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. (02)

ii) The number of variables in the primal is the same as the number of constraints in the dual and vice-versa. (02)

iii) Row penalty in connection with Vogel's approximation method is the difference between maximum cost and next maximum cost in that row. (02)

iv) An unbalanced assignment problem can be solved by using additional cost. (02)

v) No passing rule refers to the rule of arbitrary order in which jobs are to be processed on given machines. (02)

Q.1 B) **Answer the following:** (10)

i) Define (i) basic feasible solution,(ii) unbounded solution of an lpp. (02)

ii) While solving a linear programming problem with simplex method when will you conclude that the problem has multiple solutions? (02)

iii) Write mathematical model of a transportation problem. (02)

iv) How will you convert an unbalanced transportation problem into balanced one? (02)

v) How will you convert assignment problem of maximization type in minimization type? (02)

Q.2 Attempt **any two** sub-questions: (20)

a) i) Describe graphical method for solving an lpp. (05)

ii) Solve the following problem using graphical method. (05)

$$\text{Max } Z = 2x_1 + 3x_2$$
$$\text{s.t.} \quad x_1 + x_2 \leq 30$$
$$x_1 - x_2 \geq 0$$
$$0 \leq x_1 \leq 20$$
$$3 \leq x_2 \leq 12$$

b) i) What is meant by linear programming problem? Write its general form. Define slack and surplus variables. How will you use them convert lpp into standard form? (08)

ii) Define net evaluation $(Z_j - C_j)$ in a simplex table. (02)

c) i) Write the rules for construction of dual from primal. (05)

ii) Discuss basic assumptions of linear programming. (05)

Q3 Attempt **any two** sub-questions: (20)

a) i) Write the steps to find initial basic feasible solution to a transportation problem using North-West Corner rule. (07)

ii) What do you mean by degenerate solution of a transportation problem? How will you overcome this situation? (03)

b) Explain Vogel's approximation method to find initial basic feasible solution to a transportation problem giving an example. (10)

c) i) How will you 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): (03)

	D1	D2	D3	Availability
O1	8	5 (200)	6	200
O2	2 (300)	4	3 (150)	450
O3	6	5 (100)	7 (150)	250
Requirement	300	300	300	

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

a) i) Describe assignment problem. Show that it is a special case of transportation problem. (04)

ii) A department head has four subordinates and four tasks to be performed. The subordinates differ in efficiency and the tasks differ in their intrinsic difficulty. His estimate of time each man would take to perform each task is given in the matrix given below: (06)

Task|Men	1	2	3	4
A	18	26	17	11
B	13	28	14	26
C	38	19	18	15
D	19	26	24	10

How should the tasks be allocated 'one to a man', so as to minimise the total man hours?

b) Explain the procedure of processing n jobs through 2 machines. Also write optimum sequence algorithm to solve such problem. Discuss the use of Gantt chart. (10)

c) i) Describe a procedure to draw minimum number of lines to cover all the zeros in a reduced cost matrix of an assignment problem. (05)

ii) What do you mean by sequencing problem? Also write the assumptions made while solving a sequencing problem. (05)

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

a) i) Discuss the advantages of duality. (04)

ii) What are artificial variables in an lpp? Solve the following lppusing Big-M method: (06)

Max $Z = 3x_1 + 2x_2$

s.t. $2x_1 + x_2 \leq 2$ $3x_1+4x_2 \geq 12$ $x_1, x_2 \geq 0$

b) i) Discuss the method to solve a transportation problem of maximization type. (04)

ii) Show that there are (m+n-1) basic variables in a basic feasible solution of a transportation problem with m origins and n destinations. (06)

c) Describe the procedure to solve n jobs with 3 machines along with an example. (10)

****