



## SYLLABUS

Course Code	Course Num.	Course Name	Credit Hours	Lec.	Lab.	Tut.	Private study	Pre-requisites	Course Level	Teaching Language
MAT	653	Combinatorial Optimization	4	3	0	1	8		3-4	English

### A. Course Description

This course describes the most important ideas, theoretical results, and algorithms in combinatorial optimization. The course includes the essential fundamentals of graph theory, linear and integer programming, and complexity theory. It covers classical topics in combinatorial optimization as well as very recent ones. The emphasis is on theoretical results and algorithms with provably good performance. Applications and heuristics are mentioned only occasionally.

### B. Course Outcomes

At the end of this course the student will be able to:

1. Give a detailed knowledge within combinatorial optimization.
2. Learn classical optimization problems in graphs and networks, matchings, integral polyhedral, the traveling salesman problem,
3. Introduced to matroids and to NP-completeness theory.

### C. References:

*W. Cook, W. Cunningham, W. Pulleyblank, and A. Schrijver*, Combinatorial Optimization; Wiley-Blackwell, 1997.

### Required Textbook

*C. Papadimitriou, K. Steiglitz*, Combinatorial Optimization: Algorithms and Complexity, Dover Publications Inc., 2000.

**Course Website:** Google Classroom Webpage: <http://www.imamm.org/>



## D. Topics Outline

- Problems and Algorithms:** Optimal Trees and Paths: Measuring Running Times, Minimum Spanning Trees, Shortest Paths, Maximum Flow Problems: Network Flows Problems, Maximum Flow Problems, Minimum Cut Problem, Multicommodity Flows, Minimum Cost Flow Problems.
- Optimal Matchings:** Matchings and Alternating Paths, Maximum Matchings, Minimum Weight Perfect Matchings, T-joins and Postman Problem.
- Integral Polyhedra:** Convex Hulls, Polytopes, Facets, Integral Polytopes, Total Unimodularity, Total Dual Integrality, Cutting Planes, Separation and Optimization.
- The Traveling Salesman Problem:** Introduction, Heuristics for the TSP, Lower Bounds, Cutting Planes, Branch and Bound.
- Matroids:** The Greedy Algorithm, Matroids: Properties, Axioms, Constructions, Matroids Intersection, and Applications.
- NP and NP-completeness:** Introduction, Words, Problems, Algorithms and Running Time, The Class NP.

## E. Office Hours

Office hours give students the opportunity to ask in-depth questions and to explore points of confusion or interest that cannot be fully addressed in class.

## F. Exams & Grading System

The semi-official dates of the exams for this course are:

- **Midterm:** 8<sup>th</sup> or 9<sup>th</sup> week.
- **Quizzes & Homework:** During the semester.
- **Final Exam:** 16<sup>th</sup> week.

Your course grade will be based on your semester work as follows:

<b>Midterm :</b> 30 %	<b>Final Exam:</b> 40 %
<b>4 Quizzes + 4 Homeworks, Attendance &amp; Participation:</b> 30 %	

The grading distribution:

A <sup>+</sup>	A	B <sup>+</sup>	B	C <sup>+</sup>	C	F
[95, 100]	[90, 95)	[85, 90)	[80, 85)	[75, 80)	[70, 75)	[0, 70)



## G. Student Workload:

#	Teaching/learning activities	Contact Hours	Frequency	Total Contact hours	Self-study hours	Total self-study hours	Student Learning Time
1	Lecture	3	15	45	1.5	22.5	67.5
2	Tutorial	1	15	15	3	45	60
3	Lab\Practical	0	0	0	0	0	0
4	Homework	0	4	0	1.5	22.5	22.5
5	Quiz	0.25	4	1	1	4	5
6	Test (Midterm)	2	1	2	12	12	14
7	Final Exam	2	1	2	12	12	14
Total				<b>65</b>		<b>118</b>	<b>183</b>

Independent self-study =  $118/15 \cong 8$  hrs per week

## H. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. (“Immediate family” is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

[Executive Rules for Study Regulations and Examsgoo.gl/ykm7t3](http://Examsgoo.gl/ykm7t3)

