USN

Operations Research

Time: 3 hrs.   Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting*
at least TWO full questions from each part.
2. Use of SQC tables is permitted.
3. Missing data, if any may be suitably assumed.

PART – A

1 a. Define OR and mention the assumptions made in Linear Programming Problem. **(05 Marks)**
   b. An industry manufactures two items. It purchases castings which are then machined, bored and polished. Castings for items A and B cost Rs.30 and Rs.40 respectively and are sold at Rs.60 and Rs.70 each respectively. Running costs of the three machines are Rs.200, Rs.140 and Rs.175 per hour respectively. Formulate the problem as LPP and solve it graphically Capacities of the machines are

	Item A	Item B
Machining	25/hr	40/hr
Boring	28/hr	35/hr
Polishing	35/hr	25/hr

                                                                                (15 Marks)

2 a. Explain:
   i)   Leaving variable and entering variable
   ii) Non degenerate basic feasible solution
   iii) Features of duality.   **(06 Marks)**
   b. Solve by simplex method,
       Minimize $Z = 2x_1 + 3x_2$
       Subject to $x_1 + x_2 \geq 5$
       $x_1 + 2x_2 \geq 6$ and
       $x_1, x_2 \geq 0$ **(14 Marks)**

3 a. Find the optimal solution to the following transportation problem which minimizes the unit transportation cost (in Rs.):   **(08 Marks)**

		\	Destination			
		1	2	3	4	Availability
	1	8	10	7	6	50
Source	2	12	9	4	7	40
	3	9	11	10	8	30
Demand		25	32	40	23	

   b. A department has four subordinates and four tasks to be performed. The subordinates differ in efficiency and tasks differ in their intrinsic difficulty. The estimates of the profit in rupees each man would earn is given in the following matrix. Find the optimal allocation which maximizes the total earnings.   **(06 Marks)**

		Tasks			
		1	2	3	4
	1	50	400	200	50
Subordinates	2	250	350	300	250
	3	150	250	200	100
	4	150	50	300	150

c. Products 1, 2, 3, 4 and 5 are to be processed on a machine. The setup costs in rupees per change depend upon the product presently on the machine and the set up to be made and are given by the following data:
$c_{12} = 16$, $c_{13} = 4$, $c_{14} = 12$, $c_{23} = 6$, $c_{34} = 5$, $c_{25} = 8$, $c_{35} = 6$, $c_{45} = 20$ and $c_{ij} = c_{ji}$, $c_{ij} = \infty$ for all values of i and j not given in the data. Find the optimum sequence of products in order to minimize the total setup cost. **(06 Marks)**

4 Solve by the Gomory algorithm.
Maximize $Z = 5x_1 + 7x_2$
Subject to $-2x_1 + 3x_2 \leq 6$
$\qquad\qquad 6x_1 + x_2 \leq 30$
$\qquad\qquad x_1, x_2 \geq 0$ and integers **(20 Marks)**

PART – B

5 a. Define: i) Activity   ii) Event   iii) Path   iv) Network. **(04 Marks)**
   b. Draw the network for the activities involved in the computer installation process are given below:

Activity		Predecessor Activity
A.	Physical preparation	-
B.	Planning	-
C.	Personnel selection	B
D.	Equipment installation	A
E.	Personnel training	C
F.	Detailed system design	C
G.	File conversion	F
H.	Establish standards and controls	F
I.	Program preparation	H
J.	Program testing	I
K.	Parallel operations	D, E, G, J
L.	Systems documentation	I
M.	Follow up	K, L

(04 Marks)

   c. The project consists of the following activities. Determine:
   i)   Draw the network
   ii) Critical path
   iii) Earliest and latest times and
   iv) Total float. **(12 Marks)**

Activity ij	Duration t_E^{ij}
0-1	1
1-2	4
1-3	5
2-4	3
2-5	1.5
3-4	1.5
3-6	3.5
4-7	2.5
5-6	1
6-7	4

6 a. With usual notations derive an expression for expected number of units in the system. **(10 Marks)**

b. On an average 96 patients per 24 hour day require the service of an emergency clinic. Also on average, a patient requires 10 minutes of active attention. Assume that the facility can handle only one emergency at a time. The clinic costs Rs.100 per patient treated to obtain an average servicing time of 10 minutes, and that each minute of decrease in this average time would cost Rs.10 per patient. How much would have to be budgeted by the clinic to decrease the average size of the queue from $1\frac{1}{3}$ patients to 1/2 patient? **(10 Marks)**

7 a. Find the value of the game shown below and determine the optimum strategies. Is the game strictly determinable? **(04 Marks)**

Player B

Player A

6	-2	-3	8
-1	-2	-7	0
8	9	-6	-7
9	5	-7	7

b. In a game of matching coins with two players, suppose A wins one unit of value when there are two heads, wins nothing when there are two tails, and loses 1/2 unit of value when there are one head and one tail. Determine the pay off matrix, strategies for each player and value of the game. **(04 Marks)**

c. Solve the following game graphically

	Player B	
	B$_1$	B$_2$
A$_1$	-4	3
A$_2$	-7	1
A$_3$	-2	-4
A$_4$	-5	-2
A$_5$	-1	-6

Player A

(12 Marks)

8 a. List the various assumptions made in solving sequencing problems. **(04 Marks)**

b. A book binder has one printing press, one binding machine and manuscript of a number of different books. The times required in minutes to perform the printing and binding operations for each book are known. Determine the order in which books should be processed in order to minimize the total time required to turn out all the books.

Book	1	2	3	4	5	6
Printing time	30	120	50	20	90	110
Binding time	80	100	90	60	30	10

(08 Marks)

c. There are two jobs to be processed through five machines A, B, C, D and E. The order of processing and processing time in hours is given below:

Job 1 :	A	B	C	D	E
Time :	3	4	2	6	2
Job 2 :	B	C	A	D	E
Time :	5	4	3	2	6

Determine the optimal sequencing of jobs and the minimum total elapsed time. **(08 Marks)**

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