B.E. Sixth Semester (Mechanical Engineering) (C.B.S.)

Operations Research

P. Pages : 4 **KNT/KW/16/7397**

Time : Three Hours * 0 1 2 6 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Illustrate your answers whenever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.
11. Used of Random Number Table & Normal distribution chart is permitted.

1. a) Define operation research? Explain the scope and application of operation research? **6**

b) XYZ company produces an automobile spare part. The contract that it has signed with large manufacturer calls for the following 4-month shipping schedule. **8**

Month	No. of parts to be shipped
January	3,000
February	4,000
March	5,000
April	5,000

The company can manufacture 3,000 parts per month on a regular time basis and 2,000 parts per month on an overtime basis. Its production cost is Rs. 15,000 for a part produced in regular time and 25,000 for a part produced in overtime. Its monthly inventory holding cost is Rs. 500.
Formulate this problem as an LP model to minimize the overall cost.

OR

2. a) Use Penalty (Big – M) method to solve the following LP problem. **10**

Maximize $Z = x_1 + 2x_2 + 3x_3 - x_4$

Subject to constraints.

$$x_1 + 2x_2 + 3x_3 = 15$$
$$2x_1 + x_2 + 5x_3 = 20$$
$$x_1 + 2x_2 + x_3 + x_4 = 10$$

& $x_1, x_2, x_3 \geq 0$

b) Solve following LP problem with graphical method. **4**

Max $Z = x_1 + x_2$

Subject to

$$x_1 - x_2 \geq 0$$
$$3x_1 - x_2 \leq -3$$

& $x_1, x_2 \geq 0$

3. a) Differentiate between transportation and Transshipment model. **3**

b) Consider a firm having two factories. The firm is to ship its products from the factories to three retail stores. The number of units available at factories X & Y are 200 and 300, respectively, while those demanded at retail stores A, B and C are 100, 150 and 250 respectively. Rather than shipping directly from factories to retail stores, it is asked to investigate the possibility of trans-shipment. The transportation cost (in rupees) per unit is given in table. **10**

		Factory		Retail stores		
		X	Y	A	B	C
Factory	X	0	8	7	8	9
	Y	6	0	5	4	3
Retail stores	A	7	2	0	5	1
	B	1	5	1	0	4
	C	8	9	7	8	0

Find optimal shipping schedule.

OR

4. An airline that operates seven days a week has the timetable which is given below. **13**
The crew must have a minimum layover time of five hours between flights.

Flight No.	Delhi - Jaipur		Flight No.	Jaipur - Delhi	
	Dep.	Arrival		Dep.	Arrival
101	7.00 am	8.00 am	201	8.00 am	9.15 am
102	8.00 am	9.00 am	202	8.30 am	9.45 am
103	1.30 pm	2.30 pm	203	12.00 noon	1.15 pm
104	6.30 pm	7.30 pm	204	5.30 pm	6.45 pm

Obtain the pairing of flights that minimizes layover time away from home. For any given pairing, the crew will be based at the city that results in the smaller layout. For each pair also mention the town where the crew should be based.

5. Explain the principle of dominance in game theory and solve the following. **13**

	Player B		
Player A	B_1	B_2	B_3
A_1	1	7	2
A_2	6	2	7
A_3	5	2	6

OR

6. a) Find the sequence that minimizes the total time required in performing the following jobs on three machines in the order ABC. Processing times (in hours) are given in the following table. **6**

Job:	1	2	3	4	5
Machine A:	8	10	6	7	11
Machine B:	5	6	2	3	4
Machine C:	4	9	8	6	5

b) The production department for a company requires 3,600 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is Rs.36 and the cost of carrying inventory is 25% of the investment in inventories. The price is Rs.10 per kg. The purchase manager wishes to determine an ordering policy for raw material. **7**

7. Consider a project having following activities & their time estimates as shown in table – 1 **14**

a) Draw PERT network diagram for the project.
b) Compute the expected project completion time.
c) What should be the due date to have 0.90 probability of completion?
d) Find the total float & free float for all non critical activities?

Table – 1

Activity	Immediate Predecessor	Activity Time (weeks)		
		Most Optimistic	Most likely	Most Pessimistic
A	--	3	4	5
B	--	4	8	10
C	B	5	6	8
D	A, C	9	15	10
E	B	4	6	8
F	D, E	3	4	5
G	D, E	5	6	8
H	D, E	1	3	4
I	G	2	4	5
J	F, I	7	8	10
K	G	4	5	6
L	H	8	9	13
M	J, K, L	6	7	8

OR

8. The following is a table showing details of a project. **14**

Activity	Immediate Predecessor	Normal		Crash	
		Time (weeks)	Cost (Rs'000)	Time (weeks)	Cost (Rs'000)
A	--	10	20	7	30
B	--	8	15	6	20
C	B	5	8	4	14
D	B	6	11	4	15
E	B	8	9	5	15
F	E	5	5	4	8
G	A, D, C	12	3	8	4

Indirect cost is Rs. 400 per day. Find the optimum duration and the associated minimum project cost.

9. The data collected in running a machine, the cost of which is Rs. 60,000 are given below. **13**

Year	:	1	2	3	4	5
Resale value (Rs.)	:	42,000	30,000	20,400	14,400	9,650
Cost of Spare (Rs.)	:	4,000	4,270	4,880	5,700	6,800
Cost of labour (Rs.)	:	14,000	16,000	18,000	21,000	25,000

Determine the optimum period for replacement of machine.

OR

10. A computer has a large number of electronic tubes. They are subject to mortality as given below. **13**

If the tubes are group replaced, the cost of replacement is Rs. 15 per tube Group replacement can be done at fixed intervals in the night shift when computer is not normally used. Replacement of individual tubes which fail in service cost Rs. 60 per tube. How frequently should the tubes be replaced?

Period	Age of failure (hrs)	Probability of failures
1	0 – 200	0.10
2	201 – 400	0.26
3	401 – 600	0.35
4	601 – 800	0.22
5	801 – 1000	0.07

11. Arrivals at telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of phone call is assumed to be distributed exponentially, with mean 3 minutes. **13**

a) What is the probability that a person arriving at the booth will have to wait?
b) The telephone department will install a second booth when convinced that an arrival would expect waiting for at least 3 minutes for a phone call. By how much should the flow of arrivals increase in order to justify a second booth?
c) What is average length of queue that forms from time to time?
d) What is the probability that it will take him more than 10 minutes altogether to wait for the phone and complete his call?

OR

12. A dentist schedules all his patients for 30 minute appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following summary shows the various categories of work, their probabilities and time actually needed to complete the work. **13**

Category of service	Time required (minutes)	Probability of category
Filling	45	0.40
Crown	60	0.15
Cleaning	15	0.15
Extraction	45	0.10
Checkup	15	0.20

Simulate the dentist's clinic for four hours and determine the average waiting time for patients as well as idleness of doctor. Assume that all the patients show up at the clinic at exactly their scheduled arrival time starting at 8.00 am. Use following random numbers for handling, the above problem.

40 82 11 34 25 66 17 79

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