

ORDRE DES INGÉNIEURS DU QUÉBEC

NOVEMBRE 2018 SESSION

OPEN BOOK
ONLY CALCULATOR IS PERMITTED
DURATION: 3 hours

16-MC-B2 INTEGRATED MANUFACTURING SYSTEMS

QUESTION I (20 points):

One of the top-selling items in the container group at the museum's gift shop is a birdfeeder. Sales are 18 units per week and the supplier charges \$60 per units. The cost of placing an order with the supplier is \$45. Annual holding costs are 25 percent of a feeder's value, and the museum operates 52 weeks per years.

- a- What is the annual cost of the current policy of using a 390-unit lot size? **6 points**
- b- Calculate the *EOQ* and its annual cost. **4 points**
- c- How frequently should orders be placed? **4 points**
- d- The birdfeeder supplier has introduced quantity discounts to encourage larger order quantities. The price Schedule is: **6 points:**

Order Quantity	Price per Unit
0-299	\$60
300-499	\$58.80
500 or more	\$57.00

The museum's annual demand remains unchanged, ordering cost at \$45 per order, and annual holding cost at 25 percent of the birdfeeder's per unit price. What is the best purchase quantity?

QUESTION II (20 points):

Prepare a two-machine schedule, using the Johnson procedure for the following four jobs:

<i>Job</i>	Machine	
	<i>I</i>	<i>II</i>
A	4	3
B	1	7
C	8	2
D	8	5

- a- In what sequence should the jobs be processed? **7 points**
- b- Construct a Gantt chart of the schedule for both machines; **6 points.**
- c- Construct a Gantt chart, assuming there is no buffer storage between the machines (e.g machine I cannot start a new job until machine II has started the old job) **7 points .**

QUESTION III (20 points):

The management of West Allis, Industries is concerned about the production of special metal screw used by several of the company's largest customers. The diameter of the screw is critical. Historically, the process average \bar{x} has been 0.500 *in.* and the average range has been 0.18 *in.* Data from the last five samples are shown in the accompanying table. The sampling size is 4.

1. Plot the Range Chart for the Metal Screw. **12 points**
2. Is the process in control? **8 points**

Data for the *R*-Chart and \bar{x} -Chart:

Sample Number	Observations of screw Diameter in Sample (<i>in.</i>)			
	1	2	3	4
1	0.51	0.63	0.39	0.35
2	0.50	0.56	0.42	0.64
3	0.68	0.49	0.53	0.62
4	0.45	0.33	0.47	0.55
5	0.70	0.58	0.64	0.68

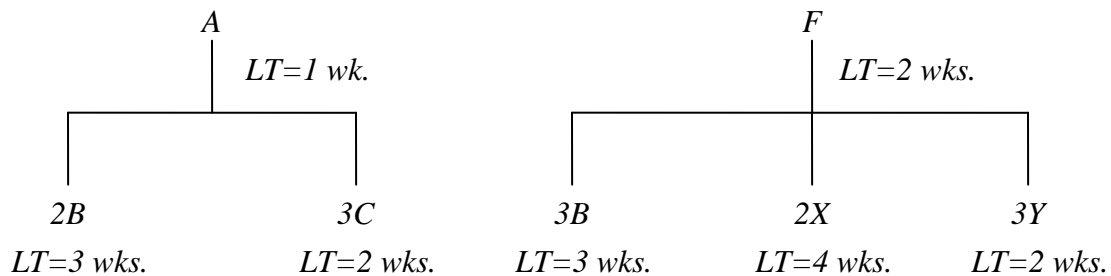
QUESTION IV (20 points):

The product structure trees for products *A* and *F* are shown below. Part of the master schedule showing when the company will complete production operations quantities of these products is shown in the table below. Find the gross requirement for item *B* throughout the first 12 weeks of the master schedule.

Master Schedule

Week	1	2	3	4	5
Product <i>A</i>			200	150	250
Product <i>F</i>			80	180	125
Week	6	7	8	9	10
Product <i>A</i>	160	250	300	325	300
Product <i>F</i>	200	210	100	180	150
Week	11	12	13	14	15
Product <i>A</i>	225	180	150		
Product <i>F</i>	250	200	260		

Structure trees for product *A* and *F*:



QUESTION V (20 points)

A manufacturer company has seasonal demand pattern, with the forecast demand for each month next year equal to 1300, 1000, 800, 700, 700, 700, 800, 900, 1000, 1200, 1400 and 1500 units respectively.

The company plans to end current year with about 800 units in inventory. The company requires a minimum of 500 units of inventory for safety stock and work in process. It costs \$1.10 per month to hold a unit in inventory.

The company will end the current year with 40 employees, and it costs \$400 to hire an employee and \$600 to lay off an employee. It takes an employee 5 hours to make a product. Employees are paid \$9.00 an hour for regular-time work and \$13.50 for overtime work. For simplified planning, each month is considered to have 20 days. Employees can begin or end employment on any day of the month, so an employee can work fractions of the month.

- 1- Compute the cost of “chase strategy” that is, one in which the number of employees is changed so the monthly production rate is made equal to the monthly demand rate. **10 points**
- 2- Compute the cost of a pure inventory strategy, with the work force and production rate held constant at the average demand rate and the variation in demand rate accounted for by accumulating and depleting inventory. A part-time employee can be used to provide any fractional employment level to obtain the desired production rate. **10 points**

Factors for calculating 3σ Limits for \bar{x} -Chart and R -Chart:

Number of observations Subgroups n	Factor for R -Chart		
	Factor for \bar{x} -Chart A_2	Lower Control Limit D_3	Upper Control Limit D_4
2	1.88	0.00	3.27
3	1.02	0.00	2.57
4	0.73	0.00	2.28
5	0.58	0.00	2.11
6	0.48	0.00	2.00
7	0.42	0.08	1.92
8	0.37	0.14	1.86
9	0.34	0.18	1.82
10	0.31	0.22	1.78
11	0.29	0.26	1.74
12	0.27	0.28	1.72
13	0.25	0.31	1.69
14	0.24	0.33	1.67
15	0.22	0.35	1.65
16	0.21	0.36	1.64
17	0.20	0.38	1.62
18	0.19	0.39	1.61
19	0.19	0.40	1.60
20	0.18	0.41	1.59

