# 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 SUPPLEMENTARY EXAMINATION
JULY/AUGUST 2015

This examination paper consists of 4 pages
Time Allowed:
Total Marks:
Special Requirements:
Examiner's Name:
INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Answer any five (5) questions
2. Each question carries 20 marks

MARK ALLOCATION

| QUESTION | MARKS |
| :--- | :--- |
| 1. | 20 |
| 2. | $\mathbf{2 0}$ |
| 3. | $\mathbf{2 0}$ |
| 4. | $\mathbf{2 0}$ |
| 5. | $\mathbf{2 0}$ |
| 6 | $\mathbf{2 0}$ |
| 7 | $\mathbf{2 0}$ |
| TOTAL | $\mathbf{1 0 0}$ |

## Question 1

a) Distinguish between two types of failures in transfer lines.
b) Using an appropriate diagram and examples describe the five generic manufacturing methods.

## Question 2

Five departments are to be assigned to locations B-F in the grid shown in Figure Q2. For technical reasons, department 6 must be assigned to location A. Transportation cost is $\$ 2$ per metre. The objective is to minimise total transportation cost. Table Q2a and Table Q2b show information interdepartmental work flows and distances between locations respectively.

Assign the departments so that total transportation cost is minimised.


Figure Q2: Location grid
Table Q2a: Number of trips per day between Departments

| FROM/TO | $\mathbf{1}$ | $\mathbf{2}$ | $\mathbf{3}$ | $\mathbf{4}$ | $\mathbf{5}$ | $\mathbf{6}$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $\mathbf{1}$ | - | 125 | 62 | 64 | 25 | 50 |
| $\mathbf{2}$ |  | - | 10 | 17 | 26 | 54 |
| $\mathbf{3}$ |  |  | - | 2 | 0 | 20 |
| $\mathbf{4}$ |  |  |  | - | 13 | 2 |
| $\mathbf{5}$ |  |  |  |  | - | 5 |
| $\mathbf{6}$ |  |  |  |  |  | - |

Table Q2b: Distance between Locations (metres)

| FROM/TO | A | $\mathbf{B}$ | $\mathbf{C}$ | $\mathbf{D}$ | $\mathbf{E}$ | F |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| A | - | 50 | 100 | 50 | 80 | 130 |
| B |  | - | 50 | 90 | 40 | 70 |
| C |  |  | - | 140 | 60 | 50 |
| D |  |  |  | - | 50 | 120 |
| E |  |  |  |  | - | 50 |
| F |  |  |  |  |  | - |

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## Question 3

a) Using examples to aid your answer describe three types of automation.
b) Outline four ways that can be used to improve line balance.

## Question 4

Consider an eight-stage transfer line. Each stage fails once every 1000 cycles. Repair times average 12 cycles. A feeder line of subassemblies merges into the main transfer line at station 5. The feeder line has six stations and these stations individually fail once every 600 cycles. Repairs also average 12 cycles for the feeder line.
a) Determine the effectiveness of this line.
b) Calculate the maximum effectiveness that could be obtained by adding buffers between every stage in both the main and feeder lines.
c) Calculate the maximum effectiveness that could be obtained by adding a buffer between the main and feeder line.
d) Suppose a buffer of size 5 was provided between the main and feeder lines. Find the effectiveness in this case.

## Question 5

An assembly line consists of eight work elements as shown in Table Q5. Assuming a cycle time of 20 minutes, you are required to design a well-balanced assembly line.

Table 5: Task data for Question 5

|  | Processing time <br> (minutes) | Immediate Predecessor |
| :--- | :--- | :--- |
| 1 | 11 | - |
| 2 | 8 | 1 |
| 3 | 9 | 2 |
| 4 | 5 | 2 |
| 5 | 8 | 3 |
| 6 | 12 | 3,4 |
| 7 | 10 | 5 |
| 8 | 3 | 6 |

a) Use the Largest candidate rule to balance the line.
b) Use the Kilbridge and Westers method to balance the line.
c) Suggest the best method between the two. Give reasons for your choice.

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## Question 6

a) Define the principle of interchangeability and the concept of division of labour and explain their significance in assembly lines.
b) Flexibility is important as a competitive strategy. Discuss circumstances where flexibility does not offer the best choice in processing decisions.

## Question 7

a) Outline the steps involved in Systematic layout planning (SLP).
b) The material flows between four equal sized departments are given in Table Q7. The cost of moving one unit per unit distance is $\$ 4.00$. Assuming the given starting solution for the facility layout, use the pair-wise exchange method to refine the current given solution.

Table Q7: Material Flow Matrix

|  |  | To dept |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| From Dept |  | 1 | 2 | 3 | 4 |
|  | 1 | - | 15 | 40 | 25 |
|  | 2 |  | - | 5 | 10 |
|  | 3 |  |  | - | 15 |
|  | 4 |  |  | - |  |

## Starting

 Solution| 1 | 2 | 3 | 4 |
| :--- | :--- | :--- | :--- |

END OF EXAMINATION

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