Time: Three Hours   **Max. Marks: 100**

Note: 1. All questions are compulsory.
     2. Figures to the right indicate full marks.
     3. Use of calculator is allowed.
     4. Graph papers will be supplied on request.

Q.1	A)	**State TRUE or FALSE and correct if necessary.**	(10)
	i)	In a basic feasible solution of a linear programming problem (lpp) with m constraints and n variables, (m-n) variables are set as zero.	(02)
	ii)	If a primal lpp has an optimal solution, then its dual also has an optimum solution.	(02)
	iii)	North-West corner rule is applied to check the optimality of solution of a transportation problem.	(02)
	iv)	A basic requirement for using the transportation technique is that thetransportation model be balanced.	(02)
	v)	If some assignment is restricted then that assignment can be effectively avoided by putting a cost equal to zero in that cell.	(02)

Q.1	B)	**Answer the following:**	(10)
	i)	While solving a linear programming problem with simplex method when will you conclude that the problem has unbounded solution.	(02)
	ii)	State the steps to obtain the optimal solution of a primal problem using the solution of its dual problem which is solved using simplex method.	(02)
	iii)	When will you get a degenerate solution in a transportation problem?	(02)
	iv)	Show that assignment problem is a special case of transportation problem.	(02)
	v)	Define the following terms in a sequencing problem: (i) processing order of jobs, (ii)total elapsed time .	(02)

Q.2		Attempt **any two** sub-questions:	(20)
a)	i)	Discuss the characteristics and advantages of a dual problem?	(05)
	ii)	Solve the following lpp using simplex method and comment on the solution.	(05)

$$\text{Max } Z= 4x_1 + 3x_2$$
$$\text{s.t.} \quad 2x_1 + x_2 \le 50$$
$$2x_1 + 5x_2 \le 100$$
$$2x_1 + 3x_2 \le 90$$
$$x_1 , x_2 \ge 0$$

b)	i)	Describe Big-M method to solve an lpp.	(08)
	ii)	If a decision variable is unrestricted in sign in an lpp, then explain the procedure so as to solve the problem using simplex method.	(02)
c)	i)	Write a table giving primal dual relationship.	(05)
	ii)	Define (i) feasible solution, (ii) basic solution, (iii) basic feasible solution, (iv) degenerate solution and (v) optimal solution.	(05)

Q3		Attempt **any two** sub-questions:	(20)
a)	i)	Describe transportation problem. Show that it is a special case of lpp.	(04)
	ii)	State and prove the necessary and sufficient condition for the existence of a feasible solution to a transportation problem.	(06)
b)	i)	Discuss MODI method to check optimality of a solution to a transportation problem.	(07)
	ii)	Test the optimality of solution given in the following table(Figures in bracket show allotment) and comment on the solution:	(03)

	D1	D2	D3	Availability
O1	3	2 (50)	6 (0)	100
O2	1 (50)	4 (50)	8	100
O3	5	4	5 (100)	100
Requirement	50	100	150	

c) i) Explain least cost method to find initial basic feasible solution to a transportation problem giving an example. (05)

ii) How will you solve a transportation problem of maximization type? (05)

Q4   Attempt **any two** sub-questions: (20)

a) i) Write the steps in solving sequencing problem of n jobs with 2 machines. (05)

ii) A book binder has one printing machine, one binding machine and the manuscripts of a number of different books. The time required (in hrs.) to perform the printing and binding operations for each book is shown below: (05)

Books:	B1	B2	B3	B4	B5	B6
Printing time:	30	120	50	20	90	110
Binding time:	80	100	90	60	30	10

Determine the order in which books should be processed, in order to minimise the total time required to turn out all the books.

b) Explain the procedure of solving sequencing problem of 2 jobs with m machines giving an example. (10)

c) i) Describe the Hungarian method of solving an assignment problem. (08)

ii) What is meant by no passing rule in a sequencing problem? (02)

Q5   Attempt **any two** sub-questions: (20)

a) i) Write general and standard form of an lpp. (06)

ii) What is meant by infeasible solution of an lpp? How will you infer that an lpp has an infeasible solution while solving it i) graphically, ii) with simplex method? (04)

b) i) What do you mean by balanced transportation problem? How will you convert a unbalanced transportation problem into a balanced one. (03)

ii) Solve the following transportation problem by obtaining initial basic feasible solution using Vogel's approximation method. (07)

	D1	D2	D3	D4	Availability
O1	90	90	100	100	200
O2	50	70	130	85	100
Requirement	75	100	100	30	

c) i) Write a short note on travelling salesman problem. (06)

ii) Explain complete enumeration method to solve assignment problem. Discuss the disadvantages of it. (04)

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