.P.B. SIDDHARTHA COLLEGE OF ARTS & SCIENCE

Siddhartha Nagar, Vijayawada – 520 010
Reaccredited at 'A+' level by NAAC
Autonomous & ISO 9001:2015 Certified

Title of the Course: LINEAR PROGRAMMING
Semester : III

Course Code	22MA3D2	Course Delivery Method	Blended Mode
Credits	4	CIA Marks	30
No. of Lecture Hours / Week	4	Semester End Exam Marks	70
Total Number of Lecture Hours	60	Total Marks	100
Year of Introduction : 2020-21	Year of offering : 2023-24	Year of Revision: 2023-24	Percentage of Revision :5%

Course Objective : The objective of this course is to acquire knowledge on basic concepts of linear programming problems, Transportation problems, Assignment problems, Job sequencing problems and to develop problem solving skills of the students.

Course Outcomes: After successful completion of this course, students will be able to

CO-NO	COURSE OUTCOME	BTL	PO	PSO
CO1	understand the theory of Simplex method.	**K3**	**1**	**1**
CO2	convert standard business problems into linear programming problems and solve using simplex algorithm.	**K3**	**3**	**2**
CO3	solve transportation problems.	**K3**	**3**	**2**
CO4	solve the Assignment problems.	**K3**	**5**	**2**
CO5	solve Job sequencing problems.	**K3**	**5**	**2**

Mapping of Course Outcomes:

CO-PO-PSO MATRIX										
22MA3D2	**CO-PO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
	CO1	**2**							**2**	
	CO2			**3**						**3**
	CO3			**3**						**3**
	CO4					**3**				**3**
	CO5					**3**				**3**

UNIT - I

Theory of the simplex method : Restatement of the problem, Slack and surplus Variables, Reduction of any feasible solution to a basic feasible solution, Some definitions and notations, Improving a basic feasible solution, Unbounded solutions, Optimality conditions, Alternative optima, Extreme points and basic feasible solutions.

[Sections 3.1, 3.2, 3.4 to 3.10 of Chapter 3 of prescribed book [1]]

UNIT –II

Detailed development and Computational aspects of the simplex method:

The Simplex method, Selection of the vector to enter the basis, degeneracy and breaking ties, Further development of the transportation formulas, The initial basic feasible solution, artificial variables, Tableau format for simplex computations, Use of the tableau format, conversion of a minimization problem to a maximization problem, Review of the simplex method, Illustrative examples.

[Sections 4.1 to 4.5, 4.7 to 4.11 of Chapter 4 of prescribed book [1]].

UNIT –III

Transportation problem: Introduction, properties of the matrix A, The Simplex Method and transportation problems, Simplifications R resulting from all $y_{ij}^{\alpha\beta} = \pm 1$ or 0, The Transportation Problem Tableau, Bases in the transportation Tableau, The Stepping-Stone algorithm, Determination of an initial basic feasible solution, Alternative procedure for computing $z_{ij} - c_{ij}$; duality.

[Sections 9.1 to 9.7 & 9.10, 9.11 of Chapter 9 of prescribed book [1]].

UNIT – IV

The Assignment problem : Introduction, Description and Mathematical statement of the problem, Solution using the Hungarian method, The relationship between Transportation and Assignment problems, Further treatment of the Assignment problem, The Bottleneck Assignment problem.(Chapter 6 of prescribed book [2])

UNIT – V

Job Sequencing: Introduction, Classification, Notations and Terminologies, Assumptions, Sequencing Problems: Sequence for n jobs through two machines, Sequence for n jobs through three machines, Sequence for 2 jobs through m machines, Sequence for n jobs through m machines.(Sections 12.1 to 12.5 of chapter 12 of prescribed book [3])

PRESCRIBED BOOKS:

[1] Hadley G, Linear programming, Addison Wesley Publishing Company(1978).

[2] Benjamin Lev and Howard J. Weiss, Introduction to Mathematical Programming, Edward Arnold Pub, London (1982).

[3] Rathindra P. Sen, Operations Research- Algorithms and Applications, PHI(2009).

REFERENCE BOOK: Nita H. Shah, Ravi M. Gor, Hardik Soni, Operations Research**,** PHI(2010).

Course has Focus on : Skill Development (Elective Paper)

Websites of Interest : 1. www. nptel.ac.in

2. www.epgp.inflibnet.ac.in

3. www.ocw.mit.edu

P B SIDDHARTHA COLLEGE OF ARTS AND SCIENCE::VIJAYAWADA

(An Autonomous college in the jurisdiction of Krishna University)

M.Sc. Mathematics

Third Semester

LINEAR PROGRAMMING -22MA3D2

Time:3 hours **Max. Marks: 70**

SECTION -A

Answer all questions. **(5x4=20)**

1 a) Define a linear Programming problem. Convert the following L.P.P. into standard form.

Min $z = 2x_1+x_2$

Sub: $3x_1+5x_2 \leq 15$

$6x_1+2x_2 \leq 24$

$x_1, x_2 \geq 0$. (CO1, K3)

(OR)

b) Reduce the feasible solution [2, 1, 3] into a basic feasible solution of the L.P.P $4x_1+2x_2-3x_3=1$, $6x_1+4x_2-5x_3=1$. (CO1, K3)

2 a) Define slack and surplus variables. Write the conditions for alternative optima of an L.P.P. (CO2, K2)

(OR)

b)Write the importance of artificial variables in simplex method. (CO2, K2)

3 a) Explain North –West corner rule. (CO3, K2)

(OR)

b) Explain row minima method to find a basic feasible solution to a transportation problem. (CO3, K2)

4 a) Show that assignment problem is a particular case of Transportation problem. (CO4, K2)

(OR)

b) Write the differences between Transportation problem and Assignment problem. (CO4, K2)

5 a) Write Johnson's algorithm to solve a Job sequencing problem. (CO5, K2)

(OR)

b) Write applications of Job Sequencing. (CO5, K2)

SECTION - B

Answer the following questions. All questions carry equal marks. (5X10=50)

6. (a) Given a system of m linear equations in n unknowns Ax = b with rank(A) = m. Prove that if there is feasible solution to the given system, then there exists a basic feasible solution. (CO1, K2)

(OR)

(b) State and prove the conditions for the existence of an optimum solution to the given L.P.P. (CO1, K2)

7. (a) Solve the following L.P.P using simplex method. (CO2, K3)

$$\min z = x_1 + x_2$$
$$sub: 2x_1 + x_2 \geq 4$$
$$x_1 + 7x_2 \geq 6$$
$$x_1, x_2 \geq 0$$

(OR)

(b) Solve the following L.P.P using simplex method. (CO2, K3)

$$\max z = 6x_1 - 2x_2$$
$$sub: 2x_1 - x_2 \leq 2$$
$$x_1 \leq 4,$$
$$x_1, x_2 \geq 0.$$

8 (a) Find the optimal solution by finding the IBFS using the least cost method for the following Transportation problem. (CO3, K4)

	I	II	III	Availabilities
A	2	7	4	5
B	3	3	1	8
C	5	4	7	7
D	1	6	2	14
Requirements	7	9	18	

(OR)

(b) Solve the following Transportation Problem using stepping stone algorithm.

(CO3, K4)

	I	II	III	IV	supply
A	40	44	48	35	160
B	37	45	50	52	150
C	35	40	45	50	190
Demand	80	90	110	220	

9 (a) Solve the following assignment problem by using Hungarian method. (CO4, K4)

	I	II	III	IV	V
A	45	30	65	40	55
B	50	30	25	60	30
C	25	20	15	20	40
D	35	25	30	30	20
E	80	60	60	70	50

(OR)

(b) Solve the following by using bottle neck assignment algorithm. (CO4, K4)

	A	B	C	D
1	2	4	2	4
2	8	5	4	5
3	4	6	8	9
4	8	4	2	4

10 (a) Five jobs are performed first on machine X and then on machine Y. Then time taken in hours by each job on each machine is given below:

Jobs	A	B	C	D	E
Time on machine X	12	4	20	14	22
Time on machine Y	6	14	16	18	10

Determine the optimum sequence of jobs that minimizes the total elapsed time to complete the jobs. Also compute the idle time. (CO5, K3)

(OR)

(b) Find the optimal sequence for the following problem to minimize the processing time and also obtain total elapsed time: (CO5, K3)

Jobs	Machine A	Machine B	Machine C
1	13	8	13
2	8	9	12
3	12	10	11
4	7	7	14
5	10	6	15
6	6	11	14

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