UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	MANUFACTURING CONTROL TECHNOLOGY
COURSE CODE	:	BDD 4083
PROGRAMME	:	BACHELOR'S DEGREE OF MECHANICAL ENGNEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2012
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	ANSWER **FOUR (4)** QUESTIONS FROM **FIVE (5)** QUESTIONS PROVIDED

THIS QUESTION PAPER CONSISTS OF FIVE (5) PRINTED PAGES

Q1 a) Maintenance and repair diagnostics refers to the capabilities of an automated system to assist in the identification of the source of potential or actual malfunctions and failures of the system.
Explain the **three (3)** modes of operation typical of a modern maintenance and repair diagnostics subsystem below.

(i) Condition monitoring,
(ii) Failure diagnostics,
(iii) Recommendation of repair procedure.

(9 marks)

b) Consider an automated cell consisting of a CNC machine tool, a parts storage unit, and a robot for loading and unloading the parts between the machine and the storage unit. Possible errors that might affect this system can be divided into the following categories: (1) machine and process, (2) cutting tools, (3) work holding fixture, (4) part storage unit, and (5) load/unload robot.

For the errors detected from the automated cell shown in **Table Q1,**
(i) categorize the error,
(ii) develop a list of possible corrective actions that might be taken by the system to address those errors.

(16 marks)

Table Q1

Errors Detected	Category	Possible Corrective Actions to Recover
Part dimensions deviating due to thermal deflection of machine tool Part dropped by robot during pickup Part is dimensionally oversized Chatter (tool vibration) Cutting temperature too high Failure of cutting tool		

Q2 A controller is a device which monitors and affects the operational conditions of a given dynamical system. Depending on the application, some types of controllers are better suited than others.

(a) Tabulate the differences between Programmable Logic Controller (PLC) and Programmable Automation Controller (PAC).

(8 marks)

(b) Using appropriate diagram, describe the features, capabilities and applications of microcontroller.

(6 marks)

(c) The sequence motion of two double acting cylinders is as the following;

A+ B+ B- A- A+ A-
B+ B-

Assuming the system use only single solenoid 5/2 way direction control valve for both cylinders, construct the ladder logic diagram programme to control the sequence.

(i) Sketch the sequence diagram.

(3 marks)

(ii) Generate the PLC programming for the above sequence.

(8marks)

Q3 The manipulator of an industrial robot is constructed of a series of joints and links. Robot anatomy is concerned with the types and sizes of these joints and links and other aspects of the manipulator's physical construction.

(a) Using the conventional notation scheme for defining manipulator configurations, draw diagrams of the following robots:

(i) TRL,
(ii) OLO,
(iii) RR:T.

(9 marks)

(b) The robot with a RR: R configuration, shown in Figure Q3, the arm-and-body (RR:) provides position of the end-of-arm, and the wrist (: R) provides orientation.
The joints and links of the suggested RR:R manipulator have the following values: $\theta_1 = 20°$, $\theta_2 = 15°$, $\theta_3 = 25°$, L_1, = 500 mm, $L_2 = 400$ mm and $L_3 = 25$ mm. Determine the values of x and z in world space coordinates.

(10 marks)

(c) Accuracy and repeatability for such a system have been defined as static parameters of the manipulator. However, these precision parameters are affected by the dynamic operation of the robot. Comment on such characteristics that will affect the robot's accuracy and repeatability.

(6 marks)

Q4 Automated Guided Vehicle System (AGVS) is appropriate where different materials are moved from various load points to various unload points.

(a) Discuss **THREE (3)** categories of AGV and their respective applications.

(7 ½ marks)

(b) For the AGVS to operate efficiently, the vehicles must be well managed. Consider the issues below and describe the means to resolve them.

(i) Traffic Control
(ii) Vehicle Dispatching,
(iii) Safety.

(7 ½ marks)

(c) The layout for an AGVS is shown in Figure Q4. Suppose that the vehicles operate according to the following scheduling rule to minimize the distances the vehicles travel empty. Vehicles delivering raw work parts from station 1 to stations 2, 3, and 4 must pick up finished parts at these respective stations for delivery to station 5. Suppose the AGVS travel at a speed of 40 m/min, the delivery distance is 103.8m and the traffic factor is 0.90.

(i) Determine the empty travel distances associated with each delivery,
(ii) Develop a From-To Chart,
(iii) How many automated guided vehicles would be required to operate the system? Assume availability A = 100% and efficiency $E = 1.0$.

(10 marks)

Q5 Supervisory Control and Data Acquisition (SCADA) is widely used in industrial processes including chemical, metallurgy, power generation and distribution.

(a) Explain **THREE (3)** benefits for adopting a SCADA system for the control of facilities.

(6 marks)

(b) Describe **FOUR (4)** basic functionalities of SCADA.

(8 marks)

(c) Data Access and control is among the major concerns in the implementation of SCADA system. Using appropriate diagrams answer the following questions.

(i) Why is Data Access needed to be controlled?
(ii) How does OLE for Process Control (OPC) overcome the problem?

(11 marks)

Appendix I

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2011/2012 PROGRAMME : 4 BDD
COURSE : MANUFACTURING CONTROL TECHNOLOGY COURSE CODE : BDD 40803

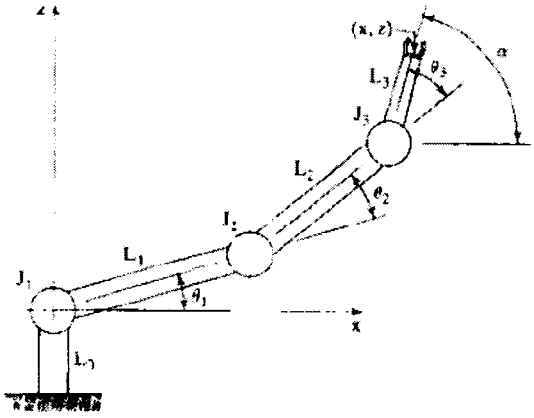

FIGURE Q3 : ROBOTIC ARM

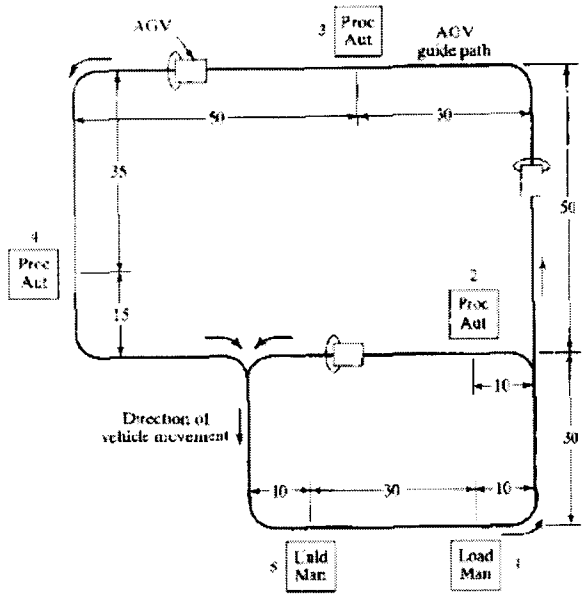

FIGURE Q4 : AGV Track