UNIVERSITY OF MORATUWA

MSC/POSTGRADUATE DIPLOMA IN OPERATIONAL RESEARCH 2006/2007

POR(507) OPERATIONAL TECHNIQUE II

THREE HOURS **September 2008**

Answer **FIVE** questions and **NO MORE**.

Question 1

The campaign manager for a politician who is running for reelection to a political office is planning the campaign. Four ways to advertise have been selected: TV ads, radio ads, billboards, and newspaper ads. The cost of these are $900 for each TV ad, $500 for each radio ad, $600 for a billboard for one month, and $180 for each newspaper ad. The audience reached by each type of advertising has been estimated to be 40,000 for each TV ad, 32,000 for each radio ad, 34,000 for each billboard, and 17,000 for each newspaper ad. The total monthly advertising budget is $16,000. The following goals have been established and ranked:

1. The number of people reached should be at least 1,500,000.
2. The total monthly advertising budget should not be exceeded.
3. Together, the number of ads on either TV or radio should be at least 6.
4. No more than 10 ads of any one type of advertising should be used.

(a) Formulate this as a goal programming problem.

(b) Find the optimal solution.

(c) Which goals are completely met and which of them are not?

Question 2

An electric utility company serving a wide rural wants to decide on the number and location of Customer-Service Linemen (CSL) centers that will provide responsive service regarding repairs and connections. The company groups its customer base in five clusters according to the data given in Table 1:

TABLE 1

Cluster	1	2	3	4	5
Number of customers	400	500	300	600	700

The company has selected five potential locations for its CSL centers. The Table 2 summarizes the average travel distance in miles from the CSL to the different clusters. The average speed of the truck is approximately 45 miles per hour.

TABLE 2

CSL center					
Cluster	1	2	3	4	5
1	40	100	20	50	30
2	120	90	80	30	70
3	40	50	90	80	40
4	80	70	110	60	120
5	90	100	40	110	90

The company would like to keep the response time to customer request to around 90 minutes. How many CSL centers should be in operation?

Question 3

TABLE 4

Product	Time to produce one unit (hrs.)	
	Machine I	Machine II
A	0.5	0.6
B	0.7	0.8
C	0.9	1.05

a) A manufacturer produces three products A, B and C. Each product requires processing on two machines I and Il. The time required to produce one unit of each product on a machine is given in Table 4. There are 850 hours available on each machine. The operating cost is Rs. 5/hr. for machine I and Rs. 4/hr. for machine II. The market requirements are at least 90 units of A, at least 80 units of B and at least 60 units of C. The manufacturer wishes to meet the requirements at minimum cost. Solve the problem by the simplex method.

(b) The sales manager for publisher of college textbook has six traveling salespeople to assign to three different regions of the country. She has decided that each region should be assigned at least one salesperson and that each individual salesperson should be restricted to one respective regions; in order to maximize sales.

The estimated increase in sales (in appropriate units) in each region are given in Table 4, if it were allocated various numbers of salespeople;

TABLE 4

Salespersons	Region		
	1	2	3
1	35	21	28
2	48	42	41
3	70	56	63
4	89	70	75

(i)Use dynamic programming to solve this problem using the usual tables, show your work graphically by constructing and filling in a network.

Question 4

a)Perform a complete parametric analysis of the following problem.

Maximise $z = 3x_1 + 2x_2 + 5x_3$

$x_1 + 2x_2 + x_3 \leq 430 + 500t$

$3x_1 + 2x_3 \leq 460 + 100t$

$x_1 + 4x_2 \leq 420 - 200t$

$x_1, x_2 \geq 0$ and t is an non negative parameter.

(b)Use the revised simplex method to solve the LPP.

Maximise $z = 2x_1 + x_2 + 2x_3$

Subject to

$x_1 + 3x_2 + 8x_3 \geq 12$

$4x_1 + x_2 + 12x_3 \leq 8$

$4x_1 - x_2 + 3x_3 \leq 8$

$x_1, x_2, x_3 \geq 0$

Question 5

TABLE 5

Expenditure				
Project	Year1	Year2	Year3	Returns
1	6	2	6	40
2	2	5	8	25
3	5	6	3	40
4	6	3	4	20
5	8	7	5	25
Maximum available funds	20	20	20	-

Consider the capital budgeting problem where five projects are being considered for execution of next three years. The expected returns for each project and the yearly expenditure (in thousand rupees) are shown in Table 5. Assume that each approved project will be executed over three year periods. The objective is to select a combination of project that will maximize the total returns.

Formulate the problem as 0-1 integer programming problem and solve by additive algorithm

Question 6

(a) Purchase manager currently follows EOQ policy of ordering for an item in the stores of his company. The annual demand of the item is 1,600 units. Its carrying cost is 40% of the unit cost where the unit cost is Rs. 400. The ordering cost is Rs. 500 per order. Recently, the vendor

supplying that item gives a discount of 10% in its unit cost if the order size is minimum of 500 units.

(i) Find EOQ and the corresponding total cost per year.

(ii) Check whether the discount offer given by the vendor can be considered by the purchase manager.

(b) Vehicles pass through a toll gate at a rate of 90 per hour. The average time to pass through the gate is 36 seconds. The arrival rate and service rate follow Poisson distribution. There is a complaint that the vehicles wait for long duration. The authorities are willing to install one more gate to reduce the average time to pass through the toll gate to 36 seconds if the idle time of the toll gate is less than 10% and the average queue length at the gate is more than 5 vehicles. Check whether the installation of the second gate is justified.

Question 7

(a)A stamping machine currently valued at Rs 10,000 is expected to last 2 years and costs Rs 4,000 per year to operate. Another automatic machine which can be purchased for Rs 30,000 will last for 4 years and be operated at an annual cost of Rs 3000. If money carries the rate of interest at 10% per annum, determine which stamper, machine should be purchased.

(b) Solve the following nonlinear programming problem using Lagrangean method:

Minimize $z = x_1^2 + 2x_2^2 + 1.5x_3^2$

subject to

$2x_1 + 2x_2 + 3x_3 = 30$

$3x_1 - 4x_2 + 4x_3 = 25$

$x_1, x_2, x_3 \geq 0$

Question 8

An airline owns an aging fleet of Boeing 737 jet airplanes. It is considering a major purchase of up to 17 new Boeing model 757 and 767 jets. The decision must take into account numerous cost and capability factors, including the following: (1) the airline can finance up to $1.6 billion in purchases; (2) each Boeing 757 will cost $80 million, and each Boeing 767 will cost $110 million; (3) at least one-third of the planes purchased should be the longer-range 757; (4) the annual maintenance budget is to be no more than $8 million; (5) the annual maintenance cost per 757 is estimated to be $800,000, and it is $500,000 for each 767 purchased; and (6) each 757 can carry 125,000 passengers per year, whereas each 767 can fly 81,000 passengers annually.

(i) Formulate this as an integer programming problem to maximize the annual passenger-carrying capability.

(ii) What category of integer programming problem is this?

(iii) Solve this problem.