UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	APPLIED MEASUREMENT AND INSTRUMENTATION
COURSE CODE	:	MDC 11003
PROGRAMME CODE	:	MDM
EXAMINATION DATE	:	JANUARY / FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. PART A: ANSWER **ALL** QUESTIONS 2. PART B: ANSWER **ONE (1)** QUESTION ONLY 3. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK/**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

PART A

Q1   **(a)**   As a postgraduate student, you are requested to setup a data logging system to record temperature of liquid in a tank. Note that the temperature needs to be continuously recorded at every half a minute for 72 hours and the liquid tank which has a capacity of 60 liter is placed in a laboratory at UTHM.

       (i)   Describe all the elements of the data logging system by drawing the appropriate block diagram.

       (ii)   Explain function of each element of the data logging system, and

       (iii)   Propose a suitable temperature sensor and components that will be used for each element in the data logging system. Also, explain the type of signal involved during transmission of the physical quantity information from the sensor to the output display.

                                                  (10 marks)

   (b)   List all the factors that you need to consider when choosing the right temperature sensor for application in question Q1(a).

                                                  (7 marks)

   (c)   Using a proper illustration, describe the working principle of the temperature sensor you choose in question Q1(a).

                                                  (8 marks)

Q2 **(a)** The principle of variable capacitance is used in displacement measuring transducers in various ways. Using a proper illustration, explain THREE (3) most common forms of variable capacitance transducer.

(9 marks)

(b) The output voltage from a translational motion potentiometer as in **Figure Q2(b)** of stroke length 0.1 meter is to be measured by an instrument whose resistance is 10 kΩ_. The maximum measurement error, which occurs when the slider is positioned two-thirds of the way along the element; AC = 2/3 AB must not exceed 1% of the full-scale reading. The highest possible measurement sensitivity is also required. A family of potentiometers having a power rating of 1 watt per 0.01 meter and resistances ranging from 100 Ω to 10 kΩ in 100 Ω steps is available.

(i) Choose the most suitable potentiometer from this range

(ii) Calculate the sensitivity of the measurement.

(10 marks)

(c) The main application of rotational velocity transducers is in speed control systems. Tachometer is an instrument available for measuring rotational velocity. Explain the working principle of DC and AC tachometer.

(6 marks)

Q3 **(a)** Vibrations are commonly encountered in machinery operation. Define TWO (2) two types of vibration that are commonly dealt in machine monitoring and why vibration measurement is extremely important?

(5 marks)

(b) Propose **ONE (1)** type of sensor that is suitable for application in machine monitoring for a setup shown in **Figure Q3(b)**. Elaborate the working principle of the sensor with the help of an appropriate illustration. Also, illustrate where the sensor can be mounted on the setup.

(10 marks)

(c) Discuss **FIVE (5)** key factors that need to be considered in choosing a suitable vibration sensor for the above application.

(10 marks)

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PART B:

Q4   Water level indicator circuits are used in factories, chemical plants, and electrical substations and in other liquid storage systems. **Figure Q4** shows a water level system controlled using Arduino microcontroller.

    (a)   List all components involve in the system and elaborate the function of each components.

(10 marks)

    (b)   Elaborate the working principle of the water level control system by drawing the appropriate block diagram.

(5 marks)

    (c)   Propose another type of sensor that can realize the same functionality as the sensor in question Q4(a)(i). Describe the working principle of the sensor with the help of a suitable illustration.

(10 marks)

Q5   Almost every modern-day device including air conditioners, power tools, toys, office machines employ microcontroller for their operation. **Figure Q5** shows a temperature controlled fan system using Arduino microcontroller.

    (a)   List all components involve in the system and elaborate the function of each components.

(10 marks)

    (b)   Elaborate the working principle of temperature controlled fan system by drawing the appropriate block diagram.

(5 marks)

    (c)   Propose another type of sensor that can realize the same functionality as the sensor in question Q5(a). Describe the working principle of the sensor with the help of a suitable illustration.

(10 marks)

-END OF QUESTIONS –

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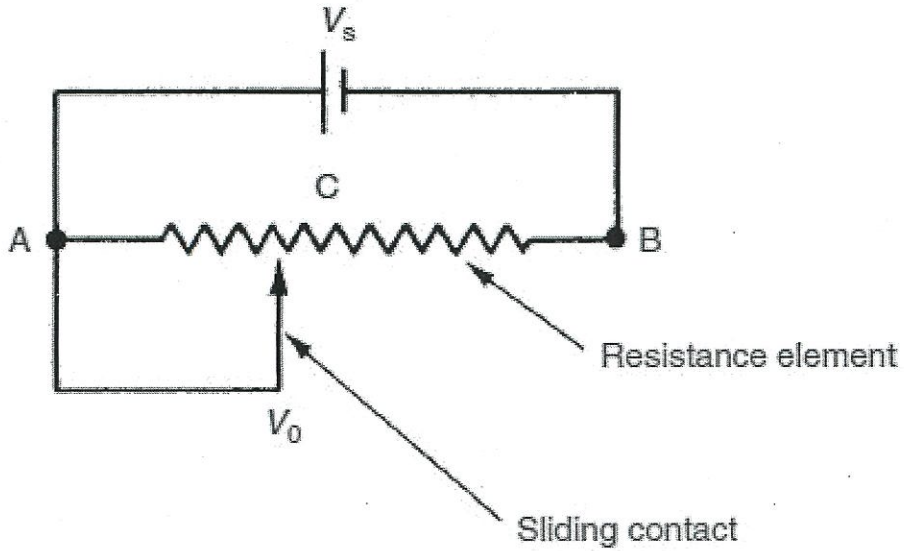   INSTRUMENTATION

Figure Q2(b): Potentiometer
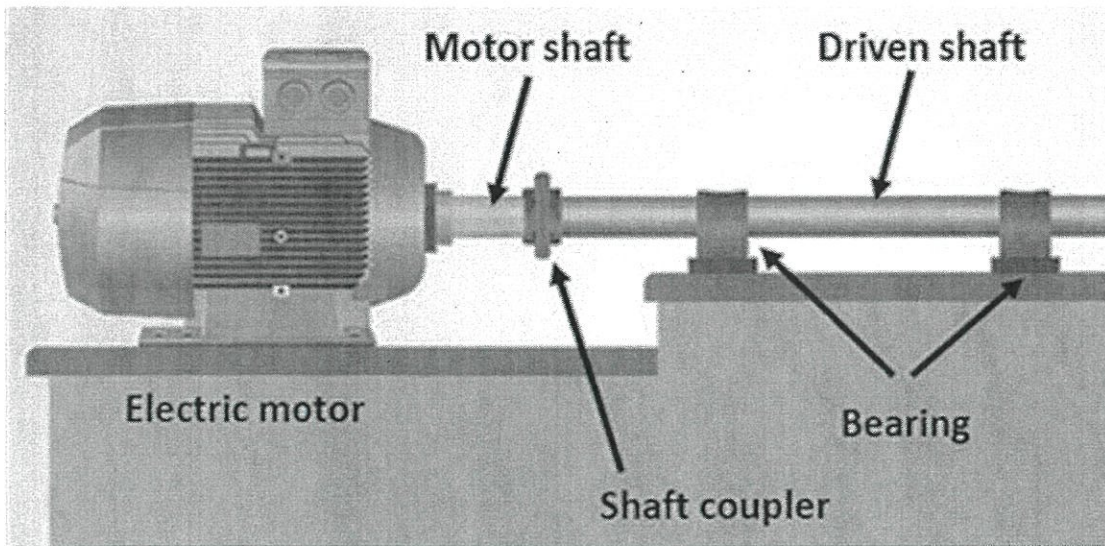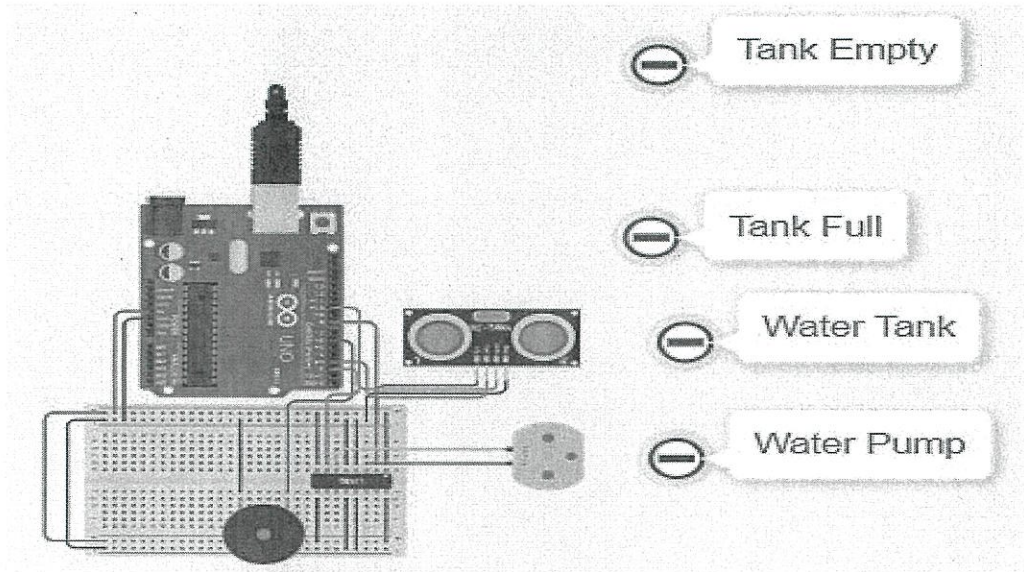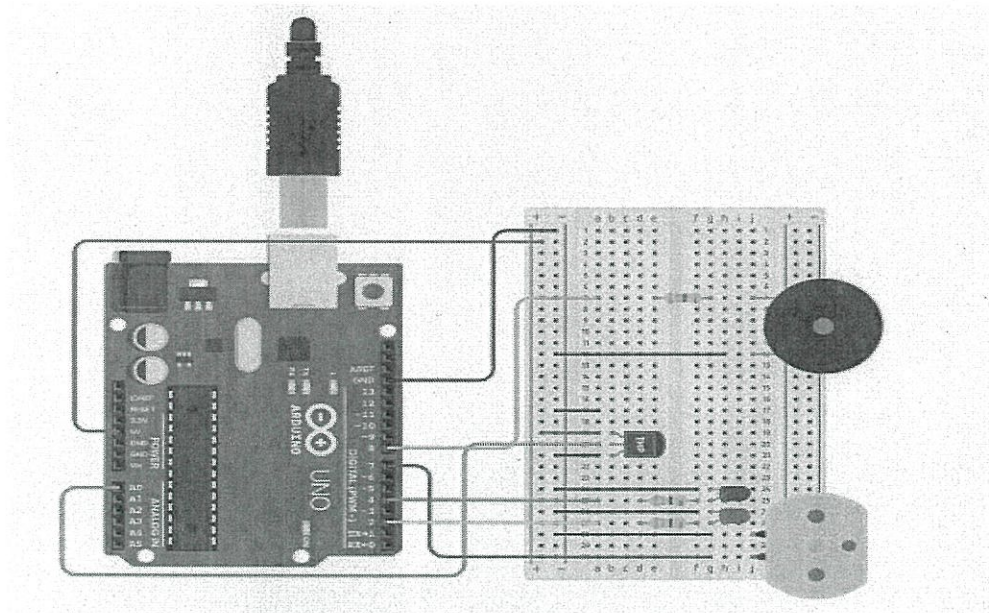

Figure Q3(b): Machine monitoring system

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Figure Q4: Water level control system

Figure Q5: Temperature controlled fan system