



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023**

COURSE NAME	:	PROCESS CONTROL AND INSTRUMENTATION
COURSE CODE	:	BDJ 31103
PROGRAMME CODE	:	BDJ
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA CLOSED BOOK . 3. STUDENTS ARE PROHIBITED TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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- Q1** (a) A pressure gauge with a range between 0 - 10 bar is found to have an error of ± 0.15 bar when calibrated by the manufacturer. Calculate,
- (i) The error percentage of the gauge.
 - (ii) The error percentage when the reading obtained is 2.0 bar.
 - (iii) Comment the answer in (ii)
- (3 marks)
- (b) Construct the process control shown in **Figure Q1(b)** for both temperature and flow control system.
- (10 marks)
- (c) Explain the basic construction of a thermocouple including:
- (i) Major component arrangement
 - (ii) Materials used
- (4 marks)
- (d) Describe the operation of the following types of actuators:
- (i) Pneumatic
 - (ii) Hydraulic
 - (iii) Solenoid
- (3 marks)
- Q2** (a) State the difference of atmospheric pressure, absolute pressure, gauge pressure and differential pressure.
- (4 marks)
- (b) A controller output is a 4 to 20 mA signal that drives a valve to control flow. The relation between current and flow is $Q=45\sqrt{I-2}$ mA) gal/min.
- (i) Determine the flow for 12 mA.
 - (ii) Calculate the current produces a flow of 162 gal/min.
- (4 marks)
- (c) Describe **FIVE (5)** basic elements comprised in DCS and explain each element.
- (5 marks)
- (d) Compare an open-loop and closed-loop system with an example of each loop. Draw the block diagram for each example for better explanation and understanding.
- (7 marks)

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- Q3** (a) Explain the definition of controller. Answer includes error/deviation, input signal and output signal. (4 marks)
- (b) Determine the difference between reverse and direct action controller in term of the its controlled variables and output. (4 marks)
- (c) List **THREE (3)** classification of controller modes and give an example of each. (6 marks)
- (d) The choice of operating mode for any given process control system is a complicated decision. Examine what is involved in this operating mode selection process. (3 marks)
- (e) Using a standard measured indication range like 4 to 20 mA. Suppose we have a setpoint of 10.5 mA and a measurement of 13.7 mA. Determine the error and comment the +ve and -ve error. (3 marks)
- Q4** (a) Explain the definition of an automatic control system. (6 marks)
- (b) (i) List the **FOUR (4)** basic functions that occurs in any automatic control system. (4 marks)
- (ii) Give **ONE (1)** example of control system that comprise the basic function in Q4(b)(i). (2 marks)
- (c) (i) Determine **THREE (3)** functional elements needed to perform the functions of an automatic control system. (3 marks)
- (ii) With the help of block diagram, demonstrate the three listed functional elements in Q4(c)(i) on how it performs the operation. (5 marks)
- Q5** (a) Pressure sensor is a most commonly used device in plant. List **FIVE (5)** types of pressure sensor used in transmitter. (5 marks)
- (b) Demonstrate how the pressure sensor works starting from the sensor sense the applied pressure until it transmits the signal to DCS/PLC. (5 marks)

- (c) There are several factors that affect the flow measurement. Discuss in detail how the density and viscosity of the fluid influence the flow measurement. (5 marks)
- (d) Analyse in detail **TWO (2)** factors that influence the pressure of liquid at any point under the liquid surface when it remains at rest in a vessel. (5 marks)

-END OF QUESTIONS-

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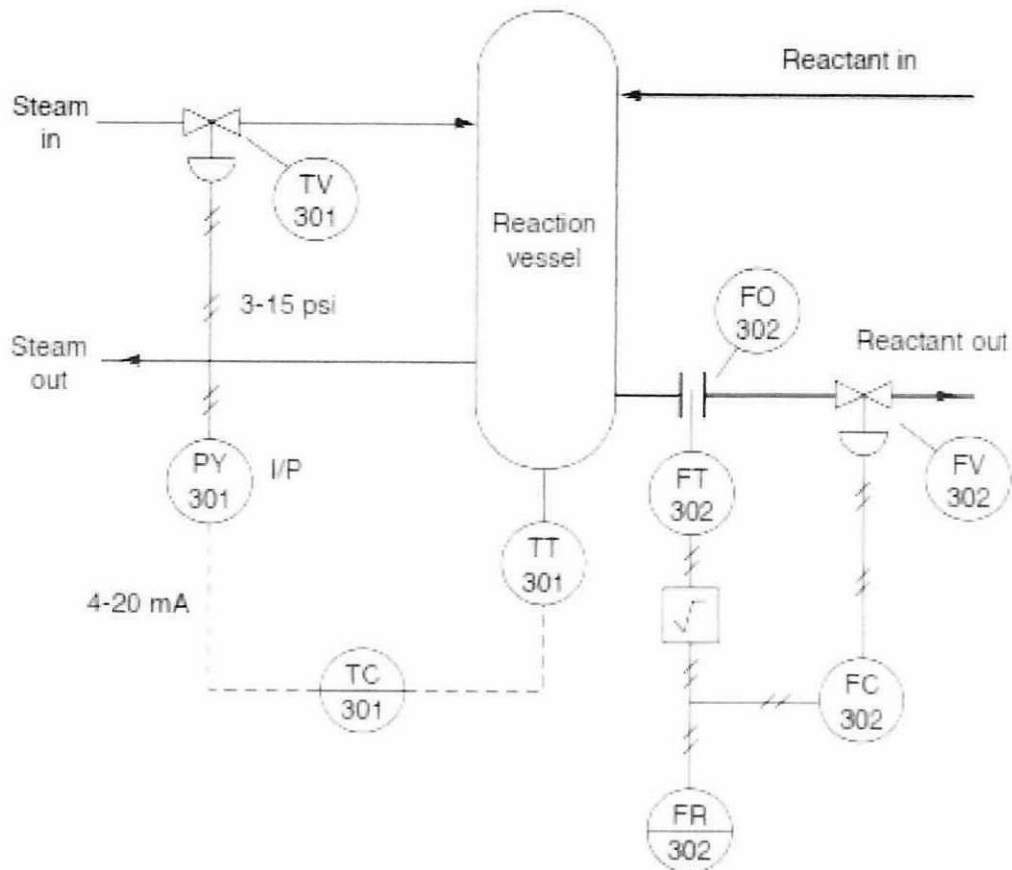


Figure Q1(b)

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PRESSURE CONVERSION TABLE

PSI	ATM	kgf/cm ²	in.H ₂ O	mmHg	in.Hg	Kpa	Bar	mm H ₂ O
1	0.068046	0.070307	27.7276	51.715	2.03602	6.895	0.6895	704.28104
14.696	1	1.0332	407.484	760	29.921	101.325	1.01325	10350.0936
14.2233	0.96784	1	394.38	735.559	28.959	98.096	0.98067	10000
0.036092	0.002454	0.00253	1	1.8651	0.07343	0.249	0.00249	25.4
0.019336	0.001315	0.001359	0.53616	1	0.03937	0.1333	0.001333	13.618464
0.491154	0.0033421	0.03453	13.6185	25.4	1	3.3864	0.033864	345.9099
0.145	0.00987	0.010197	4.0186	7.5006	0.2953	1	0.01	102.07244
14.5038	0.98692	1.01972	402.156	750.062	29.53	100	1	10214.7624

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