## NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

## FACULTY OF INDUSTRIAL TECHNOLOGY

## DEPARTMENT OF INDUSTRIAL ENGINEERING

## PART III - MANUFACTURI NG SYSTEMS - TIE 3012

SECOND SEMESTER EXAMINATION - APRIL/MAY 2000
Time Allowed: 3 Hours
Answer 5 Questions

Qu. 1 a) Seven jobs to be produced on a single machine have processing times of ( $5,3,1,13,24,2,9$ ) and due dates of ( $51,29,42,65,12,8,34$ ). Find
i) the schedule to minimize average flow time
ii) the average flow time
iii) maximum tardiness
iv) the schedule to minimize maximum tardiness
v) the average flow time
vi) the maximum tardiness
vii) the schedule to optimize the two performance measures which are minimize average flow time and tardiness
b) Given that the parts describe are to be scheduled through a flowshop. Find the possible schedules to minimize makespan then find makespan of the first schedule possible.

| Job | Machine |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | A | B | C | D |
|  | 3 | 4 | 6 | 8 |
| 2 | 4 | 6 | 13 | 11 |
| 3 | 4 | 9 | 12 | 6 |
| 4 | 5 | 6 | 11 | 4 |
| 5 | 3 | 10 | 8 | 5 |
| 6 | 5 | 4 | 10 | 3 |

Qu. 2. a) Explain briefly the characteristics of the five main manufacturing systems types and identify the business implication in choosing any of the types of systems.
b) List four hybrid systems to two of the main manufacturing systems types then explain briefly the challenge that an industrial engineer will be faced with in each of the main manufacturing systems. [8]

Qu. 3 a) What is facility layout and factors that would lead a manufacturing engineer to be concerned with facility layout problems
b) What are the aims and objectives of a good plant layout
c) What do you understand by the terms: Euclidean and linear
d) Given that the department of engineering services has six departments in the company to be served from either location A (30, 30 ) or $B(80,60)$. Given that the load/unload cost per trip Lk $=\$ 1.00$ and the cost per unit distance $\mathrm{Ck}=\$ 0.01 / \mathrm{m}$ for all customers. which is the best location.

|  | Coordinates |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Customer | $X$ | $Y$ | No of trips/ period | Measurement type |
| 1 | 40 | 60 | 185 | Rectilinear |
| 2 | 50 | 20 | 300 | Rectilinear |
| 3 | 60 | 40 | 150 | Rectilinear |
| 4 | 80 | 40 | 205 | Straight line |
| 5 | 40 | 40 | 200 | Straight line |
| 6 | 60 | 60 | 175 | Straight line |

Qu. 4 a) Your company is trying to move into the area of automated flow systems briefly explain as to your manufacturing director the possible methods of transporting of workpieces in this manufacturing system.
b) Suppose the company final decide on a 10 station transfer machine for production of the components. The component is currently produced by more conventional means which cannot meet the demand. the production department has estimated that the ideal cycle time $T_{c}=1 \mathrm{~min}$. From similar transfer times it is estimated that breakdown of all types will occur with a frequency $f=0.10$ breakdown per cycle and the average downtime per line stop will be 6 minutes. Assuming scrap rate for the current processing method is $5 \%$ and this is considered a good estimate for the transfer times. the starting cost for the components costs $\$ 1.50$ each and it will cost $\$ 60 / \mathrm{hr}$ to operate the transfer line. Cutting tools are estimated to cost 15c per work part.
Find:
i) Production rate
ii) The number of hours required to met a demand of 1500 units/week
iii) Line efficiency
iv) cost per unit produced

Qu. 5 a) Briefly explain cellular manufacturing
b) Describe briefly with aid of illustrations the different layout in group technology
c) After applying group technology it was found that one of the family of products have the work elements as shown in Table Q51 below.

Table Q51

| Element | $\mathrm{T}_{\mathrm{e}}(\mathrm{min})$ | Immediate Predecessors |
| :---: | :---: | :---: |
| 1 | 0.5 | - |
| 2 | 0.3 | 1 |
| 3 | 0.8 | 1 |
| 4 | 0.2 | 2 |
| 5 | 0.1 | 2 |
| 6 | 0.6 | 3 |
| 7 | 0.4 | 4,5 |
| 8 | 0.5 | 3,5 |
| 9 | 0.3 | 7,8 |
| 10 | 0.6 | 6,9 |

i. Assuming ideal cycle time is 1.0 min , what is the theoretical minimum number of stations required to minimize the balance delay using Rank Position Weight method?
ii. What is the balance delay?

Qu 6 a) Discuss briefly the factors that you will consider as an industrial engineer before recommending to the managing director to finance the purchase of classification and coding system.
b) What are the benefits to the company for implementing group technology.
c) Using the average-linkage clustering algorithm to determine what machines should be grouped together using information given in Table Q61.
d) Briefly discuss the methods of analyzing whether the cell design is the best.

Table Q61

|  | Part Number |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |  |
|  | M1 | 1 |  | 1 | 1 |  |  |  |  |  |  |
|  | M2 |  | 1 |  |  | 1 |  |  | 1 | 1 |  |
|  | M3 | 1 |  | 1 | 1 |  |  | 1 |  | 1 |  |
| Machines | M4 | 1 | 1 | 1 | 1 |  |  | 1 |  |  |  |
|  | M5 |  | 1 |  |  | 1 | 1 |  | 1 | 1 |  |
|  | M6 |  |  |  |  | 1 | 1 |  |  | 1 |  |

End of Exam

