Kafrelsheikh University
Faculty of Engineering
Electrical Engineering Department
Final exam June 2021
Prof. Dr. Abdel-Fattah Heliel
Dr. Sherif Emam

2nd Year (Electrical Engineering)
Systems Dynamics & Control Components
Time: 180 minutes
Mark: 70

This exam is based on course ILOS

Question 1 [15 Marks]

A-) What is a comparator? How does it differ from an op amp? **(5 Marks)**

B-) For the circuit shown in Fig. 1:

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 1: (3 Marks) Part 2: (4 Marks) Part 3: (3 Marks)

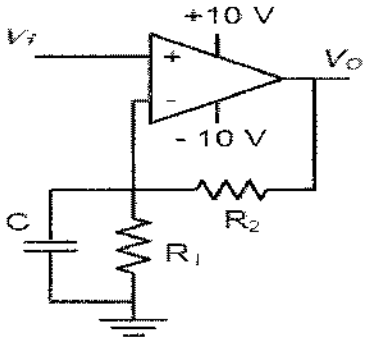

Fig. 1

Question 2 [20 Marks]

A-) A dual-slope ADC has R = 100 kΩ and C = 0.1 μF. The reference is 10 V, and the fixed integration time is 10 ms. Find the conversion time for a 6.8 V input. **(6 Marks)**

B-) Figure 2 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. The relay closes at 6.0 V and opens again at 4.8 V. The level sensor has a transfer function of $V_h = 0.8h + 0.4$ V. **8 Marks).**

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 m^3/min, Q2 =2m^3/min, and Q out =9m^3/min (when open).

What is the period of the level oscillation?

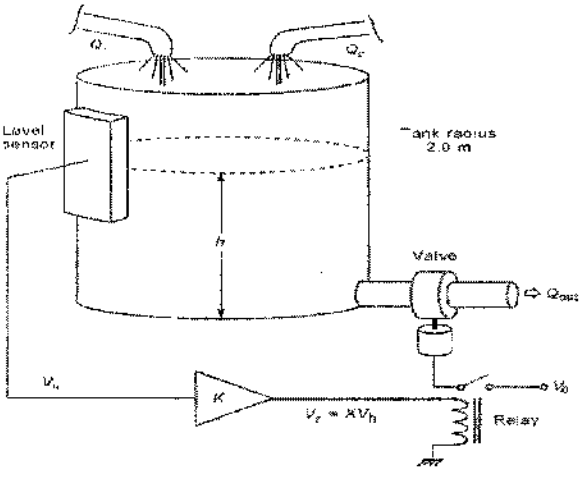

Fig. 2

C-) 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. **(6 Marks)**

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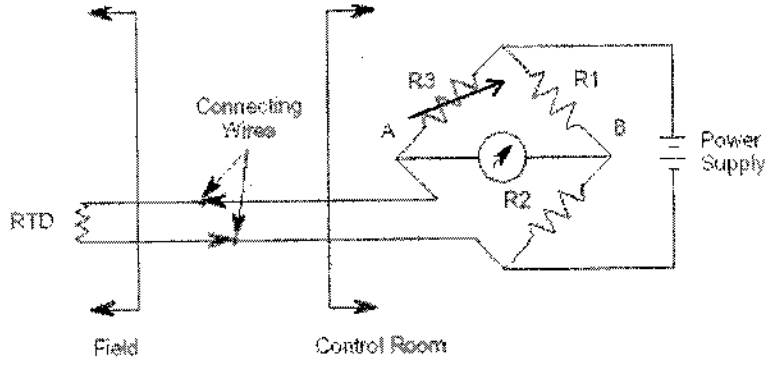
Question 3 [15 Marks]

A-) Compare between piezo electric and variable inductance pressure sensor, including the theory of operation and support your answer with the construction diagram of each one. **[4 Marks]**

B-) State the advantages and disadvantages of both RTD and thermocouple. **[4 Marks]**

C-) State how to calibrate the RTD, support your answer with figures. **[3 Marks]**

D-) An RTD has $\alpha_0 = 0.005/^0C$, R=500Ω, and a dissipation constant of $P_D = 30mW/^0C$ at 20 ^0C. 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 power supply is 10V and the RTD is placed in an ice bath at 0 ^0C, find the value of R_3 to null the bridge. **[4 Marks]**

Question 4 [20 Marks]

A-) State how to use bubblers for measuring liquid level? **[4 Marks]**

B-) What is the depth of the liquid in a container if the specific weight of the liquid is 56 lb/ft^3, the container weighs is 33 lb, and has a diameter of 63 in? A load cell measures the total weight to be 746 lb. **[5 Marks]**

C-) Compare among quick opening, linear and equal percentage control valve, support your answer with the characteristic curve of each one. **[6 Marks]**

D-) State at least five factors that involved in actuator selection. **[5 Marks]**

Our Best Wishes
Prof. Dr. Abdel-Fattah Heliel
Dr. Sherif Emam