DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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CSX4281   Approximation Algorithms

L-T-P-Cr:3-0-0-3

Pre-requisites: Fundamental knowledge of AI, linear algebra, probability & statistics, and algorithms

Objectives/Overview:
- Students will learn the basic definitions of approximation algorithms: combinatorial and LP- based algorithms.
- Students will learn basic algorithmic techniques used to design approximation algorithms.
- Students will learn the limits of approximation, and the basic ways of proving hardness of approximation.

Course Outcomes:
Understand the essential techniques to design and analyze approximation algorithms, including the following:

Sl. No.	Outcome	Mapping to POs
1.	Basic concepts and terminology used in approximation algorithms lower bound, upper bound, Familiar with combinatorial optimization problem.	PO2
2.	How to characterize a problem and design approximation algorithm and analyze its performance.	PO1, PO2,PO3
3.	How to formulate Linear programming Problem.	PO3
4.	How to use rounding technique to find approximation algorithms	PO2,PO3
5.	How to use Primal-dual and relaxation methods to find approximation algorithms	PO1, PO2

UNIT I: Introduction   **Lectures: 4**
Lower bounding, Vertex cover problem, (2-approx), Greedy set cover problem (log(n)-approximation), and its applications.

UNIT II: Combinatorial Algorithms   **Lectures: 16**
Minimum Steiner tree, Travelling salesman problem, Metric Travelling salesman problem (2-approx and 1.5-approx), Euclidean TSP, and its Applications; k-centering Problem, and its Applications; Minimum Makespan Scheduling (2-approx); Knapsack problem 2-approximation, FPTAS and its applications Shortest superstring, Multiway Cut and k-Cut, Feedback Vertex Set,

UNIT III: LP-Based Algorithms   **Lectures: 16**
Introduction to LP-Duality, LP-relaxation &Rounding applied to vertex cover and set cover, Set Cover via the Primal-Dual Schema, Maximum Satisfiability, Randomize approximate MAX-3-CNF Satisfiability, Scheduling on Unrelated Parallel Machines, Finding global MIN-CUTMulticut and Integer Multicommodity Flow in Trees, Multiway Cut, Multicut in General Graphs, Sparsest Cut, Steiner Forest, Steiner Network, Facility Location, k-Median, Semidefinite Programming,

UNIT IV: Hardness of Approximation   **Lectures: 4**

Reductions, gaps, and hardness factors, The PCP theorem, Hardness of MAX-3SAT, Hardness of vertex cover and Steiner tree, Hardness of set cover 322

Text/Reference Books

1) *Approximation Algorithms:* Vijay Vazirani, Springer-Verlag, 2001, ISBN: 3-540-65367-8