University of Kerala

Discipline	Mathematics				
Course Code	UK4DSEMAT201				
Course Title	Introduction to Operations Research				
Type of Course	DSE				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours per week
	4	3		2	5
Pre-requisites	Matrix Theory				
Course Summary	At the end of the course student get the clear ides of using technique in algebra that uses linear equations to determine how to arrive at the optimal situation (maximum or minimum) as an answer to a mathematical problem, assuming the finiteness of resources and the quantifiable nature of the end optimization goal.				

Detailed Syllabus

Module	Unit	Contents	Hrs
I	**Introduction to Linear Programming**		**9**
	1	History of Operations Research	
	2	Definitions of Operations Research	
	3	Structure of Linear Programming Model	
	4	Advantages and limitations of Linear Programming	
	5	Linear Programming Model formulation	
	6	Examples of Linear Programming Model formulation	
	Chapter 1: Sections 1.2, 1.3 , Chapter 2: Sections 2.2, 2.3, 2.7, 2.8 of Text[2]		
II	**Graphical Method**		**9**

Module	Unit	Contents	Hrs
	7	Important Definitions	
	8	Graphical Solution	
	9	Special Cases in Linear Programming(Exclude Iso-profit(Cost) function line method and Comparison of two graphical solution method)	
	Chapter 3: Sections 3.1, 3.2, 3.3, 3.4 of Text [2]		
III	**Simplex Method**		**9**
	10	Standard form of an LPP	
	11	Simplex Algorithm *(Maximization case)*	
	12	Simplex Algorithm *(Minimization case)*	
	Chapter 4: Sections 4.1, 4.2 and 4.3 of Text [2]		
IV	**Two-phase and Big-M Method**		**9**
	13	Two phase Method	
	14	Big-M Method	
	Chapter 4: Sections 4.4 of Text[2]		
V	**Teacher Designed**		**9**
	15	Simultaneous linear equations-Gaussian Elimination, Rules of Rank, Homogeneous linear equations	
	16	Some Complications and their resolution in LPP	
	17	Types of Linear Programming Solutions	
	Chapter 5: Sections 5.2,5.4 of Text[1], Chapter 4: Sections 4.5, 4.6 of Text[2]		

Topics and problems for Practical sessions and practical examinations using SageMath software – 30 hours

1. Formulating a problem using sagemath
2. Solve using graphical method (2 problems minimum)
3. Simplex algorithm - maximization (2 problems minimum)
4. Simplex algorithm - minimization (2 problems minimum)
5. Two phase method
6. Big-M method
7. Gaussian elimination of a system of equations
8. Finding rank of a system

A record should be maintained with atleast 7 problems from the above. Each problem in the record must have a description of the problem, algorithm (step by step procedure), commands used, input given and output obtained accordingly. For the ESE, the student should be able to answer two problems selected by the examiner from the 7 available in the record .

SageMath Problem resources

1. SageMath — Documentation https://doc.sagemath.org/html/en/tutorial/introduction.html
2. Online SageMath Server https://sagecell.sagemath.org/
3. Linear Algebra — SageMath Tutorial https://doc.sagemath.org/html/en/tutorial/tour_linalg.html
4. Solving Equations using SageMath https://doc.sagemath.org/html/en/tutorial/tour_algebra.html
5. Numerical Optimization — Sage Reference Manual https://doc.sagemath.org/html/en/reference/numerical/index.html
6. Linear Programming — Online Tutorial https://project.inria.fr/readinggroupoc/linear-programming-a-hello-world-in-sagemath/
7. Sage for Undergraduates — Gregory V. Bard (Online Version) https://www.faculty.luther.edu/~bernatzr/Courses/M351/sage_for_ug_color.pdf
8. P. Zimmermann *et al.*, Computational Mathematics with SageMath https://www.sagemath.org/sagebook/english.html
9. Robert A. Beezer, A First Course in Linear Algebra http://linear.ups.edu/html/sage.html

Textbooks

1. G. Hadley: Linear Algebra, Narosa, Reprint, 2002.
2. J K Sharma, Operations Research - Theory and Applications, Laxmi Publications, Sixth Edition, 2016.

References

1. Hamdy A Taha, Operations Research an Introduction, Tenth edition, Pearson, 2021.
2. I.N Herstein, Linear Algebra, Wiley Eastern, 2006.
3. Kanti Swarup, P.K.Gupta, Man Mohan, Operations Research, Sultan Chand and Sons, 2005.
4. Kenneth Hoffman and Ray Kunze, Linear Algebra, Prentice Hall, 1981.
5. S. Kumaresan, Linear Algebra, Prentice Hall, 2000.
6. G Srinivasan, Operations Research - Principle and Applications, Second Edition, PHI Learning, 2010.

Course Outcomes

CO No.	Upon completion of the course the graduate will be able to	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L) Tutorial (T)	Practical (P)
CO 1	Understand and apply the concept of mathematical modelling	PSO2, PSO3, PO2	R,U, Ap	F,P	L	
CO 2	Formulate LPP	PSO3, PO2	Ap , E	P	L	
CO 3	Solve LPP using Simplex Method	PSO2, PSO3, PO2	An, Ap	P	L	
CO 4	Solve LPP using Two-phase and Big M Method .	PSO2, PSO3, PO2	Ap,An	P	L	

(R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create)
(F-Factual, C-Conceptual, P-Procedural, M-Metacognitive)

Mapping of CO with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	3	2	-	-	-	-	2	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	3	-	-	-	-	-	-
CO3	-	3	3	-	-	-	-	2	-	-	-	-	-	-
CO4	-	3	3	-	-	-	-	2	-	-	-	-	-	-

(- -Nill, 1-Slightly/Low, 2-Moderate/Medium, 3-Substantial/High)

Assessment Rubrics

- Quiz/Assignment/Discussion/Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics

	Internal Examination	Assignment	Project Evaluation	End Semester Exam
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓