

**Note:** Be precise and correct. Marks will not be awarded for any incorrect intermediate calculation and onwards.

**Q1.**

- i) Explain the hierarchical nature of production planning. How time horizon plays a role in this context? [6]
- ii) The Great Northwest Outdoor Company is a catalog sales operation that specializes in outdoor recreational clothing. Demand for its items is very seasonal, peaking during the holiday season and during the spring. It has accumulated the following data for order per “season” (quarter) during the past five years:

Orders (1000s)					
Quarters	2006	2007	2008	2009	2010
January-March	18.6	18.1	22.4	23.2	24.5
April-June	23.5	24.7	28.8	27.6	31.0
July-September	20.4	19.5	21.0	24.4	23.7
October-December	41.9	46.3	45.5	47.1	52.8

Develop a seasonally adjusted forecast model for these order data. Forecast demand for each quarter for 2011 (using a linear trend line forecast estimate for orders in 2011). Assess the accuracy of the forecast model using MAD and determine if the forecast of various quarters of first three years reflects bias using a tracking signal and  $\pm 3$  MAD control limits. [12]

**Q2.**

- i) The office manager for the Metro Life Insurance Company orders letterhead stationery from an office products firm in boxes of 500 sheets. The company uses 6500 boxes per year. Annual carrying cost is 20% of the price of a box of stationery, and ordering cost is \$28. The following discount price schedule is provided by the office supply company:

Order Quantity (boxes)	Price per Box (\$)
200-999	16
1000-2999	14
3000-5999	13
6000+	12

Determine the optimal order quantity and the total annual inventory cost. [8]

- ii) Tariott Hotel rents rooms for \$125 a night that cost approximately \$50 per day to maintain. Overbooking is a common practice in the industry. Customers whose rooms have been leased to someone else are put up in a nearby hotel for \$100 a night. Records show that during the past month, there were 10 days with zero no-shows, 5 days with 1 no-show, 6 days with 2 no-shows, and 9 days with 3 no-shows.
- What is the cost of overbooking?
  - What is the cost of underbooking?
  - What is the optimum probability of no-shows for Tariott?
  - How many rooms should Tariott overbook?
- [6]

- iii) Caltex uses overtime, inventory, and subcontracting to absorb fluctuations in demand. An annual production plan is devised and updated quarterly. Expected demand, available capacities, and costs for the next four quarters are given below. Design a production plan that will satisfy demand at minimum cost.

Period	Demand	Regular Capacity	Overtime Capacity	Subcontracting Capacity
1	1500	1000	200	500
2	1900	1000	200	500
3	500	1000	200	500
4	2000	1000	200	500

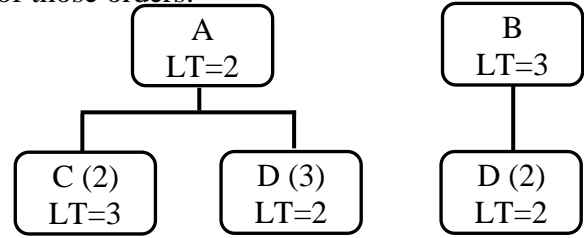
Regular production cost per unit                    \$10  
 Overtime production cost per unit                \$15  
 Subcontracting cost per unit                        \$20  
 Inventory holding cost per unit per period      \$2

[8]

**Q3.**

i) The Willow Bench Company produces two products; A and B, that are made from components C and D. Given the following product structures, master scheduling requirements, and inventory information, determine when orders should be released for A, B, C, and D and the size of those orders. [8]

	On Hand	Scheduled Receipts	Lot Size	MPS
<b>A</b>	20	0	L4L	200, period 8
<b>B</b>	15	5, period 2	L4L	250, period 7
<b>C</b>	200	100, period 3	Min 100	-
<b>D</b>	250	0	Mult 100	-



ii) The Best Wheels Bicycle Company has scheduled the production of the following bicycles this month.

Model		Week			
		1	2	3	4
(B2610)	26-inch 10-speed	50	100	195	150
(B2003)	20-inch 3-speed	15	30	65	45
(B2001)	20-inch 1-speed	20	40	80	60

The two critical work centers for producing these bikes are welding and assembly. Welding has an efficiency of 95% and a utilization of 90%. Assembly has an efficiency of 90% and a utilization of 92%. The time required (in hours) by each bike in the two work centers is as follows:

	Welding	Assembly
B2610	0.20	0.18
B2003	0.15	0.15
B2001	0.07	0.10

Assume 40 hours is available per week for each work center. Calculate the capacity and load percent per work center per week. [8]

**Q4.**

i) Fibrous Incorporated makes products from rough tree fibers. Its product line consists of five items processed through one of five machines. The machines are not identical, and some products are better suited to some machines. Given the following production time in minutes per unit, determine an optimal assignment of product to machine: [6]

Product	Machine				
	A	B	C	D	E
<b>1</b>	17	10	15	16	20
<b>2</b>	12	9	16	9	14
<b>3</b>	11	16	14	15	12
<b>4</b>	14	10	10	18	17
<b>5</b>	13	12	9	15	11

ii) Evan Schwartz has six jobs waiting to be processed through his machine. Processing time (in days) and due date information for each job are as follows:

Job	Processing Time	Due date
<b>A</b>	2	3
<b>B</b>	1	2
<b>C</b>	4	12
<b>D</b>	3	4
<b>E</b>	4	8
<b>F</b>	5	10

Sequence the jobs by FCFS, SPT, SLACK, and DDATE. Calculate the mean flow time and mean tardiness of the six jobs under each sequencing rule. Which rule would you recommend? [8]

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