



UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2009 SESSION

SUBJECT CODE : FAD10102
SUBJECT TITLE : SENSOR TECHNOLOGY
LEVEL : DIPLOMA
TIME / DURATION : 3.00pm – 5.00pm
(2 HOURS)
DATE : 30 APRIL 2010

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 8 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) There are four basic functions that occur in any automatic control system. State all of them in correct order
(4 marks)
- (b) Briefly describe open loop and close loop control system and state two (2) disadvantages of using the open loop control system
(6 marks)
- (c) State the basic composition of a Photoelectric sensor and explain two method of detection for this sensor
(4 marks)
- (d) The distance (d) between the object and the sensor is 7mm. Which of the following sensor(s) in **Table 1** is the most suitable to detect the object?
(6 marks)

Table 1: Type of Proximity Sensor

No	Sensor	Type	Sn	Specification
1	XS1-N18PA340	Inductive	5mm	3-wire, PNP, NO contact Supply voltage : 12....24V
2	XS1-N18PA349	Inductive	10mm	3-wire, PNP, NO contact Supply voltage : 12....24V
3	XS2-N18PA340	Inductive	8mm	3-wire, PNP, NO contact Supply voltage : 12....24V

Question 2

(a) Describe **three (3)** differences between Limit switch and Reed switch in pneumatic cylinder application (6 marks)

(b) State the difference between transducer and sensor and give **one (1)** example for each them (4 marks)

(c) Find the target size (length x width x thickness) for selected sensor below:

Sensor diameter: **24 mm**
 Nominal Sensing Distance, S_n : **5 mm**

(2 marks)

(d) Calculate the resistance value **R1** for non inverting amplifier in **Figure 1**. Given input voltage $V_{in} = 4V$, resistor $R_2 = 300k\Omega$ and output voltage $V_{out} = 15V$.

(4 marks)

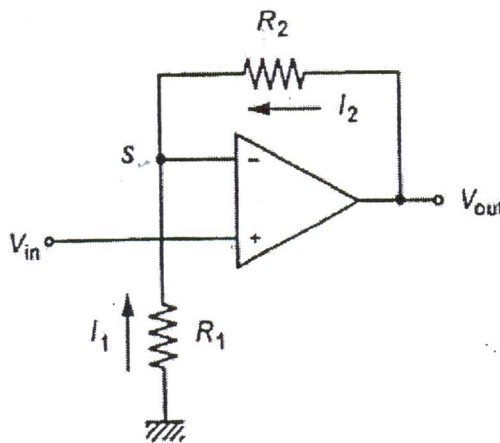


Figure 1: Non-Inverting Amplifier

(e) State the difference between non-inverting and inverting amplifier (4 marks)

Question 3

- (a) Determine the resistance of platinum RTD at 70°C if the resistance at 20°C is 160 Ω and if α (20°C) = 0.00392 (4 marks)
- (b) Select the most suitable sensor for applications in **Figure 2**. (4 marks)

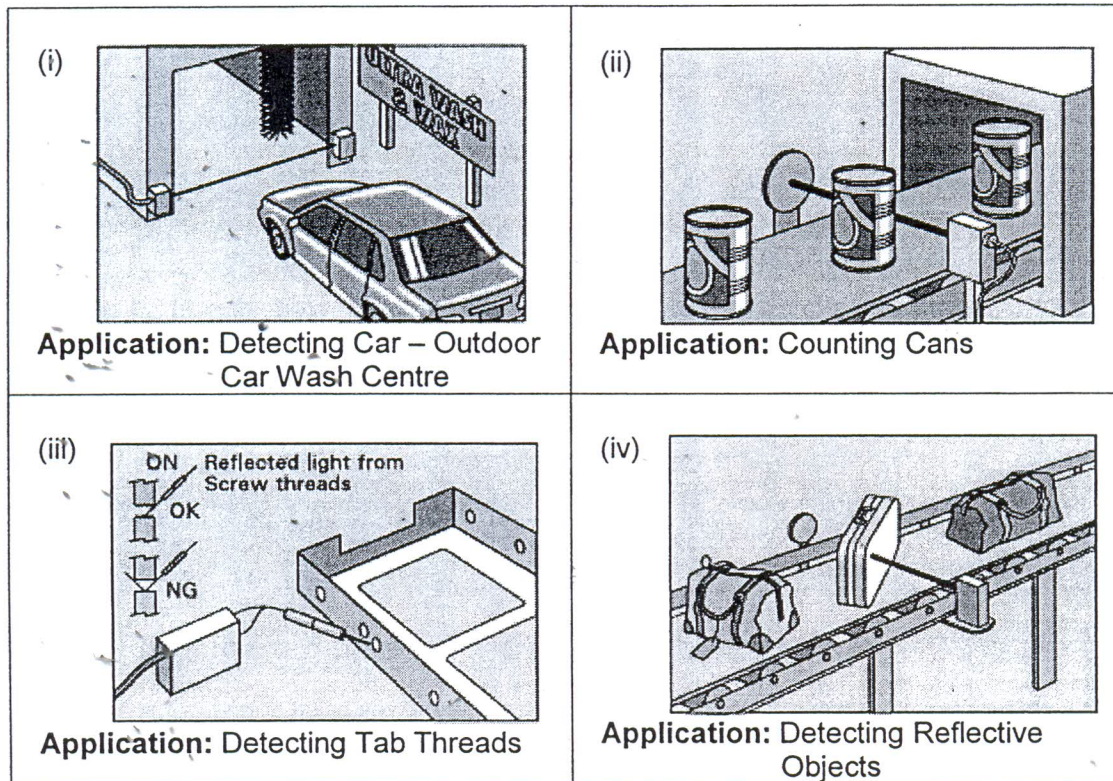


Figure 2: Sensor Applications

- (c) Describe a difference between 'Snap Action' and 'Slow Break' in Limit switch applications (4 marks)

(d) Complete the wiring circuit for the 3-wire sensors (DC type) in **Figure 3**.

(2 marks)

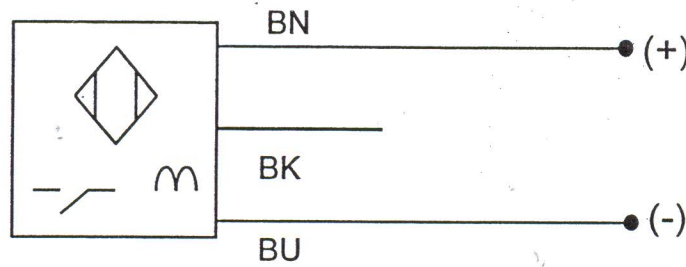


Figure 3: PNP (or Current Sourcing or Positive-Switching)

(e) Complete the sentences below with the appropriate answer.

- i. A _____ sensor can measure the longest sensing distance
- ii. The _____ refer to condition of output state is 'ON' when receiver not received light beam
- iii. The _____ pressure sensor is used to measure pressure less than the atmospheric pressure at a given location
- iv. _____ is a device for regulating the temperature of a system so that the system's temperature is maintained near a desired setpoint temperature.

(4 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer TWO (2) questions only.

Please answers all in answer booklet provided.

Question 4

(a) **Table 2** is the approximate reduction factor for metals

- i. Calculate the actual sensing distance for all the three metals in **Table 2** for a proximity sensor with sensing distance, $S_n = 8\text{mm}$ (3 marks)
- ii. Why Mild steel material have better sensing distance compare to the other two materials? State your reason. (2 marks)

Table 2: Reduction Factor

Material	Approximate Reduction Factor
Mild Steel	1.00
Copper	0.30
Stainless Steel	0.85

(b) Draw the control wiring circuit base 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 limit switch (LS) detect 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)

(15 marks)

Question 5

A process plant utilizes analog sensors to measure some input variable. Sensor 1 is a temperature sensor connected to **0-10V** analog input module, sensor 2 is a pressure sensor with a current output **4-20 mA** and sensor 3 is a level sensor connected to **-10V to 10V** analog input. The tank contains a corrosive liquid with particles. The pressure of the tank is from **0 to 300 psi**. The liquid is heated using a steam heater.

- (a) By evaluating the process above, determine the most suitable type for sensor 3. Justify your answer with some explanation. (4 marks)
- (b) Determine the current output if the pressure is 270psi (4 marks)
- (c) The level sensor measure level from 0 to 300 meter, determine the voltage output at level 100 meter (4 marks)
- (d) Write a step by step process on how the calibration is being done to the pressure sensor (5 marks)
- (e) The analog sensor being used is a thermocouple. Name three possible conditioning circuits for this sensor (3 marks)

Question 6

- (a) A strain gauge is used to measure a force of a system. A conditional circuit is built to convert the resistance value from the strain gauge to voltage. Given voltage supply V_A is 10V. Calculate the voltage output from the bridge circuit in **Figure 4** if the resistance value of the strain gauge is $20\ \Omega$

(5 marks)

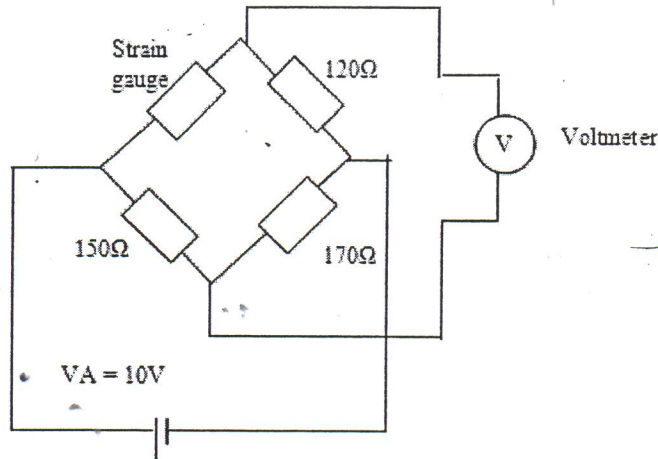


Figure 4: Wheatstone bridge circuit diagram

- (b) A Robot Arm is being engaged directly to an absolute optical encoder with 10-track disk.
- i. Find the resolution of the above said absolute optical encoder in degrees
(2 marks)
 - ii. Determine the output value of an absolute encoder if the shaft angle is $1\ rad$ and the encoder has 8 tracks
(4 marks)

(4 marks)

- (c) **Figure 5** below shows a bottle capping process. Sensor S1 used to detect the bottle is empty or full with water. Sensor S2 used to detect a presence of bottle cap.

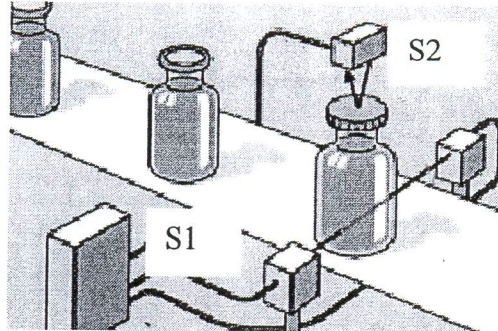


Figure 5: Bottle Capping Process

- i. Suggest suitable sensor of S1 and S2 based on the application in **Figure 5**
(4 marks)
 - ii. State a difference between reflex and polarized reflex sensor (Discuss in term of material detection)
(2 marks)
- (d) Explain three advantages of using a Diffuse System with Background Suppression
(3 marks)

END OF QUESTION