M.E. Mechanical Engineering - First Year - Second Semester, 2024

Advanced Manufacturing Systems

Time: Three hours Answer any **five** questions Full marks: 100

1. (a) Discuss briefly the Opitz coding system and cite an example of a part design to develop the form code (first five digits) in this system.
   (b) Apply the ROC method to solve the following cell formation problem.

	Parts						
Machines		A	B	C	D	E	F
	1	1				1	
	2				1		1
	3	1	1				
	4			1	1		
	5		1			1	
	6			1	1		1

[8+12]

2. (a) How does MRP II work?
   (b) Consider the small MRP tree.
   A-110 (10,1,1)→A-200 (30,2,3) →X-300 (65,1,2) Determine the L4L planned order releases for A-110, A-200 and x-300 assuming no scheduled order receipts for any item. The master schedule for the parent A-110 is as follows:

Time period	1	2	3	4	5	6	7	8	9
Gross Requirements	3	6	5	8	5	6	5	4	3

[6+14]

3. (a) What is a flexible manufacturing system? What are the advantages of the FMS? (b) Discuss briefly four tests of flexibility in an automated manufacturing system. (c) The FMC cell consists of a load/unload station and two machining workstations as stations 1, 2 and 3 respectively. Station 2 consists of two servers and station 3 has one server. The part handling system has two work carriers and its mean transport time is 3.0 minutes. The FMC produces three parts, A, B, and C. The relevant information for the problem is given in the following table. Determine the maximum production rate of the FMC, the corresponding production rates of each product, and the number of busy servers at each station.

Operation	Part A (0.25)		Part B (0.45)		Part C (0.30)	
	Station	Time	Station	Time	Station	Time
Load	1	3	1	3	1	3
Mill	2	20	2	15	2	14
Drill	3	15	3	20	3	25
Unload	1	2	1	2	1	2

[4+4+12]

4. Two products use a single assembly line in a particular facility. Precedence diagrams for the two products A and B are given in the following Tables 1 and 2 respectively. Given a cycle time of 25 minutes. Determine the balance using the Helgeson-Birnie approach on the combined precedence network. Also, determine the line efficiency and station efficiencies for both products.

Table 1 for Product A:

Activity No.	3	4	6	7	9	10	11	12	15
Immediate predecessor (s)	--	3	4	3	7	7	3	10,11	6,9,12
Activity time:	2	6	5	7	3	5	7	6	4

Table 2 for Product B:

Activity No.	1	2	3	4	5	7	8	9	10	12	13	14	15
Immediate predecessor (s)	--	1	2	3	4	1	7	4,8	9	1	12	13	5,10,14
Activity time:	6	2	4	6	5	7	10	3	3	6	7	8	4

[20]

5. (a) Explain stochastic mixed-product line balancing.
(b) A firm develops a 3-month aggregate plan. Assume that the initial inventory has no holding cost in the first period. Initial inventory – 20, regular-time (RT) cost per unit – Rs 100, overtime (OT) cost per unit – Rs 150, subcontract (SC) cost per unit – Rs 200, carrying cost per unit per month –Rs 4. Set up a production plan that minimizes cost using the transportation method.

Month	Labour		SC	Demand Forecast
	RT	OT		
1	30	10	5	40
2	35	12	5	50
3	30	10	5	40

[5+15]

6. (a) Discuss the four functions included within the scope of manufacturing support systems.
(b) Distinguish between job shop and batch production. [12+8]

7. (a) What is a just-in-time production system?
(b) Name seven forms of waste in production as identified by Taiichi Ohno.
(c) A company is moving to Kanban to support its telephone switching-board assembly lines. Determine the size of the kanban for subassemblies and the number of kanbans needed. Setup cost = Rs 30; Annual holding cost per subassembly = Rs 120; Daily production = 20 subassemblies; Annual usage = 2500 (50 weeks x 5 days each x daily usage of 10 subassemblies); Lead time = 16 days; Safety stock = 4 days' production of subassemblies. [4+4+12]