1. A photocell with a 35-ms time constant is used to measure light flashes. How long after a sudden dark-to-light flash before the cell output is 80% of the final level?
2. A manufacturer specification sheet lists the transfer function of a pressure sensor as 45±5% mV/kPa with a time constant of 4±10%. A highly accurate test system applies a step change of pressure from 20 kPa to 100 kPa. a. What is the range of the sensor voltage outputs initially and finally? b. What range of voltages would be expected to be measured 2 sec after the step change is applied?
3. A pressure-measurement system uses a sensor that converts pressure into voltage according to the transfer functions, Vp = .5√p . This voltage is then converted into a current. As pressure varies from 0 to 100 psi, the current varies from 4 to 20 mA.

a. Find the transfer function equation for the conversion of voltage to current.
b. What pressure change, Δp, will cause the current to change by 1 mA from 19 mA to 20 mA.
c. What pressure change, Δp, will cause the current to change by 1 mA from 4 mA to 5 mA? Why is the pressure change not the same as in the previous case, even though the current changed by 1 mA in both cases?
d. Is the relationship of current versus pressure linear or nonlinear?

1. Develop a voltage-to-current converter that satisfies the requirement I = 0.0021Vm. If the op amp saturation voltage is ±12 V and the maximum current delivery is 5 mA, find the maximum load resistance.
2. A sensor varies from 1 to 5 kΩ. Use this in an op amp circuit to provide a voltage varying from 0 to 5 V as the resistance changes.
3. A system is needed to measure flow, which continuously cycles between 20 and 30 gal/min with a period of 30 sec. The required output is a voltage varying from –2.5 to +2.5 V for the cycling flow range. The sensor to be used has a transfer function of √ Q volts, where Q is in gal/min, and an output impedance of 2.0 kΩ. Tests show that the output of the sensor has 60 Hz noise of 0.8 V rms. Design a signal-conditioning system, including noise filtering, and evaluate your design as follows.

a. Plot output voltage versus flow, and comment on the linearity.
b. Determine the noise on the output as percent FS.
4. A process involves moving speed, load weight, and rate of loading in a conveyor system. The variables are provided as high (1) and low (0) levels for digital control. An alarm should be initiated whenever any of the following occur: a. Speed is low; both weight and loading rate are high. b. Speed is high; loading rate is low.

Find a Boolean equation describing the required alarm output. Let the variables be S for speed, W for weight and R for loading rate.

1. A 6-bit DAC has an input 1001012 and uses a 10.0-V reference.

a. Find the output voltage produced.

b. Specify the conversion resolution.
2. A computer will be used to control flow through 10 pumping stations. The pumps exhibit a surging effect with a period of 2.2 sec. What is the minimum sampling rate to ensure quality data? How much time can be spent processing each station’s data? Data acquisition hardware and software take 200µ sec for a channel.