

Time: 2 ½ Hours

Marks: 75

Note :

1. All questions are compulsory. ( Subject to internal Choice )
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 papers will be supplied on request.

Q.1 A State whether the following statements are True or False (Attempt any 8) 8

- 1 Operation Research is also termed as Management Science.
- 2 All LPP can be solved using graphical solution.
3. The feasible region is convex set.
4. The key column is determined by higher positive value of  $\Delta_j = c_j - z_j$
5. If saddle point is available in a game it is called as pure strategy game.
6. We use Hungarian method to solve assignment problem.
7. Regret matrix is made to convert the maximization problem into minimization problem in assignment problem.
- 8) PERT stands for program efficiency and review techniques.
- 9) EST Stands for earliest start time of any activity.
- 10) A job starts on machine as soon as the job end the machine both are idle.

Q.1 B Match the right and closely related answer from column Y with the text term given in column X (Attempt any seven questions) 7

Column X	Column Y
1. Optimal job sequence	a) Time estimates import by considering worst delays.
2. Maximin strategy	b) Coefficient of the variable in the objective function .
3. Principle of dominance	c) Minimum total elapsed time
4. Total flute	d) Production scheduling problem
5. Pessimistic time	e) Reduction in order of matrix
6. Maximum crashing possible	f) Player one should select the strategy whose minimum payoff to player 2 is largest.
7. $C_j$ row	g) latest start time - earliest start time
8. Feasible solution	h) Normal Time - crash Time
9. Industrial application of OR	i) Vogel's approximation method
10. VAM stand for	j) Solution for which all constraints are satisfied

- Q.2 A) A company manufactures two types of items P and Q the contribution for each products as calculated by the accounting department is Rs 5 per P and Rs 7 per B .Both products are processed on time machine Mixer and Roller .The time required in hours by each product and total time available per week on each machine are as follows. 7

Machine	Product A	Product B	Available hours per week
Mixer	6	4	12
Roller	10	4	10

Formulate the problem as a linear programming problem to maximize contribution

- Q2. B **Solve the following linear programming problem LPP graphically.** 8

$$\text{Min } Z = x + y$$

Subject to constraints

$$2x + 5y \geq 50$$

$$2x + 3y \geq 60$$

$$x \geq 0, y \geq 0$$

OR

- Q.2 C) In a factory there are 5 Employees and 5 jobs are to be done on a one basis. Time required In minutes is given for each employee job combination. Find optimal assignment of employees and job to minimize total time 7

Pilot	A	B	C	D	E
1	160	130	175	190	200
2	135	120	130	160	175
3	140	110	155	170	185
4	50	50	80	80	110
5	55	35	70	80	105

- D) Solve the following linear programming problem LPP by using simplex method. 8

$$\text{Max } Z = 2x_1 + 5x_2$$

Subject to constraints

$$2x_1 + x_2 \leq 20$$

$$34x_1 + 4x_2 \leq 24$$

$$x_1 \geq 0, x_2 \geq 0$$

- Q.3 A) You are given the following details for project consisting of aid activities 8
- i) Draw the network diagram and identify the critical path and project completion time. 4
- ii) Find EST, EFT, LST, LFT 4

Activity	Node	Duration in days
A	-	3
B	A	5
C	A	7
D	B	10
E	C	5
F	D,E	4

- Q.3 B) ABC company is transporting its unit from three factories F1, F2, F3 to four distribution place D1, D2, D3, D4. The supply and demand of unit with unit cost of transportation is given in rupees and the schedule followed for the plants to distribution center are given below. 3

i) Test the solution for optimality. 4

ii) If solution is not optimal find optimal solution.

Factories	Distributers				
	D1	D2	D3	D4	Supply
F1	20 (5)	30	50	15 (2)	7
F2	70	35	40 (7)	60 (3)	10
F3	40	12 (8)	60	25 (10)	18
Demand	5	8	7	15	

OR

Q.3 C) A small project consisting of eight activities as the following characteristics.

Activity	Preceding activity.	Most optimistic time (a)	Most likely time (m)	Most pessimistic time (b)
A	—	2	5	8
B	—	2	5	14
C	A	4	6	14
D	A	5	7	15
E	B,C	2	3	10
F	D	3	3	3
G	E	1	2	3

- i) Draw the **PERT** network diagram and find expected completion time of project. 3
- ii) If the project manager wants an assurance of 95% that the project is completed on time, how many days before the scheduled date he should start the project. 3
- iii) What is the probability that the project will be completed in?
  - a) 18 days 3
  - b) 21 days 3
- iv) If the project manager wants to be 99% certain that the project should be completed on schedule what will be the project duration? 3

- Q.4 A) For the following game matrix check if there is saddle point using principles of dominance. 8

	Player B			
	B I	B II	B III	
Player A	A I	20	18	-12
	A II	8	-10	10
	A III	14	16	16

- Q.4 B) There are six different jobs (1,2,3,4,5), each of which must go through machines A and machine B in order A and B. processing time (in hours) are given below.

- i) Find the sequence of products that minimize the total elapse to time. 4  
 ii) Calculate idle time for machine A and machine B. 3

	1	2	3	4	5
Machine A	16	8	2	8	10
Machine B	6	4	10	12	14

OR

- Q.4 C) There are five jobs ( namely 1,2,3,4,5 )each of which must go through machines at X,Y,Z in order x-y-z .Processing time in hours are given below: Find the sequence that minimize the total elapsed time required to complete the jobs. Calculate the total elastic time and idle time on machine X, Y and Z. 8

Jobs	1	2	3	4	5
Machine X	22	25	23	22	24
Machine Y	21	22	19	20	19
Machine Z	23	24	22	25	20

- Q.4 D) A company has three plants and four warehouses. The supply and demand in units and the corresponding transportation cost are given below in the table. Find out IBFS by NWCM Method. 7

Plant	Warehouse				Supply
	P	Q	R	S	
A	42	32	50	26	11
B	34	36	28	46	13
C	64	54	36	82	19
Demand	6	10	12	15	

- Q.5 A) a) What are the major application areas for operation research techniques? 8  
b) Explain various costs involved in project crashing. 7

OR

- Q.5 B) Write a short notes (Any Three) 15

- Degeneracy in transportation problem.
- Basis and non-basis variable in simplex table.
- Optimality test in Transportation problem.
- Explain the three time estimates in PERT.
- Explain North West Corner Rule method (NWCM) in transportation problem.

## NORMAL DISTRIBUTION TABLE

Area Under the Standard Normal Distribution

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	0.2291	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	0.2705	0.2734	0.2764	0.2797	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	0.4464	0.5473	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	0.4938	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4846	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.7893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4820	0.4922	0.4925	0.4927	0.4931	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	0.4958	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	0.4988	0.4986
3.0	0.49865	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4996
4.0	0.49968									