



PROGRAM : BACCALAUREUS INGENERIAE
MECHANICAL ENGINEERING

SUBJECT : **ADVANCED MANUFACTURING SYSTEMS**

CODE : **MVS4A11**

DATE : WINTER EXAMINATION
JUNE 2019

DURATION : (1-PAPER) 08:30 - 11:30

WEIGHT : 50 : 50

TOTAL MARKS : 100

EXAMINER : Dr. N MADUSHELE

MODERATOR : Mr. T LEKWANA (UNISA)

NUMBER OF PAGES : 7 PAGES AND 1 ANNEXURES

INSTRUCTIONS : QUESTION PAPERS MUST BE HANDED IN.

REQUIREMENTS : ANSWER BOOKLET.


T. M. Lekwana

INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

25 Marks

1(a) It is usually difficult to divide the total work equally amongst the different work-stations in a production plant. This leads to one work-station having the longest operation time, this work-station is referred to as a bottleneck station. Against this background the cycle time of a mass production line is computed differently. Provide a mathematical expression of the cycle time when analyzing a mass production operation, and also explain why the mathematical expression is given as such. (4 Marks)

(b) Production Capacity as the maximum rate of output that a production facility is able to produce under assumed conditions plays a pivotal role in monitoring how well the production plant is performing. Provide at least two (2) short term changes as well as at least two (2) long term changes that can be made to increase or decrease the Plant Capacity. (4 Marks)

(c) There are fundamentally two major categories of manufacturing costs in a plant. Name, and define the two (2) cost categories, also provide a mathematical expression on how they are related. (3 Marks)

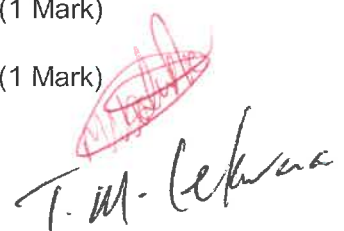
(d) What are factory overhead costs? Also provide at least three (3) examples of such costs (4 Marks)

(e) A welding inspector in a factory ensures that the welds done on parts manufactured complies with a given welding standard. You want to monitor the effectiveness of your welding inspector, and you have decided to use the precision-recall measure. Where 1 is associated with welding defects and 0 is associated with welds that pass the inspection. Out of a total of 500 welds that were inspected, you found that the inspector correctly predicted that 25 parts had welding defects, and 320 parts did not have welding defects. However, the inspector incorrectly predicted that 55 parts did not have defects, and the components turned out to have defects. Finally, the inspector incorrectly predicted that 100 parts had defects, and the components turned out to not have defects.

(i) Provide a contingency table for the analysis. (2 Marks)

(ii) Compute the Precision of the inspector. (1 Mark)

(iii) Compute the Recall of the inspector. (1 Mark)



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(iv) What is the inspector's accuracy?

(1 Mark)

(e) Suppose that you have a known voltage of 15.9 volts. If you are trying to measure the voltage using the Successive Approximation Method, wherein your analog to digital converter (ADC) has a full scale range of 40 volts, and having a eight (8) bit register. How much voltage will you read on your screen dial?

(5 Marks)


T. M. C. Kuma

QUESTION 2

25Marks

2(a) Automation is the technology by which a process or procedure is accomplished without human assistance. The principal power source in automation is electricity. Can you justify why that is the case?
(4 Marks)

(b) Control systems in automation primarily takes one of two configurations. List and define the two configurations, and also provide three (3) instances where one can use the open-loop control system.
(6 Marks)

(c) There are three (3) advanced automation functions i.e. safety monitoring, maintenance and repair diagnostics; error detection and recovery. Define safety monitoring, provide a reason why one would employ this automation function, and finally provide two (2) possible responses to hazards that are used by the safety monitoring function.
(4 Marks)

(d) Continuous controllers are used in instances wherein the objective is to maintain the value of an output variable at a desired level. Critically discuss the objective(s), performance measure(s), and the limitation(s) of a Regulatory Control. Also provide a sketch of the Regulatory Control.
(6 Marks)

(e) There are primarily two types of interlocks in automation. Define what an interlock is, also list and provide definitions of each type of interlock.
(5 Marks)


T. M. Gekko

QUESTION 3

25Marks

3(a) Using the notation scheme for defining manipulator configurations (covered in class), draw diagrams of the following robots:

(i) TRT, (2 Marks)

(ii) VVR. (3 Marks)

(b) There are conceptions that industrial robots in the 4th Industrial Revolution (4IR), will make human workers obsolete, whilst others share a more positive sentiment that industrial robots will actually aid human workers, and improve organisations production rates. Irrespective of the conceptions, it is evident that industrial robots are important. Against this background, elaborate on the importance of industrial robots (substantiate your response with 4 key points)? (4 Marks)

(c) What is the difference between repeatability and accuracy in a robotic manipulator?

(4 Marks)

(d) In the circuit of Figure 3.1, suppose a photodetector were used to determine whether the lamp worked. If the lamp does not light when both switches are closed, the photodetector causes a buzzer to sound. Construct the ladder logic diagram for this system. (4 marks)

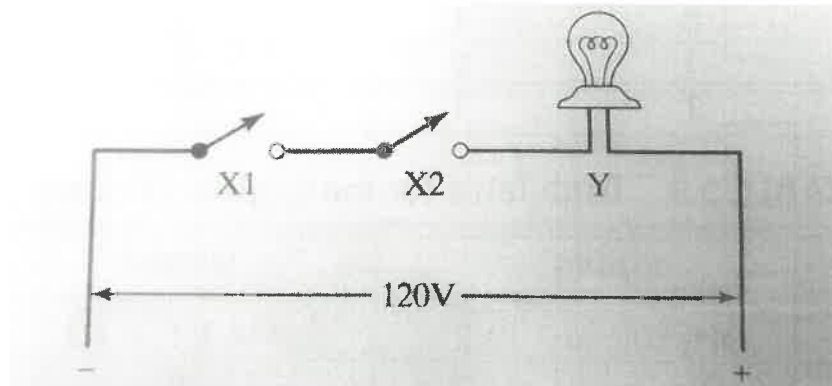


Figure 3.1

(e) In the manual operation of a sheet metal stamping press, a two button safety interlock system is often used to prevent the operator from inadvertently actuating the press while his hand is in the die. Both buttons must be depressed to actuate the stamping cycle. In this system, one press button is located on one side of the press while the other button is located on the opposite side. During the work cycle the operator inserts the part into the die and depresses both pushbuttons, using both hands.

(i) Write the truth table for this interlock system. (6 Marks)

(ii) Write the Boolean logic expression for the system. (1 Mark)

(iii) Construct the ladder logic diagram for the system. (1 Mark)

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T. M. Gekko

QUESTION 4

25 Marks

4(a) Material handling is concerned with internal logistics i.e. the movement and storage of material in a facility, and by contrast, external logistics is concerned with the transportation of materials between facilities by rail, truck, seaway, air transportation, and/or pipelines. During the semester we covered internal logistics. What are the five material handling functions that must be provided in a manufacturing system? (5 Marks)

(b) Self-Guided Vehicles are one indication of leaning towards the forth industrial revolution. However, Automated guided vehicles (AGVs) are still utilised extensively in industry. Describe what AGVs are and discuss features that distinguish self-guided vehicles from conventional AGVs. (6 Marks)

(c) A rail-guided vehicle system is being planned as part of an assembly cell. The system consists of two parallel lines, as in Figure 4.1. In operation, a base part is loaded at station 1 and delivered to either station 2 or 4, where components are added to the base part. The RGV then goes to either station 3 or 5, respectively, where further assembly of components is accomplished. From stations 3 or 5, the product moves to station 6 for removal from the system. Vehicles remain with the products as they move through the station sequence; thus, there is no loading and unloading of parts at stations 2, 3, 4, and 5. After unloading parts at station 6, the vehicles then travel empty back to station 1 for reloading. The hourly moves (parts/hr) and distances (m) are listed in the Table 4.1. RGV speed = 100 m/min. Assembly cycle times at stations 2 and 3 = 4.0 min each, and at stations 4 and 5 = 6.0 min each. Load and unload times at stations 1 and 6 respectively are each 0.75 min. Traffic factor = 1.0 and availability = 1.0.

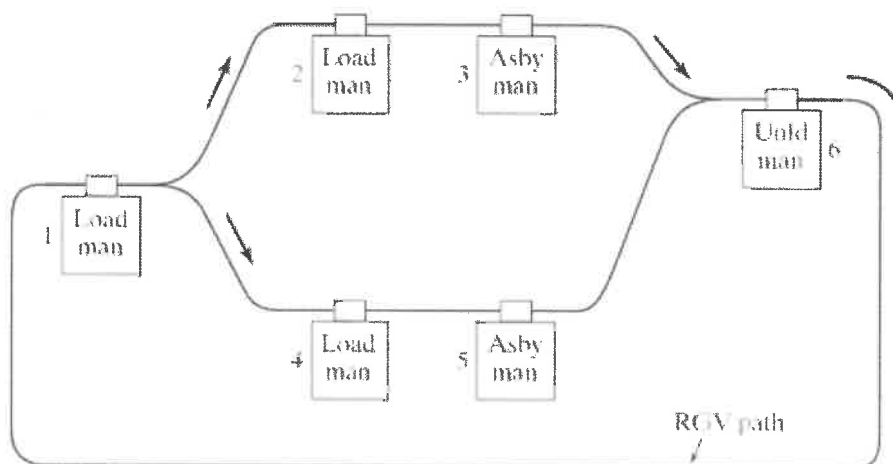


Figure 4.1: Plant Layout

(i) With the aid of Table 4.1 populate the missing information. **NB: Remember to specify whether the rail-guided vehicle is loaded (L) or Empty (E)** (7 Marks)

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T.M. Gekwa

Table 4.1						
To:	1	2	3	4	5	6
From: 1	0/0		0/NA		0/NA	0/NA
2	0/NA	0/0		0/NA	0/NA	0/NA
3	0/NA	0/NA	0/0	0/NA	0/NA	
4	0/NA	0/NA	0/NA	0/0		0/NA
5	0/NA	0/NA	0/NA	0/NA	0/0	
6		0/NA	0/NA	0/NA	0/NA	0/0

(ii) How many vehicles are required to operate the system?

(7 Marks)


T-M. Gekko