



Tutorial #1

ELL-225: Control Engineering

Session: Semester-II (2022-23)

1. Consider a water tank, where it is required to maintain the desired water level when it becomes empty through a water tap at the bottom. Can you propose some control mechanism to achieve the above objective. Draw a schematic diagram for the proposed scheme. Further, draw a block diagram for this arrangement, and mention which elements are actuators, sensors and controllers.
2. In roadway traffic intersections traffic lights are used to control the traffic. Considering such traffic control scenario, answer the following questions.
 1. Is the current traffic control in India open-loop control or closed-loop control? Justify.
 2. Can traffic control be managed efficiently by making a closed-loop control system? Draw schematic diagram and block diagram for the proposed control system.
3. Consider a toaster, and answer the following questions.
 1. How can it be operated as an open loop system?
 2. How can it be operated as a closed-loop system to get good quality toasts? Draw block and schematic diagrams for such arrangement.
4. Some high-speed rail systems are powered by electricity supplied through a pantograph on the train's roof from a catenary overhead, as shown in Figure 1. The force applied by the pantograph to the catenary is regulated to avoid loss of contact due to excessive transient motion. A proposed method to regulate the force uses a closed-loop feedback system, whereby a force, F_{up} , is applied to the bottom of the pantograph, resulting in an output force applied at the catenary at the top. The contact between the head of the pantograph and the catenary is represented by a spring. The output force is proportional to the displacement of this spring, which is the difference between the catenary and pantograph head vertical positions. Draw a functional block diagram showing the following signals: the desired output force as the input; the force, F_{up} , applied to the bottom of the pantograph; the difference in displacement between the catenary and pantograph head; and the output contact force. Also, show blocks representing the input transducer, controller, actuator generating F_{up} , pantograph dynamics, spring described above, and output sensor. All forces and displacements are measured from equilibrium.

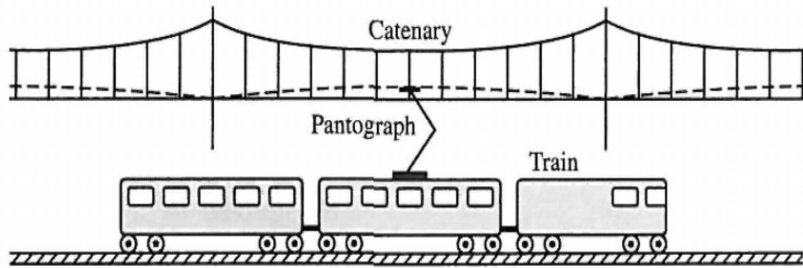


Figure 1: High-speed rail system showing pantograph and catenary

5. A university wants to establish a control system model that represents the student population as an output, with the desired student population as an input. The administration determines the rate of admissions by comparing the current and desired student populations. The admissions office then uses this rate to admit students. Draw a functional block diagram showing the administration and the admissions office as blocks of the system. Also show the following signals: the desired student population, the actual student population, the desired student rate as determined by the administration, the actual student rate as generated by the admissions office, the dropout rate, and the net rate of influx.