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CONFIDENTIAL

SET B

# UNIVERSITI KUALA LUMPUR
## Malaysia France Institute

## FINAL EXAMINATION

## JANUARY 2011 SESSION

| | | |
|---|---|---|
| SUBJECT CODE | : | FAD 10102 |
| SUBJECT TITLE | : | SENSOR TECHNOLOGY |
| LEVEL | : | DIPLOMA |
| TIME / DURATION | : | 12.30pm – 2.30pm<br>( 2 HOURS ) |
| DATE | : | 09 MAY 2011 |

### 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) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) question only.
6. Answer all questions in English.

THERE ARE 9 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

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

**INSTRUCTION: Answer ALL questions.**
**Please answers all in answer booklet provided.**

**Question 1**

(a) State the difference between transducer and sensor and give **one (1)** example for each of them.

(4 marks)

(b) Data acquisition is the process of sampling signals that measure the real world physical conditions to generate data that can be manipulated by a computer (DAQ or DAS). Define **four (4)** basic components when building a data acquisition system and state the function of each component.

(4 marks)

(c) Limit switch is one type of position sensor that is widely used in industrial control devices and consumer electronic products. Give **two (2) advantages** and **two (2) disadvantages** of using limit switch.

(4 marks)

(d) Give **three (3)** differences between limit switch and Reed switch in pneumatic cylinder application.

(3 marks)

**Question 2**

(a) Explain the difference between inductive and capacitive proximity sensor. Discuss in term of sensing element, material detection ability and oscillator amplitude condition when target approach and move away from the sensor.

(6 marks)

(b) Define the term **Nominal Sensing Distance** and **Usable Sensing Distance** for proximity sensor.

(2 marks)

(c) List **two (2)** considerations on choosing a proximity sensor.

(4 marks)

(d) For each selected sensor in **Table 1,** find the standard target size (length x width x thickness) to be detected.

**Table 1 : Type of Proximity Sensor**

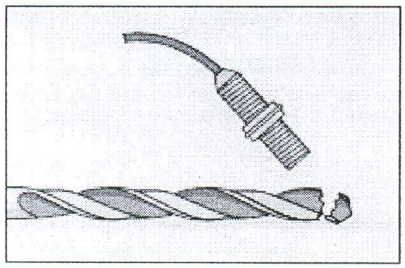
| No | Sensor Model | Type | Sn | Diameter |
|---|---|---|---|---|
| a) | XS1-N18PA340 | Inductive | 5mm | 18mm |
| b) | XS1-N18PA349 | Inductive | 10mm | 18mm |
| c) | XS2-N18PA340 | Inductive | 8mm | 12mm |

(3 marks)

**Question 3**

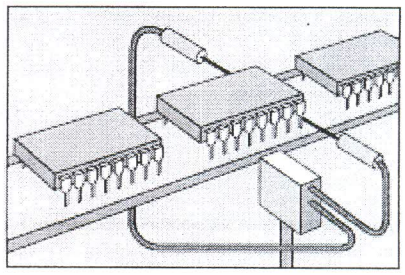
(a) (Select the most suitable sensor for applications in **Figure 1.**

i.



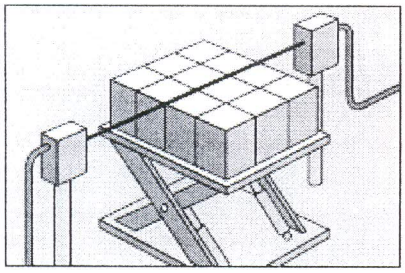
**Application:** Detecting the presence of a broken drill bit

ii.



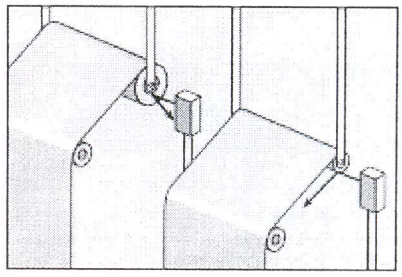
**Application:** Counting IC chip pins

iii.



**Application:** Controlling height of stack

iv.



**Application:** End of roll detection

**Figure 1**: Sensor applications

(4 marks)

(b) Photo electric sensor has been used to replace the proximity sensor in certain application. State **one (1)** advantage of using photo electric sensor compared to proximity sensor.

(1 mark)

(c) List the basic compositions of the photoelectric sensor and draw a simple PNP photoelectric sensor wiring for 3 wires.

(4 marks)

(d) Briefly explain the operating principle of Reflex photoelectric sensor.

(4 marks)

(e) Suggest **one (1)** type of sensor that suitable in polluted environment.

(2 marks)

**Question 4**

(a) Thermocouple is a type of analogue temperature sensor that converts temperature to voltage. Explain briefly the operation of thermocouple.

(3 marks)

(b) Resistance Temperature Detector (RTD) is another type of temperature sensor with the purpose of detects a change in a physical parameter that corresponds to a temperature change. Define the most difference between RTD and thermocouple.

(2 marks)

(c) Determine the resistance of a platinum RTD at 90°C if the resistance at 20°C is 145.5 Ω and if $\alpha$ (20°C) = 0.00392

(3 marks)

(d) State **three (3)** function of using an Op-Amp circuit.

(3 marks)

(e) **Figure 2** shows one type of pressure sensor. Name the sensor and describe its functionality.

(4 marks)

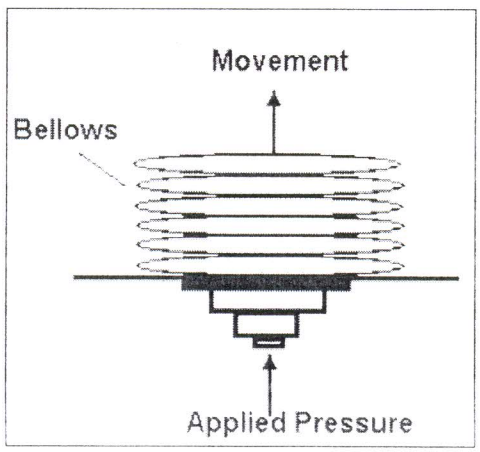



**Figure 2 :** Pressure sensor

**SECTION B (Total: 40 marks)**

**INSTRUCTION: Answer TWO (2) questions only.**

**Please answers all in answer booklet provided.**

**Question 5**

(a) **Figure 3** is where turbine flow sensor is used to measure flow. Answer the following questions based on this figure.

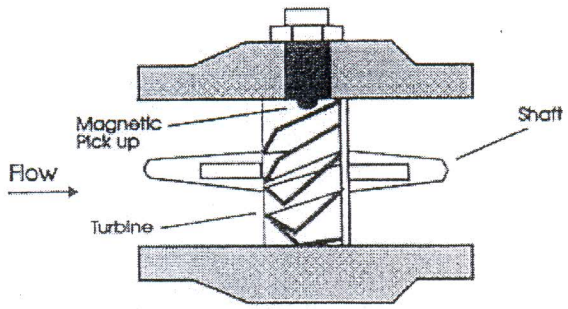



**Figure 3:** Turbine flow sensor

i. State **three (3)** considerations when choosing a flow sensor.

(3 marks)

ii. If the output from the flow sensor is from **0 to 105ft**/s corresponds to **-10V to 10V** output, determine the flow if the voltage output is -5V.

(4 marks)

iii. If the output of flow sensor connects to a 8 bit Analog to Digital converter (A to D converter) and the full scale value is 10V, find resolution of A to D converter

(4 marks)

(b) A Robot Arm is being engaged directly to absolute optical encoder with the output bit as in **Figure 4**.

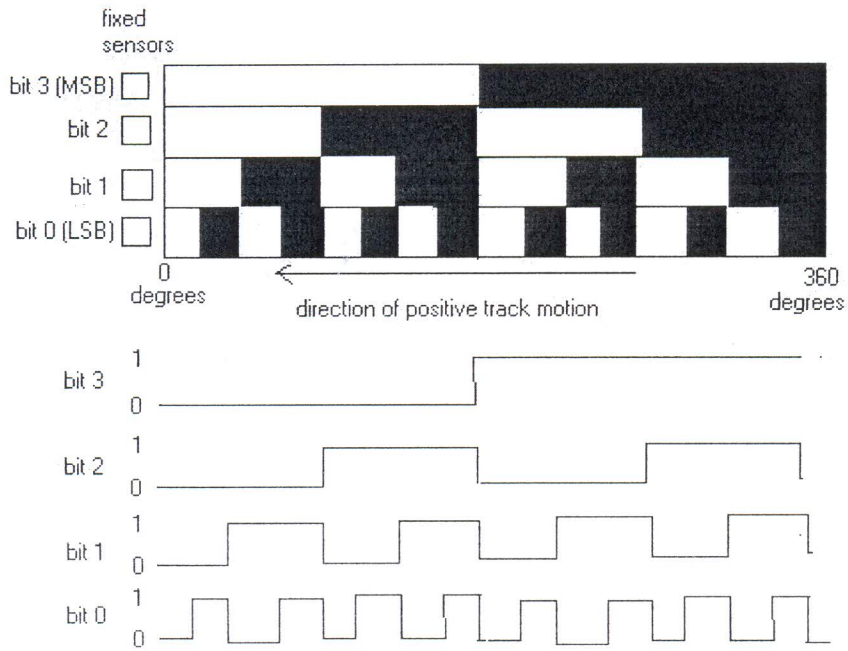



**Figure 4:** 4-Bit binary code absolute encoder disk track pattern

i. Calculate the angle of each sector of the disc.

(4 marks)

ii. Give **one (1)** advantage of using absolute encoder rather than incremental encoder.

(2 marks)

iii. State between three bits or four bits encoder, which of these two gave more precise output. Justify your answer.

(3 marks)

## Question 6

(a) **Figure 5** shows an automatic single head capping processing line. Answer the following questions based on this figure.

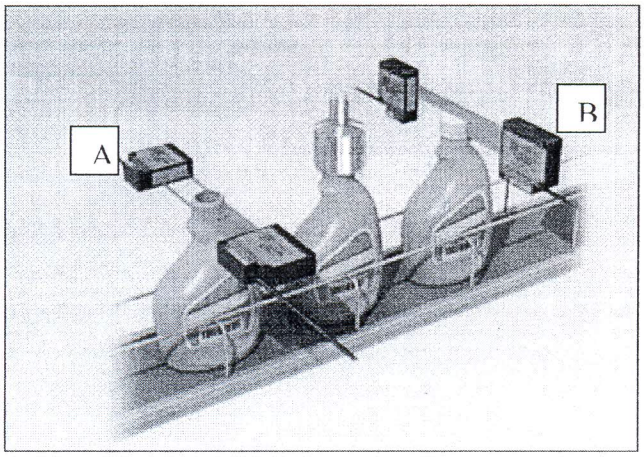



**Figure 5:** Head capping production line

i. Sensor A will detect the diameter of bottle-neck before adding the caps onto bottle, while sensor B will detect the cap tightness by detecting its height. Propose a type of sensor that can be used in the place of sensor A and sensor B. Justify your answer.

(6 marks)

ii. An upgrade will be done in the system. We want to add sensor C to detect the liquid level inside the bottle which is made from plastic. Suggest a type of sensor that can be used as sensor C and give your reason.

(4 marks)

(b) **Figure 6** below shows a summing amplifier circuit. Calculate the output voltage Vo if RA = 100, RB = 200, Rf = 600, VA = 10v and VB = -5 V.

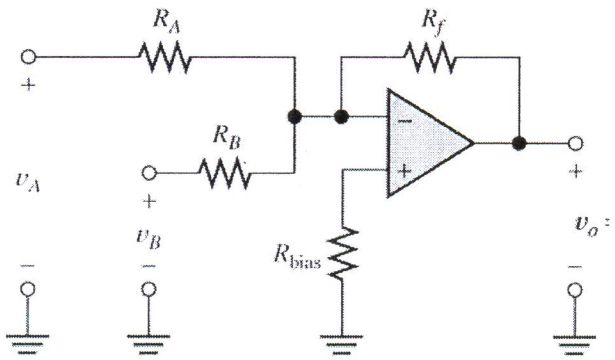



**Figure 6**: Summing Amplifier Circuit

(4 marks)

(c) **Figure 7** is a voltage versus temperature curves for type E,J,K and R thermocouples.

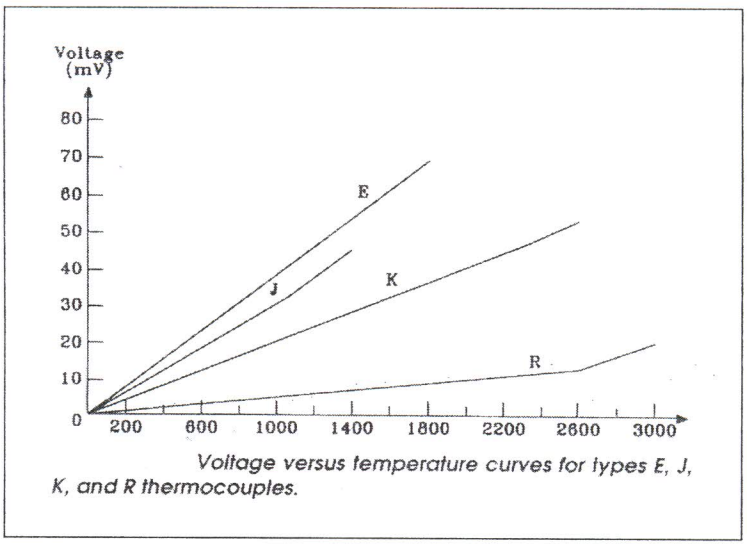



**Figure 7**: Voltage versus temperature curves for type E,J,K and R

i. Explain the difference between type R and type K

(4 marks)

ii. 'The system is to measure a 500°C material and to be used in low oxygen condition. The worker need to ensure that there is no sulfur exposed in the environment.' Based on the graph shown in **Figure 7** and the characteristic of each type, choose a suitable type of thermocouple for this application.

(2 marks)

**Question 7**

(a) Draw the control wiring circuit based on the explanation below:

- When we push either start button 1 (ST1) or start button 2 (ST2), Contactor 1 (KM1) will energize.
- At the same time green light (LG) will ON.
- When the proximity sensor (S1) detects one object, KM1 and green light will OFF. But Contactor 2 (KM2) will energize and red light (LR) will ON
- The operation will stop when we push the stop button (STOP)

***Note:*** *Don't forget to insert the self holding circuit/latching using relay (KA1)*

(10 marks)

(b) **Figure 8** shows Wheatstone bridge application with tank level transmitter system.

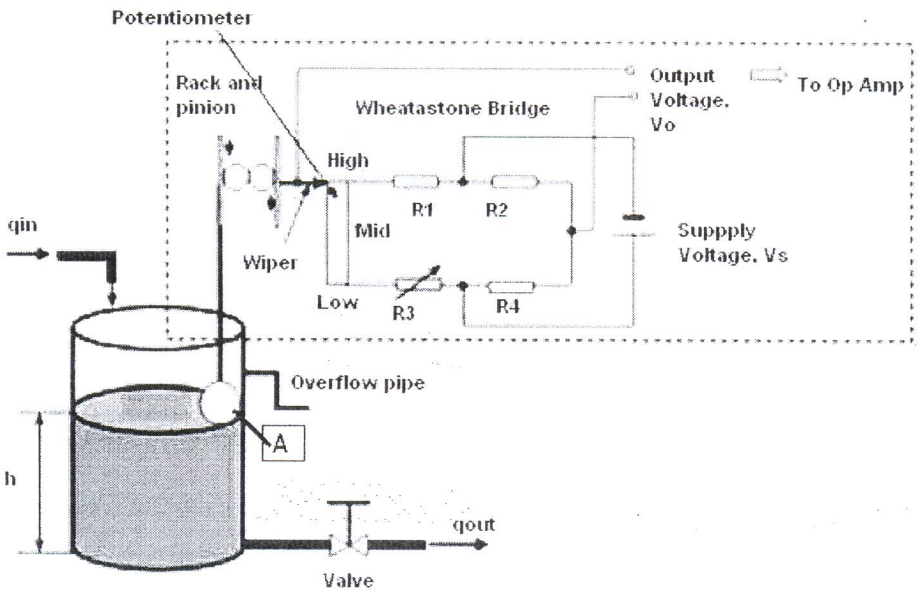



**Figure 8:** Tank Level System Control

i. State type of level sensor A.

(2 marks)

ii. If the Wheatstone bridge nulls with R1 = 1000 Ω , R2 = 842 Ω and R3 =500 Ω , find the value of R4.

(4 marks)

iii. A tank holds water with a depth of 7.0 ft. Calculate the pressure at the tank bottom in psi.

(2 marks)

iv. Give **two (2)** example of Wheatstone bridge application in industrial environment.

(2 marks)

END OF QUESTION