

Please check whether you have got the right question paper.

- N.B:
1. All questions are compulsory.
 2. Figures to the right indicate full marks.
 3. Use of non programmable calculator is allowed and mobile phones are not allowed.
 4. Normal distribution table is printed on the last page for reference.
 5. Support your answers with diagrams/ illustrations, wherever necessary.
 6. Graph paper will be supplied on request.

1. Attempt any two questions:

- a) Use simplex method to solve the following linear programming problem.

$$\text{Maximize } Z = 3X_1 + 8X_2$$

Subject to the constraints,

$$X_1 + 3X_2 \leq 10$$

$$X_1 + 2X_2 \leq 4$$

$$X_1 \geq 0, X_2 \geq 0$$

7.5

- b) A manufacturer manufactures two products A and B. These products are produced on two machines M1 and M2. The processing time in hours required per unit of these products and resource capacities are as under:

Processing time per unit (machine hours)	Product A	Product B	Maximum capacity Per week (hrs.)
M1	5	3	30
M2	2	5	20

Product A gives a profit of Rs.8 per unit while product B generates a profit of Rs. 5 per unit. Formulate the L.P.P. and solve by Graphical Method.

- c) Answer each question in brief:

- i) Discuss characteristics of Operations Research.
- ii) What do you mean by Objective function and decision variables in LPP?
- iii) Explain "Infeasibility" in Graphical Method of LPP. Explain with sketch.

2.5

2.5

2.5

2. Attempt any two questions:

- a) Four jobs are to be assigned to four workers on one to one basis. Cost of each assignment is given in Rs. Thousands. Find optimal assignment of job and worker to minimize total cost.

7.5

Jobs \ Workers	A	B	C	D
Sunil	3	6	4	5
Jainil	12	7	6	5
Anil	2	9	4	3
Swapnil	6	4	3	2

Q.P. Code :01857

- b) There are 3 Factories A, B, C and three Markets X, Y and Z. Supply at the factories is 60, 80 and 85 units. Demand at the market places is 75, 110 and 40 units. The supply and Demand of units with unit cost of Transportation (in Rs.) and the schedule followed from factories to Markets are given below. (The numbers which are shown in circle indicates numbers of units transported from factories to Markets.)

(cost in Rs.)				
Factories \ Markets	X	Y	Z	Supply
A	35 (35)	25 (25)	5 (5)	60
B	40 (40)	9 (9)	2 (2)	80
C	10 (10)	7 (7)	8 (8)	85
Demand	75	110	40	225

- i) Test the given solution for optimality and find optimal Transportation solution. 03
 ii) Find one more optimal alternate Transportation solution. 4.5
 c) Answer each question in brief:
 i) What principle is applied to prevent prohibited route being part of Transportation Solution? 2.5
 ii) Discuss difference between Assignment and Transportation Problem. 2.5
 iii) Discuss the concept of Regret Matrix in Assignment Problem. 2.5

3. Attempt any two questions:

- a) A small project consists of following activities:

Activity	Preceding Activity	Time (days)
A		6
B	A	7
C	A	9
D	B	12
E	C	7
F	D, E	8

- i) Construct the network diagram and find out critical path and project completion time. 2.5
 ii) Calculate Earliest Start Time, Earliest Finish Time, Latest Start Time and Latest Finish Time for each activity. 4
 iii) Calculate slack of Tail Event and Slack of Head Event for non critical activities. 1

Q.P. Code :01857

- b) The following table gives data on normal time and cost and crash time and cost for a project.

Activity	Duration (Weeks)		Total Cost (Rs.)		Cost Slope per Week in Rs.
	Normal	Crash	Normal	Crash	
1-2	4	3	300	500	200
2-3	3	3	100	100	-----
2-4	6	4	300	400	50
2-5	4	4	150	150	-----
3-4	5	2	120	210	30
4-6	4	3	100	140	40
5-6	4	2	60	110	25

- a) Construct the network diagram and find out critical path and the normal project duration. 03
- b) The Total Direct Normal Cost is Rs.1130. Indirect cost (overhead Cost) is Rs. 70 per week. Find out the optimum duration by crashing and the corresponding project cost. 4.5
- c) Answer each question in brief:
- Discuss the use of Dummy Activity in Network Analysis. 2.5
 - Discuss "Time and Cost Trade Off" in Project Crashing. 2.5
 - Distinguish between Activity and Event. 2.5

4. Attempt any two questions:

- a) A consumer goods company has set up following pay-off table (in Rs.100) for the sales return of their product. Three strategies (S_1, S_2, S_3) are identified to deal with three uncertain states of Nature (N_1, N_2, N_3).

States of nature	Strategies		
	S_1	S_2	S_3
N_1	800	500	300
N_2	350	400	200
N_3	400	700	100

You are required to identify right strategy under following criteria:

- Maximin. 1
- Maximax. 1
- Laplace. 1.5
- Hurwicz (Hurwicz Constant Alpha = 0.7). 1.5
- Minimax Regret. 2.5

- b) There are 7 different products in a machine shop. Their manufacturing time in Hrs on machines 1 and 2 are given below. Each of the product must go through two machines 1 and 2 in the order 1-2.

Products	Time in Hrs on Machine 1	Time in Hrs on Machine 2
A	25	15
B	40	25
C	15	45
D	20	30
E	75	35
F	100	40
G	60	45

Q.P. Code: 01857

- i) Find the sequence of products that minimizes the total elapsed time. 1.5
- ii) Find the Total Elapsed Time for the optimum Sequence. 03
- iii) Calculate the idle time for machine 1. 1.5
- iv) Calculate the idle time for machine 2. 1.5

c) The following game matrix is given (in Rs. '000)

		Player B			
Player A		B1	B2	B3	B4
	A1	6	10	-4	11
	A2	14	16	9	12
	A3	-7	14	7	18

- i. Find the Maximin Strategy. 2.5
- ii. Find the Minimax Strategy. 2.5
- iii. What is the value of the Game? 2.5

- 5 A project which is planned using PERT technique has following details of Average Expected Times Calculated using the formula, $te = (a + 4m + b) / 6$ and the details of standard deviation.

Activity	Average Expected Time in Weeks (te)	Standard Deviation
1-2	2	1
1-3	5	0.5
2-3	4	0.5
2-4	8	1
3-5	3	1
4-6	5	0.5
5-6	2	1

- i. Construct the network diagram of PERT network and find expected completion time of the project. 3
- ii. Calculate and tabulate the Variance of each activity. 2
- iii. Determine the probability of completing the project in 14 Weeks. 2
- iv. If there is a huge penalty for exceeding the project completion deadline of one week after estimated project completion time. What is the probability of being penalized? 2
- v. Find project completion time for 95% confidence level. 2
- vi. If the fixed cost of the project is Rs.3000000/- and the variable cost is Rs.15000/- per week. Find the amount firm should bid under the policy of 95% confidence of completion of the project (for the purpose of bidding, consider only cost that is break even – no loss and no profit). 2
- vii. If the project includes a penalty clause of Rs. 10000/- per week for any delay beyond 15 weeks. What is the probability of paying a penalty exactly equal to Rs. 20000/-? 2

Q.P. Code: 01857

NORMAL DISTRIBUTION TABLE

Area Under Standard Normal Distribution

	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	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	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	0.3264	0.3289	0.3315	0.3340	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	0.4115	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	0.4564	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	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990