

Supply Chain Management (DM-404)

Trimester-IV, End Term Examination, September 2016

Time allowed: 2 hr 30 min

Max Marks: 50

Roll No: _____

Instruction: Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means**. In case of rough work, please use answer sheet.

Section A: Short answer questions (Five marks each. Attempt any three; total marks 15)

- A1. What are the three stages of supply chain decisions? Give two examples of decisions made in each stage.
- A2. Total logistics costs are the sum of inventory, transportation, and facility costs for a supply chain network. How does the *inventory* cost change as the number of facilities increases? Explain.
- A3. Explain what is meant by postponement. Give two examples.
- A4. Company XYZ supplies electronic subassemblies ('Products') to customers. The orders received versus supplies made from available stock for two products A and B are shown in the table below.

Product A

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Order	150	150	200	250	150	100	100	150	250	200	100	100
Supply	150	150	180	240	150	100	100	150	200	200	100	100

Product B

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Order	600	600	600	500	500	500	400	600	400	700	500	200
Supply	600	600	600	500	490	500	400	600	400	670	500	200

Cycle service level (CSL) is defined as the fraction of replenishment cycles that end with all demand met. Considering that each month a single order is placed each for products A and B, and is replenished by a single supply of each, what is the CSL for products A and B for the period Jan till Dec?

- A5. McMaster-Carr sells maintenance, repair, and operations (MROs) equipment directly from five warehouses in the United States. Customer orders are received via the web. Its competitor WW Grainger also sells MRO products, but from more than 350 retail locations, supported by several warehouses. Discuss the merits and demerits of the two distribution strategies.

Section B: 10 marks each. Attempt any 2; total marks 20

- B1. Weekly demand for gaming consoles at Liverpool, a Mexican department store chain, is normally distributed with a mean of 1,000 and a standard deviation of 400. The replenishment lead time from the supplier is four weeks. Liverpool is targeting a CSL of 95 percent and uses a periodic review policy under which it reorders consoles every eight weeks.
- How much safety inventory of consoles should Liverpool carry? (4 marks)
 - What should its order up to level be? (3 marks)
 - How much safety inventory would be required if Liverpool switched to a continuous review policy? (3 marks)
- B2. Summer is high season for tourism in Jaipur: tens of thousands of tourists visit the city's historical landmarks. Many visitors take guided tours around these locations. Many of these guided tours make a stop at the Amer Palace. The thousands of tourists that stop here every summer, usually thirsty, are a great market for cold bottled water. A local store based next to the Palace takes advantage of this opportunity by placing dozens of water bottles in huge blue buckets with ice in the shade, within sight of the tourists. The colder the water bottles are, the better they sell. It takes usually several hours to chill the bottles, so the decision of how many bottles to prepare for sale is taken the previous day.
- You have been asked by the store to help them calculate the number of water bottles they should chill and stock in the ice buckets, ready to sell to tourists each day. Based on historical data, you have determined the daily demand for bottled water during the summer is – on average – normally distributed with a mean of 400 bottles, and a standard deviation of 100 bottles. The store buys the water bottles at Rs.5.50 a piece, and spends an additional Rs.1.00 in electricity and ice to chill it and keep it that way. A chilled bottle is sold to the tourists at Rs.10.00 a piece. Since the labels of the bottles deteriorate under water, the bottles that do not sell at the end of the day have to be discarded.
- What are the values of the shortage (underage) cost, excess (overage) cost, and the critical ratio? (3 marks)
 - How many water bottles should the store prepare for sale every day? Round to the closest multiple of 10. (2 marks)
 - The store's owner is concerned that your recommendation calls for stocking much less water than he is used to. He is convinced that for every person that doesn't get to buy water (because of shortage), the store loses an additional amount of Rs.5.00 worth of profit from sales in snacks and other things these people would have bought. Using Rs.5.00 as an additional penalty per lost sale, what is the new critical ratio? (3 marks)
 - Based on the value calculated in question (c), how many water bottles should the store prepare for sale every day? Round to the closest multiple of 10. (2 marks)

B3. Answer any two of the following. (5 marks each)

- a. Describe the two types of ordering policies and the impact that each of them has on safety inventory.
- b. Mattel has historically allowed toy retailers to place two orders for the holiday shopping season. Mattel is considering allowing retailers to place only one order. What impact will this have on retailer orders? What impact will this have on supply chain profits?
- c. What problems result if each stage of a supply chain views its demand as the orders placed by the downstream stage? How should firms within a supply chain communicate to facilitate coordination?

Section C: Case study; 15 marks

ALKO began in 1943 in a garage workshop set up by John Williams. In February 1948, Williams obtained a patent for one of his designs for lighting fixtures. He produced it in his workshop and marketed it in the Cleveland area. The product sold well and by 1957 ALKO had grown to a \$3 million company. Its lighting fixtures were well known for their outstanding quality.

With time ALKO started distributing its products nationwide. As competition intensified in the 1980's, ALKO introduced many new products. The company's profitability, however, began to worsen despite the fact that ALKO had taken great care to ensure high product quality. Margins had begun to shrink. At this point the Board decided to reorganize the company. Gary Fisher was hired to do so.

When Fisher arrived in 2009, he found a company teetering on the edge. He spent the first few months trying to understand the business and the way it was structured. He realized that the key was in the operating performance. Although ALKO was always outstanding in developing and producing new products, it had historically ignored its distribution system. Fisher set up a task force to review the current distribution system and come up with recommendations.

The Current Distribution System

In 2009 ALKO had 100 products. All production occurred at three facilities located in the Cleveland area. For sales purposes, the country's geography was divided into five regions. A DC owned by ALKO operated in each of these regions. Customers (retailers) placed orders with the DCs, which supplied them from product in inventory. As the inventory for any product diminished, the DC ordered from the plants. The plants scheduled production based on DC orders.

The orders were transported from plants to the DCs in TL quantities because order size tended to be large. On the other hand, shipments from the DC to customers were LTL. ALKO used a third party trucking company for both inbound and outbound transportation from the

DCs. In 2009, inbound transportation cost from the plants to the DCs averaged \$0.09 per unit quantity, while outbound transportation from the DCs averaged \$0.10 per unit quantity. On average it took five days for the plants to replenish a DC's order. This time was more or less the same for all the DCs.

In 2009, the policy was to stock each item in every DC. There were three basic categories of products in terms of volume of sales – high, medium, and low. Demand data for a representative product in each category are shown in Table 1. Products 1, 3, and 7 are representative of high, medium, and low demand products, respectively. Of the 100 products that ALKO sold, 10 were of high, 20 of medium, and 70 of low category. Assume each of their demands to be identical to those of the representative products 1, 3, and 7, respectively as shown in the table.

The DCs ordered using a periodic review policy with a fixed review period of six days. The holding cost incurred was \$0.15 per unit per day. All DCs carried safety inventory to ensure a CSL of 95 percent.

Alternative Distribution System

The task force recommended that ALKO build a national distribution centre (NDC) just outside Chicago. It also recommended that the five present DCs be closed. All customers were to be served from the NDC. The CSL out of the NDC would continue to be 95 percent.

Given that Chicago is close to Cleveland, the inbound transportation cost from plants to the NDC would reduce to \$0.05 per unit. The replenishment lead time would still be 5 days. Given the increased outbound distance, however, the outbound transportation cost from the NDC would increase to \$0.24 per unit.

Gary Fisher pondered the task force report. They had not detailed any of the numbers supporting their recommendation. He decided to evaluate the numbers before making a decision.

Table 1. Daily Demand (in units)

	Region 1	Region 2	Region 3	Region 4	Region 5
Part 1; Mean	35.5	22.6	17.7	11.8	3.4
Part 1; Stdev	7.0	6.5	5.3	3.5	4.4
Part 3; Mean	2.4	4.1	6.1	6.1	7.4
Part 3; Stdev	3.1	6.2	6.3	6.7	3.5
Part 7; Mean	0.5	0.7	0.8	1.9	2.5
Part 7; Stdev	1.9	1.4	2.3	3.7	3.9

C1. The average cycle inventory is equal to half the average demand during the cycle. Assume that the centralized NDC follows a periodic review policy with a fixed review period of 6 days.

- a. What is the duration of a cycle followed by (i) each of the five DCs, (ii) the centralized NDC? (2 marks)
- b. The total average cycle inventory at present is the sum of the average cycle inventories at all five DCs. Will there be any change in the average cycle inventory between the present and the proposed systems? Elaborate, preferably with supporting numbers. (3 marks)

C2. All transportation costs given in the case are purely variable (per unit transported). Estimate the change in *total* average transportation cost if the proposed centralized system is implemented. (3 marks)

C3. Answer the following.

- a. How much is the total safety inventory of the parts 1, 3, and 7 in the present distribution system? How much will the total safety inventory of these parts be if the proposed system is implemented? (4 marks)
- b. Therefore, by how much will the total cost of carrying safety inventory (of all 100 products) change if the proposed system is implemented? (3 marks)

