University of Tehran
School of Electrical and Computer Engineering

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<tr><td>Course:</td><td>8101642 – Advanced Optimization.</td></tr>
<tr><td>Course type:</td><td>
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<tr><td></td><td colspan="6">EE*</td><td colspan="4">CE*</td><td rowspan="2">Credit:

3</td></tr>
<tr><td></td><td>Com</td><td>E</td><td>P</td><td>B</td><td>Con</td><td>D</td><td>SW</td><td>HW</td><td>IT</td><td>MI</td></tr>
<tr><td>Required</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
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<tr><td>Level:</td><td>Undergraduate ☐
Graduate ☒</td></tr>
<tr><td>Co-requisite(s):</td><td>None.</td></tr>
<tr><td>Prerequisite(s):</td><td>Calculus 2 (8120122).</td></tr>
<tr><td>Prerequisite by topic:</td><td>None.</td></tr>
<tr><td>Textbook(s):</td><td>[1] Jorge Nocedal and Stephen J. Wright. Numerical Optimization. Springer Series in Operations Research and Financial Engineering, 2nd edition, 2006.
[2] Dimitri P. Bertsekas. Nonlinear Programming. Athena Scientific Publication, 2nd edition, 1999.
[3] Stephen Boyd and Lieven Vandenberghe. Convex Optimization. Cambridge University Press, 2004.</td></tr>
<tr><td>Coordinator:</td><td>Dr. Hosseini, Assistant professor, School of ECE.</td></tr>
<tr><td>Goals:</td><td>In the most of engineering problems, it is required to minimize a specific cost function to find the optimal parameters of a developed model. In this course, we discuss about these optimization problems with feasible optimal solution. Considering the materials presented in this course, engineers are be able to design and develop their model in such a way that it can be optimized. If there is no available algorithm to solve a problem, one has learned the required tools to develop a suitable one. In addition, in this course, the methods of optimizing high order problems, which are applicable in machine intelligence, will be presented.</td></tr>
<tr><td>Outcome:</td><td>Upon successful completion of the course, students will be able:
1. To determine solvability of a problem with optimization method;
2. To apply constrained/unconstrained optimization methods, nonlinear least square, or etc, to their problems;
3. To distinguish the local or global optimality of found solution;
4. To innovate a specific optimization method for custom problem;
5. To develop optimal model due to learnt mathematical views.</td></tr>
<tr><td>Topics:</td><td>1. Basics of unconstraint optimizations;</td></tr>
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	2. Linear search methods; 3. Trust region methods; 4. Conjugate gradient and Newton-type methods; 5. Derivative-free methods; 6. Least square methods; 7. Nonlinear equation and fixed point theorem; 8. Basics of constraints optimizations; 9. Quadratic optimization; 10. Augmented Lagrangian method; 11. Sequential quadratic method; 12. Interior-point method; 13. Non-convex optimization in convex optimization; 14. Optimization method in machine intelligence.
Computer usage:	Implementing the homeworks and projects using Matlab Software.
Assignments:	5 to 6 homeworks, covering different topics.
Projects:	Applied the optimization methods to a real problem.
Grading:	Assignments: 25% Projects: 15% Midterm exams: 25% Final exam: 35%
Further readings:	[1] Ravi P. Agarwal, Maria Meehan, Donal O'Regan. Fixed Point Theory and Applications. Cambridge University Press, 2001. [2] Suvrit Sra, Sebastian Nowozin, Stephen J. Wright. Optimization for Machine Learning. MIT Press, 2011.
Prepared by:	Dr. Reshad Hosseini.
Date:	November, 4, 2017.

*EE: Electrical Engineering		CE: Computer Engineering	
Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics	MI	Machine Intelligence and Robotics
Con	Control		
D	Digital System		