**Course title:** Graphs & Algorithms
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**References:**
1-Graph Theory, J.A. Bondy and U.S.R. Murty, 2008.
2- Approximation algorithm, V. Vazirani, 2001.
3- Design of approximation algorithms, D. Williamson, D. Shmoys, 2010.
4- Algorithms, S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, 2006.

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**Outline:** This is a secondary course in graph theory which is aimed to study some significant developments and powerful tools in graph theory with flavour of algorithms. At the end, students are supposed to acquire the main techniques in computational and algorithmic aspects of graph theory. The course discusses the known efficient algorithms for some important problems as well as some negative news in the sense that no efficient algorithm is possible. Thus, it will be an amalgamation of the algorithm design and the computational complexity. The course is offered to the students familiar with the basic concepts of graph theory and is organized to provide them with necessary knowledge to get ready for entering professional research.

**Note:** The materials of the course will be provided in the webcourse[1] and the assignments will be proposed and collected there.

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**Topics:**

1. Complexity of algorithms: Classes P, NP and Co-NP. Reductions. NP-complete problems.

2. Matching theory: Bipartite and non-bipartite graphs. Hungarian and Edmonds' algorithms. Weighted Matching and LP formulation.

3. Approximation algorithms: Greedy Approximation Algorithms. Dynamic Programming and Weakly Polynomial-Time Algorithms. Relaxation and Rounding Techniques. Linear Programming Relaxations. Randomized Rounding.

4. The probabilistic method.

5. Connectivity: Flows and cuts, Multicommodity flow, Sparsest cut and expanders, Multicut and max cut, Gomory-Hu tree.

6. Travelling salesman problem: Euclidean and non-Euclidean.

7. Treewidth and algorithmic application: Baker's method.

8. Graph Minors.

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[1] http://lms.iut.ac.ir