NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering Honours Degree Industrial & Manufacturing Engineering

1ST SEMESTER EXAMINATIONS - DECEMBER 2011

MANUFACTURING SYSTEMS 1 **COURSE CODE TIE 3112**

EXAMINATION DURATION 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. **Answer Any FIVE (5) Questions**
2. **All Questions carry Equal Marks**

QUESTION 1

a) A company wishes to establish the best location for a new production facility that will supply four warehouses in different locations. The locations and the demand for each of the warehouses are shown in Table Q1.1. The unit transportation cost per unit distance is assumed to be the same for the four warehouses.

Determine the best location for the new production facility. [6 marks]

Table Q1.1: 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

b) Table Q1.2 shows six customers that can be served from any of the three locations A(x = 20, y=50), B(x = 80, y = 70) or C(x=40, y=60). The load/unload cost, L_k = \$0.80 per trip and the cost per unit distance, C_k = \$0.003/m for customers 1, 2 and 3 and L_k = \$0.60 per trip and C_k = \$0.002/m for customers 4, 5 and 6.

Determine the best location. [14 marks]

Table Q1.2: Customer Data for Question 1 b

Customer	Co-ordinate x	y	No of trips per period	movement type
1	40	60	250	Straight line
2	60	70	165	Straight line
3	80	70	201	Straight line
4	40	30	104	Rectangular
5	10	80	306	Rectangular
6	10	60	55	Rectangular

QUESTION 2

a) Outline the steps involved in systematic layout planning (SLP). [6 marks]

b) A proposal has been made to replace one of the current manual stations with an automatic workhead on a 10 station transfer line. The current system has 6 automatic workheads and 4 manual stations. The proposed automatic station would allow the cycle time to be reduced from the current 30s to 24s. The new station is cost at \$0.25/min. Other cost data for the existing line are: C_o = \$0.15/min, C_{as} = \$0.10/min, and C_{at} = \$0.10/min. Breakdowns occur at each of the 6 automatic workstations to a probability p= 0.01. The average down time per breakdown is 3 min. It is estimated that the value of P for the new automatic station is P = 0.02. The average down time for the line will be unaffected. Material cost C_m = \$3.50/Unit and tooling costs C_t= 0.3 in both cases.

Compare the new automated station with the current manual station on the basis of cost per unit. [14 marks]

QUESTION 3

An assembly line consists of twelve work elements as shown in Table Q3. Assuming a cycle time of 1 min, you are required to design a well balanced assembly line.

Table Q3: Element Description and Data for Question 3

No.	Element description	T_{ej} (min)	Preceded by
1	Place frame as work-holder and clamp	0.2	-
2	assemble plug	0.4	-
3	assemble brackets to frame	0.7	1
4	wire power code to motor	0.1	1,2
5	wire power cord to switch	0.3	2
6	assemble plate to bracket	0.11	3
7	assemble blade to bracket	0.32	3
8	assemble motor to brackets	0.6	3,4
9	align blade and attach to motor	0.27	6,7,8
10	assemble switch to motor bracket	0.38	5,8
11	attach cover, inspect, test	0.5	9,10
12	pack	0.12	11

a) Determine the minimum possible number of workstations for the line. [2 marks]
b) Use the largest candidate rule method to balance the assembly line. [12 marks]
c) Identify the bottleneck station on the designed assembly line. [1 mark]
d) Explain three ways of eliminating bottleneck stations in assembly lines. [6 marks]

QUESTION 4

a) Briefly explain three factors which affect facility layout. [6 marks]
b) Outline four objectives of a good layout. [4 marks]
c) The material flows between four equal sized departments are given in Table Q4. Assuming the given starting solution for the facility layout, use the pair-wise exchange method to refine the current given solution. [10 marks]

Table Q4: Material Flow Matrix

		To dept			
		1	2	3	4
From Dept	1	-	10	20	30
	2		-	5	5
	3			-	10
	4				-

Starting Solution

3	2	1	4

QUESTION 5

a) Using an appropriate diagram, compare the five generic types of manufacturing processes in terms of production volumes and product variety. [10 marks]

b) Transfer line systems are characterised by operation dependant and time dependent failures. Distinguish the two failure types. [4 marks]

c) Consider a two station line. Given that station one fails on average every 10 cycles, the second every 15 cycles, and the average repair time is two cycles, determine the line effectiveness assuming the following:

   i) The line is subjected to operation dependant failures [3 marks]

   ii) The line is subjected to time dependant failures [3 marks]

QUESTION 6

a) Give brief explanations of the following three methods of work transportation:

   i) Synchronous transfer [2 marks]

   ii) Asynchronous transfer [2 marks]

   iii) Continuous transfer [2 marks]

b) Outline the factor you would consider when selecting the most appropriate method of work part transportation. [4 marks]

c) Suppose a 10 station transfer line is being considered for production of a digital camera. The weekly demand is 3 000 units and the production department has estimated that the ideal cycle time T_c is 2 minute. It is also estimated that breakdown of all types will occur with a frequency F = 0.2 breakdowns per cycle and that the average downtime per line stop will be 6 minutes (T_d = 6 mins). The scrap rate for the current processing method is 5% and this is considered a good estimate for the transfer times. Material costs are $35 per camera and it will cost $120 an hour ($2 a minute) to operate the transfer line. Tooling costs are estimated to cost $5 per unit.

   Determine the following:

   i) Production rate [4 marks]

   ii) Line efficiency [2 marks]

   iii) Cost per unit produced [2 marks]

   iv) Hours required to meet weekly demand [2 marks]

END OF EXAM