02.5 graphs.exe Exercises for Chapter 02 graphs

Exercise 02.1 playmate

Consider the illustration of Fig. exe.1 in which a bending plate scale is to have a heavy load placed upon it. Such scales measure the weight of the load by measuring the strain on the sensors and electronically converting this to the weight placed on the plate. (It goes without saying that calibration is required for such systems.)
It takes time for the system to come to equilibrium, during which oscillation occurs. Develop a one-dimensional lumped-parameter model of the mechanical aspect of the system and its applied load, via the following steps.

1. Declare what you will take to be the system and its input(s).
2. Declare a one-dimensional, mechanical, lumped-parameter model for the system. How might you determine the lumped-parameter model parameters (e.g. mass, spring constant, etc.)?
3. Draw a schematic of the lumped-parameter system model.
4. Draw a linear graph corresponding to your lumped-parameter model.

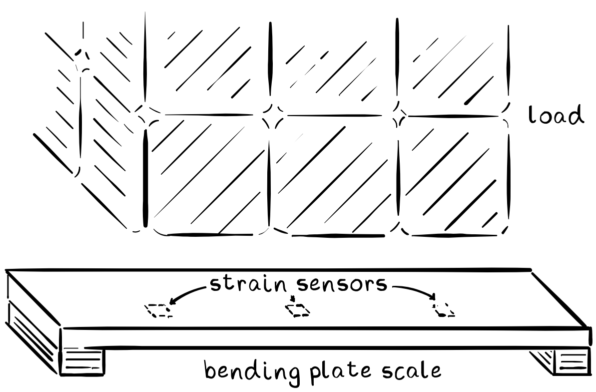

Figure exe.1: a bending plate scale with strain sensors and load.

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28 p.

Exercise 02.2 nod

Consider the illustration of Fig. exe.2 in which a motor is on a machine and an instrument is atop a nearby workbench. The motor typically spins at a fixed velocity, generating a vibration that is transmitted through the machine and into the floor.
Suppose you are given the task of designing the feet of the instrument such that less than a certain amount of vibratory motion from the motor will be transmitted through the floor and workbench to the instrument.
Develop a one-dimensional lumped-parameter model of the mechanical aspect of the system via the following steps.

1. Declare what you will take to be the system and its input(s).
2. Declare a one-dimensional, mechanical, translational, lumped-parameter model for the system.
3. Draw a schematic of the lumped-parameter system model.
4. Draw a linear graph corresponding to your lumped-parameter model.

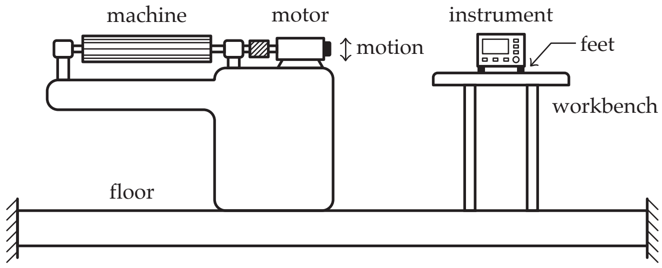


Figure exe.2: A motor on a machine and a nearby instrument on a workbench.

Exercise 02.3 johnnycash

Consider the illustration of Fig. exe.3 in which a wind turbine is harvesting wind energy. An electrical generator converts the rotational mechanical power into electrical energy. ——/ 35 p.
Suppose you are given the task of designing the bearing and the flexible shaft coupler assemblies. For the design, you will need to know how wind speeds will affect the angular velocities and torques throughout the

rotational mechanical system. Therefore, you resolve to develop a dynamic system model.

Develop a one-dimensional lumped-parameter model of the mechanical aspect of the system. Assume that the wind produces an input torque T_S via the turbine blades. Further assume that the generator draws power from the mechanical system in a manner that produces a load torque T_G that is proportional to the generator shaft angular velocity Ω_G; that is, for constant β,

$$T_G = \beta \Omega_G. \tag{1}$$

Use the following steps:

1. Declare what you will take to be the system and its input(s).
2. Declare a one-dimensional, rotational mechanical, lumped-parameter model for the system.
3. Draw a schematic of the lumped-parameter system model.
4. Draw a linear graph corresponding to your lumped-parameter model.

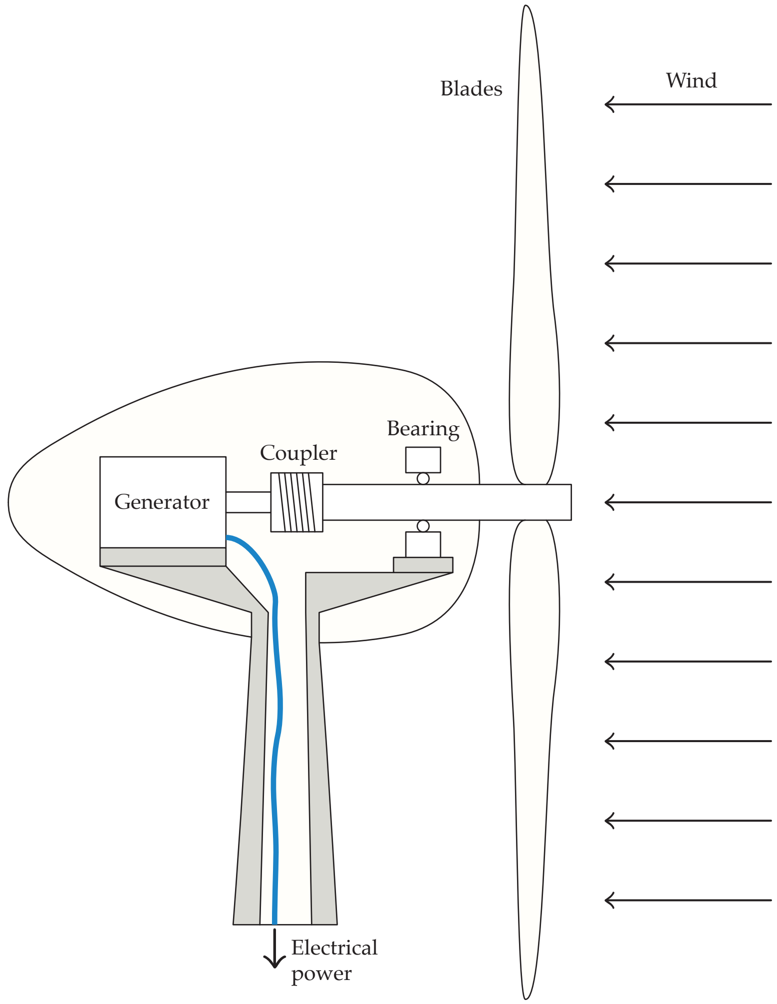
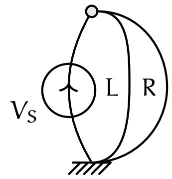


Figure exe.3: A sketch of a wind turbine.

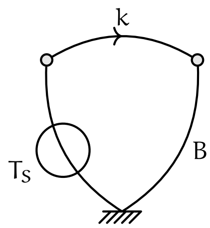
Exercise 02.4 lillimoomie

Finish applying the sign coordinate arrows on the following linear graphs.

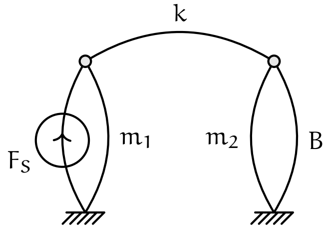
a. electronic system



b. rotational mechanical system (assume T_S is in the positive direction)



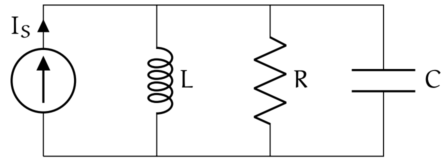
c. translational mechanical system



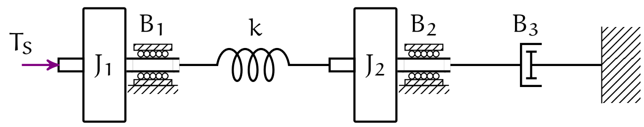
Exercise 02.5 varieties

Draw necessary sign coordinate arrows and a linear graph for each of the following schematics.

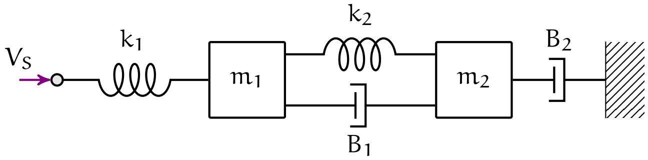
a. electronic system, current source



b. rotational mechanical system, torque source



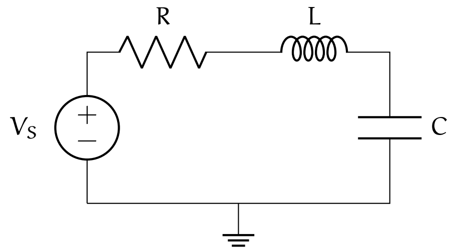
c. translational mechanical system, velocity source



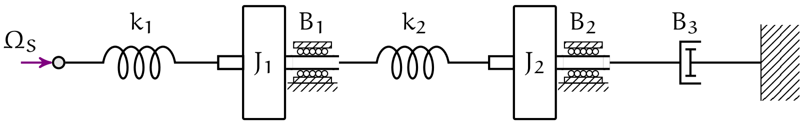
Exercise 02.6 cormac

Draw necessary sign coordinate arrows and draw a linear graph for each of the following schematics.

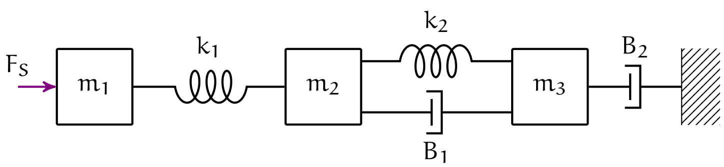
a. electronic system, voltage source



b. rotational mechanical system, angular velocity source



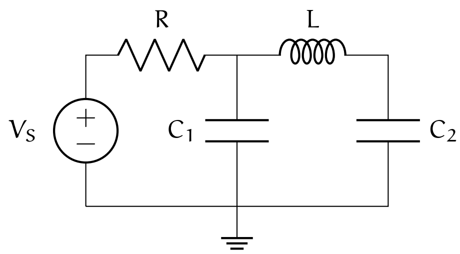
c. translational mechanical system, force source



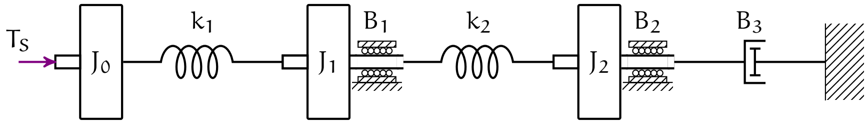
Exercise 02.7 kurt

Draw necessary sign coordinate arrows and a linear graph for each of the following schematics.

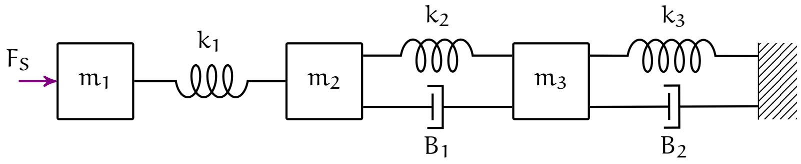
a. electronic system, voltage source



b. rotational mechanical system, torque source



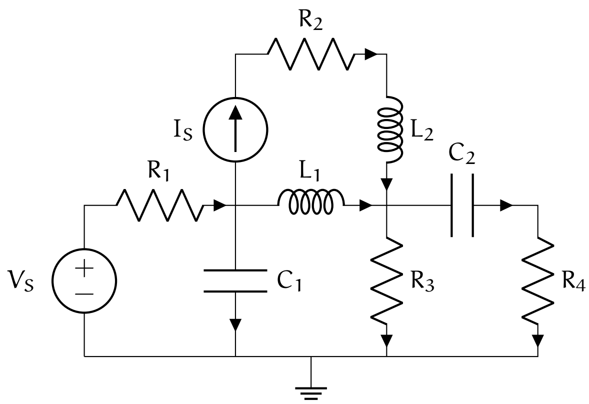
c. translational mechanical system, force source



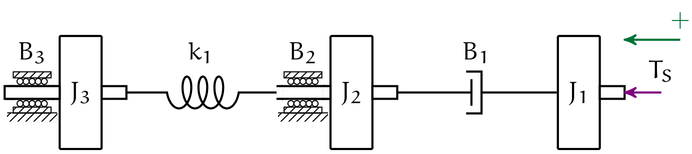
Exercise 02.8 bunker

Use the assigned coordinate arrows to draw a linear graph for each of the following schematics.

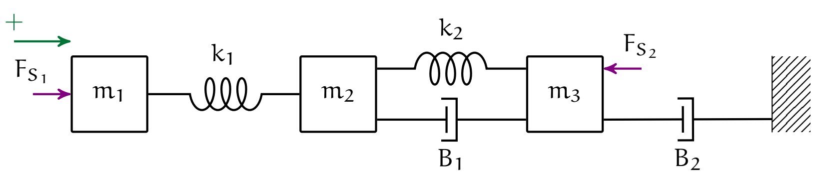
a. electronic system, voltage and current source



b. rotational mechanical system, torque source, coordinate arrow



c. translational mechanical system, force sources (2)



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