SYLLABUS

Course Code	*Course Num.*	*Course Name*	*Credit Hours*	*Lec.*	*Lab.*	*Tut.*	*Private study*	*Pre-requisites*	*Course Level*	*Teaching Language*
MAT	**645**	**Numerical Optimization**	**4**	**3**	**0**	**1**	**8**	**MAT 641**	**3-4**	**English**

A. Course Description

Frequently, in science, engineering, business, and economics, it is required to maximize or minimize a certain quantity, that is, an objective function that models a system, device or plan, which satisfies a required set of specifications, called constraints. The function allows comparison of the different choices for determining which might be "best". For instance by finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones. This is exactly what we call optimization problem.

B. Course Outcomes

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

1. Find analytical solution to this kind of problems when possible.
2. Use numerical methods for solving optimization problems.
3. Acquire a basic mathematical understanding of modern approaches to numerical optimization.
4. Discuss practical aspects of implementation for solving optimization problems.

C. References

Numerical Optimization, J. Nocedal, S.J. Wright, Springer, 2nd Ed. 2006.

Required Textbook

1. *Nonlinear Optimization,* A. Ruszczynski, Hardcover, 2006.

2. *Iterative Methods for Optimization,* C.T. Kelley, SIAM, North Carolina State University, Raleigh, North Carolina.

3. *Numerical Optimization with Applications,* S. Chandra, Jayadeva, and A. Mehra, Alpha Science Intl Ltd; 1st Ed., 2009.

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

D. Topics Outline

1. **Convexity:** Convex Sets, Convex Functions, Characterization of Convex Functions, Properties of Convex Functions.
2. **Unconstrained Problems:** First Order And Second Order Local Optimization Conditions, The Case of Convex Functions.
3. **Constrained Problems:** Optimal Conditions for Constrained Problems, Karush Kuhn and Tucker Theorem, Lagrange Multipliers and Duality, The Case of Convex Problems.
4. **Optimization Algorithms and Methods:** The Simplex Method, Deterministic Direct Search (Nelder Mead), Descent-Type Methods (Gradient, Quasi-Newton Methods, $BFGS$), Genetic Algorithms, Evolution Strategies, PSO, Numerical Implementation.

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^{th} or 9^{th} week.
- **Quizzes & Homework:** During the semester.
- **Final Exam:** 16^{th} week.

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

Midterm : 30 %	**Final Exam:** 40 %
4 Quizzes + 4 Homeworks, Attendance & Participation: 30 %	

The grading distribution:

A^+	A	B^+	B	C^+	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				**65**		**118**	**183**

Independent self-study = 118/15 ≅ 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