Kafrelsheikh University
Faculty of Engineering
Electrical Engineering Department

Final exam, 2016

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

Answer all the following questions:

Problem (1) [15 marks]

a) A bridge circuit shown in Fig. 1 is used with a sensor located 100m away. The bridge is not lead compensated, and the cable to the sensor resistance of 0.45Ω/ft. The bridge nulls with R_1=3400Ω, R_2=3445Ω, and R_3=1560Ω. What is the sensor resistance?

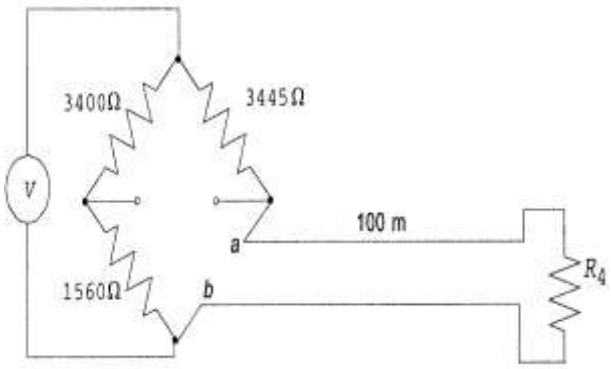

Fig.1

b) For the manufacturing process diagram shown in Fig. 2: The following independent control requirement.

- Control the level at L_{sp}.
- Control temperature at T_{sp}.
- Control the output flow rate at Q_{sp}.

i. Complete the diagram showing the control loops by using the block diagram error detector symbols and controller blocks. Include blocks for necessary signal converters.

ii. Explain which of the control loops are self-regulating; give reasons why and why not.

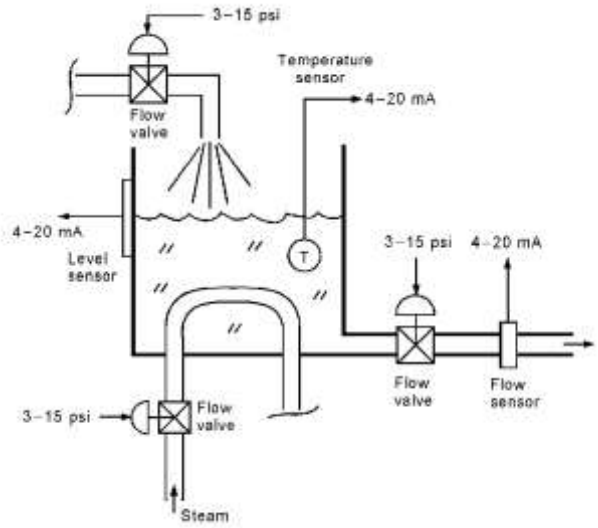

Fig. 2

Problem (2) [15 marks]

a) What are advantages and disadvantages of Resistance-Temperature Detectors (RTD)?

b) A 6 bits uni-polar ADC with V_{ref} = 10.0V, If 4.22V is applied to the input. The ADC uses successive approximation to estimate the digital output. **Show** the intermediate approximation steps and the final digital output. **Calculate** ADC resolution, minimum and maximum output. **What** is the maximum input signal frequency if the conversion time is 50μs and the input signal is represented by 10 sin(wt).

Problem (3) [15 marks]

(a) Consider the shown bridge circuit in Fig. 3. RT is a temperature sensor which has a resistance of 2 KΩ at 0 °C and increases linearly 10 Ω per °C. I_c is a current source. R1 = R2 = R3 = R4 = R5 = 1 KΩ.

i) Determine Ic which would balance the bridge at 0 °C.

ii) When temperature increases, should you increase, decrease, or keep Ic unchanged in order to keep the bridge balanced? Explain why.

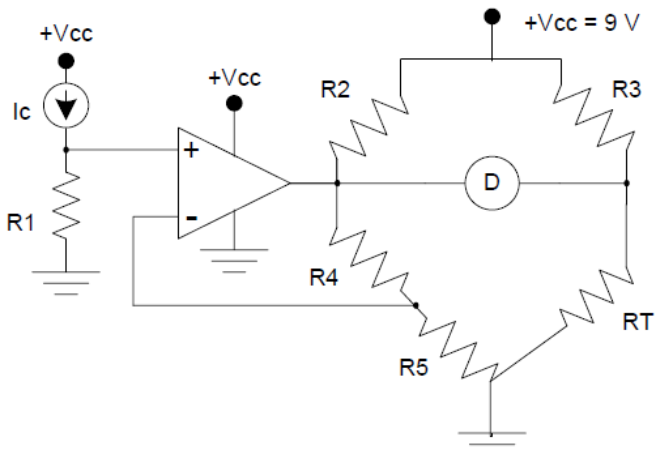

Fig.3

(b) A potentiometric displacement sensor is to be used to measure work-piece motion from 0 to 10 cm. The resistance changes linearly over this range from 0 to 1 kΩ. Develop signal conditioning to provide a linear, 0- to 10- V output.

Problem (4) [15 marks]

a) Explain TRIAC (Triode for Alternating Current) Operation and its Characteristics?

b) How much current must be drawn through T2 to turn the GTO in Fig.4 below off if the following specifications apply to the GTO: β_{OFF}=7, R_{on} = 2.5 mΩ, V_B = 75, and R_L = 2 Ω? What average power is dissipated by the GTO for a 50% duty cycle?

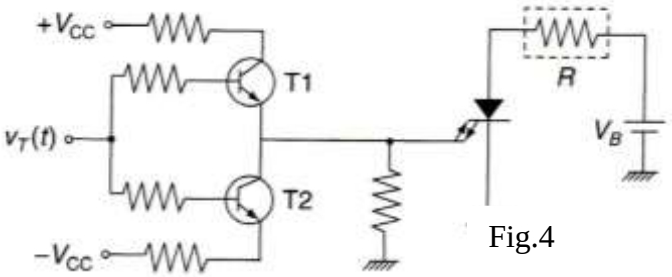

Fig.4

Problem (5) [15 marks]

a) Develop the digital circuit using AND/OR gates that implements equation:

$$D = \bar{A} \bullet B + A \bullet C + A \bullet \bar{C} \bullet B$$

b) A 4-bit digital word is intended to control the setting of a 2-Ω DC resistive heater. Heat output varies as a 0 – 24 V input to the heater. Using a 10–V DAC followed by an amplifier and a unity gain high-current amplifier, calculate: a) the settings from minimum to maximum heat dissipation, and b) how the power varies with LSB changes.