Kafrelsheikh University
Faculty of Engineering
Electrical Engineering Department
Dr. Abdel-Fattah Heliel
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2nd Year (Electrical Engineering)
Course: Systems Dynamics & Control Components
Time: 180 minutes
Mark: 70 Marks
Final exam: 2018- 2019
Date: 20 / 6 / 2019

Intended learning outcomes (ILOs): [a1, a4, a5, b1, b2, b3, b5, c8, c9, d1, d3]

Answer all the following questions:

Question N0. [1] [10 Marks]

a) Explain how the basic strategy of control is employed in a room air-conditioning system. What is the controlled variable? What is the manipulated variable? Is the system self-regulating? **[4 Marks]**

b) Figure 1 shows a simple level-control system in which a closed relay opens the valve and an open relay closes the valve. Input flow is not controlled. Tile relay closes at 6.0 V and opens again at 4.8 V. The level sensor bas a transfer function of $V_h = 0.8h + 0.4$ V.

1) Find the value of amplifier gain K required to open the valve when the level reaches 1.5 m.
2) At what level does the valve close?
3) Suppose Q1 = 5 m3/min, Q2 =2m3/min, and Q out =9m 3/min (when open). What is the period of the level oscillation? **[6 Marks]**

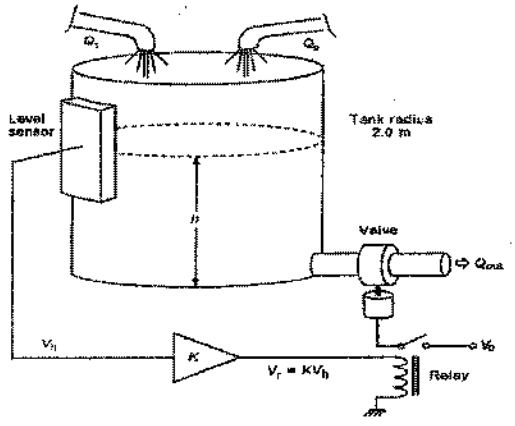


Fig. 1

Question N0. [2] [15 Marks]

a) Given $R_3 = 50$ K, and the two capacitors must be equal, calculate the rest of the components so that the circuit will act as a band-pass filter for frequency range 1 KHz to 10 KHz, with a mid-band gain of magnitude = 5. (**6 Marks**)

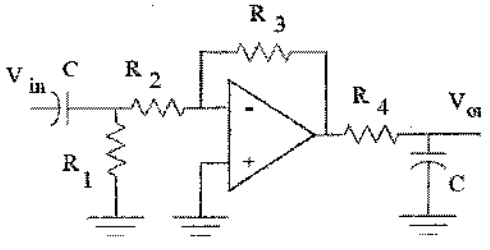


Fig. 2

b) For the circuit shown in Fig. 3:

1. Determine the voltage gain at DC.
2. Derive the transfer function $F(s) = V_O/V_i$.
3. Can this circuit be used as an integrator or differentiator?

If yes, are there any restrictions or conditions?

Part a: (3 Marks) Part b: (3 Marks) Part c: (3 Marks)

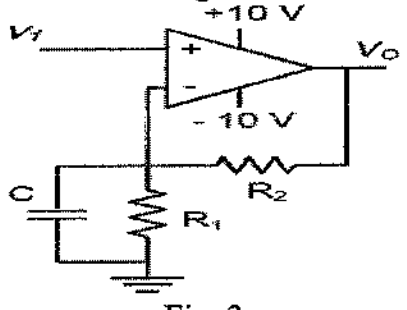


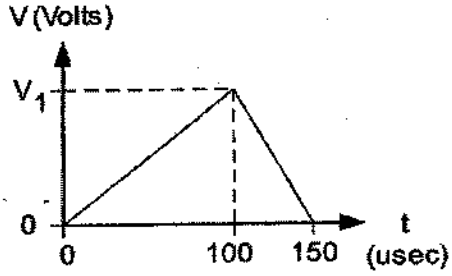
Fig. 3

Question N0. [3] [10 Marks]

a) A dual-slope ramp ADC was designed with the following specifications: the magnitude of $V_R = 6$ Volts, the output of the op-amp integrator can be in the range of ±10 Volts.

Determine: **[6 Marks]**

1. The magnitude of the input voltage which produced the shown timing diagram.
2. Suitable values of R and C used in the integrator.
3. The maximum conversion time τ_C (The time delay it takes the ADC to convert an input voltage to a digital output).



b) A process-control system specifies that temperature should never exceed 160 °C if the pressure also exceeds 10kPa. Design an alarm system to detect this condition, using temperature and pressure transducers with transfer functions of 2.2mv/°C and 0.2 V/kPa, respectively. **[4 Marks]**

Question N0. [4] [15 Marks]

A-) State the advantages and disadvantages of both RTD and thermocouple. **[6 Marks]**

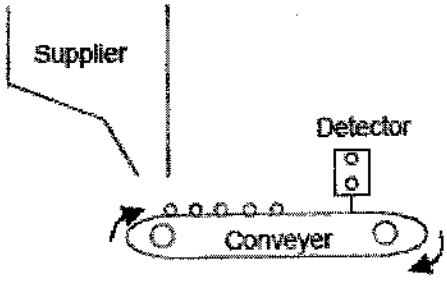
B-) An RTD has $\alpha_o = 0.005$ /°C, R = 500Ω, and a dissipation constant of PD = 30mW/°C at 20 °C. The RTD is used in a bridge circuit, with $R_1 = R_2 = 500\Omega$ and R_3 is a variable resistor used to null the bridge. If the supply is 10 V and the RTD is placed in a bath at 0 °C, find the value of R_3 to null the bridge. **[9 Marks]**

Question N0. [5] [20 Marks]

A-) State the difference between both the digital and analog outputs and give an example for each one. **[4 Marks]**

B-) By using two timers, a lamp flickers periodically for 1 second High and 1 second Low while a switch S1 is on. **Create an assignment list of the inputs and the outputs, draw up a terminal diagram, and write a PLC program in ladder diagram mode. [8 Marks]**

C-) Detect the fault of conveyer by check that a product is passed within a specified period or not. **[8 Marks]**



If a specific period of 5 seconds elapsed and no product is detected, then output a continuous siren and a flicker lamb, when the operator press the acknowledgement bosh button switch then reset the siren and the flicker lamb. **Create an assignment list of the inputs and the outputs, draw up a terminal diagram, and write a PLC program in ladder diagram mode.**

مع أطيب تمنياتي بالنجاح الباهر ...
د/ عبدالفتاح هليل
د/ شريف امام