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10ME74

## Seventh Semester B.E. Degree Examination, May 2017 Operation Research

Time: 3 hrs.

Max. Marks: 100

**Note: 1. Answer any FIVE full questions, selecting atleast TWO questions from each part.  
2. Use of statistical tables permitted.**

### PART - A

- 1 a. A firm plans to purchase atleast 200 quintals of scrap containing high quality metal 'X' and low quality metal 'Y'. It decides that the scrap to be purchased must contain atleast 100 quintals of X -metal and not more than 35 quintal of Y-metal. The firm can purchase the scrap from two suppliers (A and B) in unlimited quantities. The percentage of X and Y metals in terms of weight in the scraps supplied by A and B is given below Table Q1(a).

Metal	Supplier A	Supplier B
X	25%	75%
Y	10%	20%

Table Q1(a)

The price of A's scrap is Rs. 200 per quintal and that of B's is Rs. 400 per quintal. Formulate this problem as LP model and solve graphically to determine the quantities that the firm should buy from the two suppliers so as to minimize total purchase cost. (14 Marks)

- b. Explain the various principal phases involved in implementing OR study into practice. (03 Marks)
- c. What are the limitations of OR for its implementation in industries? (03 Marks)
- 2 a. With suitable examples, illustrate the use of slack, surplus and artificial variables in simplex method to solve LP problem. (06 Marks)
- b. Write the dual of below given primal LP problem :  

$$\text{Min } Z = x_1 + x_2 + x_3 ;$$
 Subject to constraints  $x_1 - 3x_2 + 4x_3 = 5$   
 $x_1 - 2x_2 \leq 3$   
 $2x_2 - x_3 \geq 4$   
 $x_1, x_2 \geq 0$  and  $x_3$  unrestricted. (04 Marks)
- c. Solve the below given LP problem using Big-M or penalty method and comment on the obtained optimal solution :  

$$\text{max } Z = 3x_1 + 2x_2 ;$$
 subject to constraints :  $2x_1 + x_2 \leq 2$   
 $3x_1 + 4x_2 \geq 12$   
 $x_1, x_2 \geq 0.$  (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

- 3 a. A leading firm has three auditors. Each auditor can work upto 160 hours during the next month, during which three projects must be completed. Project 1 will take 130 hours, project 2 will take 140 hours and the project 3 will take 160 hours. the amount per hour that can be billed for assigning each auditor to each project in given in the Table Q3(a) below:



Auditor	Project		
	1(Rs)	2(Rs)	3(Rs)
1	1,200	1,500	1,900
2	1,400	1,300	1,200
3	1,600	1,400	1,500

Table Q3(a)

Formulate this as a transportation problem and find optimal solution. Also, find out the maximum total billings during next month. (10 Marks)

- b. A private firm employs typists on hourly piece rate basis for their daily work. Five typists are working in that firm and their charges and speeds are different. On the basis of some earlier understanding, only one job is given to one typist and the typist is paid for full hours even when he or she works for a fraction of an hour. Find the least cost allocation for the data listed in Table Q3(b)(i) and Table Q3(b)(ii). (10 Marks)

Typist	Rate per hour (Rs)	Number of pages typed per hr
A	5	12
B	6	14
C	3	8
D	4	10
E	4	11

Table Q3(b)(i)

Job	Number of pages
P	199
Q	175
R	145
S	298
T	178

Table Q3(b)(ii)

- 4 a. Illustrate why integer programming is needed with suitable example. (04 Marks)  
 b. Distinguish between pure and mixed integer programming problems. (04 Marks)  
 c. Solve the below given integer programming problem using Gomory's cutting plane method :

$$\text{Max } Z = 7x_1 + 9x_2$$

$$\text{Subject to constraints } -x_1 + 3x_2 \leq 6$$

$$7x_1 + x_2 \leq 35$$

$$x_1, x_2 \geq 0 \text{ and are integers.}$$

(12 Marks)

**PART - B**

- 5 A project consists of activities as given in the Table Q5(a)(i) below :

Activities job	A	B	C	D	E	F	G	H	I	J	K	L
Duration (days)	13	5	8	10	9	7	7	12	8	9	4	17

And the constraints as listed in Table Q5(a)(ii)

Sl.No.	Constraint
1	A and B are starting jobs
2	A controls CD and E
3	B controls F and J
4	G depends on C
5	H depends on D
6	E and F controls I and L
7	K follows J
8	L is also controlled by K
9	G, H, I and L are last activities

- i) Draw activity on arrow (AoA) network for the above project  
 ii) Find the critical path and project duration  
 iii) Calculate early start time [EST], early finish time (EFT), late start time (LST), late finish time (LFT) and total float (TF) for each activities. (20 Marks)

- 6 a. An airline's organization has one reservation clerk on duty in its local branch at any given time. The clerk handles information regarding passenger reservation and flight timings. Assume that the number of customers arriving during any given period is Poisson distributed with an arrival rate of eight per hour and that reservation clerk can serve a customer in six minutes on an average, with an exponentially distributed service time.
- What is the probability that system is busy
  - What is the average time a customer spends in the system
  - What is the average length of the queue
  - What is the average number of customers in the system? (14 Marks)
- b. Discuss on the limitations for the application of queuing models. (06 Marks)
- 7 a. Explain the following with any suitable examples :
- Pay off matrix
  - Two person zero sum game. (04 Marks)
- b. A and B play a game in which each has three coins i) 5 paise ii) 10 paise and iii) 20 paise. Each selects a coin without the knowledge of the others choice.. If the sum of the coins is an odd amount, player 'A' wins player 'B's coin. If the sum an even amount, then player B wins player A's coin. Formulate the given problem and find best strategy for each player. Also, find value of game. (08 Marks)
- c. Solve the game given in the Table Q7(c), using graphical method. Also, find alternate solutions, if any : (08 Marks)

		B			
		I	II	III	IV
A	I	2	2	3	-1
	II	4	3	2	6

Table Q7(c)

- 8 a. State the assumptions made while dealing with sequencing problems. (04 Marks)
- b. A manufacturing company processes six different jobs on two machines A and B in the order AB. Number of units of each job and its processing times on machine A and B are given in Table Q8(b). Find the optimal sequence, the total minimum elapsed time and idle time for either machine. (08 Marks)

Job number	Number of units of each job	Processing time	
		Machine A (minute)	Machine B (minutes)
1	3	5	8
2	4	16	7
3	2	6	11
4	5	3	5
5	2	9	7.5
6	3	6	14

Table Q8(b)

- c. Use graphical method to minimize the time required to process the jobs given in Table Q8(c) on machines. Calculate the total elapsed time to complete the jobs. For each machine specify the job that should be done first. (08 Marks)

		Machines				
		A	B	C	D	E
Job 1	Sequence	A	B	C	D	E
	Time (hrs)	1	2	3	5	1
Job 2	Sequence	C	A	D	E	B
	Time (hrs)	3	4	2	1	5

Table Q8(c)

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