



**UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY**

**FINAL EXAMINATION
JANUARY 2016 SEMESTER**

COURSE CODE : JCB 20503
COURSE TITLE : SENSORS AND ACTUATORS
PROGRAMME LEVEL : BACHELOR
DATE : 19 MAY 2016
TIME : 2.30 PM – 5.30 PM
DURATION : 3 HOURS

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. This question paper consists of ONE (1) section.**
 - 4. Answer ALL questions in Section A.**
 - 5. Please write your answers on the answer booklet provided.**
 - 6. Please answer all questions in English only.**
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THERE ARE 6 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

SECTION A (Total : 100 marks)**INSTRUCTION: Answer FIVE (5) questions ONLY.****Please use answer booklet provided.****Question 1**

- (a) Magnetic field sensor depending on the magnitude of the measured field. The sensor working principle is based on two different metal plates, consist of two different poles which are north and south. Explain magnetic sensor operation in piping inspection application.

(6 marks)

- (b) Capacitive sensors based on capacitive coupling, it will dense anything that is conductive or has dielectric differences from air. Given the triangular plate with base, width and radius is 1cm x 2cm x 20cm respectively. The relative permittivity of dielectric material and permittivity of free space is 2×10^5 and 7.5×10^7 . Calculate the capacitance in farad unit.

(8 marks)

- (c) Wireless energy transmission is the transmission of electrical energy from a power source to an electrical load. Given voltage and resistance are 10 kvolt and 10k ohm for the devices. The length for wireless contact is 1m, while physical contact is 2m. Determine which device use more energy.

(6 marks)

Question 2

- (a) Figure 1.0 show pressure sensor type OMEGA, the sensor generates signal as a function of pressure imposed. It is used to measure fluid, gas flow and etc. Explain **FOUR (4)** differences between pressure sensor and force sensor.

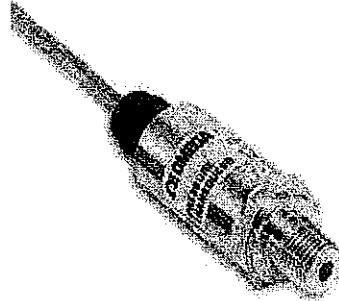


Figure 1.0: OMEGA pressure sensor

(8 marks)

- (b) An accelerometer is a device that measures different velocity from 1 point to other point. The accelerometer sense object velocity 100 m/s at point A, then the sensor sense the same object decelerate 20 m/s at point B, eventually the object should decelerate at 15 m/s. Calculate the final velocity of the object and accuracy of the sensor in percentage (%).
- (c) Gyroscope is a spinning wheel in which the axis of rotation is free to assume any orientation by itself. Coriolis acceleration used to measure speed of gyroscope, due to its position and orientation. Given acceleration 1.5 m/s and angular velocity is 5 rad/s. Find linear velocity (Y-direction).

(6 marks)

(6 marks)

Question 3

- (a) Pressure is force act on area of solid material. Given pressure at point A is 20kPa and area at point B is $10m^2$. Explain the relation between pressure at point A and force at point B.

(10 marks)

- (b) A free-body diagram of the wheel (isolated from the rod) is show at Figure 2.0.

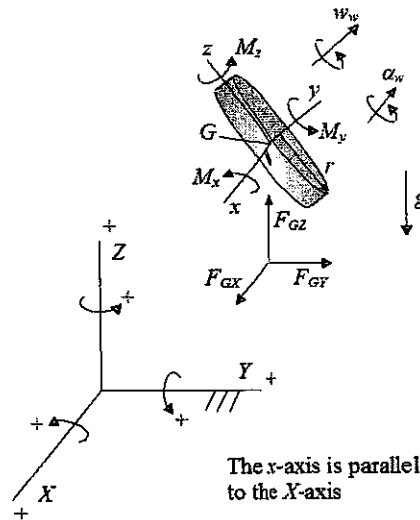


Figure 2.0: Free body diagram of gyroscope.

Note that a local xyz axes is defined as shown, and is attached to the wheel so that it moves with the wheel, and has origin at point G. Based from Figure 2.0, prove equation $[F_{Gz} - m_w g = 0]$.

(10 marks)

Question 4

- (a) The optical force mechanism consist of several items which are optical source, feed fiber, measurement zone, return fiber and optical detector. Interpret all those elements into working principle by using a diagram.

(8 marks)

- (b) Electro kinetics is an application or mechanism that combine 2 mechanism that is electronic or electrical and physical component. Explain the relation between electro and kinetics mechanism using an example of DC motor.

(12 marks)

Question 5

- (a) Figure 3.0 show a single phase inductor. It is made of coil or reactor, and it is functioning to transform low voltage from one state to other state.

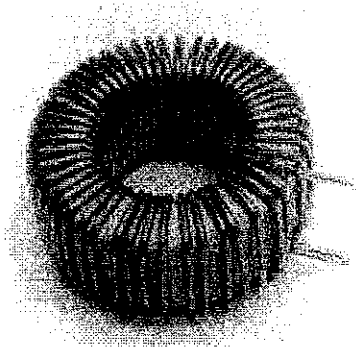


Figure 3.0: Single phase inductor

Based on Figure 3.0, show **FOUR (4)** type of inductor.

(8 marks)

- (b) Semiconductor industry widely use micro-strip inductor to manufacture printed circuit board (PCB). A PCB mechanically support and electrically connect electronic component using conductive tracks, pads and other features. Given wire radius is 2.2 inch and length is 5 inch. Examine the inductance value of a micro-strip etched on a printed circuit board (PCB).

(6 marks)

- (c) An electronic filter is a signal processing device used to filter unwanted signal at radio frequencies. A digital filter is a system that perform mathematical operations to reduce certain aspect of signal. Illustrate with diagram **THREE (3)** types of filter.

(6 marks)

Question 6

- (a) Figure 4.0 show a thermal sensor, it function to capture high temperature image and categorize into contour of color. Magnetic and thermal sensor have some similarities in measuring mechanism, both method are used to measure potential different effect at the same time.

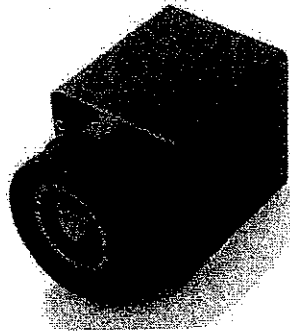


Figure 4.0: Thermal sensor

Based on Figure 4.0, determine **FOUR (4)** similarities for magnetic and thermal mechanism.

(8 marks)

- (b) Thermal actuation is a device to measure different temperature on different points at same time. Given applied power of 20 volt, resistive of 15k ohm and length of 100 centimeter. Determine the electro-thermal electric energy.

(6 marks)

- (c) An actuator is a type of motor that is responsible for moving or controlling a mechanism or system. The actuator type are pneumatic, hydraulic and electric. Explain **TWO (2)** differences for each of the actuator.

(6 marks)

END OF EXAMINATION PAPER

