National University of Science and Technology Faculty of Industrial Technology Department of Industrial and Manufacturing Engineering Bachelor of Engineering in Industrial and Manufacturing Engineering (Hons) First Semester Examination April 2009 Manufacturing Systems TIE5101

Duration: 3 hours **Paper has 3 Sections: Answer** *FIVE* **questions with** *ONE* **from each** *SECTION*

SECTION A: FLEXIBLE MANUFACTURING SYSTEMS

Question 1

a) Discuss the three types of tool allocation policies.

b) Given that a plant SHASHA which has a drill press and three CNC milling machines has been combined into a flexible system. The drill press can store seven bits on a rotation head. The milling machines can each hold six tools. The operating policy is to setup machines once per day, then produce for 10hours. The system makes eight (8) part types. Given the additional information in Table 1.1 devise a rotating plan (plan will repeat every N days) to meet demand. [14] Table 1.1

| | | Unit Processing (Hours) | | Tools Required | |
|-----------|--------------|-------------------------|---------|-----------------|---------------|
| Part Type | Daily Demand | Drill Press | Milling | Drill Press | Milling |
| 1 | 35 | 0.02 | 0.23 | 3, 5, 6, 9, 10 | 5, 6, 9, 11 |
| 2 | 15 | 0.04 | 0.18 | 3, 6, 9 | 2, 4, 11, 12 |
| 3 | 13 | 0.04 | 0.05 | 1, 4, 6, 13 | 3, 7, 12 |
| 4 | 18 | 0.01 | 0.26 | 2,4 | 5, 11, 12 |
| 5 | 30 | 0.02 | 0.17 | 4, 7, 9, 10, 12 | 4, 6, 7 |
| 6 | 5 | 0.03 | 0.05 | 1, 2, 6 | 7, 8, 13 |
| 7 | 20 | 0.15 | 0.20 | 1, 3, 4, 5 | 1, 2, 3, 4, 5 |
| 8 | 10 | 0.20 | 0.30 | 1.5.6.9 | 2, 4, 5, 8 |

Question 2

a) Describe briefly three types of flexibility.

b) A cement manufacturer produces two types of cement, namely granules and powder. He cannot make more than 1600 bags a day due to a shortage of vehicles to transport the cement out of the plant. A sales contract means that he must produce at least 500 bags of powdered cement per day. He is further restricted by a shortage of time - the granulated cement requires twice as much time to make as the powdered cement. A bag of powdered cement requires 0.24 minutes to make and the plant operates an 8 hour day. His profit is \$40 000per bag for granulated cement and \$30 000 per bag for the powdered cement.

Formulate the problem of deciding how much he should produce as a linear program. [14]

[6]

[6]

Question 3

| a) | Briefly explain two | types of layouts i | n the design of flexible | e manufacturing systems. | [4] |
|----|---------------------|--------------------|--------------------------|--------------------------|-----|
|----|---------------------|--------------------|--------------------------|--------------------------|-----|

- b) Briefly explain two tool magazines in flexible manufacturing systems design. [4]
- c) A new flexible manufacturing cell containing milling and turning operations is being designed. Currently all part are being outsourced. All units of a part must be built in or totally outsourced. Potential parts are shown in Table 3:1. Given the number of milling machines in the cell is of no concern but the turning center has 600 time units available per period.

[10]

[2]

- i) What is the set of parts to be manufactured in the cell?
- ii) What is the cost savings per period?

| Table 3.1 | | | | | |
|-----------|---------------|-------------|-------------|-------------|-------------|
| Part | Demand/Period | Turning | Milling | Purchase | Variable |
| | | (time/part) | (time/part) | (cost/part) | Machining |
| | | | | | (cost/part) |
| 1 | 4 | 20 | 15 | 100 | 35 |
| 2 | 3 | 35 | 10 | 125 | 45 |
| 3 | 2 | 40 | 50 | 250 | 90 |
| 4 | 5 | 10 | 60 | 165 | 70 |
| 5 | 2 | 55 | 25 | 110 | 80 |
| 6 | 5 | 75 | 65 | 300 | 140 |
| 7 | 8 | 15 | 55 | 215 | 70 |

SECTION B: MATERIAL HANDLING

Question 4

| a) Briefly describe four principles of material handling and possible application. | [8] |
|--|------|
| b) Describe four category characteristics of industrial trucks. | [12] |
| Question 5 | |
| a) Discuss briefly two types of conveyors. | [10] |
| b) Describe briefly two accessories in material handling. | [10] |
| Question 6 | |
| a) What are the difficulties in applications of the material handling principles? | [8] |
| b) Briefly discuss the steps in material handling design. | [12] |

SECTION C: CASE STUDIES

Question 7

a) Situation: The Allen Export Company ships sugar to many overseas ports. Over the years the company has stacked large bags of sugar onto pallets for shipping. Because of a lumber shortage, pallets for export have become very difficult to obtain. The management of Allen Export has presented the dock manager with the challenge of reducing the number of wooden pallets used and/or to find a new way to supplement or change their stevedoring system. Question: Can a system be devised to eliminate the shortage of pallets? [4]

b) The Jones Company operates a centrally located storeroom in their manufacturing complex.

Every afternoon each craft foreman (Tin Shop, Electric Shop, Iron Workers, etc.) writes a requisition for common use items that will be required for the next day's work. These common use items include nuts, bolts, screws, washers, flashlight batteries, and gloves. All specialty items are ordered separately. During the night shift, storeroom personnel fill the orders of items requested by the craft foreman. Each morning, one or two workers from each department go to the storeroom with a four-wheel platform truck to pick up the filled order.

Although studies have never been performed to determine the amount of time craftsmen spend waiting for supplies, it is the thoughts of the management that idle craft manpower is a problem resulting from this procedure. How can time spent traveling to and from the described storeroom be reduced, thus, eliminating or decreasing crafts' personnel travel time?. Give four alternative solutions from which you will recommend the best one with reasons of choice. [16]

End of Exam