

ORDRE DES INGÉNIEURS DU QUÉBEC

SESSION MAI 2019

Open book exam
Computers and programmable calculators are not permitted
Duration : 3 hours

16-MC-B2 Integrated manufacturing systems

QUESTION I (20 POINTS)

The sales of an article, registered during the last 10 periods, are as follows:

PERIOD	1	2	3	4	5	6	7	8	9	10
SALES	39	47	39	44	49	48	45	56	53	61

- a) Use simple exponential smoothing with a smoothing constant $\alpha = 0.20$ and an initial value of 38.0 to predict the period 11 sales. (6 points)
- b) Calculate the sum of the squares of the deviations. (6 points)
- c) Using the regression line, predict sales for period 11. (6 points)
- d) Which of the two models do you think is appropriate? (2 points)

QUESTION II (20 POINTS)

Mesquite Company manufactures a patented product with seasonal demand. The demand forecast for the next 6 months is as follows:

PERIOD	1	2	3	4	5	6
PREDICTION	60	70	80	90	80	70

One unit of the product costs \$ 15 if it is produced on a regular time. The capacity in regular time is 70 units per period. The unit cost of overtime production is \$ 20. Overtime production capacity is 10 units per period. The inventory cost is \$ 3 per period. The company has no initial stock and does not plan to end the sales period with an inventory. Develop an optimal production plan in a context where there is no shortage.

QUESTION III (20 points)

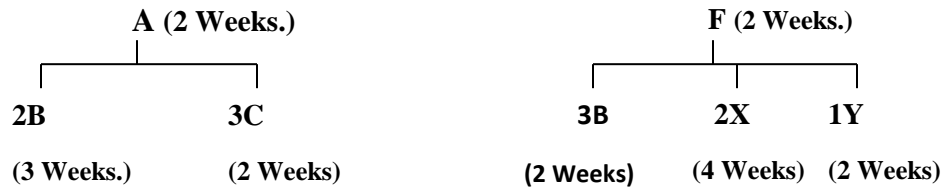
The times required to complete each of eight jobs on two machines are shown in the table that follows. Each job must follow the same sequence, beginning with machine MI and moving to machine MII.

- a) Determine the sequence that will minimize the makespan time. (8 points)
- b) Construct a chart of the resulting sequence, and find machine MII's idle time. (6 points)
- c) For the sequence determined in part *a*, how much would machine MII's idle time be reduced by splitting the last two jobs in half? (6 points)

Jobs	TIME (HOURS)	
	Machine MI	Machine MII
A	16	5
B	3	13
C	9	6
D	7	9
E	2	14
F	12	4
G	18	12
H	20	14

QUESTION IV (20 POINTS)

The product trees A and F are shown below. The lead time is indicated in parentheses.



The company has 500 B units and plans to receive 1000 units at week 3.

The production plan is as follows:

PRODUCTION PLAN										
Week	1	2	3	4	5	6	7	8	9	10
Product A								100	150	80
Product F							225	225	170	

Develop the component B procurement program indicating, for each period, gross requirements, net requirements, inventory status, planned receipts and planned orders. The procurement strategy is Lot for Lot

QUESTION V (20 POINTS)

The manufacturing process controls is performed by sampling.

Data are available for the first four samples taken:

SAMPLES			
1	2	3	4
4.5	4.6	4.5	4.7
4.2	4.5	4.6	4.6
4.2	4.4	4.4	4.8
4.3	4.7	4.4	4.5
4.3	4.3	4.6	4.9

- a) Determine the average of each sample. (3 points)
- b) If process parameters are unknown, estimate mean and standard deviation. (3 points)
- c) Estimate the mean and standard deviation of the sample distribution function. (3 points)
- d) Determine the control limits and assess the alpha risk? (3 points)
- e) Control limits of 4.14 and 4.86 would give alpha risk? (3 points)
- f) Using the control limits of 4.14 and 4.86, are there any samples that exceed the control limits? If yes, which ones? (2 points)
- g) If the process has a known average of 4.4 and a known standard deviation of 0.18, what would be the control limits for a control card. Is the process under control? (3 points)