system, voltage source



2. Rotational mechanical system, torque source, coordinate arrow



3. Translational mechanical system, force source, coordinate arrow



Exercise 03.12 granada

Use the assigned coordinate arrows to draw a *linear graph*, a *normal tree*, and identify *state variables* and *system order* for each of the following systems.

1. Rotational mechanical system, two torque sources



2. Translational mechanical system, velocity source



Exercise 03.13 valencia

Use the following linear graph for a mechanical translational system to answer the questions below, which are the steps to determining a state-space model from the linear graph.

Use the sign convention from the diagram. F_S is a force source. Let the outputs be v_{m_1} and v_{m_2} .



- 1. Determine the *normal tree, state variables, system order, state vector, input vector, and output vector.*
- 2. Write the required *elemental*, *continuity*, and *compatibility equations*.
- 3. Solve for the *state equation* in standard form.
- 4. Solve for the *output equation* in standard form.

Exercise 03.14 stevenash

Use the linear graph of Fig. exe.1 for an electrical system to answer the questions below, which are the steps to determining a state-space model from the linear graph.

Use the sign convention from the diagram. V_S is a voltage source. Let the outputs be v_{C_2} , v_R , and i_S (i.e., the source current).

35 p.



Figure exe.1: A linear graph of an electrical system.

- 1. Determine the *normal tree, state variables, system order, state vector, input vector, and output vector.*
- 2. Write the required *elemental*, *continuity*, and *compatibility equations*.
- 3. Solve for the *state equation* in standard form.
- 4. Solve for the *output equation* in standard form.

