

ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2018 SESSION

Open-book examination
Calculators : only authorized models
Duration : 3 hours

14-IN-A3 FACILITIES PLANNING

QUESTION I (20 POINTS)

Four plant locations are under consideration for a new microchip plant. Here are estimates of the fixed and variable costs at each location.

	Fixed cost	Variable cost
<u>Location</u>	<u>Per year</u>	<u>Per unit</u>
A	\$3,500,000	\$600
B	\$3,000,000	\$800
C	\$4,000,000	\$500
D	\$4,500,000	\$400

- What is the total cost function for each location? **8 points**
- Which location should be selected for an output of 4,000 chips per years? 12,000 chips per year? **4 points**
- Find the cut-off points algebraically. **8 points**

QUESTION II (20 POINTS)

Producing widgets involves fourteen production tasks, lettered a through n, below. For each task, the time required to accomplish it is given, and the immediately preceding task.

Production Tasks	Time (min.)	Preceding Task
a	0.2	-
b	0.4	a
c	0.5	b
d	0.4	c
e	1.0	a
f	0.5	e
g	1.1	d, f
h	0.7	g
i	0.8	g
J	0.4	h
k	1.2	i
l	0.9	k
m	0.6	l
n	0.4	j, m

The manager expects to produce 300 widgets per eight-hour shift. The workers are allowed two 10-minutes coffee breaks per shift, and 40 minutes is allocated to cleanup and maintenance tasks.

- Is it possible to accomplish the objective of 300 widgets per shift with one workstation? **5 points**
- What is the maximum possible output with 14 workstations? **5 points**
- Draw the precedence diagram for this process. **5 points**
- What is the minimum number of workstations which will be required to achieve an output of 300 pieces per shift? **5 points**

QUESTION III (20 POINTS)

The following table gives part routing matrix for eight products (A, B, C, D, E, F, G, H) processed on 12 machines (M1, M2...M12). In each cell (I,J) of the matrix we put an X if the product I uses the machine J. You are asked to group machines in three independent cells (no flow between two distinct cells) to treat the 8 products.

Routing matrix

PRODUCTS	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
A	x	x		x				x		x		
B					x		x				x	x
C			x			x			x			
D	x	x		x				x		x		
E					x	x						x
F	x			x				x				
G			x			x			x			x
H							x				x	x

QUESTION IV (20 POINTS)

Due to an increase in the volume of sales, Sam Melder, the owner of Melder, Inc., a small manufacturing firm located in Muncie, Indiana, has decided to expand production capacity. A new wing has been added to the plan that will house four machines: (1) a punch press, (2) a grinder, (3) A lathe, and (4) a welding machine. There are only four possible locations for these machines, say A, B, C and D. However, the welding machine, which is the largest machine, will not fit in location B.

The plant foreman has made estimates of the impact in terms of materials handling costs of locating each of the machines in each of the possible locations. These costs expressed in terms of dollars per hour, are represented in the table below.

		Location			
Machines		A	B	C	D
	1	94	13	62	71
	2	62	19	84	96
	3	75	88	18	80
	4	11	M	81	21

The entry M stands for a very large cost. It is used to indicate that machine 4 is not permitted in location B. Find the optimal location for each

QUESTION V (20 POINTS)

Locate nine square departments 1 through 9 in a 3 x 3 grid so that the priorities in the matrix are satisfied and service 4 must be installed in the room at the top right corner like the following figure.

		4

A= absolutely necessary
 E= very important
 I= important
 O= OK, ordinary importance
 U= unimportant
 X= undesirable

Department 1										
Department 2	A									
Department 3		A		E						
Department 4					X		A			
Department 5				A				A		
Department 6					E				I	
Department 7						X				A
Department 8							X			
Department 9								X		