SET A



# UNIVERSITI KUALA LUMPUR Malaysia France Institute

# FINAL EXAMINATION

## **SEPTEMBER 2013 SESSION**

SUBJECT CODE	:	FAB38204
SUBJECT TITLE	:	INDUSTRIAL INSTRUMENTATION
LEVEL	:	BACHELOR
TIME / DURATION	:	( 3 HOURS )
DATE	:	

## INSTRUCTIONS TO CANDIDATES

- 1. Please read the instructions given in the question paper CAREFULLY.
- 2. This question paper is printed on both sides of the paper.
- 3. Please write your answers on the answer booklet provided.
- 4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
- 5. This question paper consists of Two(2)Section. Answer All questions in section A. For section B answer Two(2) only
- 6. Answer all questions in English.

THERE ARE8 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

#### **SECTION A (Total: 60 marks)**

INSTRUCTION: Answer all questions. Please use the answer booklet provided.

### **Question 1**

(a) A result from bullet shooting is at **Figure 1**. In the middle is the target. Describe the best performance and explain each situation on A, B and C





(b) An engineer would like to build signal conditioning circuit which uses strain gauge connected with microcontroller. Figure 2 is the circuit diagram of the signal conditioning circuit.



Figure 2: Circuit Diagram of Signal Conditioning Circuit

i.	Determine the type of bridge is strain gauge connected to in the circuit			
		(2 marks)		
ii.	Determine the function of amplifier LM741 react.			
		(2 marks)		
iii.	ISL261902 act as a 4 bit ADC, State all possible output from this			
	ADC.	(3 marks)		
i.	If the strain gauge resistance is 350 $\Omega$ , calculate voltage across the st	rain		
	Gauge and state whether the bridge is balanced or not.			
		(3 marks)		

#### **Question 2**

- (a) Define what is industrial instrumentation and give three(3) devices under industrial instrumentation
  (5 marks)
- (b) Explain the difference for these standards: International standards, working standards and National standards. Do give examples of each organization for National and international standard (6 marks)
- (c) The following **Table 1** represents a meter output in terms of output voltage from an experiment. The actual voltage reading is 8V. Answer all the questions below by referring **Table 1**

No of reading	Output voltage
1	7v
2	7.9v
3	7v
4	7.8v
5	7.9v

Table 1	:	Output	Value	in	voltage
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i. Calculate the absolute error, % error, relative accuracy, and % accuracy for each reading. (6 marks)

ii.	Calculate the average value.	(2 marks)
iii.	Calculate the precision for reading no 2 and no 4	(3 marks)
iv.	Determine the most accurate reading from all the measurement.	(2 marks)

(d) A thermocouple is used to measure temperature. The cool junction was let open to the air while the hot junction is connected to a heated liquid. The thermocouple wired is connected to a voltmeter. The reading from the voltmeter is 4.095. As a reference, the air temperature in the room is 26 °C and ice temperature is 0 °C. Calculate the exact measured temperature of the heated liquid. The datasheet of thermocouple is at Figure 3

°C	0	1	2	3	4	5	6
0	.000	.039	.079	.119	.158	.198	.238
10	.397	.437	.477	.517	.557	.597	.637
20	.798	.838	.879	.919	.960	1.000	1.041
30	1.203	1.244	1.285	1.325	1.366	1.407	1.448
40	1.611	1.652	1.693	1.734	1.776	1.817	1.858
50	2.022	2.064	2.105	2.146	2.188	2.229	2.270
60	2.436	2.477	2.519	2.560	2.601	2.643	2.684
70	2.850	2.892	2.933	2.975	3.016	3.058	3.100
80	3.266	3.307	3.349	3.390	3.432	3.473	3.515
90	3.681	3.722	3.764	3.805	3.847	3.888	3.930
100	4.095	4.137	4.178	4.219	4.261	4.302	4.343
110	4.508	4.549	4.590	4.632	4.673	4.714	4.755
120	4.919	4.960	5.001	5.042	5.083	5.124	5.164
130	5.327	5.368	5.409	5.450	5.490	5.531	5.571
140	5.733	5.774	5.814	5.855	5.895	5.936	5.976
150	6.137	6.177	6.218	6.258	6.298	6.338	6.378
160	6.539	6.579	6.619	6.659	6.699	6.739	6.779
170	6.939	6.979	7.019	7.059	7.099	7.139	7.179
180	7.338	7.378	7.418	7.458	7.498	7.538	7.578
190	7.737	7.777	7.817	7.857	7.897	7.937	7.977

Figure 3 : Thermocouple chart

(4 marks)

## SECTION B(40 marks) Answer TWO questions only

Please use the answer booklet provided.

### **Question 3**

(a)	Figure 4 is a P&ID drawing of chemical process. Answer the question below

i.	Name the exact equipment/device of g, d, c.	
		(3 marks)
ii.	Determine the type of valve ${f b}$ and ${f e}$ .	(2 marks)
iii.	Determine the type of line at <b>h</b> and the meaning of <b>I/P</b> symbol a	it <b>a.</b>
		(2 marks)
iv.	Explain the different between of <b>TT</b> and <b>TC</b> .	(2 marks)
V.	If the system is control using PLC, draw <b>PLC</b> symbol.	(2 marks)
vi.	Explain why all the valve are numbered such as V-4, V-5.	(2 marks)
vii.	If <b>TK-10</b> is a heated tank, a safety valve should be located at the symbol of cofety valve	ne tank. Draw
		(Z marks)



Figure 4 : P&ID drawing of chemical process

(b) Based on Figure 5, an engineer would like to INVERT the original signal ,then amplify the signal ten(10) times from the original signal and lastly filter the low frequency noise at 10Mhz. Draw the signal conditioning circuit



Figure 5 : Flow circuit diagram

(5 marks)

#### **Question 4**

A plant is build based on Liquid A process. The process includes boiling and fermentation. The process starts by using steam jacket to boil the Liquid A, which sterilizes the liquid. Next, Liquid A is pumped into a filter where impurities are removed. Liquid A is then cooled to 15 degrees C, using a heat exchanger. Once it is cooled, it is sent to the fermentation tank, where it is a close vessel for 2 days. Here yeast is added, which metabolizes sugar in the liquid into alkali and carbon dioxide. After a couple days, Liquid A is sent to open tank before it is clarified and bottled. A temperature transmitter is located at the steam jacket and a level transmitter and a level indicator were attached to the open tank. A PLC is use to control the opening of control valve after the steam jacket which the feedback came from the temperature transmitter.

Draw the P&ID drawing based on the operation given and include also safety and maintenance valve, drain valve at proper location

(20 marks)

#### **Question 5**

- (a) Sensor calibration is an important task before fitting them into a system. An engineer would like to install a pressure sensor range (0 to 200 bar) in a plant correspond with the output of 4 to 20mA current.
  - i. Determine the equipment to do pressure calibration.

(4 marks)

ii. Elaborate the calibration using 5 points method up down calibration.

(4 marks)

iii. A hysteresis error occurred during the calibration. Elaborate what and why is it happen.

(3 marks)

iv. If the pressure is 10 bar, identify the current output.

(2 marks)

v. After the calibration process, the engineer finds out that the sensor is still not linear (where the output pressure and the current output are not linear), determine the next step on what should the engineer do next.

(2 marks)

vi. Give two(2) consequences if the sensor is not linear when applied to a high power station such as a nuclear power station

(2 marks)

(b) Elaborate the operation of universal circular chart as in Figure 6 briefly.



Figure 6 : Universal Circular Chart

(3 marks)

### **Question 6**

 (a) i. Cavitation is one of valve problem. Explain what is cavitation in the liquid flow inlet and outlet of the valve in Figure 7.

(4 marks)



Figure 7 : Liquid Flow in a valve

ii. How to overcome cavitation ?

(2 marks)

- (b) Refer Figure 8 for this question.
- i. Elaborate the operation of double seat globe valve.

(4 marks)

(3 marks)

ii. Determine the reason of using double seat valve instead of single seated valve

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Figure 8: Liquid Flow in a valve

- iii. Globe valve is use for throttling and gate valve suitable for tight shut-off. Elaborate what does it means with throttling and shut-off. You may use any example application or Sketching. (3 marks)
- iv. Material selection and Flow capacity are among the selection criteria on choosing valve. Elaborate them.

(4 marks)

