The University of Jordan
School of Engineering
Chemical Engineering Department

Program: B.Sc.
Academic Year:
Semester:

- **CHE 0905584: Process optimization**
- **Course Catalog (2019)**

Structure and formulation of optimization problems in chemical engineering; Optimality criteria; Single and multivariable methods for unconstrained optimization; Linear programming; Optimality criteria for constrained optimization; Selected applications in chemical engineering.

Credit hours	**3**	**Level**	**5**	**Pre-requisite(s)**	**0905302, 0915571**
Instructor **Prof. Menwer Attarakih**		**Office number** **CHE311**		**Office phone** Ext. 22887	
Course website https://elearning.ju.edu.jo/login/index.php Live Streaming Platform: Microsoft Teams		**E-mail** **m.attarakih@ju.edu.jo**		**Place** Refer to Registration website	

- **Textbooks:**
  - T. F. Edgar, D. M. Himmelblau & L. S. Lasdon, 2001. Optimization of Chemical Processes, 2nd Ed.. McGraw-Hill, New York.
  - R. Turton, J. Shaeiwitz, D. Bhattacharyya, W. B. Whiting (2018). Analysis, synthesis and design of chemical processes, 5th Ed., Prentice Hall, PTR, New Jersey.
  - Instructor Handouts.
- **References:**
  - Ravindran, A., Ragsdell, K. M., Reklaitis, G. V., 2006. Engineering Optimization Methods and Applications, 2nd Ed., John Wiley & Sons, Inc., New Jersey.
  - Taha, H. A., 2011, Operations Research: An Introduction, 9th Ed., Pearson, New York.
  - Yang, W. Y., Cao, W., Chung, T.-S. & Morris, J., 2005. Applied Numerical Methods using MATLAB. John Wiley & Sons, Inc., New Jersey.

Learning Objectives and Intended Learning Outcomes

Objectives	Outcomes
1. Introducing students to the structure and basic concepts of process optimization (O1)	1.2 Developing models for optimization (O1) 1.3 Understanding the general outlines for solving optimization problems (O1) 1.4 Preliminary application of optimization theory to single equipment & flowsheet models (O1)
2 Introducing the the basic optimization theory (O1)	1.1 Understanding the basic concepts of optimization (O1) 1.2 Understanding the continuity of functions & its application to optimization (O1) 1.3 Be able to write Nonlinear Programing Problem (NLP) in the standard formulation (O1) 1.4 Understanding the importance of Convexity in optimization (O1) 1.5 Understanding quadratic approximation of objective functions (O1) 1.6 Be able to apply the necessary & sufficient conditions for the Extremum of unconstrained objective function (O1)

▪ Learning Objectives and Intended Learning Outcomes (Continued)

Objectives	Outcomes
3. Introducing the optimization Theory: Unconstrained one dimensional objective functions (O1)	3.1 Understanding numerical methods for one dimensional objective function optimization (O1) 3.2 Understanding and applying the Bracketing methods: The Golden search method (O1) 3.3 Be able to apply Newton Methods in optimization (O1) 3.4 Understanding & using Polynomial approximation methods (O1) 3.5 Be able to know how to extend to higher dimensional problems (O1) 3.6 Be able to apply the MATLAB optimization toolbox (O1)
4. Apply the optimization Theory: Linear Programming (LP) (O1)	4.1 Know the applications of LP 4.2 Understand the geometrical interpretation & graphical solution (O1) 4.3 Understand the basic linear programming definitions (O1) 4.4 Be able to understand and apply the Simplex method for solving LP (O1) 4.5 Be able to solve applied linear optimization problems from Chemical Engineering using MATLAB optimization toolbox (O1)
5. Introducing the optimization theory: Nonlinear Programming (NLP) with constraints (O1)	5.1 Understand and apply the direct substitution method (O1) 5.2 Understand and apply the first-order necessary conditions for a local Extremum (O1) 5.3 Understand and apply Quadratic Programming (O1) 5.4 Understand and apply the Augmented Lagrangian method (O1) 5.5 Understand and apply The Generalized Reduced Gradient Method (O1) 5.6 Be able to solve applied NL optimization problems from Chemical Engineering using MATLAB optimization toolbox (O1)
6. Enhance the ability of students for life-long learning and communication skills (O7)	9.1 Enhance students' skills through intensive use of available data resources and short projects with written and oral presentations (O7)

▪ Topics Covered

Week	Topics	Reference
1-2	Introduction to structure and process optimization	Handouts, Textbook (1), Chap. 1, 2, 3
3-5	Introduction to the the basic optimization theory	Handouts, Chap. 4
6-8	Optimization Theory: Unconstrained one dimensional objective functions	Handouts, Chap. 5
9-10	Optimization Theory: Unconstrained multidimensional objective functions	Handouts, Chap. 6
11-12	Optimization Theory: Linear Programming (LP)	Handouts, Chap. 7
13-16	Programming (NLP) with constraints	Handouts, chap. 8

▪ Evaluation

Evaluation Tool	Weight	Date
Midterm Exam	30	Will be announced by the department
Project	15	Will be arranged between the 5th and 16th weeks
Presentations	5	To be arranged one week after the assignment
Homework	5	Will be submitted one week after the assignment
Final Exam	50	Will be announced by the University

▪ Relationship to Program Outcomes

O1	O2	O3	O4	O5	O6	O7				
X						X				

▪ Relationship to CHE Program Objectives

PEO1	PEO2	PEO3	PEO4	PEO5	PEO6	PEO7	PEO8	PEO9	PEO10	PEO11
√	√	√		√						

▪ Document Control

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