MMS-II

Operations Research.

27/4/12

OR02

Please Do not type Name of the Institute and

Name of the subject

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Roll No. _____ Total No. of Printed Pages: 5

Total No. of Questions : 9 Maximum Marks : 60

Duration (hrs.) : 3 Hours

Note : Each Question Carries Equal Marks i.e. 10 Marks, Q.1 & Q.2 are compulsory. Attempt any 4 from Q.3 -- Q.9

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Q.1] Rapid Fire Questions (Give Justifications and calculations wherever required) Answers without reasons will not be corrected. **Do not write only options no**, write answer in complete sentences.

1. The special case of LPP model, i.e. the case of ***unbounded solution*** is hinted in the Simplex method when either of the following condition is encountered (1 M)
   a. Artificial Variable will be present in the final solution
   b. Prior to obtaining the final solution if all the minimum ratios are either negative or infinite.
   c. One of the non basic variables will have a "zero" value in C-Z row
   d. There may be a tie in the minimum ratios.

2. What is float? (1 M)

a. The latest time an activity can be started without affecting the next activity's earliest start
b. The length of time an activity can be deferred without affecting the project duration
c. The length of time an activity can be deferred without affecting the next activity's earliest start
d. The latest time an activity can be started without affecting the project duration

3. In Vogel's Approximation Method; the opportunity cost associated with a row is determined by (1 M)

a. the difference between the smallest cost and the next smallest cost in the row
b. the difference between the smallest unused cost and the next smallest unused cost in the row
c. the difference between the smallest cost and next smallest unused cost in the row
d. none of the given

4. Which of the following statements hold true for safety stock **(1 M)**
   a. The greater the risk of running out of stock, the larger the safety stock needed.
   b. The lower the opportunity cost of the funds invested in inventory, the smaller the safety stock needed.
   c. The greater the uncertainty associated with forecasted demand, the lower the level of safety stock needed.
   d. The higher the profit margin per unit, the lower the safety stock necessary.

5. If EOQ = 1,000 units, order costs are $200 per order, and sales total 5,000 units, what is the carrying cost per unit? **(2 M)**
   a. 2 $ b. 10 $ c. 100 $ d. 1000 $

6. In an assembly line 8 jobs are being produced on two machines I & II. The processing the times of these jobs on each machine is

	A	B	C	D	E	F	G	H
Machine I	30	45	15	20	80	120	65	10
Machine II	20	30	50	35	36	40	50	20

Find the optimal sequence of the 8 jobs to be processed **(2 M)**

7. The encircled figures are the allocations to the cells.

	A	B	C	Supply
1	M	12	7	
			180	180
2	14	11	6	
	60		40	100
3	9	5	M	
		160		160
4	11	7	9	
	80	40		120
5	0	0	0	
	100			100
Demand	240	200	220	660

Is the above solution to transportation problem **a unique** optimal solution, justify? **(2 M)**

Q.2] G limited, manufacturer of superior garden ornaments, is preparing its production budget for the coming period. The company makes four of ornaments, the data for which are as follows:

Product → / Particulars ↓	Pixie	Elf	Queen	King
Direct material	25	35	22	25
Variable OH	17	18	15	16
S.P.	111	98	122	326

Product → / Labor type ↓	Labor hours required for each product			
	Pixie	Elf	Queen	King
Unskilled	8	6	-	-
Semi-Skilled	-	-	10	10
Skilled	-	-	5	25

Fixed over heads amount to Rs.15000 per period. Each type of labor is paid Rs.5 per hour but because of the skills involved; an employee of one type cannot be used for work normally done by another type. The maximum hours available for each type of labor are:

Unskilled: 8000 Hours; **Semi-Skilled:** 20000 Hours; **Skilled**: 25000 Hours

There is an unlimited demand for all the products.
You are required to,

(a) Formulate the above problem in the form of linear programming model so as to maximize the contribution of all the 4 products. **5 Marks**

(b) Write the dual of the formulated problem. **5 Marks**

Q.3] The demand and production costs vary from month to month in an industry. The following table contains the budgeted information of a firm in this industry on the quantity demanded, the production cost per unit and the production capacity in each of the coming five months.

Month	Jan	Feb	March	April	May
Demand	200	250	150	80	120
Production Cost	24	27	32	30	34
Capacity	250	225	250	200	225

It is known that the production cost in any month can meet demand in that month or can be held for the future. The Holding cost is Rs.5 per unit per month. Using this information

a) Formulate the transportation model to assist in the production planning **5 Marks**

b) Determine the optimum production plan **5 Marks**

Q.4] ABC Company is engaged in manufacturing 5 brands of packed snacks. It is having 5 manufacturing setups, each capable of manufacturing any of its brands one at a time. The cost to make a brand on these setups varies according to the table below:-

	S1	S2	S3	S4	S5
B1	4	6	7	5	11
B2	7	3	6	9	5
B3	8	5	4	6	9
B4	9	12	7	11	10
B5	7	5	9	8	11

Assuming 5 setups are S1, S2, S3, S4, S5 and 5 brands are B1, B2, B3, B4, and B5. Find the optimum assignment of products on these setups resulting in the minimum cost. **10 Marks**

Q.5] Dr. Strong is a dentist who schedules all her patients for 30-minutes appointments. She starts from 8.00 A.M and gives appointments at the interval of half an hour like 8.30 A.M, 9.00 A.M till 11.30 A.M. So in total only 8 Appointments.

Some of the patients take more or less than 30 minutes depending upon the type of dental work to be done. The following is the summary shows the various categories of work, their probabilities and the time actually needed to complete the work.

Category	Filling	Crowning	Cleaning	Extraction	Check-Up
Time Required in Minutes	45	60	15	45	15
Probability	0.40	0.15	0.15	0.10	0.20

Simulate the dentist's clinic for four hours morning shift and determine the average waiting time for the patients as well as the idle time of the doctor. Assume that all the patients show up at the clinic at their scheduled arrival time and are treated by Dr. Strong the moment he is done with the previous patient. Starting from 8.00 A.M use the following series of random numbers for each of the 30 minutes appointment.

40, 82, 11, 34, 25, 66, 17, 79.

Q.6] Following is the precedence relationship between the activities of a particular project.

Activity Code	A	B	C	D	E	F	G	H	I
Preceding Activity	-	-	-	A	A	B,D	B,D	C,F	E
Optimistic (a)	2	6	6	2	11	8	3	9	4
Most Likely (m)	4	6	12	5	14	10	6	15	10
Pessimistic (b)	6	6	24	8	23	12	9	27	18

a) Draw a PERT network diagram for the project. **2.5 Marks**

b) Find the critical path AND the critical activities. **2.5 Marks**

c) What is the expected project completion time and its variance. **2.5 Marks**

d) What is the probability that the project will be completed in 2 weeks later than the expected time calculated in above sub-question? **2.5 Marks**

Q.7] A&B] A company manufacturing two products A and B. The manufacturing time required making them, the profit, and the capacity available at each work center are as follows:

Product	Work Center (in hours)			Profit Per Unit
	Machining	Fabrication	Assembly	
A	1	5	3	80
B	2	4	1	100
Total Capacity	720	1800	900	

If X and y represent the number of units of each products A and B respectively, while S1, S2, S3 represent the slack variables indicating the unused capacity in the three work centers, following is the final iteration of the problem solved using simplex algorithm.

C_B	Var	Soln:	X	Y	S_1	S_2	S_3
100	Y	300	0	1	5/6	-1/6	0
80	X	120	1	0	-2/3	1/3	0
0	S_3	240	0	0	7/6	-5/6	1
		[C]	80	100	0	0	0
		[Z]	80	100	30	10	0
		[C] - [Z]	0	0	-30	-10	0

Part A 5 marks

i. Suppose the cost of over time in each of the departments is Rs.15 per hour. Would it be advisable to work either of the departments on an overtime basis? What would be the maximum amount of overtime authorized in each case?

ii. Would your answer be any different if the overtime cost is negotiated to Rs. 8 per hour?

Part B 5 Marks

Discuss the sensitivity of the profit margin change in the two products on the production plan.

Q.8] A manufacturer is offered two machines A & B. The value of money is 10% per year. Details of the two machines are as follows: 10 Marks

Machine	Cost Price	Maintenance	Scrap Value
A	Rs.5000	Rs.800 for first 4 years then increase by Rs. 200 per year	Nil
B	Rs.2500	Rs.1200 for first 6 years then increase by Rs. 200 per year	Nil

Find the optimal replacement period for both the machines and also which machine should be selected.

Q.9] Short Notes on any two of the following topics: 10 Marks

a) Shadow price b) Game Theory c) Markov Chain Analysis

d) Queuing Theory

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