THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF MANAGEMENT STUDIES DEGREE PROGRAMME
LEVEL 06 – 2007/2008
FINAL EXAMINATION – 2008
OPERATIONS RESEARCH – MCU 4202
DURATION : THREE (03) HOURS

DATE : 13.07.2008 **TIME : 9.30 AM – 12.30 PM**

ANSWER ANY FIVE QUESTIONS

1) The following table is an incomplete table of the final simplex solution to a linear programming maximization problem.

C_J / C_b	BASIS	SOLUTION	4	8	2			
			X_1	X_2	X_3	S_1	S_2	S_3
	S_1	30	½		¼			-¾
	S_2	20	4		-½			-½
	X_2	20	½		¼			¼
	Zj							
	$C_j - Z_j$							

(i) Copy the above table and complete it.
(ii) Write down the objective function.
(iii) Is the solution feasible (give reasons)?
(iv) Is the solution optimal (give reasons)?
(v) Are there more than one optimal solution? Explain the reasons for your answer.
(vi) Write down the optimal solution(s).
(vii) At one of the optical solutions identify the surplus resources and their quantity.
(viii) Find the range of values of the coefficients of X_2 and X_3 for which the optimal solution would remain optimal.

2) C_1, C_2 and C_3 are three milk collecting centers with weekly collection of 1500, 750, and 1750 litres respectively. These collecting centers distribute milk to four processing centers P_1, P_2, P_3 and P_4 whose weekly demands are 800, 1300, 900 and 1000 liters respectively The cost of transporting one litre of milk between the milk collecting centers and the milk processing centers is explained in the table below.

		MILK PROCESSING CENTRES			
		P_1	P_2	P_3	P_4
MILK COLLECTING CENTRES	C_1	7	4	6	9
	C_2	2	3	2	1
	C_3	6	8	5	7

I.) Show the above as a linear programming model.
II.) Using Least Cost method or North West Corner rule to find an initial feasible solution to the problem.
III.) Find the optimal transportation plan that would minimize total transport cost.
IV.) What is the minimum transportation cost?

3) a) Explain the conditions that have to be fulfilled for a problem to be solved using assignment theory.
b)A businessman has four buses with different capacities and four route permits to run them. The daily profit earned would depend on the type of bus and on which route it runs on as explained in the table below. The businessman wishes to maximize his profit. Use assignment theory to find, to which route each bus should be assigned so as to maximize daily profit.

DAILY PROFIT RS. "000"

BUS	ROUTE			
	R_1	R_2	R_3	R_4
B_1	17	14	12	15
B_2	2	3	4	1
B_3	8	15	12	17
B_4	17	22	25	18

4) a) (i) Explain the term critical path in your own words.
(ii) Can there be two critical paths in a network? Explain with suitable illustrations.
(iii) Could it be possible to have a network without a critical path? Explain.
b) A project consists of eight activities, A, B...........,and H, whose precedence and durations are explained below.

ACTIVITY	PRECEDENCE	DURATION (DAYS)
A	PROJECT START	8
B	PROJECT START	4
C	PROJECT START	7
D	AFTER "A"	6
E	AFTER "B"	7
F	AFTER "C"	10
G	AFTER "D" AND "E"	3
H	AFTER "F" AND "G"	3

(i) Construct the network diagramme.
(ii) Time analyse and name the critical path.
(iii) How long could you afford to neglect activity "B" without delaying the project.
(iv) How long would it take to complete the project.
(v) Find EST, EFT, LFT and LST with respect to activity "B".

5) A project consists of eight activities, A,B …..,and H, whose precedence and durations are explained below.

ACTIVITY	PRECEDENCE	DURATION DAYS
A	PROJECT START	4
B	AFTER "A"	6
C	AFTER "A"	8
D	AFTER "B"	4
E	AFTER "C"	7
F	AFTER "B"	3
G	AFTER "D" AND "E"	4
H	AFTER "F" AND "G"	2

a) (i) Construct the network diagramme.
(ii) Time analyse and name the critical path.

b) Five days after the commencement of the project a progress review was carried out and its results are explained below.

ACTIVITY	PROGRESS
A	COMPLETE
B	ONE DAYS WORK DONE
C	SEVEN DAYS WORK DONE
REMAINING ACTIVITIES	NOT COMMENCED

It is now observed that to commence activity "G" a special machine is required and it would take five days to get this machine. Let us call this new activity of getting down the machine as "K".

(i) Construct the new network taking this progress into account.
(ii) Time analyse and name the new critical path.
(iii) How many more days would it take to complete the project?

6) An insurance company works 9 hours a day. They observe that insurance claims arrive in a Poisson pattern at the rate of 4 per hour. These claims are evaluated by

an officer who takes 10 minutes to complete one claim. He is helped by another person by way of searching for documents. This service time is observed to have a Negative Exponential distribution.

- (i) How many hours will the insurance officer idle per day?
- (ii) On the average how many claims are there with the insurance officer?
- (iii) How long will a claim have to wait until it is attended to?
- (iv) On the average how many claims are there waiting to be taken for evaluation?
- (v) How long will claim have to wait until it is taken for evaluation?
- (vi) What is the probability that there will be eight claims with the insurance officer?
- (vii) What is the probability that there will be more than eight claims with the insurance officer?
- (viii) In a nine hour working day how many minutes will the insurance officer have more than eight claims with him?
- (ix) Since the insurance officer has idle time it is suggested that he need not have a helper and that he could search for the documents himself. This arrangement would increase his service time to 18 minutes. Do you agree with this suggestion? Explain with reasons.

7) Write notes with suitable illustrations on the following

- (i) Simulation.
- (ii) Economic order quantity (EOQ) of inventory models.
- (iii) Re-order level (ROL) in inventory where manufacturing takes place.
- (iv) Stochastic inventory models.

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Varibles

λ Rate of arrival of units

μ Rate of service completion

$\theta = \lambda / \mu$

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

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

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

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

(Probability that queuing system empty) $= (1-\theta)$ (4)

(Probability that the server is idle) $= (1-\theta)$ (5)

(Number of hours server idle per day) $= H(1-\theta)$ (6)

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

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

$$L_s = \lambda W_s \quad (9)$$

$$L_q = \lambda W_q \quad (10)$$