UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY

FINAL EXAMINATION

JANUARY 2016 SEMESTER

COURSE CODE	:	JLB 21203
COURSE TITLE	:	OPERATIONAL RESEARCH
PROGRAMME LEVEL	:	BACHELOR
DATE	:	30 MAY 2016
TIME	:	9.00 AM – 12.00 PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consists of TWO (2) sections.
4. Answer ALL questions in Section A. Choose THREE (3) questions in section B.
5. Please write your answers on the answer booklet provided.
6. Table and formula are enclosed as reference.
7. Please answer all questions in English only.

THERE ARE 5 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

Explain the stages of development of Operations Research process.

(10 marks)

Question 2

A company makes two products (X and Y) using two machines (A and B). Each unit of X that is produced requires 50 minutes processing time on machine A and 30 minutes processing time on machine B. Each unit of Y that is produced requires 24 minutes processing time on machine A and 33 minutes processing time on machine B.
At the start of the current week there are 30 units of X and 90 units of Y in stock. Available processing time on machine A is forecasted to be 40 hours and on machine B is forecasted to be 35 hours. The demand for X in the current week is forecasted to be 75 units and for Y is forecasted to be 95 units. Company policy is to maximize the combined sum of the units of X and the units of Y in stock at the end of the week.

(a) Formulate the problem of deciding how much of each product to make in the current week as a linear program.

(5 marks)

(b) Solve this linear program graphically.

(5 marks)

Question 3

An auto parts supplier sells Hardy-brand batteries to car dealers and auto mechanics. The annual demand is approximately 1,200 batteries. The supplier pays $28 for each battery and estimates that the annual holding cost is 30 percent of the battery's value. It costs approximately $20 to place an order (managerial and clerical costs). The supplier currently orders 100 batteries per month.

(a) Determine the ordering, holding, and total inventory costs for the current order quantity.

(3 marks)

(b) Determine the economic order quantity (EOQ).

(2 marks)

(c) Calculate total orders will be placed per year using the EOQ.

(2 marks)

(d) Determine the ordering, holding, and total inventory costs for the EOQ. Determine whether has ordering cost changed, Holding cost, and Total inventory cost.

(3 marks)

Question 4

A company has three employees and four machines and wishes to assign employees to machine to minimize total cost. The cost matrix showing the cost in units RM, incurred by each employee on each machine is given in Table 1.

Table 1: Three employees and Four machines

	1	2	3	4
A	8	11	12	10
B	5	16	13	8
C	5	10	23	15

Determine the optimal assignment and calculate the total minimum cost.

(10 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE (3) questions.
Please use the answer booklet provided.

Question 1

Solve wheat of three cities with Vogel's Approximation Model and Least Cost Method in the Table 2.

Table 2: Wheat of Three Cities

From \ To	A	B	C	Supply
1	6	8	10	150
2	7	11	11	175
3	4	5	12	275
Demand	200	100	300	600

(20 marks)

Question 2

Monica Britt has enjoyed sailing small boats since she was 7 years old, when her mother started sailing with her. Today, Monica is considering the possibility of starting a company to produce small sailboats for the recreational market. Unlike other mass-produced sailboats, however, these boats will be made specifically for children between the ages of 10 and 15. The boats will be of the highest quality and extremely stable, and the sail size will be reduced to prevent problems of capsizing. Her basic decision is whether to build a large manufacturing facility, a small manufacturing facility, or no facility at all. With a favorable market, Monica can expect to make $90,000 from the large facility or $60,000 from the smaller facility. If the market is unfavorable, however, Monica estimates that she would lose $30,000 with a large facility, while with small facility she would lose only $20,000. Because

of the expense involved in developing the initial molds and acquiring the necessary equipment to produce fiberglass sailboats for young children, Monica has decided to conduct a pilot study to make sure that the market for the sailboats will be adequate. She estimates that the pilot study will cost her $10,000. Furthermore, the pilot study can be either favorable or unfavorable. Monica estimates that the probability of a favorable market given a favorable pilot study is 0.8. The probability of an unfavorable market given an unfavorable pilot study result is estimated to be 0.9. Monica feels that there is a 0.65 chance that the pilot study will be favorable. Of course, Monica could bypass the pilot study and simply make the decision as to whether to build a large plant, small plant, or no facility at all. Without doing any testing in a pilot study, she estimates that the probability of a favourable market is 0.6.

(a) Develop a decision tree that shows all alternatives, states of nature, probability values, and economic consequences.

(15 marks)

(b) Give your recommendation.

(2 marks)

(c) Find EVPI.

(3 marks)

Question 3

To complete the wing assembly for an experimental aircraft, Scott DeWitte has laid out the major steps and seven activities involved. These activities have been labeled A through I in the following Table 3 which also shows their estimated completion times (in weeks) and predecessor.

Table 3: Activity

ACTIVITY	a	m	b	PREDECESSOR ACTIVITY
A	2	4	6	—
B	3	6	9	A
C	8	10	12	A
D	9	12	15	B
E	8	9	10	C
F	16	21	26	D,E
G	19	22	25	D,E
I	1	3	5	G

(a) Construct the project network for the project.

(5 marks)

(b) Determine the expected time and variance for each activity.

(5 marks)

(c) Determine the earliest and latest start and finish times for all activities.

(5 marks)

(d) Determine the critical path.

(5 marks)

Question 4

Suppose inter-arrival times are determined by rolling a die. If the numbers 6, 1, 4, 3, 6, 5 are rolled this means that the customers arrive at times

0,6,7,11,14,20,25

as in the following Table 4:

Table 4: Customer Arrival Time

Customer	Inter-arrival time	Arrival time on clock
1	-	0
2	6	6
3	1	7
4	4	11
5	3	14
6	6	20
7	5	25
8	3	28

(a) Using the following random numbers, simulate service time for 20 customers

Random numbers: 55,65,37,25,44,78,84,49,68,66,47,69,45,47,30,68,31,20,92,49

(15 marks)

(b) Calculate the average and expected service time

(5 marks)

END OF EXAMINATION PAPER

FORMULA LIST

Inventory Control

Deterministic Model

a) Economic Order Quantity, EOQ = $\sqrt{\frac{2C_oD}{C_h}}$

b) Reorder Point, ROP = $\frac{DL}{N}$

c) Economic Production Quantity – Single Item, EPQ_s = $\sqrt{\frac{2C_sDp}{C_h(p-d)}}$

d) Economic Production Quantity – Multiple Item, m^* = $\sqrt{\frac{\sum_{i=1}^{n}\frac{C_{hi}D_i(p_i-d_i)}{p_i}}{2\sum_{i=1}^{n}C_{si}}}$

e) Run-Out Time, ROT_i = $\frac{\text{Current inventory position of item i}}{\text{Demand per period for item i}}$

f) Economic Order Interval – Single Item, EOI_s , T^* = $\sqrt{\frac{2C_0}{PFD}}$

g) Economic Order Interval – Multiple Item, TIC (EOI_m) = $\sqrt{\frac{2(C_0+nc)}{F\sum_{i=1}^{n}D_iP_i}}$

Uncertain Demand

Reorder Point = $\frac{LD}{N}+Z\sigma_D\sqrt{L}$

Uncertain Lead Time

Reorder Point = $\frac{LD}{N}+Z\sigma_L\frac{D}{N}$

Uncertain Demand and Lead Time

Reorder Point, ROP = $\frac{LD}{N}+Z\sqrt{L\sigma_D^2+D^2\sigma_L^2}$