UNIVERSITY
OF JOHANNESBURG

PROGRAM	:	BACCALAUREUS INGENERIAE *MECHANICAL ENGINEERING*
SUBJECT	:	**ADVANCED MANUFACTURING SYSTEMS**
CODE	:	**MVS4A11**
DATE	:	WINTER EXAMINATION JUNE 2018
DURATION	:	(1-PAPER) 08:30 - 11:30
WEIGHT	:	50 : 50
TOTAL MARKS	:	100

EXAMINER	:	Dr. N MADUSHELE
MODERATOR	:	Mr. N NDOU (UNISA)
NUMBER OF PAGES	:	5 PAGES AND 1 ANNEXURES

INSTRUCTIONS	:	QUESTION PAPERS MUST BE HANDED IN.
REQUIREMENTS	:	ANSWER BOOKLET.

INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

25 Marks

1(a) Manufacturing and Production are terms which are often used interchangeably, and that is incorrect. Discuss the differences between these two approaches and also provide an example for each.

(4 Marks)

(b) The world is leaning towards the 4th industrial revolution, and as a result, automation is increasingly playing a significant role in industry. Consequently, manufacturing systems are increasingly becoming automated as well. Critically discuss the concept of programmable automation, and also provide key features of such systems.

(8 Marks)

(c) Current literature suggests that there are nine reasons why companies are constantly trying to automate their operations. Provide three reasons from the nine stipulated in literature.

(3 Marks)

(d) There are nine machines in the automatic lathe section of a certain machine shop. The setup time on an automatic lathe averages 6 hours. The average batch size for parts processed through the section is 90. The average operation time = 8.0 minutes. Under shop rules, an operator can be assigned to run up to three machines. Accordingly, there are three operators in the section for the nine lathes. In addition to the lathe operators, there are two setup workers who perform machine setups exclusively. These setup workers are kept busy the full shift. The section runs one 8-hour shift per day, 6 days per week. However, an average of 15% of the production time is lost due to machine breakdowns. Scrap losses are negligible. The production control manager claims that the capacity of the section should be 1836 pieces per week. However, the actual output averages only 1440 units per week. What is the problem?

(8 Marks)

(e) Recommend a solution.

(2 Marks)

QUESTION 2

25Marks

2(a) One of the key advanced automation functions is safety monitoring. In an automated system, describe what is meant by safety monitoring and also provide examples of how one would identify a safety monitoring system function? (4 Marks)

(b) Manufacturing systems are not immune to deviations from normal operations. Deviations from normal operations tend to reduce the systems availability which ultimately has financial implications for the company. Error detection and recovery systems are specifically designed to address such problems. What is error detection and recovery in an automated system? Also provide two possible strategies possible in error recovery. (6 Marks)

(c) A DC servomotor has a torque constant = 0.088 N-m/A and a voltage constant = 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 just as the voltage is applied, (2 Marks)

(ii) The maximum speed at a torque of zero; (2 Marks)

(iii) 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 = 0.011 N-m/(rad/sec). (6 Marks)

(d) The shaft of a stepper motor is directly connected to a lead screw that drives a worktable in an *x-y* positioning system. The motor has a step angle = 5°. The pitch of the lead screw is 6 mm, which means that the worktable moves in the direction of the lead screw axis by a distance of 6 mm for each complete revolution of the screw. It is desired to move the worktable a distance of 300 mm at a top speed of 40 mm/sec. Determine:

(i) The number of pulses (2.5 Marks)

(ii)The pulse frequency required to achieve this movement. (2.5 Marks)

QUESTION 3

25 Marks

3(a) Most manufacturing robots used have anthropomorphic (human-like) features. Thus manufacturing robots are described through robot anatomy. Critical describe robot anatomy in the context of a robot manipulator. (6 Marks)

(b) Describe the differences in orientation capabilities and work volumes for a :TR and a :RT wrist assembly. Use sketches as needed. (5 Marks)

(c) What is the difference between repeatability and accuracy in a robotic manipulator? (4 Marks)

(d) Sketch a logic network diagram for a device that has a (start,stop) button, used to supply power to a motor, which then drives the motor. (5 marks)

(e) Construct the ladder logic diagrams for the NOR gate. (5 Marks)

QUESTION 4

25 Marks

4(a) How does material handling fit within the scope of logistics? (3 Marks)

(b) There are four categories of material handling equipment. Unitizing equipment is one such equipment. What is included in the term unitizing equipment and how does it relate to the unit load principle? (6 Marks)

(c) 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)

(d) 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. How many vehicles are required to operate the system? (10 Marks)

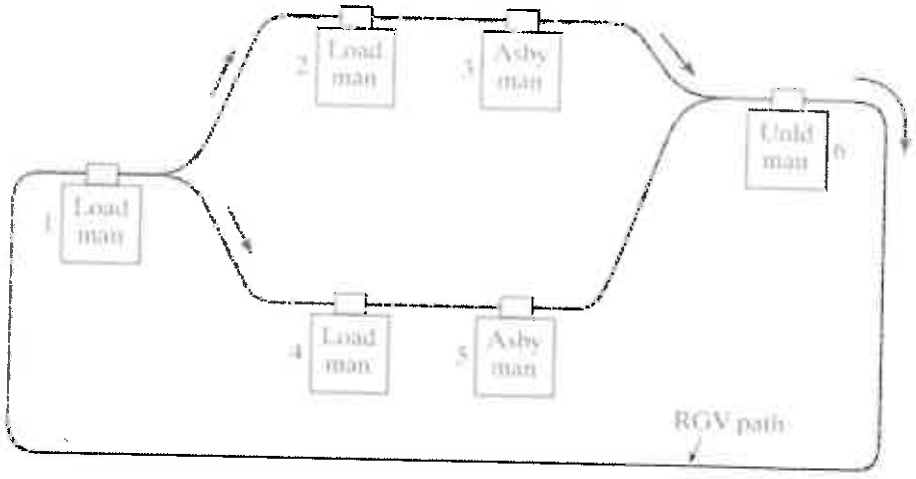

Figure 4.1: Plant Layout

Table 4.1

To:	1	2	3	4	5	6
From: 1	0/0	14L/200	0/NA	9L/150	0/NA	0/NA
2	0/NA	0/0	14L/50	0/NA	0/NA	0/NA
3	0/NA	0/NA	0/0	0/NA	0/NA	14L/50
4	0/NA	0/NA	0/NA	0/0	9L/50	0/NA
5	0/NA	0/NA	0/NA	0/NA	0/0	9L/100
6	23E/400	0/NA	0/NA	0/NA	0/NA	0/0