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

A production manager is faced with the problem of job allocation between his two production teams. The production rate of Team X is 6 units per hour, while the production rate of Team Y is 10 units per hour. The normal working hours for each of the teams are 50 hours per week. The production manager has prioritized the following goals for the coming week:

P_1: Avoid underachievement of the desired production level of 825 units.

P_2: Any overtime operation of Team X beyond 10 hours should be avoided.

P_3: Any overtime operation of Team Y beyond 15 hours should be avoided.

P_4: Any underutilization of regular working hours should be avoided. Again, assign differential weights according to the relative productivity of the two teams.

(a)Formulate this problem as a goal programming model.

(b)Find an optimal solution by simplex method.

Question 2

(b) 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

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 3, if it were allocated various numbers of salespeople;

TABLE 3

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

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

Question 4

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 the table 4. 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.

TABLE 4

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	-

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

Question 5

(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.

Question 6

(a) The annual demand of a product is 36,000 units. The average lead time is 3 weeks. T$_i$le standard deviation of demand during the average lead time is 150 units/week. The cost of ordering is Rs. 500 per order. The cost of purchase of the product per unit is Rs. 15. The cost of carrying per unit per year is 20% of the purchase price. The maximum delay in lead time is 1 week and the probability of this delay is 0.3. Assume a service level of 0.95.

(i) What is the reorder level if Q system is followed?

(ii) What is the maximum inventory level, if P system is followed?

(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.

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

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

(c) Solve this problem.