

COMMONWEALTH OF AUSTRALIA

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Family Name	
Given Names	
Student Number	
Teaching Period	Semester 2, 2016

FINAL EXAMINATION	DURATION
ENG342 – Instrumentation	Reading Time: 10 minutes Writing Time: 120 minutes

INSTRUCTIONS TO CANDIDATES

EXAM CONDITIONS

You may begin writing from the commencement of the examination session. The reading time indicated above is provided as a guide only.

This is a RESTRICTED OPEN BOOK examination

Any non-programmable calculator is permitted

One A4 sheet of handwritten double-sided notes permitted

No dictionaries are permitted

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
none	1 x 16 Page Book 1 x Scrap Paper Formula Sheet/s

**THIS EXAMINATION IS PRINTED
DOUBLE-SIDED.**

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Answer ALL Questions

Total Marks = 100

The Questions should be answered in the Answer Booklet provided.

Marks for each question are indicated.

Question 1

Figure 1 is a schematic representation of a shell and tube heat exchanger in which a liquid feed is to be heated to 80°C by condensation of steam. The outlet temperature of the process fluid was required to be kept under tight control and the fluid inlet temperature is known to fluctuate significantly. It was decided that a feedforward-feedback control scheme is best suited for this purpose.

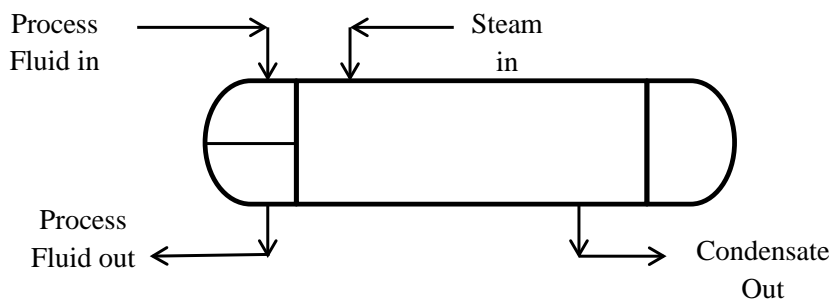


Figure 1. Shell and tube heat exchanger system.

Draw the P&ID for this process including the feedforward-feedback control scheme. Give a brief explanation of how your scheme works indicating clearly the feedforward and feedback parts of the loop.

(Marks: 25)

Question 2

Specifications dictate that the flowrate of a liquid through a pipe has to be measured with an accuracy of at least 2%. A differential-pressure flowmeter was chosen for this purpose. It is found that the flowmeter should have a turn down ratio of 3:1 in order to cover the range of flowrate that is expected for this application. A DP cell with 3 cm measurement error can achieve the required accuracy in flowrate. Determine the turndown ratio of the DP cell that would be needed for the flowmeter to achieve the stated requirements.

(Marks: 15)

Question 3

A cylindrical steel displacer of 3 litre volume and 6 cm diameter is to be used as a level sensor in a vessel containing crude oil whose density is 0.96 g/cm^3 . The density of steel is 8 g/cm^3 and the acceleration due to gravity $g = 980 \text{ cm/s}^2$.

(a) Calculate the minimum weight of the displacer.

(Marks: 15)

(b) Calculate the maximum range of level that can be sensed by this sensor.

(Marks: 15)

Question 4

A gas in a fixed-volume temperature sensor has a pressure of 1.3 atm at 30°C . Calculate the temperature in $^\circ\text{C}$ if the pressure in the detector increases to 1.8 atm. State assumptions (if any) that you needed to make in order to calculate the temperature.

(Marks: 15)

Question 5

A differential pressure cell is used to measure the specific gravity of a liquid. The experiment consists of measuring the differential pressure of a column of the liquid of height 25 cm. Calculate the specific gravity of the liquid if the differential pressure is 105 cm of water. The density of water is 1000 kg/m^3 .

(Marks: 15)