NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering Honours Degree Industrial and Manufacturing Engineering

MANUFACTURING SYSTEMS I

TIE 3112

FIRST SEMESTER MAIN EXAMINATION

DECEMBER 2014

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
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

Question 1

a) Product layouts are used for repetitive processing while process layouts are used for non-repetitive processing. By describing the product and process layouts explain why this is the case. Use appropriate examples and illustrative diagrams to aid your answer. [12]

b) Outline two key factors in service layout design. Explain how these factors influence layout decisions. [8]

Question 2

a) A farm implements dealer, TRC Holdings, is seeking a fourth warehouse location to complement three existing warehouses. The three potential locations are Bulawayo, Gweru, and Masvingo. Bulawayo would involve a fixed cost of $4 000 per month and a variable cost of $4 per unit. Gweru would involve a fixed cost of $3 500 per month and a variable cost of $5 per unit. Masvingo would involve a fixed cost of $5 000 per month and a variable cost of $6 per unit. Use of Bulawayo would increase transportation costs by $19 000 per month, Gweru by $22 000, and Masvingo by $18 000 per month.

Determine the location that results in the lowest cost to handle 800 units per month. [8]

b) A manufacturing company has been operational since 1983. Management is now considering layout redesign as a way of improving productivity. Write a report to management outlining ways in which layout can aid or hinder productivity. Suggest and explain two alternative ways of improving productivity besides layout redesign. [12]

Question 3

A 20 stage transfer line with two buffers is being considered. Tentative plans place buffers of size 15 after workstations 10 and 15. The first 5 workstations have a cumulative failure rate of $\alpha = 0.0050$. Workstations 6 to 10 have a cumulative failure rate of $\alpha = 0.0025$ and workstation 11 to 20 together yield a failure rate of $\alpha = 0.0150$. Repair of any station would average 10 cycles in length. Estimate the effectiveness of this line design. [20]

Question 4

a) Explain what is meant by line balancing. [2]
b) Outline three reasons why it is difficult to attain a perfectly balanced line. [6]
c) Discuss the impact of technology on both process selection and layout decisions. [12]

Question 5

Table Q5 shows tasks that are to be arranged with the objective of minimising idle time. Management has designed an output rate of 275 units per day. There are 440 minutes available per day.

Table Q5: Task data for Question 5

Task	**Preceded by**	**Task time (minutes)**
A	-	0.3
B	-	0.6
C	A	0.4
D	B	1.2
E	C	0.2
F	D	0.6
G	E	0.1
H	F, G	0.5
I	H	0.3

a) Determine the appropriate cycle time. [3]
b) Determine the minimum number of workstations required. [3]
c) Assign the tasks to workstations using the Ranked Positional Weights method. Break ties using the greatest number of following tasks rule. [12]
d) Calculate the percentage idle time and the line efficiency. [2]

Question 6

a) A company wishes to establish the best location for a new depot that will supply seven customers in different locations. The locations and the demand for each of the warehouses are shown in Table Q6. Determine the best location for the new production facility. [8]

Table Q6: Warehouse Locations and Demand

Warehouse	**Location (x,y)**	**Demand (units)**
A	(200,300)	5000
B	(100,50)	1500
C	(50,200)	3000
D	(50,50)	200
E	(75,150)	400
F	(20,80)	2500
G	(0,0)	500

b) Using examples to aid your answer, explain the three types of automation. [12]

Question 7

a) The costs of setting up a given multi-model assembly and the succeeding models are shown in Table Q7. Determine the order of the model batches to minimize the total set-up costs. [12]

Table Q7: Cost of setting up line

	Succeeding Model			
	A	**B**	**C**	**D**
A	-	155	150	80
B	50	-	110	75
C	90	40	-	100
D	115	80	60	-

b) Consider a ten station line. Stations one to four fail on average every 10 cycles, the station five every 30 cycles, stations six to eight every 15 cycles, and stations nine to ten every 25 cycles. The average repair time for stations five and ten is 5 cycles and that of all the other stations is 4 cycles. Determine the line effectiveness assuming the following:

i) The line is subjected to operation dependant failures, [4]

ii) The line is subjected to time dependant failures. [4]

END OF EXAMINATION