Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	INDUSTRIAL AUTOMATION SYSTEM
COURSE CODE	:	BND 45903
PROGRAMME CODE	:	BND
EXAMINATION DATE	:	JULY/ AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS.
		2.THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
		3.STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) Identify the general characteristics of industrial work situations that tend to promote the substitution of robots for human workers?

(6 marks)

(b) Sensors are important components for controlling the industrial robots and can be classified into internal and external sensors. Briefly explain these **TWO (2)** classifications of sensors with examples.

(8 marks)

(c) In material handling applications, industrial robot is use to move parts from one location to another and the basic application in this category is pick and place operation. Analyse the factors to consider while using industrial robots for material handling.

(8 marks)

(d) Identify **THREE (3)** types of robot's joint drive systems

(3 marks)

Q2 (a) Briefly explain the difference between analog sensor and discrete sensor.

(4 marks)

(b) During calibration, an iron/ constantan thermocouple emits a voltage of 1.02 mV at 2 °C and 27.39 mV at 500 °C. The reference temperature is to be set to emit a 0.02 mV voltage at 0 °C. Assume the transfer function is linear relationship between 0 °C and 500 °C. Determine:

(i) The transfer function of the thermocouple.

(5 marks)

(ii) The temperature corresponding to a voltage output of 24.0 mV.

(4 marks)

(c) A DC servomotor has a torque constant of 0.088 Nm/A and a voltage constant of 0.12 V/(rad/sec). The armature resistance is 2.3 ohms. A terminal voltage of 30 V is used to operate the motor. Determine:

(i) The starting torque generated by the motor when the voltage is initially applied and the maximum speed when the torque is equal to zero.

(6 marks)

(ii) The operating point of the motor when it is connected to a load whose torque characteristic is proportional to speed with a constant of proportionality at 0.011 Nm/(rad/sec).

(6 marks)

Q3 (a) Identify **THREE (3)** types of sensors mainly used in the automation system and their application.

(6 marks)

(b) The concept of automated systems can be applied to various levels of factory operations. Construct a practical diagram containing the process flow for producing a large-scale potato chip in an automation factory system. You are required to show the input, output, sensors, stations, quality checking and other related processes in completing the production of the product. Then explain what happen in each process.

(13 marks)

(c) By considering soft drink production, analyse the sensors criteria that are suitable to be applied in this industry.

(6 marks)

Q4 (a) Briefly explain the importance of vision system in automation.

(2 marks)

(b) Machine vision is widely used in automated quality control inspection tasks, most of which are either on-line/in-process or on-line/post-process. Identify the machine vision operation for the dimensional measurement inspection to determine the size of certain dimensional features of parts or products usually moving at relatively high speeds on a moving conveyor. The machine vision system must compare the features (dimensions) with the corresponding features of a computer-stored model and determine the size value.

(9 marks)

(c) Determine the application of the vision system in industry.

(6 marks)

(d) The pixel count of a digital camera that uses a CCD image sensor is 1600×1200 pixel matrix. Each pixel is converted from an analog voltage to the corresponding digital signal by an analog-to-digital converter. Each conversion takes $0.015\ \mu s$.

(i) By considering the conversion time, determine how long will it take to collect and convert the image data for one frame.

(4 marks)

(ii) Based on result from **Q4 (d)(i)**, analyse whether the time is compatible with the processing at the rate of 30 frames/s.

(4 marks)

- **END OF QUESTIONS -**