Q.P. Code :01855

[Time: 2 ½ Hours]

[Marks:75]

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.

Q.1   **Attempt any two from the following:-**

a) A diet for a sick person must contain at least 18 units of vitamins, 12 units of minerals and 10 units of   7.5
calories. Two foods F_1 and F_2 are available at a cost of Rs. 4 and Rs. 8 per unit respectively. One unit of
F_1 contains 6 units of vitamins, 1 unit of minerals and 3 units of calories. One unit of food F_2 contains 1
units of vitamins, 4 units of minerals and 1 unit of calories. Formulate the problem as LPP and solve it
graphically to minimize the total cost.

b) Solve by using Simplex method.   7.5
Maximize $Z=15X_1+5X_2$
Subject to constraints
$4X_1+5X_2 \leq 100$
$5X_1+2X_2 \leq 80$
$X_1 \geq 0, X_2 \geq 0$.

c) **Answer the following:**
i) Explain "infeasibility" in LPP using graphical sketch.   2.5
ii) Explain limitations of Operations Research.   2.5
iii) What is a unique optimal solution? How do you test of a solution is unique in Simplex method?   2.5

Q.2   **Attempt any two from the following:-**

a) a company is transporting its units from three factories F_1, F_2 and F_3 to four warehouse W_1, W_2, W_3 and
W_4. The supply and demand of units with transportation cost per unit (in Rs.) are given below.

Cost matrix (Rs. per unit)

	W_1	W_2	W_3	W_4	Supply (units)
F_1	6	2	6	11	120
F_2	4	12	2	6	95
F_3	·10	2	8	16	85
Demand (units)	50	60	90	100	300

i)   Find initial feasible solution (IFS) using Vogel's Approximation method (VAM).   3.5
ii)   Test IFS for optimality using MODI method and find optimal solution.   04

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b) A departmental head has four subordinates who differ in efficiency and the tasks differ in their 7.5 intrinsic difficulty. His estimate of the time each man would take to perform each task is given in the matrix below.
How should the tasks be allocated on one to one basis to minimize the total man-hours? Find optimal assignment of men and tasks.

Time (in hours)

Tasks	Men			
	E	F	G	H
A	18	26	17	11
B	13	28	14	26
C	38	19	18	15
D	19	26	24	10

c) Answer the following:
   i) What is Degeneracy in transportation problem? How to resolve it? 2.5
   ii) Explain regret matrix in assignment problem. 2.5
   iii) How do you detect and find multiple optimal solutions to an assignment problem? 2.5

Attempt any two from the following:-

a) A small project consists of following six activities.

Activity	Duration (in days)
1-2	3
1-3	1
2-5	5
3-4	10
3-5	2
4-5	3

   i.   Draw network diagram. Find critical path and project completion time. 03
   ii. Find EST, EFT, LFT, LST and Total float for all activities. 4.5

b) A project consists of the activities A,B,C,D,E,F and G whose time estimates and given below:

Activity	Preceding activity	Estimate duration (in days)		
		(a) Optimistic	(m) Most likely	(b) Pessimistic
A	-	2	4	6
B	-	3	6	9
C	A	1	4	7
D	A	2	3	4
E	B, C	1	3	5
F	D	1	1	1
G	E	1	2	3

   i.   Find expected time and variance of all activities. 03
   ii. Draw network diagram find expected project completion time. 03
   iii. Find probability of project completion in 15 days. 1.5

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c) Answer the following:
   i. What is critical path in PERT / CPM analysis?   2.5
   ii. Define optimistic, pessimistic and most likely times in PERT.   2.5
   iii. What is project crashing?   2.5

Q.4   **Attempt any two from the following :-**

a) A company has a choice of adopting any one out of four courses of action A1, A2, A3, A4. There are four possible states of nature S1, S2, S3, S4. Find optimal decision using each of the following decision criterion.

   i.   Maximin
   ii.   Maximax   01
   iii.   Laplace   01
   iv.   Hurwicz ($\propto = 0.4$)   1.5
   v.   Minimax regret criterion   02
      02

States of nature	Courses of action			
	A1	A2	A3	A4
S1	50	40	30	20
S2	50	55	45	35
S3	50	55	60	50
S4	50	55	60	65

B) Consider the following pay off matrix

$$
\text{Player A} \quad
\begin{array}{c}
\text{I}\\
\text{II}\\
\text{III}
\end{array}
\begin{array}{c}
\text{Player B}\\
\begin{array}{ccc}
\text{I} & \text{II} & \text{III}
\end{array}\\
\begin{bmatrix}
180 & 60 & -90\\
-100 & -40 & 120\\
100 & 80 & 140
\end{bmatrix}
\end{array}
$$

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

C) In a factory there are 6 jobs which are to be performed on two machines A and B in the order AB. The processing time (in minutes) for the jobs are given below.

Job	Processing time (minutes)	
	Machine A	Machine B
1	30	80
2	120	100
3	50	90
4	20	60
5	90	30
6	110	10

   i. Determine the optimum sequence for performing jobs.   02
   ii. Total minimum elapsed time.   3.5
   iii. Idle time for each machine.   02

Case study :

From four warehouse A, B, C and D the stocks are to be transported to four market are W, X, Y, Z. The supplies from warehouses are 100, 100, 150, 250 tons respectively. Whereas the requirement of markets are 180, 160, 160, 100 tons respectively. The cost matrix (in Rs. per unit) and a solution to the problem is given in the following table.

Markets / Warehouse	W	X	Y	Z
A	12	4 (100)	6	16
B	24	26	12 (100)	26
C	16	6 (50)	16	8 (100)
D	10 (180)	8 (10)	2 (60)	12

i. Is the above solution feasible? justify — 1.5

ii. Is the above solution non-degenerate? Justify. — 1.5

iii. Is the solution optimal? Find by using MODI method and also find optimal transportation cost. — 04

iv. Is there more than one optimal solution? Justify. — 02

v. Calculate the opportunity cost to the route 'A to Y' and 'C to Y'. — 02

vi. What should be the minimum decrease in unit cost of the cell B to X so that the company can optimally use this route alternately? — 02

vii. If the transport carrier offers discount of 75 % on existing cost for the route A to Z should the management accept the offer. Justify. — 02

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