NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL & MANUFACTURING ENGINEERING

Bachelor of Engineering in Industrial and Manufacturing

PART III - MANUFACTURING SYSTEMS - TIE 3112

1st SEMESTER EXAMINATIONS APRIL 2009

Time allowed: 3 hours

Instructions to students

1. **Answer Any Five (5) questions. All questions carry equal marks**

Question 1

a) Briefly explain five major aspects business implications of process choice. [10]

b) Briefly describe the manufacturing processes found in a sugar processing company. [10]

Question 2

a) Describe briefly three factors which stimulate facility layout. [6]

b) How would you improve line balancing in a flowline plant? [4]

c) Applying Largest Candidate Rule method design an assembly line given that cycle time is 40 time units using data given in Table 2.1. [10]

Table 2.1

Operation	Time	Immediate Predecessors
A	3	-
B	5	-
C	10	A, B
D	11	C
E	24	C
F	26	D
G	24	E
H	15	G

Question 3

Shown below is the activity relationship chart along with the space requirements for each of the seven cells in a small auto parts manufacturing facility.

a) Construct relationship and space relationship diagrams [10]

b) Design the corresponding block layout using SLP. [5]

c) Construct a block layout using relationship Diagramming. [5]

	Area	Cell A	Cell B	Cell C	Cell D	Cell E	Cell F	Cell G
Cell A	2100	-	A	E	I	O	U	E
Cell B	2100		-	E	A	O	U	U
Cell C	2100			-	U	U	O	U
Cell D	2800				-	E	I	I
Cell E	1500					-	E	O
Cell F	1500						-	A
Cell G	2900							-

Question 4

a) Five special-purpose machines are located in a plant at point (0, 0), (0, 10), (30, 25), (15, 10) and (20, 20). The machines require maintenance at expected frequencies of 10, 16, 8, 5 and 12 times per month, respectively. Due to the nature of the maintenance all machine maintenance must be performed at the maintenance center. The annual cost of owning and operating a maintenance center is $5000. The cost of moving machine to the maintenance center is estimated to be $10 per unit distance. What is the total cost and location of the maintenance center if one maintenance center is the optimum number? [12]

b) Briefly explain two performance measures that you would use in your company. [8]

Question 5

a) Explain two methods of part transfers. [4]

b) Briefly explain three factors that one would use in the choosing of method of transfer of parts. [6]

c) Design considerations are being made for an automated paced assembly line system with four workstations. The mean cycles to failure should be 100, 200, 100, and 50 cycles respectively. Repair times should average 8 cycles.

i) Find the line availability, assuming no buffer [4]

ii) Profit is appreciable only if availability is increased by at least 0.04. A buffer of size 5 is available. What is the optimum location for the buffer? Should the buffer be included anyway? [6]

$$x_i = \frac{\alpha_i}{b_i}$$

$$s = \frac{x_2}{x_1} \qquad r = \frac{\alpha_2}{\alpha_1} \qquad \text{and } C = \frac{(\alpha_1+\alpha_2)(b_1+b_2)-\alpha_1 b_2(\alpha_1+\alpha_2+b_1+b_2)}{(\alpha_1+\alpha_2)(b_1+b_2)-\alpha_2 b_1(\alpha_1+\alpha_2+b_1+b_2)}$$

$$E_z = \frac{1 - sC^z}{1 + x_1 - (1 + x_2)sC^z} \qquad \text{when } s \neq 1$$

$$\text{or } E_z = \frac{1 + r - b_2(1+x) + Zb_2(1+x)}{(1+2x)[1 + r - b_2(1+x)] + Zb_2(1+x)^2} \qquad \text{when } s = 1$$

Question 6

a) Two products are produced on the same line. Task times are shown in Table 2.1. One half of demand is for product A and the other one half of demand is for product B.

Table 2.1: Task Times

		Product		
Task	Immediate Predecessors	A	B	
A	-	5	15	
B	a	23	8	
C	a	9	10	
D	a	30	14	
E	b	18	6	
F	b, c	12	14	
G	d, f	6	3	
H	g	16	3	
I	d	4	4	
J	i, h	20	20	
K	e, j	11	12	

Due to equipment requirements, stations must be assigned the same set of tasks for both products. Balance the line using Positional Weight method with cycle time C=40. [16]

a) Briefly explain two mode of failure. [4]

Question 7

a) Five products are produced on the same assembly line. Table 7.1 contains weekly demand for each product and time required by work station 6 per unit. Workstation 6 is more heavily loaded than the other workstations. Find a repeating cycle for entering product onto the mixed model line. The demand rate is constant and continuous for each product and management desires to avoid accumulating excess or shortage inventory of more than two units of any product at any time. Management would like to operate the line with the largest average production rate possible. [12]

Table 7.1: Demand and Bottleneck Processing Times

Product	Weekly Demand	Bottleneck Station Processing Time
A	1000	45
B	500	40
C	750	45
D	500	50
E	250	55

b) A production manager has five workers and five tasks that need to be completed. One is interested in minimizing total worker time. Based on skill levels and task requirements, she has estimated the times for each worker to perform each task. Find the best assignment by using the times in Table 7.2. ? [8]

Table 7.2 Task Times by Worker

			Task		
Team	1	2	3	4	5
A	10	8	20	15	3
B	13	12	25	2	10
C	4	15	16	5	8
D	10	12	14	2	12
E	8	11	28	3	9

END OF EXAM