THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF MANAGEMENT STUDIES DEGREE PROGRAMME - LEVEL 6
ASSIGNMENT TEST – 2011/2012
OPERATIONS RESEARCH- MCU 4202

DATE: 18.06.2011 **TIME: 10.00 am - 12.00 noon**

This paper consists of six questions.
Answer any four questions.

Q1) Four machines M_1, M_2, M_3 and M_4 are to be installed in a newly built factory. Four locations L_1, L_2, L_3 and L_4 are reserved for the installation of machines. The cost of installations of machines would depend on the machine and the selected location as explained in the table below. Use Assignment Theory to find how the machines should be assigned to the locations so that the total cost of installation is a minimum.

COST OF INSTALLATION "Rs 000"

MACHINE	LOCATION			
	L_1	L_2	L_3	L_4
M_1	9	12	40	14
M_2	11	9	10	8
M_3	16	50	15	12
M_4	10	12	11	7

Q2) A project consists of seven activities A, B, C,..., and G whose precedence and durations are given in the table below.

ACTIVITY	PRECEDENCE	DURATION (DAYS)
A	PROJECT START	4
B	PROJECT START	7
C	PROJECT START	3
D	AFTER "A"	5
E	AFTER "B" AND "D"	2
F	AFTER "C"	9
G	AFTER "E" AND "F"	3

a) Construct the network diagramme.
b) Calculate the float of each activity.
c) Name the critical path.
d) Find "EST", "EFT", "LFT" and "LST" of activity "E".
e) How many days would it take to complete the project?

Q3) a) State the six factors that control the behavior of a queuing system.

b) Prove that the condition for equilibrium in a single server queue is

$\lambda < \mu$ Where

λ = Rate of arrival of units

μ = Rate of service completion

c) At an election counting centre ballot boxes arrive in a Poisson fashion at the rate of 5 per hour. There is only one counting officer who takes on the average 10 minutes to count one box. (This counting time is assumed to have a negative exponential distribution). The boxes are counted as and when they are received.

(i) What is the probability that there are three ballot boxes at the counting centre?

(ii) What if the probability that the counting officer is idle?

(iii) On the average how many ballot boxes are there at the counting centre?

(iv) On the average how long will a ballot box be kept at the counting centre?

(v) On the average how many ballot boxes are there waiting to be taken for counting?

(vi) On the average how long must a ballot box be kept until it is taken for Counting?

Q4) A trader engaged in selling car batteries observes that the annual demand for his batteries is 720. The cost of a battery is Rs. 3000. The cost of placing one order for batteries is Rs. 1500 and the cost of holding one battery in stock for one year is Rs.96.

a) Calculate the Economic Order Quantity (EOQ).
b) Calculate Re-Order Level (ROL) if lead time is one month.
c) Calculate Re-Order Level (ROL) if lead time is three months.
d) Find Economic Order Quantity if the shelf space occupied by a battery is 30 sq inches and the total shelf space available is 6000 sq inches.
e) Find the Economic Order Quantity if the capital available to purchase batteries is Rs.400,000/- .
f) Find the Economic Order Quantity if a 5% discount is given to all purchases more than 100 batteries.

Q5) The Road Development Department operates four worksites w_1, w_2, w_3 and w_4 whose weekly requirement of bitumen is 200, 500, 100 and 700 containers respectively. This bitumen is supplied by three suppliers S_1, S2, and S_3 whose weekly capacities are 600, 400 and 500 containers respectively. The cost of transporting one container from a given supplier to a given worksite is explained in the table below.

COST OF TRANSPROTING ONE CONTAINER "RS. 000"

SUPPLIER	WORK SITE			
	W_1	W_2	W_3	W_4
S_1	12	7	15	8
S_2	5	11	9	14
S_3	10	16	12	17

The Road Development Department wishes to find the transportation plan that would minimize transportation cost

(i) Find an initial feasible solution.
(ii) Solve the transportation problem.

Q6) Write short notes on the following topics.

a) Critical Path
b) Economic-Order Quantity (EOQ)
c) Balance Transportation Problem
d) Re-Order Level (ROL)

MATHEMATICAL FORMULAE

Inventory Control

$$EOQ = \sqrt{\frac{2DA}{C}}$$

Variables

λ **Rate of arrival of units**

μ **Rate of service completion**

θ = λ / μ

H = **Number of working hours per day.**

$P_{(n)}$ = **Probability of "n" units in the queuing system**

L_s = **Average number of units in queuing system**

L_q = **Average number of units in queue**

W_s = **Average time spent by unit in queuing system**

W_q = **Average time spent by unit in queue.**

Formulae

$P(n) = \theta P(n-1)$ _____ (1)

$P(n) = \theta^n P(0)$ _____ (2)

$P(n) = \theta^n (1-0)$ _____ (3)

$$\left[\begin{matrix}Probability\ that \\ queuing\ system\ empty\end{matrix}\right] = (1-\theta) \quad \text{\_\_\_\_\_ (4)}$$

$$\left[\begin{matrix}Probability\ that \\ the\ server\ is\ idle\end{matrix}\right] = (1-\theta) \quad \text{\_\_\_\_\_ (5)}$$

$$\left[\begin{matrix}Number\ of\ hours \\ server\ idle\ per\ day\end{matrix}\right] = H(1-\theta) \quad \text{\_\_\_\_\_ (6)}$$

$L_s = \theta/(1-\theta)$ _____ (7)

$L_q = \theta^2/(1-\theta)$ _____ (8)

$L_s = \lambda W_s$ _____ (9)

$L_q = \lambda W_q$ _____ (10)