Subject - O.R.
T.YBMS VI Sem (2015).

QP Code : 21819

(2½ Hours) **[Total Marks : 75**

N.B.: (1) Attempt **all** questions from **Q.1** to **Q.5** (15 marks each).
(2) **Figures** to the **right** indicate **full** marks.
(3) Use of non-programmable calculator is allowed and mobile phones are not allowed.
(4) Support your answers with diagrams / illustrations wherever necessary.
(5) Graph papers will be supplied on request.
(6) Normal distribution table is printed on the last page if required.

1. Attempt **any two** form the following :-

(a) A firm manufactures two products desk chairs and book shelves, with help of machinery M1 and labours. To produce one unit of desk chairs 20 machine hrs and 50 labour hrs are required, also to produce one unit of book shelve 10 machine hrs and 50 labour hrs are required. Machine hrs and labour hrs can be utilized for maximum 500 hrs and 300 hrs respectively. Formulate the given problem in standard form of LPP and solve using simplex method only. **7.5**

(b) BMS Ltd. produces two products P and Q. Daily production capacity is 600 units for total production. But atleast 300 total units must be produced everyday. Machine hrs consumption per unit is 6 for P and 2 for Q. Atleast 1200 machine hrs must be used daily. Manufacturing costs per unit are Rs. 50 and Rs. 20 for P and Q respectively. Find the optimal solution by graphical method. **7.5**

(c) Solve by simplex algorithm. 7.5

Maximize $Z = 60x + 120y$

Subject to :

$2x + 2y \leq 8$

$3x + y \leq 6$

$3x + 2y \leq 12$

$x, y \geq 0$

2. Attempt **any two** form the following :-

(a) The following is an intermediate table in the solution of a transportation problem. 7.5

Plants	Distribution Centres				Supply in units
	I	II	III	IV	
X	9	(6) 7	6	11	6
Y	11	12	(5) 5	(2) 9	7
Z	(8) 7	(1) 9	11	(4) 13	13
Demand in units	8	7	5	6	

Figures in the top right corner of every cell represent the cost of transporting (in Rs.) one unit from plants to distribution centres. Allocations are circled. Answer the following questions (giving reason).

(i) Is the solution optimal ? If not, find the optimal solution. 5. 5

(ii) Does the problem have an alternate solution ? If so, show alternate optimal solution. 1

(iii) In the optimal solution, if the cost for route Z - IV is reduced from Rs. 13 to Rs. 11, will the optimality change ? 1

(b) Followning table shows all necessary information on the available supply from each Manufacturing plant and demand of each warehouse. Transportation cost per unit in Rs. is given in the table from manufacturing plants M1, M2 and M3 to warehouses W1, W2 and W3. 7.5

From	To			~~Demand~~ Supply in units
	W 1	W 2	W 3	
M 1	10	8	20	80
M 2	7	9	15	90
M 3	17	11	15	110
~~Supply~~ Demand in Units	60	70	150	280

(i) Find the Initial Feasible solution (IFS) by North West Corner Rule for the above transportation problem. 2.5

(ii) Test the IFS for optimality and if required improve it to optimality and calculate minimum total transportation cost. 5

(c) Five salesmen are to be assigned to five territories. Base on past performance, the following table shows the annual sales (is Rs. lakh) that can be generated by each salesman in each territory. Find optimum assignment to maximise sales. 7.5

Sales man	Territory				
	T 1	T 2	T 3	T 4	T 5
S 1	26	14	10	12	9
S 2	31	27	30	14	16
S 3	15	18	16	25	30
S 4	17	12	21	30	25
S 5	20	19	25	16	10

3. Attempt any **two** from the following :

(a) A small project consists of seven activities, details of the project are as follows:-

Activity	Time Estimates (days)		
	to Optimistic	tm Most likely	tp Pessimistic
1 - 2	2	4	6
1 - 3	3	6	9
2 - 3	1	4	7
2 - 4	2	3	4
3 - 5	1	3	5
4 - 6	1	1	1
5 - 6	1	2	3

(i) Draw project network diagram and find critical path along with project completion time. 3

(ii) Tabulate Variance and expected project completion time. 1.5

(iii) Find the probability of project completion in 15 days ? 3

(b) 'Relicare Ltd' prepared a set of interdependent activities for their upcoming project; details of which is given in below table. 7.5

Activity	Preceding Activity	Duration (weeks)
A	-	2
B	-	3
C	A	3
D	B	4
E	C	3
F	C, D	2
G	E, F	6

(i) Construct a network diagram, find critical path and project completion time. 3.5

(ii) Tabulate / Calculate Earliest Start and Finish Time, Latest Finish Time and Total Float. 4

(c) For a project different activities along with time and cost estimates are given below: 7.5

Activity	Normal Time (days)	Crash Time (Days)	$\frac{\Delta C}{\Delta T}$ (Rs)	Normal Cost (Rs)
1 - 2	4	3	30	100
1 - 3	6	4	50	250
1 - 4	2	1	20	45
2 - 4	5	3	50	100
3 - 4	2	2	NIL	150
2 - 5	7	5	35	120
4 - 5	4	2	60	115

Indirect cost is Rs. 100/day crash the project sytematically.

4. Attempt **any two** form the following :-

(a) A businessman has three alternatives A1, A2 and A3 each of which gives rise to four possible events E1, E2, E3 and E4. The pay offs in Rs. are given below :

Course of action / Alternatives	States of Nature (Events)			
	E 1	E 2	E 3	E4
A 1	8	0	– 10	6
A 2	– 4	12	18	– 2
A 3	15	7	0	8

What will be the businessman's decision if following criterion is applied.

(a) Maximin 1

(b) Maximax 1.5

(c) Laplace 1

(d) Hurwicz alpha criterion (alpha = 0.8) 2

(e) Regret criterion is applied ? 2

(b) One type of sweet is manufactured at Rs. 5 and sold at Rs. 10 per unit. The product is such that if it is produced but not sold during a day's time it becomes worthless. Left over sweets are therefore is a complete loss. 7.5

The daily sales records in the past are as follows:

Demand per Day	40	50	60	70
Probability of Demand estimated	0.4	0.3	0.2	0.1

(i) Construct the conditional pay-off table. 1.5

(ii) Calculate Expected Pay-off (Profit), using EMV method and suggest best course of actions. What is the optimal number of sweets that should be bought each day? 1.5

(iii) Construct the Opportunity Loss table. 1.5

(iv) Calculate Expected Opportunity Loss using EOL method and suggest best course of actions. 1.5

(v) Calculate the Expected Value of Perfect Information. 1.5

(c) Given below is the data of a manufacturing company which has to select one of the three products A, B and C for manufacturing. Product A requires an investment of Rs. 5,000, Product B requires an investment of Rs. 10,000 and product C requires an investment of Rs. 15,000. 7.5

Market	Probability			Return from sales in Thousands of Rs.		
	A	B	C	A	B	C
High	0.3	0.4	0.3	60	90	80
Medium	0.5	0.1	0.4	40	70	60
Low	0.2	0.5	0.3	20	60	50

Construct the decision tree and state which product company should select.

5. Case Study. 15

A company has 3 plants and 4 warehouses. The supply and Demand in units and corresponding transportation costs in Rs. per unit are given below. On the basis of past experience, following dispatch schedule has been finalized.

Plants	Transportation costs in Rs./Unit				Supply capacity (in units)
	Warehouses				
	W 1	W 2	W 3	W 4	
A	2	6 (400)	3 (100)	7	500
B	3 (500)	9	8	3 (200)	700
C	1	4	1 (800)	2	800
Demand (in units)	500	400	900	200	

Figures in the top right corner of every cell represent the cost of transporting (in Rs.) one unit from plant to warehouse. Allocations are circled.

Answer the following questions.

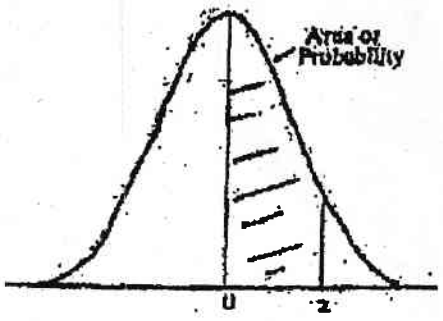
(i) Is the solution degenerate. 1

(ii) Improve the above solution to optimality. Find the minimum transportation cost. 6

(iii) Does the problem has alternate / Multiple optimal solution. If so, show alternate /multiple optimal solution 3

(iv) Comment upon the managerial significance of alternate / multiple optimal solution with reference to the given problem. 3

(v) In the optimal solution, if the cost for route A to w4 is reduced from Rs. 7 to Rs. 5/-, will the optimality change ? 2



Entries in the following table give the area under the curve between the mean and z standard devintions above the mean. For example, for z = 1.25 the area under the curve between the mean and z is 0.3944.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.7291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2518	0.2549
0.7	0.2580	0.2612	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3289	0.3315	0.3340	0.3365	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4113	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.465	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4986	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990