

Time: 3 Hours

Total Marks: 100

- N.B. 1. All questions are compulsory.**
2. Figures to the right indicate full marks.
3. Use of non-programmable calculator is allowed.
4. Graph papers will be provided on request.

- Q.1 (a) Choose correct Answer for the following (ANY FIVE) (10)**
- i.** The constraints are always of less than or equal to in (2)
 - a) general form of LPP
 - b) canonical form of LPP
 - c) standard form of LPP
 - d) none of the above
 - ii.** In Degenerate solution value of objective function (2)
 - a) increases infinitely
 - b) basic variables are non zero
 - c) decreases infinitely
 - d) One or more basic variables are zero
 - iii.** Solution to LPP satisfies (2)
 - a) only constraints
 - b) only non-negative restrictions
 - c) (a) and (b) both
 - d) (a), (b) and optimum solution
 - iv.** The transportation problem in which then it is called as unbalanced transportation problem (2)
 - a) Total Supply \neq Total Demand
 - b) Total Supply $<$ Total Demand
 - c) Total Supply $>$ Total Demand
 - d) all the above
 - v.** The dummy source or destination in transportation problem is introduced to (2)
 - a) prevent solution to become degenerate
 - b) to satisfy rim requirements
 - c) ensure that total cost does not exceed limit
 - d) solve the balanced transportation problem
 - vi.** An optimal solution of an assignment problem can be obtained only if (2)
 - a) each row and column has at most one zero element
 - b) each row and column has at least one zero element
 - c) the data are arrangement in a square matrix
 - d) none of the above
 - vii.** A sequencing problem involving three jobs and three machines requires evaluation of: (2)
 - a) $(3! + 3! + 3!)$ sequences
 - b) $(3!)^3$ sequences
 - c) $(3 \times 3 \times 3)$ sequences
 - d) $(3 + 3 + 3)$ sequences
- Q.1 (b) Answer the following in one/ two sentences (ANY FIVE) (10)**
- i.** How do you recognize optimality in the simplex method? (2)
 - ii.** Write a role of pivot element in the simplex method. (2)
 - iii.** What is Iso-cost line in graphical solution to LPP? (2)
 - iv.** What is meant by balanced transportation problem? (2)
 - v.** Which tests are applied to a transportation solution before testing it for optimality? (2)
 - vi.** Give any one difference between transportation problem and assignment problem. (2)
 - vii.** Define prohibited route. (2)

Q2 Attempt Any Two sub-questions: (20)

(a) (i) Vitamin A and Vitamin B are found in two foods E and F. 1 unit of E contains 3 units of A and 4 units of B. 1 unit of F contains 5 units of A and 3 units of B. Minimum daily prescribed consumption of A and B is 50 and 60 units respectively. Cost per unit of E and F is Rs. 6 and Rs. 3 respectively. Formulate LPP. (03)

(ii) A firm is engaged in animal breeding. The animals are to be given nutrition supplements everyday. There are two products A and B which contain the three required nutrients. (07)

Nutrients	Quantity/ unit		Minimum Requirement
	X	Y	
A	72	12	216
B	6	24	72
C	40	20	200

Product cost per unit are-X: Rs. 40, Y: Rs: 80. Find out the quantity of X and Y be given to provide minimum nutritional requirements using graphical method.

(b) Maximize $Z = 5x + 3y$ subject to constraints: (10)

$$\begin{aligned} x + y &\leq 2, \\ 5x + 2y &\leq 10, \\ 3x + 8y &\leq 12, \\ x, y &\geq 0. \end{aligned}$$

Find optimal solution using simplex method.

(c) (i) Find dual of the following LPP: (05)

Maximize $Z = 2x + y$ subject to constraints:

$$\begin{aligned} x + 5y &\leq 10, \\ x + 3y &\geq 6, \\ 2x + 2y &\leq 8 \\ y &\geq 0, x \text{ is unrestricted.} \end{aligned}$$

(ii) Write down the standard form of general LPP and its characteristic. (05)

Q3 Attempt Any Two sub-questions: (20)

(a) A company has three factories A, B, C with production capacities of 7, 10, 18 units respectively (in thousands). It has four warehouses W, X, Y and Z with demands 5, 8, 7, 15 units respectively (in thousands). Unit cost of transportation is given from each factory to each warehouse. (10)

From ↓ To →	W	X	Y	Z
A	38	60	100	24
B	140	60	80	120
C	80	20	120	40

Based on above information, Find initial basic solution using (i) North-West Corner Rule Method and (ii) Least cost method. Also compare the solution obtained by both the methods and comment on it.

- (b) (i) Consider following profit Table: (05)

Sources	P	Q	R	Supply
A	25	22	23	2000
B	15	20	18	1500
C	18	17	16	1000
Demand	1200	1800	1000	

Find initial basic feasible solution using VAM to maximize total profit.

- (ii) Define transportation problem. Also discuss the structure of transportation problem. (05)
 (c) (i) Explain Least cost Method to solve transportation Method for an initial solution. (05)
 (ii) How to solve unbalanced transportation problem of maximization type? (05)

Q4 Attempt Any Two sub-questions: (20)

- (a) Define Assignment Problem. Also give mathematical formulation of the assignment problem. Also Find optimum assignment to maximize sales if a sales manager has to assign salesman to four territories. He has four candidates of varying experience and capabilities. The manager assesses the profit for each salesman in each territory as given below: (10)

Salesman	Territory			
	T ₁	T ₂	T ₃	T ₄
S ₁	35	27	28	37
S ₂	28	34	29	40
S ₃	35	24	32	33
S ₄	24	32	25	28

- (b) Explain the complete enumeration method of solving assignment problem. Also solve the following problem to find which route should be selected by the salesmen so that the total distance travelled by it is minimized using following data? (10)

From	To			
	A	B	C	D
A	∞	40	70	30
B	40	∞	60	30
C	70	60	∞	70
D	30	30	70	∞

- (c) Define sequencing problem and suggest optimum sequence of processing the jobs if Six (10) jobs are to be processed on two machines A and B in the order AB. Each machine can process only one job at a time. The processing times in minutes are as follows:

Job	A	B	C	D	E	F
Machine A	30	120	180	90	150	60
Machine B	90	180	240	240	30	150

Also calculate the total elapsed time.

Q5 Attempt Any Two sub-questions: (20)

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

Profit per unit: Desk chair Rs. 50, Book shelf Rs. 20.

- (b) (i) What is degeneracy in transportation problem? How it can be resolved? (05)
 (ii) Explain the procedure of selecting outgoing and incoming cell in context of transportation problem. (05)
- (c) (i) Define the following terms: (a) Number of machines, (b) Processing order, (c) Processing time, (d) Total elapsed time, (e) Idle time on a machine. (05)
 (ii) Six jobs are to be processed on two machines M_1 and M_2 in the order $M_1 \rightarrow M_2$. Each machine can process only one job at a time. The processing times in hours are as follows: (05)

Job	A	B	C	D	E	F
Machine M_1	1	3	8	5	6	3
Machine M_2	5	6	3	2	2	10

Suggest optimum sequence of processing the jobs and the total elapsed time.
