



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

**BACHELOR OF ENGINEERING (HONS) DEGREE INDUSTRIAL AND MANUFACTURING
ENGINEERING**

MANUFACTURING SYSTEMS III

TIE 5101

FIRST SEMESTER SUPPLEMENTARY EXAMINATION

JULY/AUGUST 2015

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Nil

Examiner's Name: Eng. T R Chikowore

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Answer any five (5) questions, at least TWO from each section
2. Each question carries 20 marks

MARK ALLOCATION

QUESTION	MARKS
1.	20
2.	20
3.	20
4.	20
5.	20
6	20
7	20
TOTAL	100

SECTION A: FLEXIBLE MANUFACTURING SYSTEMS (FMS)

Question 1

- a) Briefly explain three tool allocation policies. [6]
- b) Several jobs are waiting to be produced in a manufacturing cell. Job characteristics are shown in Table Q1. The cell has two identical machines. All tooling is standard, and therefore no tools must be added or removed from the machines except for normal regrinding after excessive tool wear. Jobs must be produced completely during the shift in which they are scheduled. It is currently the morning of day 103. Find the set of jobs to produce in the next 8-hour shift. [14]

Table Q1: Job Data for Question 1

Job	Due Date	Order Size (units)	Unit Processing Time (hrs)
1	103	34	0.005
2	103	10	0.010
3	103	25	0.230
4	104	125	0.120
5	104	14	0.205
6	105	100	0.071
7	105	25	0.200
8	105	250	0.023

Question 2

You are an Industrial Engineer in a manufacturing company that is considering installing a Flexible Manufacturing System (FMS). Your task is to:

- a) describe five types of FMS [10]
- b) describe five types of FMS layouts [10]

SECTION B: MATERIAL HANDLING

Question 3

- a) Suppose an Automated Storage and Retrieval System (AS/RS) has a throughput of 300 storage and retrievals per hour. The AS/RS has 10 aisles and each is served by on Storage and Retrieval (S/R) machine. Furthermore, 30% of the operations are performed as single-command and the rest as dual-command operations. The single-command transaction cycle time is 2.059 minutes and the dual-command transaction cycle time is 3.235 minutes.
- i) Determine the percentage utilisation of the machine. [6]
 - ii) Determine the number of transactions at which the S/R machine is 100% utilised. [4]
- b) Briefly explain any five principles of material handling. [10]

Question 4

- a) Distinguish between the Unit load Automated Storage and Retrieval System and the Person-on-board automated storage and retrieval system. [8]
- b) Briefly describe the four main components of automated guided vehicle systems. [12]

Question 5

- a) Describe the two alternative robot sequences for a two-machine robotic cell. Use appropriate diagrams to aid your answer. [14]
- b) Determine the optimal cycle time and corresponding robot sequences in a two machine robotic cell with the following data: [6]

Processing time of machine M1	=	11.0 minutes
Processing time of machine M2	=	9.0 minutes
Robot gripper pickup	=	0.16 minutes
Robot gripper release time	=	0.16 minutes
Robot move time between the two machines	=	0.24 minutes

Question 6

- a) Outline six objectives of material handling. [6]
- b) Briefly discuss two means of guidance used for AGV systems. [4]
- c) The oval of a top-driven carousel track has a length = 50m and width = 4m. The speed of the carousel = 75 m/min. There are 100 carriers around the carousel and each carrier has 5 bins suspended from it. For a single direction carousel and a bidirectional carousel, compare how long it takes to retrieve 20 parts from the carrier if each part is in a different storage bin and random storage is used in the carousel. Also determine the spacing between carriers and the dual command transaction cycle time. The handling time associated with retrieval is 20 seconds. [10]

Question 7

- a) Briefly explain how a manufacturing company may benefit from using Automated Storage and Retrieval Systems. [8]
- b) Using appropriate diagrams describe three types of material handling equipment in the family of conveyors. [12]

END OF EXAMINATION