## NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY



## FACULTY OF INDUSTRIAL TECHNOLOGY DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

B-Eng Hons Industrial and Manufacturing Engineering SUPPLEMENTARY EXAMINATION

COURSE : MANUFACTURING SYSTEMS III
CODE : TIE 5101
DATE : AUGUST 2013
DURATION : 3 HOURS

INSRTUCTIONS AND INFORMATION TO CANDIDATE

1. Answer ANY five questions at LEAST TWO from each section.
2. All questions carry $\mathbf{2 0}$ marks each.
3. This paper contains seven (7) questions.
4. There are five (4) printed pages.

QUESTION 1
a) Outline five advantages of Flexible manufacturing Systems (FMS).
b) Briefly describe five FMS software modules.

## QUESTION 2

a) Discuss briefly two types of layout in a Flexible Manufacturing System (FMS) plant.
b) Consider a set of orders shown in Table Q2 awaiting processing in a manufacturing cell. The cell has three machines of type A and one of type B. Both machine types are capable of holding two tools. The machines are set up once each day and are available for 12 hours per day. It is currently morning of day 5 . Find the set of part types to be produced in the next 12hour shift.
[14]

Table Q2: Part Type Data for Question 2

|  |  |  | Unit processing time (hours) |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Part type | Order size | Due date | Machine A | Machine B | Tools |
| a | 5 | 5 | 0.1 | 0.3 | A1, B2 |
| a | 10 | 9 | 0.3 | 0.2 | A1, B2 |
| b | 10 | 6 | 1.2 | - | A2 |
| e | 4 | 7 | 0.3 | 0.2 | A5, B3 |
| c | 25 | 6 | 0.7 | 0.4 | A3, B4 |
| d | 10 | 6 | 0.1 | 0.3 | A1, B2 |

## QUESTION 3

a) Briefly describe three types of flexibility.
b) Eight part types are being considered for a Flexible Manufacturing System (FMS) workcell. The workcell is available for 250 hours. The workcell is charged at a rate of $\$ 50$ per hour. Table Q3 shows unit purchase price, raw material cost demand rate, and unit production time for each part type.

Table Q3: Part Type Data for Question 3

|  | Part Type |  |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :---: |
|  | $\mathbf{1}$ | $\mathbf{2}$ | $\mathbf{3}$ | $\mathbf{4}$ | $\mathbf{5}$ | $\mathbf{6}$ | $\mathbf{7}$ | $\mathbf{8}$ |  |
| Unit purchase price (\$) | 200 | 155 | 300 | 125 | 300 | 86 | 93 | 165 |  |
| Material cost (\$) | 45 | 35 | 124 | 50 | 120 | 34 | 36 | 114 |  |
| Demand per period (units) | 100 | 50 | 50 | 75 | 60 | 30 | 50 | 600 |  |
| Unit production time (hours) | 1.0 | 2.0 | 4.0 | 1.0 | 2.0 | 1.0 | 1.0 | 0.5 |  |

i) Using the Greedy heuristic determine the part types that should be added to the FMS workcell.
ii) Calculate the saving associated with the assignment of part types to the workcell.

## SECTION B: MATERIAL HANDLING

## QUESTION 4

a) Outline five objectives of material handling.
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b) An Automated Guided Vehicle System (AGVS) has an average travel distance per delivery of 500 m and an average empty travel distance of 300 m . The system must make a total of 75 deliveries per hour. The load and unload times are both 0.5 min and the speed of the vehicles is $150 \mathrm{~m} / \mathrm{min}$. The traffic factor for the system is 0.85 .

Determine:
i) the average total time per delivery
ii) the handling system efficiency
iii) the resulting average number of deliveries per hour for a vehicle
iv) the number of vehicles needed to satisfy the indicated deliveries per hour

## QUESTION 5

a) Describe four characteristics of industrial trucks.
b) Briefly describe the steps involved in material handling design.

## QUESTION 6

a) Briefly discuss the steps involved in material handling design.
b) Outline any four principles of material handling.

## QUESTION 7

a) Briefly describe five types of identification and control equipment for material flow.
b) Consider an operation of unit load Automated Storage and Retrieval System (AS/RS), which uses a Storage and Retrieval (S/R) machine for each aisle of the system. The length of storage aisle is 300 m and its height is 50 m . Horizontal and vertical speeds of S/R machine are $400 \mathrm{~m} / \mathrm{min}$. and $75 \mathrm{~m} / \mathrm{min}$. respectively. The $\mathrm{S} / \mathrm{R}$ requires 30 seconds to accomplish pickup and delivery. Determine the single and dual command cycle times.

