NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

1ST SEMESTER EXAMINATIONS - DECEMBER 2011

MANUFACTURING SYSTEMS III **COURSE CODE TIE 5101**

EXAMINATION DURATION 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. **Answer FIVE (5) questions, at Least TWO (2) from each section.**
2. **All Questions carry Equal Marks**

SECTION A: FLEXIBLE MANUFACTURING SYSTEMS

QUESTION 1

An Flexible Manufacturing System (FMS) consists of four stations. Station 1 is a load/unload station with one server. Station 2 performs milling operations with three servers (three identical CNC milling machines). Station 3 performs drilling operations with two servers (two identical Computer Numerical Controlled (CNC) drill presses). Station 4 is an inspection station with one server that performs inspection on a sampling of the parts. The stations are connected by a part handling system that has two work carriers and whose mean transport time is 3.5 min. The FMS produces four parts, A, B, C, and D. The part mix fractions and process routings for the four parts are shown in Table Q1.

Table Q1: Part Type Data for Question 1

Part j	Part mix p_j	Operation k	Description	Station i	Process time t_{ijk}	Frequency f_{ijk}
A	0.1	1	Load	1	4	1.0
		2	Mill	2	20	1.0
		3	Drill	3	15	1.0
		4	Inspect	4	12	0.5
		5	Unload	1	2	1.0
B	0.2	1	Load	1	4	1.0
		2	Drill	3	16	1.0
		3	Mill	2	25	1.0
		4	Drill	3	14	1.0
		5	Inspect	4	15	0.2
		6	Unload	1	2	1.0
C	0.3	1	Load	1	4	1.0
		2	Drill	3	23	1.0
		3	Inspect	4	8	0.5
		4	Unload	1	2	1.0
D	0.4	1	Load	1	4	1.0
		2	Mill	2	30	1.0
		3	Inspect	4	12	0.3
		4	Unload	1	2	1.0

Determine:

a) the maximum production rate of the Flexible Manufacturing Systems (FMS) [10 marks]

b) the corresponding production rate of each part [4 marks]

c) the utilisation of each station in the system [4 marks]

d) the overall Flexible Manufacturing Systems (FMS) utilisation [2 marks]

QUESTION 2

a) Briefly describe three types of flexibility. [6 marks]

b) Eight part types are being considered for an Flexible Manufacturing Systems (FMS) workcell. The workcell is available for 350 hours. Table Q2 shows unit purchase price, raw material cost demand rate, and unit production time for each part type.

Table Q2: Part Type Data for Question 2

	Part Type							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Unit purchase price ($)	200	155	165	125	300	86	93	300
Material cost ($)	45	35	114	50	120	34	36	124
Demand per period (units)	100	50	600	100	60	15	50	50
Unit production time (hours)	1.0	2.0	0.5	1.0	2.0	2.0	1.0	4.0

i) Which part types should be added to the FMS workcell? [11 marks]
ii) Calculate the saving associated with the assignment of part types to the workcell. [3 marks]

QUESTION 3

a) Discuss briefly two types of tool allocation policies. [6 marks]

b) Consider a set of orders shown in Table Q3 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 12- hour shift. [14 marks]

Table Q3: Part Type Data for Question 3

			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

SECTION B: MATERIAL HANDLING

QUESTION 4

a) Outline four types of material handling costs and ways to reduce them. [8 marks]
b) Briefly describe the steps involved in material handling design. [12 marks]

QUESTION 5

a) Briefly explain how a manufacturing company may benefit from using Automated Storage and Retrieval Systems. [4 marks]
b) Briefly describe any three types of Automated Storage and Retrieval Systems. [6 marks]
c) Discuss briefly any five material handling principles. [10 marks]

QUESTION 6

a) Using appropriate diagrams describe three types of material handling equipment in the family of conveyors. [12 marks]
b) Discuss, citing examples, how material handling can be used to improve productivity in a company of your choice. [8 marks]

QUESTION 7

a) Describe the unit load concept in material handling and its two advantages. [6 marks]
b) Describe five characteristics of industrial trucks. [10 marks]
c) Briefly discuss two means of guidance used for Automated Guided Vehicles (AGV) systems. [4 marks]

END OF EXAM