



INDIAN INSTITUTE OF MATERIALS MANAGEMENT
Post Graduate Diploma in Materials Management
PAPER – 18 C
OPERATIONS RESEARCH.

Dec 2013

DATE: 21.12.2013
TIME: 2.00 p.m to 5.00 p.m.

Max. Marks: 100
Duration: 03 Hrs.

Instructions:

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| 1. The question paper is in two parts. | |
| 2. Part A is compulsory. Each question carries one mark | Total 25 marks |
| 3. In part B answers 5 questions out of 6. Each question carries 15 marks. | Total 75 marks |

PART A

25 marks

Compulsory -Each question carries 1 mark

Q. 1. Select the correct answer from the multiple choices.

- i) The main objective of inventory management is to
- a) Minimize the cost of purchasing inventory
 - b) Maximize customer satisfaction
 - c) Minimize the overall cost of inventory
 - d) Increase safety stock level
- ii) In a transportation problem when the number of occupied cells is less than the number of rows plus the number of columns minus one, the solution is said to be
- a) Unbalanced
 - b) Infeasible
 - c) Optimal
 - d) Degenerating
- iii) Solution to an assignment problem is found out using
- a) MODI method
 - b) Hungarian method
 - c) North-west corner method
 - d) Stepping-stone method
- iv) To convert a less than or equal to constraint in simplex model to an equation, we should add
- a) A slack variable
 - b) A surplus variable
 - c) An artificial variable
 - d) A non negative variable

v) The sequence in which customers receive service is determined by queue

- a) Size
- b) Ballking
- c) Reneging
- d) Discipline

Q.2. Fill in the blanks. (Please do not reproduce the statement)

- a) All constraints in an LPP as well as its objective function must be _____ in nature.
- b) To prepare an equal to constraint for use in a simplex table we must add _____ variable.
- c) A transportation problem is said to be _____ if the aggregate supply is equal to aggregate demand.
- d) All dummy rows/columns must have elements equal to _____
- e) The process of customers shifting to the fast moving queue in an attempt to save waiting time is called _____
- f) PERT is probabilistic in nature while CPM is _____
- g) A _____ activity in a project network always has zero duration.
- h) _____ point in a game theory is the point of equilibrium.
- i) Monte Carlo is a _____ simulation model.
- j) ABC analysis is based on _____ law

Q.3. Please state True or False

- a. Every linear programming problem has a unique optimal solution.
- b. The simplex method is an iterative process which involves the substitution of variables for obtaining successively better solutions.
- c. The dual to the dual of an LPP is the primal LPP itself.
- d. VAM cannot be used to find an initial solution to a transportation problem if some routes are given to be prohibited.
- e. In case multiple zeros are obtained in all rows and columns, multiple optimal solutions are indicated.
- f. Total elapsed time is determined by the point of time at which the first job of n jobs goes to machine A until the point on which the last job comes off machine B.
- g. Arrival of patients with appointment to a dentist can be described as arrival by Poisson process.
- h. The replacement theory is concerned with replacement of assets when they stop working.
- i. Player A's strategy is determined on the basis of maximin criterion whereas player B's is on minimax criterion.
- j. Simulation is an optimizing technique.

PART B

75 marks

(Attempt any 5 Questions, each question carry 15 marks)

Q.4. Use simplex method to find the maximum value of

$$Z = 2X_1 - X_2 + 2X_3$$

Subject to the constraints

$$2X_1 + X_2 \leq 10$$

$$X_1 + 2X_2 - 2X_3 \leq 20$$

$$X_2 + 2X_3 \leq 5$$

Where $X_1, X_2, X_3 \geq 0$

(15 marks)

Q.5. The products of three plants X, Y, Z are to be transported to four warehouses I, II, III, and IV. The profit per unit from each plant to each warehouse is tabulated below.

		Warehouses				Available
		I	II	III	IV	
Plant	X	40	25	22	33	100
	Y	44	35	30	30	30
	Z	38	28	28	30	70
Requirement		40	20	60	30	

- Determine the optimum solution to maximize the profits. (10 marks)
- Calculate the maximum profits. (3 marks)
- Is the solution unique? (2 marks)

Q.6. The maintenance cost and resale value per year of machine whose purchase price is Rs7000.00 is given below.

Year	1	2	3	4
Maintenance cost	900	1200	1600	2100
Resale value	4000	2000	1200	600

When should the machine be replaced?

(15 marks)

Q.7. The following table gives activities and time taken by each of these activities.

Activity	Time estimate (days)		
	to	tm	tp
1-2	5	8	17
1-3	7	10	13
2-3	3	5	7
2-4	1	3	5
3-4	4	6	8
3-5	3	3	3
4-5	3	4	5

- a) Draw the network diagram (4 marks)
- b) Identify the critical path and its duration. (3 marks)
- c) Calculate variance for each of the activities. (3 marks)
- d) Calculate earliest start time, earliest finish time, latest start time, latest finish time and float for each of the activities. (5 marks)

Q.8. a) A service station has a central store where mechanics arrive to take spare parts. The average arrival rate of mechanics is 6 per hour and the service rate of one attendant who mans the store is 8 per hour. Assuming that the arrival rate is Poisson and the service rate is exponential, determine:

- i) Expected time spent by a mechanic in the system.
- ii) Expected time spent by a mechanic in the queue
- iii) Expected number of mechanics in the queue
- iv) Probability that the attendant is idle. (12 marks)

Q.8. b) Define Jockeying, Balking and Reneging (3 marks)

Q.9. A company has received order from a large company to manufacture five components (J1 to J5). All the jobs require processing on same type of machine. The processing time (in minutes) of the various jobs on the machines from past experiences are given in the table below.

Machines	M1	M2	M3	M4	M5
J1	12	18	11	22	16
J2	10	10	8	7	20
J3	17	5	15	18	10
J4	9	7	19	21	14
J5	13	12	20	4	17

Assign the jobs to machines such that the total processing time is the minimum. Also find the total processing time of the jobs. (15 marks)

Q.10. A book store wishes to carry a particular book in stock. Demand is not certain and there is a lead time of 2 days for stock replenishment. The probabilities of demand are given below.

Demand (units/day)	0	1	2	3	4
Probability	0.05	0.10	0.30	0.45	0.10

Each time an order is placed, the store incurs an ordering cost of Rs 10 per order. The store also incurs a carrying cost of rs 0.5 per book per day. The inventory carrying cost is calculated on the basis of stock at the end of each day.

Manager of the book store is considering a plan of ordering 8 books when present inventory plus any outstanding order falls below 8 books.

Currently the store has a stock of 8 books plus 6 books ordered two days ago and expected to arrive next day. Carry out simulation for 10 days to determine total cost. Following random numbers may be used:

89, 34, 78, 63, 61, 81, 39, 16, 13, and 73.

(15 marks)

Q.11. Write short notes on any five.

- a) Project crashing
- b) Sensitivity analysis
- c) Markov chains
- d) Sequencing
- e) ABC analysis
- f) Game theory

(5x3 marks)
