THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF MANAGEMENT STUDIES – LEVEL 5
FINAL EXAMINATION 2013
OPERATIONS RESEARCH – MCU4202

DURATION THREE (03) HOURS

DATE: 14ᵗʰ July, 2013	TIME: 1.30 pm – 4.30 pm

Instructions

- Answer any FIVE (5) questions.
- All questions carry equal marks. (20 marks each)
- Use of a non-programmable calculators is allowed.
- Graph papers will be provided

Q1. a) What are the limitations of assignment theory?

b) An election campaign is to be organized for the forthcoming election. There are four weeks left and four electorates to be covered. It is planned to allocate one week for each electorate. The expected coverage in terms of voters would depend on the electorate and which week assigned as shown in the table below.

Expected Coverage "000" Voters

Electorate	Week			
	First week	Second Week	Third Week	Fourth Week
Electorate(A)	17	27	15	23
Electorate(B)	28	32	27	25
Electorate(C)	14	12	15	17
Electorate(D)	18	22	26	14

(i) Use assignment theory to find how the electorates should be assigned to the four weeks so as to maximize total coverage.

(ii) In view of a proposed campaign by a rival party, it is decided not to assign fourth week to Electorate (A). Find the optimal plan subjected to this condition.

Q2. a) Explain the term "Balanced transportation problem". Explain briefly how an unbalance transportation problem is converted to a balanced transportation problem.

b) Road construction work is about to commence. There are three work sites W1, W2 and W3 whose weekly requirements (Demands) are 220, 140, and 200 truckloads of metal, respectively. This metal is supplied by three suppliers S1, S2 and S3 whose weekly capacities are 170, 120 and 270 truckloads of metal, respectively. The cost of

transporting one truck load from a given supplier to a given work-site is explained in the table below.

Cost of Transport RS. "000"

Supplier	Work -Site		
	W_1	W_2	W_3
S_1	20	7	5
S_2	6	10	18
S_3	2	15	12

(i)   Find an initial feasible solution using either North-West corner rule method or least cost method.

(ii)   Solve this transportation problem so that find how metal should be transported between suppliers and work sites with a view to minimize total transport cost.

Q3.   Sri Lanka Tyre Mart produces two different sizes of tyres, namely size (A) and Size (B). They use raw materials and machine hours as resources. One tyre of size (A) uses Rs.8,000 worth of raw materials, 5 hours of machine time and gives a profit of Rs.20,000. One tyre of size (B) needs Rs.5,000 worth of raw materials, 10 machine hours and gives a profit of Rs.30,000. For the daily production there is Rs.400,000 worth of capital to purchase raw materials and 500 machine hours are available. It is also observed that the maximum daily demand for size (A) and size (B) tyres are 40 each. As per the industry obligations Sri Lanka Tyre Mart has to produce minimum of 10 size (B) tyres each day.
Sri Lanka Tyre Mart hopes to maximize profit and wishes to know how many of each tyre size should be produced daily.

a)   Formulate this as a linear programming model.

b)   Solve the linear programming problem using graphical method.

c)   By how much the demand for size (A) tyres should drop to change the optimal solution?

Q4.   A project consists of 9 activities A,B,......,J, whose precedence and durations are shown below.

ACTIVITY	PRECEDANCE	DURATION (DAYS)
A	PROJECT START	4
B	PROJECT START	7
C	PROJECT START	7
D	AFTER "A"	5
E	AFTER "A"	8
F	AFTER "B" AND "D"	8
G	AFTER "C"	6
H	AFTER "F" AND "G"	3
I	AFTER "E" AND "H"	12
J	AFTER "I"	3

a)   Construct the network diagramme for the project.
b)   Calculate the float of each activity.
c)   Name the critical path.
d)   Find "EST", "EFT", "LST" and "LFT" of activity "G"
e)   What is the shortest duration for the project?
f)   A foreign agency is prepared to spend money either on activity (B) or on activity (F) so that it will reduce project completion by two days. Which activity would you choose? Why?

Q5. a)   Prove that the condition for equilibrium in a single server queue is $\lambda < \mu$.

b)   At a sub post office there is only one server who on the average takes 4 minutes to serve one customer. This service time has a negative exponential distribution. Customers arrive in a Poisson fashion at the rate of 12 per hour. The sub post office works 8 hours a day.

   (i)   What is the probability that there are three customers at the sub post office?
   (ii) How many hours does the server idle per day?
   (iii) On the average how many customers are there at the post office?
   (iv) How long will a customer have to wait at the post office?
   (v)   On the average how many customers are there waiting to receive service?
   (vi) How long will a customer have to wait until he/she receive service?
   (vii) Generally the post office closes for lunch from 12.00 to 1.00. However if the length of queue exceed ten, the post Master would decide to skip the lunch break. What is the probability that post master skips lunch break?

Q6. A motor car manufacturer observes that the annual demand for one of the special spare part is 6000. The cost of placing one order for this spare part is Rs.1800/- and the cost of holding one spare part for one year is 10% of the cost of the product. The cost of the product is Rs.150/-. Assuming that stock outs are not allowed calculate the following.

a)   Economic order quantity (EOQ)
b)   The total cost corresponding to this (EOQ)
c)   If EOQ is ordered, the number of orders the manufacturer has to place a year.
d)   Re-order level (ROL), if lead time is two months.
e)   Find economic order quantity (EOQ), if a discount of 8% is given to all orders that exceed 1000.
f)   If stock-outs are allowed and the cost of running one item out of stock for one year is Rs.50, find;
   (i)   Economic Order Quantity (EOQ)
   (ii) Maximum Level of Stock (a)

Q7. Write short notes on the following topics.

a) Factors affecting the decision on determining Economic Order Quantity (EOQ) and explain how to determine EOQ with graphical illustrations

b) Advantages of graphical method and simplex method in solving linear programming models

c) Simulations and use of random numbers

d) Critical Path and resource allocation in project analysis

e) Simplex method and dual simplex method

MATHEMATICAL FORMULEE

(i) $P(n) = \theta^n (1 - \theta)$

(ii) Server Idle Time $= H(1 - \theta)$

(iii) $L_s = \dfrac{\theta}{1 - \theta}$

(iv) $L_Q = \dfrac{\theta^2}{1 - \theta}$

(v) $L_s = \lambda w_s$ and $L_Q = \lambda w_Q$

(vi) $1 + x + x^2 + x^n + \alpha) = \dfrac{1}{1-x}$

(vii) $EOQ = \sqrt{\dfrac{2DA}{C}}$

(viii) $K = \dfrac{DA}{Q} + \dfrac{1}{2}QC$

(ix) $EOQ = \sqrt{\dfrac{2DA}{C} \times \left(\dfrac{C+S}{S} \right)}$ — with stock outs

(x) $a = \dfrac{S \times EOQ}{(C+S)}$