INDIAN INSTITUTE OF MATERIALS MANAGEMENT
Post Graduate Diploma in Materials Management
Graduate Diploma in Materials Management
PAPER - 2
QUANTITATIVE METHODS

Date: 09.12.2009   Max. Marks: 100
Time: 2.00pm to 5.00pm   Duration: 3 hours

Instructions:
1].   The question paper is in two parts- Part A: Objective Type (Compulsory) and Part B: Theory problems.
2].   From part A, answer all questions. Each question carries 1 mark, total 25 marks.
3].   From part B, answer any 5 questions out of 8 questions. Each question carries 15 marks, total 75 marks.
4].   Use of calculator and/or mathematical table is permitted.
5].   Graph sheet can be used wherever necessary.

PART A
Q1. (A) State whether the following statements are true or false: (15 Marks)

a).   Linear Programming consists of an objective function and decision variables.

b).   A three variable LPP problem can be solved by Graphical method.

c).   If a constraint type is of less than type an artificial variable is added.

d).   A feasible solution to a transportation problem is an optimal solution.

e).   In a minimization transshipment problem, a large negative unit cost is assigned to an impossible route.

f).   A good network will not have any dummy activity.

g).   An assignment problem involves allocation of resources to capacity.

h).   Any action that maximizes expected gain would also maximize expected loss.

i).   Expected time of an activity follows beta distribution.

j).   Time spent in the system is waiting time and service time.

k).   A single phase system has more than one servers..

l).   A safety stock protects an organization against stock outs..

m).   Integer programming generates non-integer solutions to an LPP.

n). ρ indicates an service rate in a queue system.

o).   An exponential distribution applies to a variable taking discrete values.

Q1. (B) Define the following: **(10 Marks)**

a).   Extreme Point

b).   Origin

c)   N-person game

d).   Critical path

e).   Reorder point

PART B

                                                        (15 Marks)

Q.2. (A).   A city hospital has the following minimal daily requirements for nurses.

Period	Clock time (24 hours day)	Minimum number of nurses required
1	6 a.m. – 10 a.m.	2
2	10 a.m. – 2 p.m.	7
3	2 p.m. – 6 p.m.	15
4	6 p.m. – 10 p.m.	8
5	10 p.m. – 2 a.m.	20
6	2 a.m. – 6 a.m.	6

Nurses report at the hospital at the beginning of each period and work for 8 consecutive hours. The hospital wants to determine the minimal number of nurses to be employed so that there will be a sufficient number of nurses available for each period. Formulate this as a linear programming problem by setting up appropriate constraints and objective function.

Q.2. (B).   Solve the following LPP by graphical method

        Maximize $Z = 5X_1 + 3X_2$

Subject to constraints

        $2X_1 + X_2 \leq 1000$

        $X_1 \leq 400$

        $X_1 \leq 700$

        $X_1, X_2 \geq 0$

Q.3. A company has two plants producing a certain product that is to be shipped to three distribution centers. The unit production costs are the same at the two plants, and the shipping cost per unit is shown below.

Plant	Distribution Centre		
	I	II	III
A	4	6	4
B	6	5	2

Shipments are made once per week. During each week, each plant produces at most 60 units and each distribution center needs at least 40 units.

a) Compute the initial basic feasible solution using Vogel's Approximation Method. **(5 Marks)**

b) Test the solution for optimality and find the optimal basic feasible solution and total transportation cost. **(10 Marks)**

Q.4. The coach of a swim team needs to assign swimmers to a 200-yard medley relay team (four swimmers, each swims 50 yards of one of the four strokes). Since most of the best swimmers are very fast in more than one stroke, it is not clear which swimmer should be assigned to each of the four strokes. The five fastest swimmers and their best times (in seconds) they have achieved in each of the strokes (for 50 yards) are as follows **(15 Marks)**

	Backstroke	Breaststroke	Butterfly	Freestyle
Carl	37.7	43.4	33.3	29.2
Chris	32.9	33.1	28.5	26.4
David	33.8	42.2	38.9	29.6
Tony	37	34.7	30.4	28.5
Ken	35.4	41.8	33.6	31.1

How should the swimmers be assigned to make the fastest relay team?

Q.5. The Mohawk Discount Store is designing a management training program for individuals at its corporate headquarters. The company wants to design a program so that trainees can complete it as quickly as possible. Important precedence relationships must be maintained between assignments or activities in the program. For example, a trainee cannot serve as an assistant to the store manager until the employee has obtained experience in the credit department and at least one sales department. The following activities are the assignments that must be completed by each program trainee. Construct the project network for this problem and assess the critical duration. **(10+5 Marks)**

Activity	A	B	C	D	E	F	G	H
Immediate Predecessor	---	---	A	A, B	A,B	C	D,F	E,G

Q.6.(A).   Explain with an example scheduling.   **(5 Marks)**

Q.6.(B).   There are 4 jobs, each of which must go through the two machines A and B in the order AB. Processing time in hours are given in the table below:
                                                                              (10 Marks)

Job	1	2	3	4
Machine A	4	2	5	6
Machine B	1	4	6	7

Determine the sequence for the 4 jobs that will minimized the elapsed time.

Q.7.   **(5+10 Marks)**

On average 18 customers are served by a barber every hour. What is the probability that a customer shall be free within 3 minutes and what is the probability that a customer shall be serviced in more than 12 minutes?

Q.8.   **(15 Marks)**

Solve the LPP using Simplex Method:

Maximize $Z = 2X_1 + 4X_2$

Subject to the constraints:

$2X_1 + X_2 <= 18$
$3X_1 + 2X_2 >= 30$
$1X_1 + 2X_2 = 26$

$X_1, X_2 >= 0$

Q.9.   **(15 Marks)**

For the given payoff matrix of a game being played by A and B, determine the optimal strategies and value of the game.

Player B

		B1	B2
Player A	A1	8	-7
	A2	-6	4