University School of Automation and Robotics
GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY
East Delhi Campus, Surajmal Vihar
Delhi - 110092

Paper Code: ABS 212
Subject: Convex Optimization

L	T/P	Credits
3	-	3

Marking Scheme

1. Teachers Continuous Evaluation: 25 Marks
2. End Term Theory Examination: 75 Marks

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks : 75**

1. There should be 9 questions in the end term examination question paper
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 15 marks.
3. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 15 marks.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes:

CO1:	Ability of students to translate the problem given in descriptive form into a mathematical model.
CO2:	Ability of students to examine and evaluate various optimization problems according to their characteristics.
CO3:	Ability of students to adopt scientific approach for analyzing problems and making decisions.
CO4:	Ability of students to practically implement knowledge gained from various optimization methods for solving linear and nonlinear mathematical models.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale 1: Low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	-	-	-	3
CO2	3	3	3	3	2	-	-	-	-	-	-	3
CO3	3	3	3	3	2	-	-	-	-	-	-	3
CO4	3	3	3	3	2	-	-	-	-	-	-	3

Unit I

Linear programming: Fundamental theorem of linear programming, Simplex methods, Method of artificial variables, Degeneracy and Cycling, Simplex tableau in the condensed form, Duality, Complementary slackness conditions, Dual simplex method. **[10]**

Unit II

Transportation and assignment problems: Transportation problem, Balanced transportation problem, Unbalanced transportation problem, Assignment problem, Hungarian method for assignment problem, Dual interpretation of Hungarian method. **[10]**

Unit III

Optimality conditions and duality in non-linear programming : Convex functions and their properties, convex optimization problems, feasible directions and linearizing cone, Basic constraint qualification, Lagrangian and Lagrange multipliers, Karush-Kuhn- Tucker necessary/sufficient conditions, Duality in nonlinear programming. **[10]**

Approved by PoS of USAR: 1/08/22

Prof. Ajay S. Singhal
Professor Incharge, USAR 20/08/22
Guru Gobind Singh Indraprastha University
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Unit IV **[10]**

Un-constraints optimization problems: Basic scheme and certain desirable properties, line search method for unimodal functions, the Steepest decent method, Newton's method, modified Newton's method, Conjugate gradient method.

Text Books

1. Chandra, S., & Jayadeva, M. A. (2009). *Numerical Optimization with Applications*, Alpha Science International.
2. Bertsekas, D. P. (1997). *Nonlinear programming. Journal of the Operational Research Society*, *48*(3), 334-334.
3. Chvátal, V. (1983). *Linear Programming WH Freeman and Company, New York*, 13-26.
4. Chong, E. K., & Zak, S. H. (2004). *An introduction to optimization*. John Wiley & Sons.

Reference Books

1. Fletcher, R. (2013). *Practical methods of optimization*. John Wiley & Sons.
2. D. Luenberger, *Linear and nonlinear programming*, 2nd Edition, 1984, Kluwer Academic Publisher, New York
3. Mangasarian, O. L. (1994). *Nonlinear programming*. Society for Industrial and Applied Mathematics.
4. Nocedal, J., & Wright, S. J. (Eds.). (1999). *Numerical optimization*. New York, NY: Springer New York.
5. Ruszczynski, A. (2011). *Nonlinear optimization*. Princeton university press.
6. Sundaram, R. K. (1996). *A first course in optimization theory*. Cambridge university press.

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