



**UNIVERSITI KUALA LUMPUR**  
**Malaysia France Institute**

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**FINAL EXAMINATION**  
**SEPTEMBER 2014 SESSION**

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**SUBJECT CODE** : FAB38204  
**SUBJECT TITLE** : INDUSTRIAL INSTRUMENTATION  
**LEVEL** : BACHELOR  
**TIME / DURATION** : 2.00 PM – 5.00 PM  
( 3 HOURS )  
**DATE** : 5 JANUARY 2015

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**INSTRUCTIONS TO CANDIDATES**

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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 Sections. Answer All questions in section A. For section B answer Two(2) only
  6. Answer all questions in English.
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**THERE ARE 9 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.**

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

**INSTRUCTION: Answer all questions.**

**Please use the answer booklet provided.**

**Question 1**

(a) The following **Table 1** represents a meter output in terms of output voltage from an experiment. The actual voltage reading is 10.5 V. Answer all the questions below by referring **Table 1**

**Table 1:** Output Value in voltage.

No of reading	Output voltage
1	10v
2	10.4v
3	10v
4	10.8v
5	10.4v

- (i) Calculate the absolute error, % error and % accuracy for each reading. (4 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)
- (b) International Standard is defined by International Agreement represent the closest possible accuracy attainable by the current science and technology. Name another three (3) standards. (3 marks)
- (c) List 3 type error that could happen during a measurement is taken. (3 marks)

**Question 2**

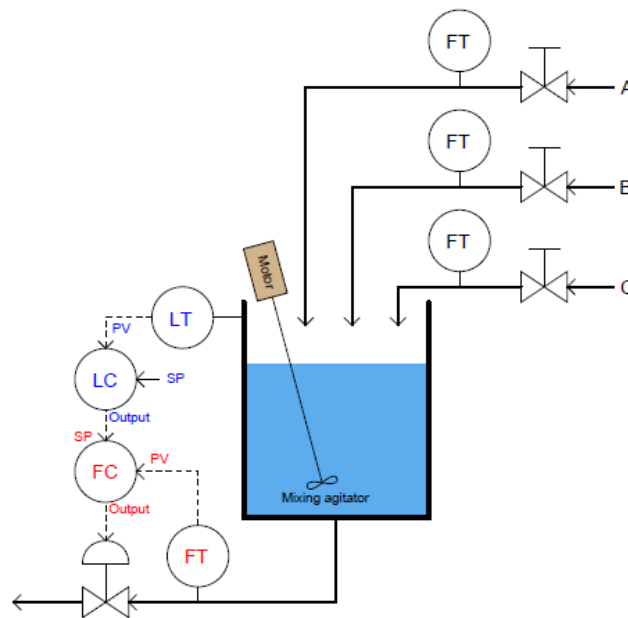
(a) There are Several Industrial Controller such as Programmable Logic Controller ( PLC ) Distribute Control System ( DCS ) and Programmable automation controller( PAC ).

(i) Define DCS (2 marks)

(ii) Give 2 advantages of DCS (3 marks)

(iii) Give 3 criteria on selecting a suitable controller in the industry. (3 marks)

(b) One type of control is cascade control. Describe cascade control and explain base on example on **Figure 1**



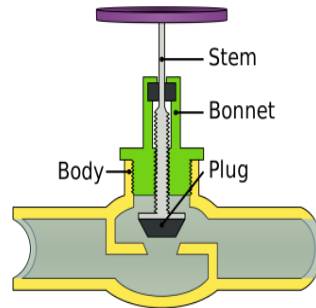
**Figure 1:** Cascade control

(5 marks)

**Question 3**

(a) **Figure 2a** and **Figure 2b** are manual valve

- (i) Name Each type of valve
- (ii) Describe the operation of each valve



**Figure 3a:** manual valve



**Figure 3b:** manual valves

(6 marks)

(b) Select a suitable valve based on the application below :

- (i) This valve is use to fully open and fully shut of the gas flow in a pipe.
- (ii) Valve for throttling.
- (iii) A valve for quick opening.
- (iv) A valve for safety to release the air pressure
- (v) Valve that allows one way direction.

(10 marks)

- (c) Cavitations as in **Figure 3** will cause wear and tear to valves.

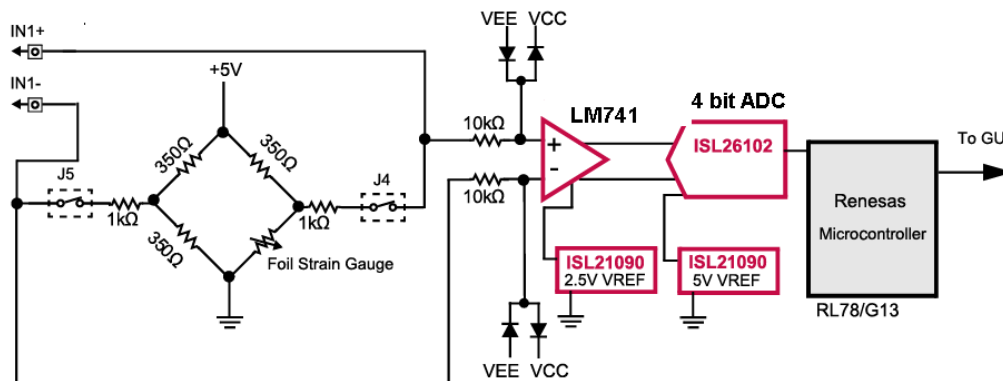


**Figure 3:** Cavitations

- (i) Describe one factor cavitation could appear on valves (2 marks)
- (ii) Determine One ( 1 ) solution to reduce the problem. (2 marks)

**Question 4**

- (a) An engineer would like to build signal conditioning circuit which uses strain gauge connected to a microcontroller. **Figure 4** is the circuit diagram of the signal conditioning circuit.



**Figure 4:** Circuit Diagram of Signal Conditioning Circuit

- (i) Determine the type of bridge connected to the strain gauge (2 marks)
  - (ii) Determine the function of amplifier LM741. (2 marks)
  - (iii) ISL261902 act as a 4 bit ADC with 5v voltage supply. Determine the voltage input if the digital output is 0111 (3 marks)
- (b) Name any three(3) signal conditioning block diagram in the DC power supply unit. (3 marks)

**PART B(Total:40 marks)**  
**Answer TWO questions only**

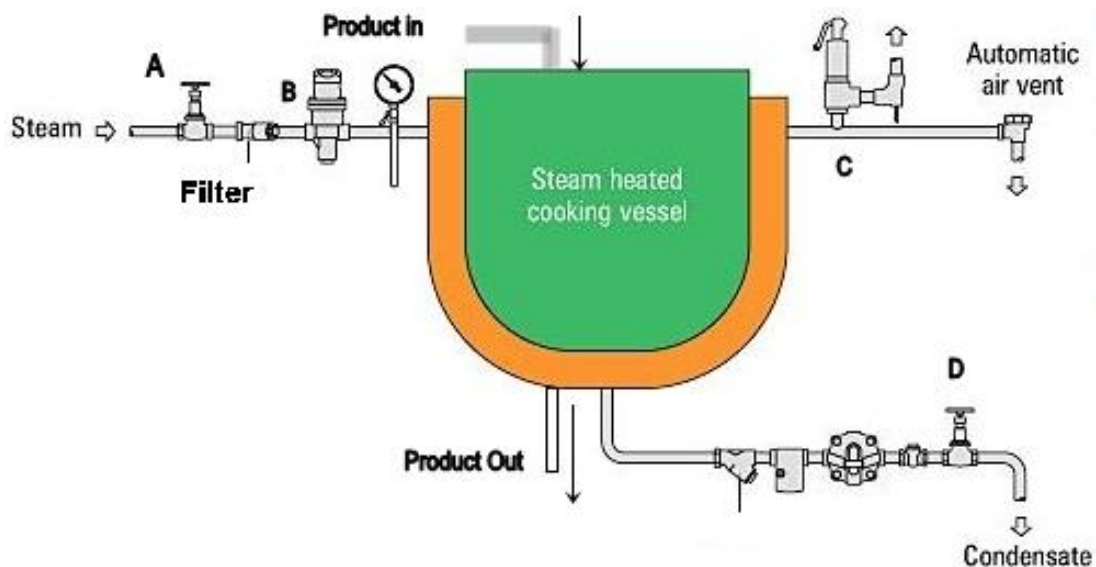
**Please use the answer booklet provided.**

**Question 5**

(a) **Figure 5** is a close steam jacket cooking vessel. A temperature sensor is placed in the cooking vessel and a flow sensor is connected at the inlet pipe to the steam jacket. A mixer is used to mix the product. The end product will flow out and place in a close tank. A, D are manual ball valve, B is control valve and C is a manual valve. The steam is pumped into the vessel and control by valve B. Centrifugal Pumps are located at the inlet and outlet of the steam jacket. The access steam in flow back to a suitable close vessel. A pressure relief valve is located at the close vessel. A temperature sensor is attached in the cooking vessel to control valve B. The actuator to control the opening of the valve is an electric actuator with 4 to 20mA control current. The system is control using a temperature controller.

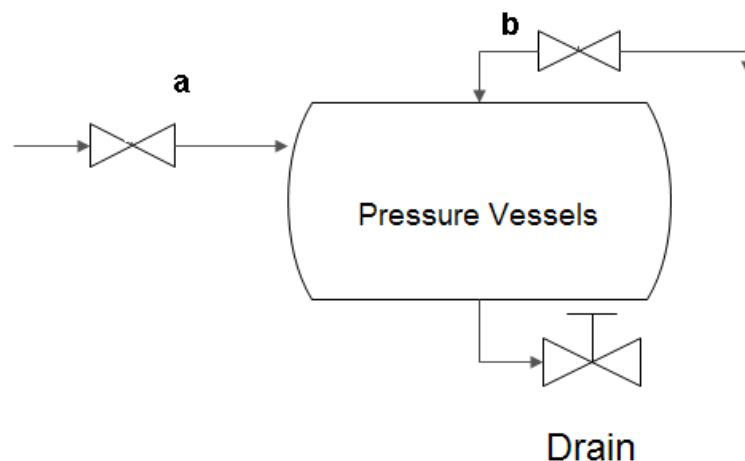
(i) Design the P&ID drawing for above application. (8 marks)

(ii) Draw safety valve, manual valve for maintenance at suitable place in the diagram. (4 marks)



**Figure 5:** Steam Jacket Cooking Vessel

- (b) As a safety precaution, a Fail to Open (FO) and Fail to Close valve (FO) is installed at the inlet and outlet of a pressure vessel at **Figure 6**. The pressure vessel contained high pressure steam. Both valves are electric valve.
- i. Draw the arrow of safety valve at **a** and **b**. (2 marks)
  - ii. Name whether the valve is Fail to Open ( FO ) or Fail to Close valve ( FC ). (2 marks)
  - iii. Explain the function of valve the suddenly there is electric power failure. (4 marks)

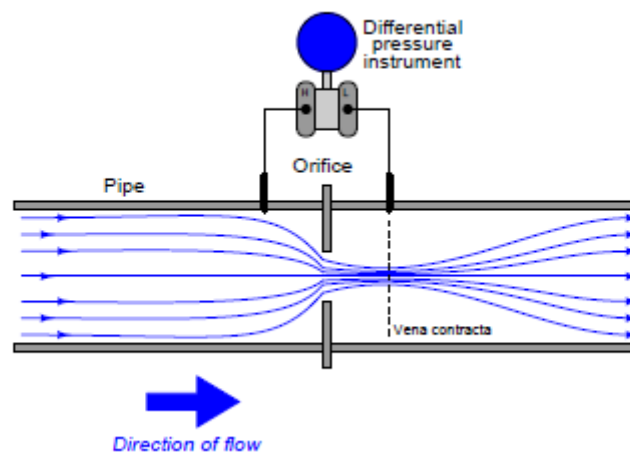


**Figure 6:** Pressure Vessel

**Question 6**

- (a) One way to measure flow is to measure the pressure difference between the inlet and outlet of the pressure from an obstruct material as in **Figure 7**. Answer the question below:
  - i. Calculate the value of flow if the area of the pipe is a 4 in. diameter and the average velocity of the flow in the pipe is 20 in. per second. (2 marks)
  - ii. Explain the operation of this type of flow meter and give one(1) advantage and one(1) disadvantage of this flow sensor. (4 marks)

- iii. Name 3 type of flow sensors under the category of differential pressure measurement. (3 marks)
- iv. Determine the most suitable flow sensor for high flow and high accuracy application such as in the water tunnel. (3 marks)
- v. **Table 2** is the flow meter datasheet. If the flow meter is calibrated for 0 to 50 GPM , calculate the voltage output if the flow is 14 GPM. (2 marks)
- iv. If the flow reading full scale reading is 50 GPM, what would be the true reading range . (2 marks)
- v. What would be the voltage output If there is a temperature occurred in the system for about 15 °C. (2 marks)
- vi. Determine whether this flow sensor is suitable to measure flow for hot water. Justify your answer (2 marks)



**Figure 7:** Flow Sensor

**Table 2:** Flow Transmitter datasheet

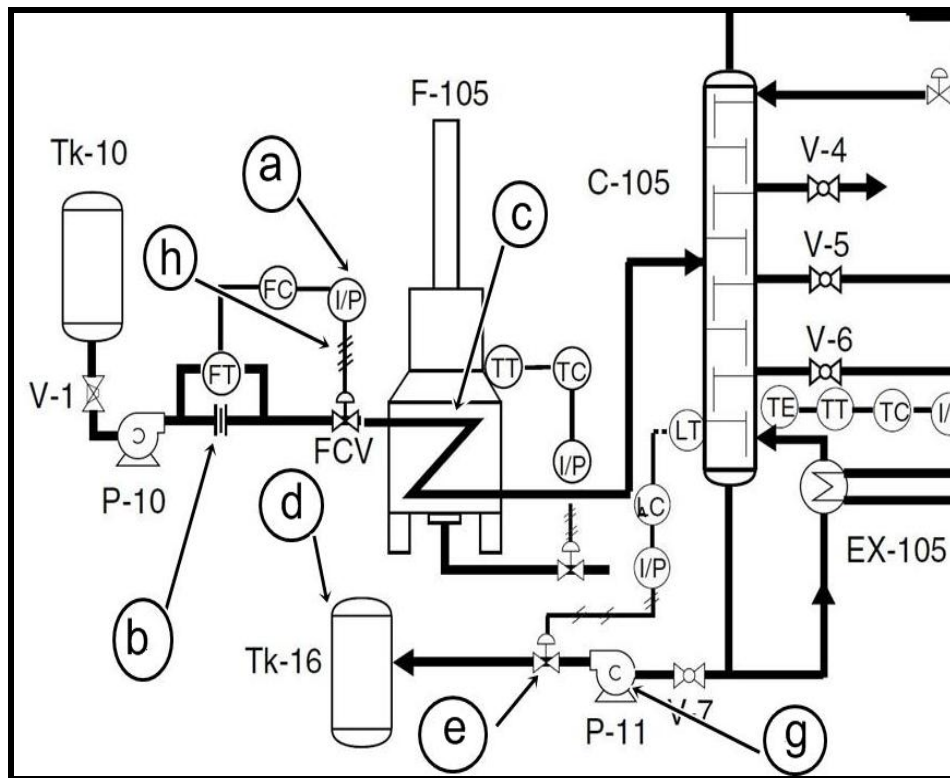


Accuracy	$\pm 2\%$ of the full scale reading
Output	0 to 10V
Flow	0 to 100 GPM ( gallon per minute )
Temperature sensitivity	10uV/ 1°C temperature

### Question 7

(a) **Figure 9** is a P&ID drawing of a chemical process. Answer the question below

- i. Name the exact equipment/device of **g, d, c.** (3 marks)
- ii. Determine the type of valve **b** and **e** . (2 marks)
- iii. Determine the type of line at **h** and the meaning of **I/P** symbol at **a.** (2 marks)
- iv. Determine the different between of **TT** and **TC.** (2 marks)
- v. If the system is control using PLC, draw **PLC** symbol. (2 marks)
- vi. If **TK-10** is a heated tank, a safety valve should be located at the tank. Draw the symbol of safety valve. (2 marks)



**Figure 8:** P&ID drawing of chemical process

- (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 20psi ) in a plant correspond with the output of 4 to 20mA current.
- i. Determine the equipment to do pressure calibration. (2 marks)
  - ii. Elaborate the calibration using 3 points method up down calibration. (5 marks)