Tutorial – Week - 7   MTRN3026 Mechatronics Systems

Q1. Write a few standard inputs and outputs with reference to a PLC for industrial automation.

Q2 Please explain why the analog input 4mA to 20mA is a very useful input for process control compared to 0mA to 20mA or 0V to 10V voltage.

Q3 Draw the electrical connection diagram to interface two push buttons and one solenoidal valve to the input ports and output port of a PLC respectively.

Q4 Write a simple ladder diagram to control the valve of Q3 by one push button to energize and other push button to switch it off.

Q5 The doors of public vehicles need to be controlled based on PLC based system. Assuming that the opening and closing of the doors are controlled by two button switches ON and OFF. When the button switch ON is pressed, the door will open. When the button switch OFF is pushed, the door will close. Draw a complete schematic diagram with proper explanation that can be used to operate the doors of vehicle. Please use only one motor for controlling the movement of door.

Q6: The input v_i will need to be interfaced to a PLC. The signal needs to be conditioned as shown in the figure below. Find $v_o(s)/v_i(s)$ as shown in Figure 1.
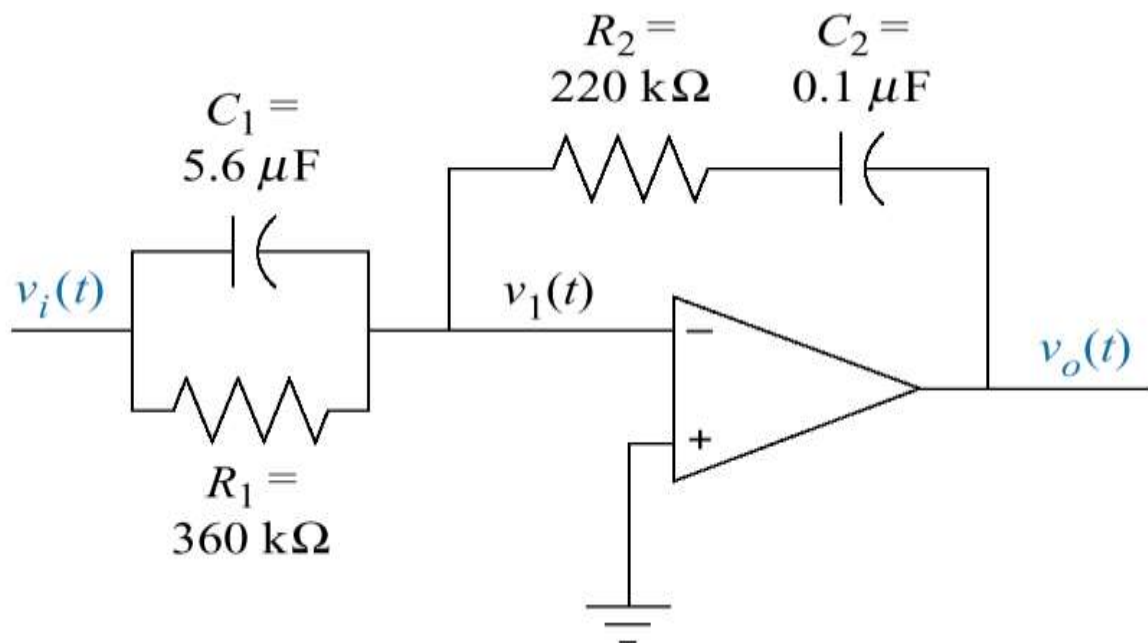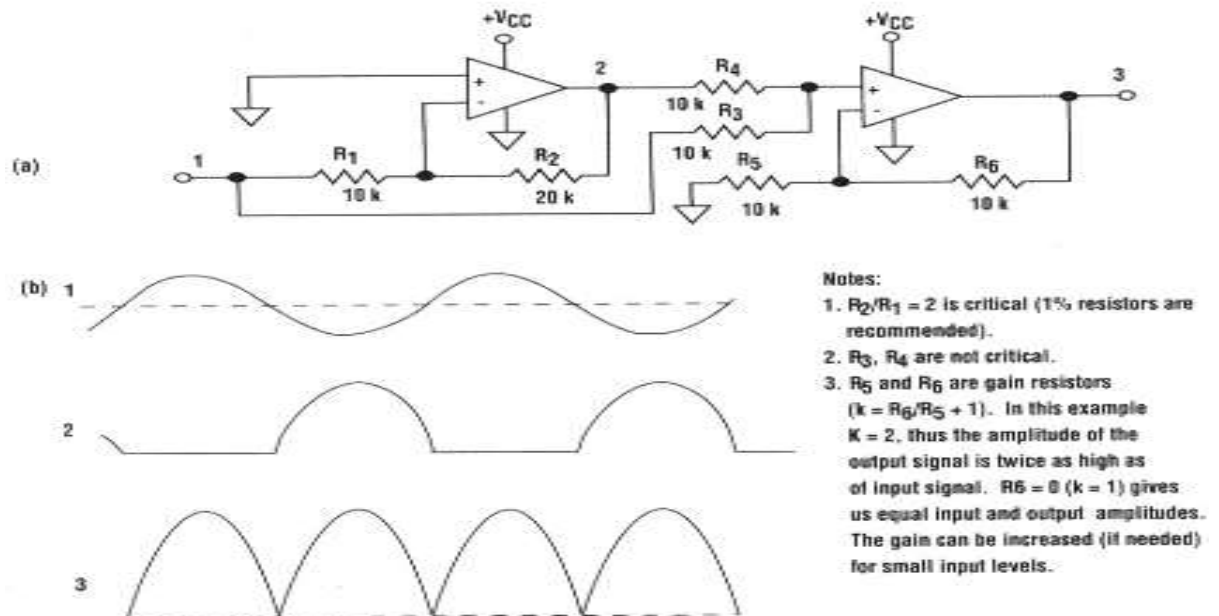

Figure 1

Q7: A very weak sinusoidal input signal will need to be interfaced to a PLC. A precision rectifier is used to rectify the signal. For the precision rectifier as shown below, Find the equation of the output at point #2 and #3 of the Figure 2. What can you change and add in the circuit to amplify the output signal to 3.3V and make a perfect DC voltage?

Notes:
1. $R_2/R_1 = 2$ is critical (1% resistors are recommended).
2. R_3, R_4 are not critical.
3. R_5 and R_6 are gain resistors ($k = R_6/R_5 + 1$). In this example $K = 2$, thus the amplitude of the output signal is twice as high as of input signal. $R6 = 0$ ($k = 1$) gives us equal input and output amplitudes. The gain can be increased (if needed) for small input levels.

This simple circuit, built around two sections of an LM2902 quad op amp, is actually a high-precision full-wave rectifier that requires no diodes (a). Rectification is accomplished by summing with the input signal, the negative signal excursions which have been inverted and amplified by a factor of 2 (b).

Figure 2

Q8: For the circuit as shown in Figure 3, find the output expression, V_{out} in terms of the output of the current transformer ASM010, across pin 1 and 2. Assume the voltage across pin 1 with respect to pin 2 is V_{in}.
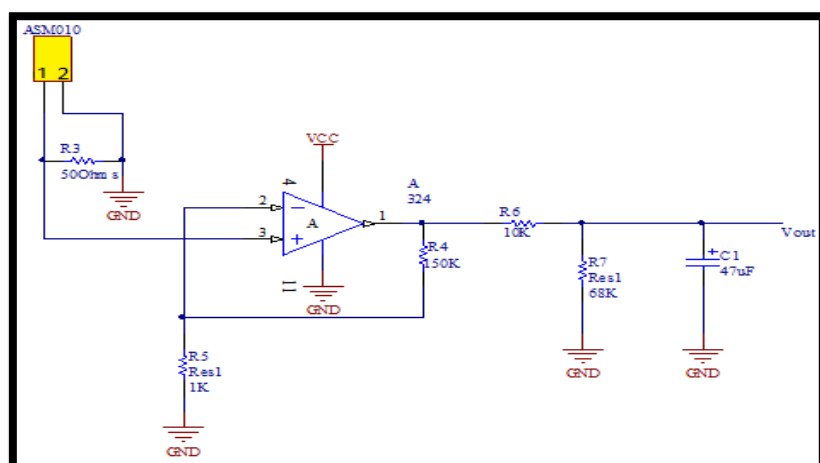

Figure 3