P1591   **[3764]-191**
B.E. (Prod/SW)
OPERATIONS RESEARCH & MANAGEMENT
(411126) (2003 Course)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *Figures (in bracket) to the right indicate full marks.*
3) *Assume suitable data, if necessary & state it clearly.*
4) *All units are compulsory.*
5) *Use of pocket calculator, log tables, stats tables, graph paper is allowed.*

SECTION - I
Unit - I

Q1) a) Given - Minimize $Z_y = 30y_1 + 36y_2 + 20y_3$

S.t. $5y_1 + 3y_2 + 2y_3 \geq 10$

$3y_1 + 6y_2 + 5y_3 \geq 20$ & $y_1, y_2, y_3 \geq 0$

Write the dual form of above problem.   **[2]**

b) Solve this <u>dual</u> by <u>Simplex Method</u>.   **[8]**

c) Write also values of primal variables from above final simplex table.**[2]**

d) What is the advantage of solving dual of above original primal problem?
                                                              [2]

e) In above dual, which is redundant constraint? Why?   **[2]**

f) For the above dual, do the RHS ranging for the first constraint.   **[2]**

                              OR

a) Explain in brief the Methodology of OR.   **[6]**

b) A dairy firm has two milk plants with daily milk production of 6 million litres & 9 million litres respectively. Each day the firm must fulfil the needs of its three distribution centres which have milk requirement of 7, 5,& 3 million litres. Cost of shipping one million litres of milk from each plant to each distribution centre is given, in hundreds of rupees below. <u>Formulate</u> only the <u>L.P.</u> model to minimize the transportation cost, having only two variables.   **[7]**

```
                  Distribution Centres
                 1      2      3      Supply
       Plants  1 | 2      3      11 |    6
              2 | 1      9      6  |    9
       Demand    7      5      3
```

c) Explain in brief wrt LPP. **[5]**

   i) Unrestricted variable.

   ii) Unbounded solution.

   iii) Basic solution.

   iv) Infeasibility.

   v) Degenerate solution.

Unit - II

Q2) a) Write the LP form of transportation problem. **[2]**

b) The captain of a cricket team has to allot five middle batting positions to five batsmen. The average runs scored by each batsman at these positions are as follows.

Batsman	Batting Positions				
	I	II	III	IV	V
P	40	40	35	25	50
Q	42	30	16	25	27
R	50	48	40	60	50
S	20	19	20	18	25
T	58	60	59	55	53

   i) Find the assignment of batsmen to positions which would give the maximum number of runs. **[5]**

   ii) If another batsman 'U' with the following average runs in batting positions as given below :

   Batting position -   I   II   III   IV   V
   Average runs   -   45   52   38   50   49

   is added to the team, should he be included to play in the team? If so, who will be replaced by him? **[7]**

c) What is degeneracy in transportation problem? **[2]**

OR

a) For square assignment problem, how many constraints are there in LP form? How many decision variables are there? What are the values of decision variables? While solving assignment problem by simplex, how many total variables are involved? **[5]**

b) The following table shows all information about transportation problem, with cost figures in Rs. The shipping clerk has worked out schedule as: 12 units from A to Q, 1 unit from A to R, 9 units from A to S, 15 from B to R, 7 from C to P & 1 from C to R. Check the schedule of the clerk whether optimal or not, otherwise suggest the suitable schedule for minimum cost. **[8]**

		Market				
		P	Q	R	S	Supply
Ware house	A	6	3	5	4	22
	B	5	9	2	7	15
	C	5	7	8	6	08
Demand		7	12	17	9	

c) What are trans-shipment problems? How they are solved? **[3]**

Unit - III

Q3) a) Find the optimal order quantity for a product when the annual demand is 500 units, the cost of storage per unit per year is 10% of the unit cost and ordering cost per order is Rs. 180. The unit costs are given below:

Order Quantity	Unit Cost
$0 \leq q < 500$	Rs. 25.00
$500 \leq q < 1500$	Rs. 24.80
$1500 \leq q < 3,000$	Rs. 24.60
$3,000 \leq q$	Rs. 24.40

[10]

b) Mention the costs involved in inventory control models & sketch the cost-quantity trade-off. **[3]**

c) Mention any three optimality criteria in sequencing problems. **[3]**

OR

a) A manufacturing company processes 6 different jobs on two machines A & B. Number of units of each job and its processing times on A & B are given below. Find the optimum sequence, the total minimum elapsed time & idle time for both machines. **[9]**

Job No.	No. of Units of each Job	Processing Time (min.)	
		Machine A	Machine B
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

b) A firm uses every year 12,000 units of raw material costing Rs. 1.25 per unit. Ordering cost is Rs. 15.00 per order and the holding cost is 5% per year of average inventory.

    i)   Determine E.O.Q. & corresponding cost. **[2]**

    ii)   The firm follows E.O.Q. purchasing policy. It operates for 300 days per year. Procurement time is 14 days and safety stock is 400 units. Find the reorder point, the maximum inventory and the average inventory. **[3]**

    iii) Sketch the inventory cycle you used in above problem. **[2]**

SECTION - II

Unit - IV

Q4) a) State the advantages & limitations of simulation. **[6]**

b) The occurance of rain in a city on a day is dependent upon whether or not it rained on the previous day. If it is rained on the previous day, the rain distribution is as

Event - No rain 1 cm rain 2 cm rain 3 cm rain 4 cm rain 5 cm rain

p -   0.50   0.25   0.15   0.05   0.03   0.02

If it did not rain the previous day, rain distribution is as

Event - No rain   1 cm   2 cm   3 cm

p -   0.75   0.15   0.06   0.04

Simulate the city's whether for 10 days and determine by simulation the total days without rain as well as the total rainfall during the period.

Random Nos. :- 67, 63, 39, 55, 29, 78, 70, 06, 78, 76. **[12]**

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<center>OR</center>

a) A taxi owner estimates from his past records that the cost/year for operating a taxi whose purchase price when new is Rs. 60,000 is as -

Age	→	1	2	3	4	5
Operating cost (Rs.)	→	10,000	12,000	15,000	18,000	20,000

After 5 years, the operating cost = 6000 K, where K = 6, 7, … 10 (K is the age in years). If resale value decrease by 10% of purchase price each year, what is the best replacement policity? Cost of money is zero. **[6]**

b) The following rates have been observed for certain items.

End of month	-	1	2	3	4	5
p (failure)	-	0.10	0.30	0.55	0.85	1.00

The cost of replacing an individual item is Rs. 1.25. The decision is made to replace all the items simultaneously at fixed interval and also to replace individual items as they fail. If the cost of group replacement is 50 paise, what is the best interval of group replacement? At what group replacements price per item, would a policity of strictly individual replacement become preferrable to the adopted policy? Assume that the items failing during a month are replaced at the end of the month & there are 1000 items in use. **[12]**

<center>**Unit - V**</center>

Q5) a) Explain Kendall's notation for representing queing models. **[6]**

b) Goods trucks arrive randomly at a stockyard with a mean of 8 trucks/hour. A crew of four operatives can unload a truck in 6 minutes. Trucks waiting in queue to be unloaded are paid a waiting charge at the rate of Rs. 60/hour. Operatives are paid a wage rate of Rs. 20/hour. It is possible to increase the number of crews to 2 or 3 (of four operatives per crew). When the unloading time will be 4 minutes or 3 minutes respectively per truck. Find the optimal crew size. **[8]**

c) Define Row & Column Dominance. **[2]**

<center>OR</center>

a) In a small town there are only two stores. ABC & XYZ that handle sundry goods. The total number of customers is equally divided between the two, because price & quality of goods sold are equal. Both stores plan to run yearly pre-Natal sales during the 1st week of December. Sales are advertised through a local news paper/radio and cable TV. With the aid of an advertising agency, store ABC constructed a game matrix given below. (figures in matrix represent a gain or loss of market share).

| | | Strategies of XYZ | | |
		Newspaper	Radio	TV
	NP	30	40	80
Strategies of ABC →	R.	0	15	20
	TV	90	20	50

Determine optimal strategies for both ABC & XYZ & value of game. **[9]**

b) For the following 2 × 2, game without saddle point, find the optimal mixed strategies & value of the game. **[7]**

Unit - VI

Q6) a) A small project has the following data to offer.

Activity		1 - 2	1 - 3	1 - 4	2 - 5	3 - 5	4 - 6	5 - 6
time	Optimistic	1	1	2	1	2	2	3
(weeks)	Most likely	1	4	2	1	5	5	6
	Pessimistic	7	7	8	1	14	8	15

i) Draw the network, identity expected duration of project & critical path. **[4]**

ii) What is the probability that the project will be completed 4 weeks latter that expected? **[2]**

iii) What is the expected duration for 75% chance of project completion? **[2]**

iv) Which activities will cause more uncertainty in meeting the due date of project? Why? **[2]**

b) Explain in brief. **[6]**

   i) Earliest start & Earliest finish time for activity.

   ii) Latest start & Latest finish time for activity.

   iii) Total & Free float.

<div align="center">OR</div>

a) A small project has following data.

Activity $\rightarrow$	1 - 2	1 - 3	1 - 4	2 - 4	2 - 5	3 - 6	4 - 6	5 - 6
Time (days) { Normal $\rightarrow$	6	8	5	3	5	12	8	6
Crash $\rightarrow$	4	4	3	3	3	8	5	6
Cost penalty / day (Rs.) $\rightarrow$	2400	2700	1500	-	1200	6000	1500	-

The cost of completing all activities in normal time is Rs. 1,74,000/- without over heads. The overhead cost is Rs. 4,800 per day.

   i) Identity critical path for project completion, find out normal duration and the corresponding cost for project. **[4]**

   ii) Find out optimum duration & minimum cost of the project. **[4]**

   iii) Find out minimum duration & corresponding cost of project. **[4]**

b) Explain briefly. (any two) **[4]**

   i) Earliest occurrence & latest allowable occurrence time for event.

   ii) Significance of slack.

   iii) Dummy activity.

Given Data : Z = −0.50   −0.67   −1.00   −1.33   −2.00   +1.645

               p = 0.3085   0.25   0.16   0.0918   0.028   0.95

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