

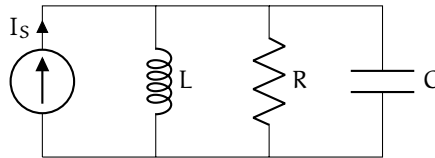
## 03.8 ss.exe Exercises for Chapter 03

### SS

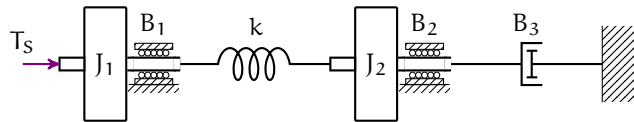
#### Exercise 03.1 metroid

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

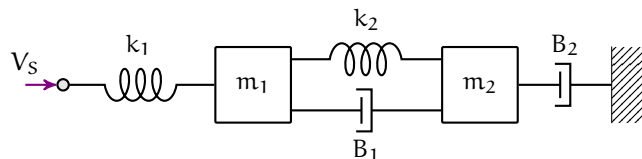
- a. Electrical system, current source



- b. Rotational mechanical system, torque source



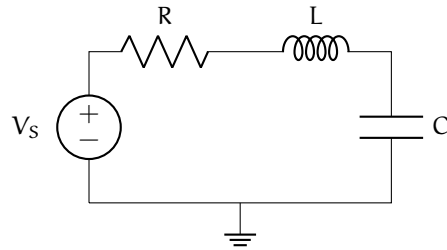
- c. Translational mechanical system, velocity source



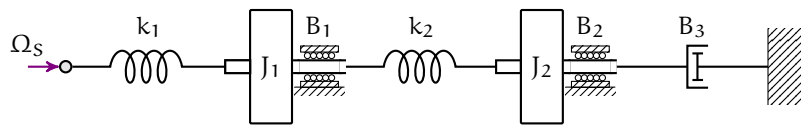
#### Exercise 03.2 megaman

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

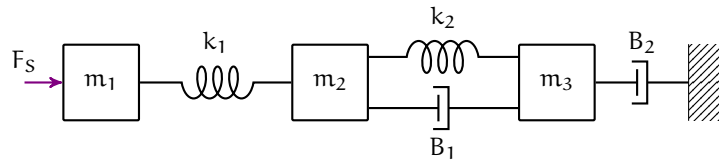
- a. Electrical system, voltage source



b. Rotational mechanical system, angular velocity source



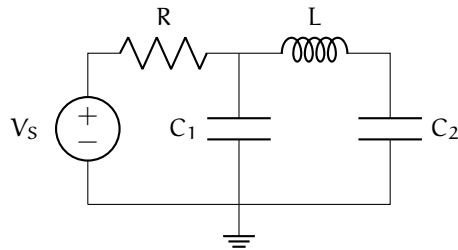
c. Translational mechanical system, force source



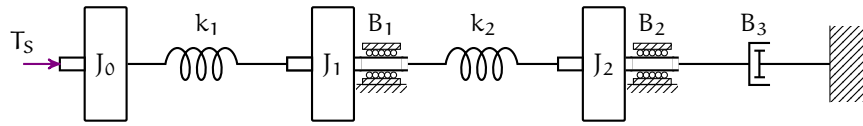
**Exercise 03.3 sonic**

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

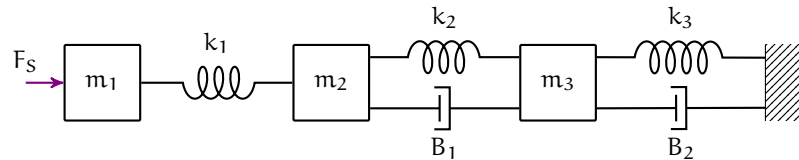
a. Electrical system, voltage source



b. Rotational mechanical system, torque source

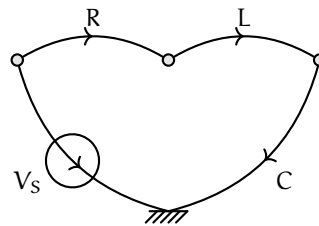


c. Translational mechanical system, force source



### 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.

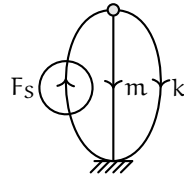


- Determine the *normal tree*, *state variables*, *system order*, *state vector*, *input vector*, and *output vector* for the outputs  $i_R$  and  $v_C$ .
- Write the required *elemental*, *continuity*, and *compatibility equations*.
- Solve for the *state equation* in standard form.
- Solve for the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

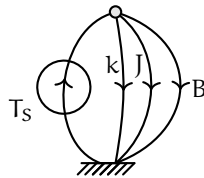


- Determine the *normal tree*, *state variables*, *system order*, *state vector*, *input vector*, and *output vector*.
- Write the required *elemental*, *continuity*, and *compatibility equations*.
- Solve for the *state equation* in standard form.
- Solve for the *output equation* in standard form.

### 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  $\Omega_J$  and  $T_B$ .

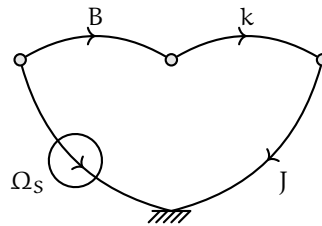


- Determine the *normal tree*, *state variables*, *system order*, *state vector*, *input vector*, and *output vector*.
- Write the required *elemental*, *continuity*, and *compatibility equations*.
- Solve for the *state equation* in standard form.
- Solve for the *output equation* in standard form.

**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.  $\Omega_S$  is an angular velocity source. Let the outputs be the angular velocity  $\Omega_J$  of the inertia and the angular displacement  $\theta_k$  across the spring.

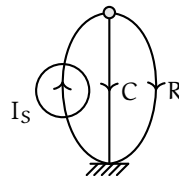


1. Determine the *normal tree*, *state variables*, *system order*, *state vector*, *input vector*, and *output vector*.
2. Write the required *elemental*, *continuity*, and *compatibility equations*.
3. Solve for the *state equation* in standard form.
4. Solve for the *output equation* in standard form.

**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  $i_R$ .

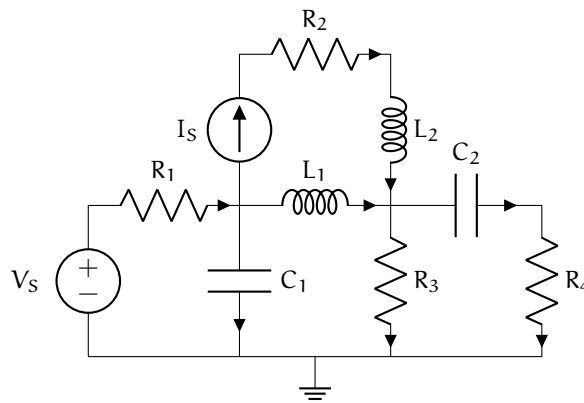


1. Determine the *normal tree*, *state variables*, *system order*, *state vector*, *input vector*, and *output vector*.
2. Write the required *elemental*, *continuity*, and *compatibility equations*.
3. Solve for the *state equation* in standard form.
4. Solve for the *output equation* in standard form.

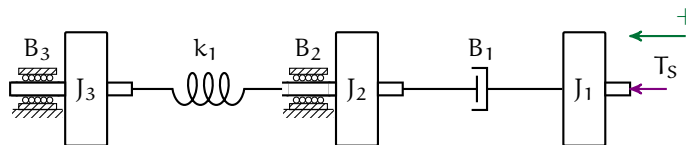
**Exercise 03.9 chunker**

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.

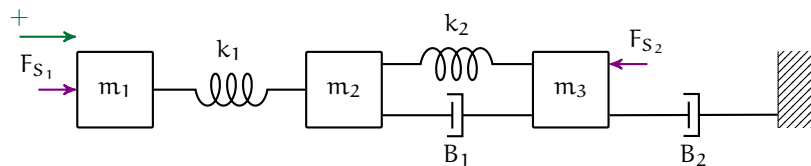
1. Electrical system, voltage and current source



2. Rotational mechanical system, torque source, coordinate arrow



3. Translational mechanical system, force sources (2)

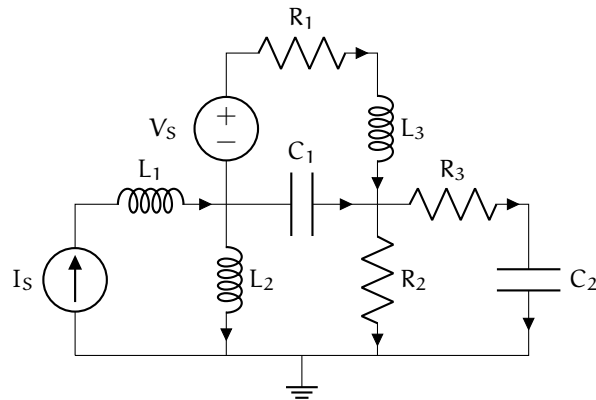


**Exercise 03.10 stevenuniverse**

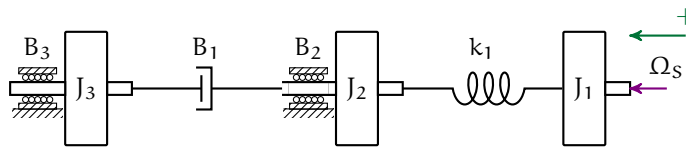
Use the assigned coordinate arrows to draw a *linear graph*, a *normal tree*, and identify *state variables*, *system order*, and *dependent energy storage elements* for each of the following schematics.

\_\_\_\_\_/ 30 p.

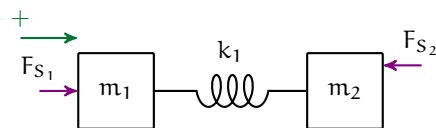
1. Electrical system, voltage and current source



2. Rotational mechanical system, angular velocity source



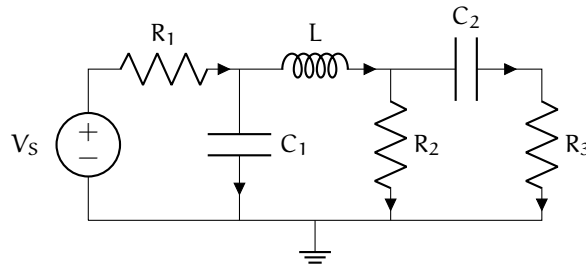
3. Translational mechanical system, force sources (2)



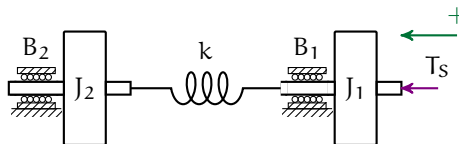
**Exercise 03.11 winken**

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.

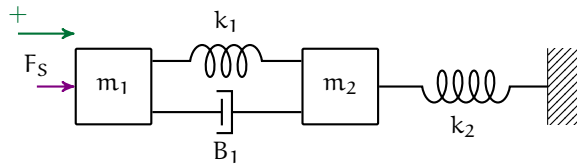
1. Electrical system, voltage source



2. Rotational mechanical system, torque source, coordinate arrow



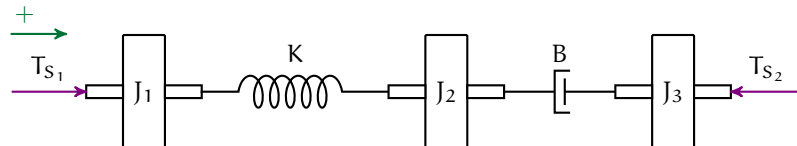
3. Translational mechanical system, force source, coordinate arrow



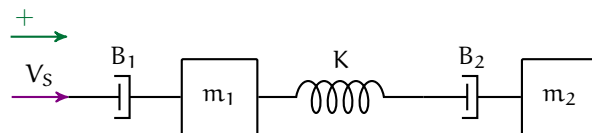
### Exercise 03.12 granada

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

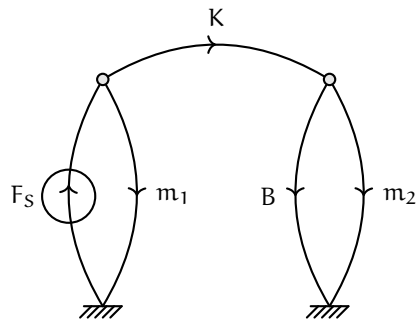




**Exercise 03.13 valencia**

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.

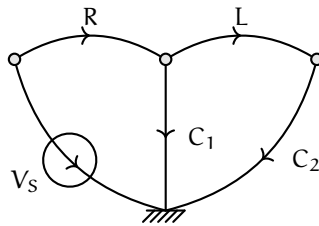
**Exercise 03.14 stevenash**

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.

## 04 emech

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