The University of Jordan
Faculty of Engineering & Technology
Department of Chemical Engineering
1st Term – Academic Year: 2012-2013

Course: Computer-Aided Design 0905761 (3 Cr. – Core Course)

Catalogue Data: Review of process optimization, Computer-aided design of continuous and non-continuous chemical processes: Strategies for process flowsheeting, algorithms for partitioning, selection of design variables and tearing, sparse matrix computation and data storage, design and scheduling of batch chemical processes, process synthesis of heat exchanger network, Individual projects using available process simulators.

Prerequisites by Course: No prerequisites

Prerequisites by topic: Students should have a good background on the following topics:

- Fundamentals of optimization
- Basic Linear Algebra
- Basics of process design (flowsheeting, synthesis, HENs, …)
- High-level programming language such as MATLAB

Textbook: No single textbook is available

References **See the list of references at the end of this syllabus**

Schedule & Duration: 16 Weeks, 48 (32) lectures, 50 (75) minutes each (including exams).

Minimum Student Material: Selected references, class handouts and an access to personal computer

Minimum College Facilities: Classroom with blackboard and projection display facilities, library, and computational facilities and process simulation software (Any of: Chemcad, ASPEN, HYSYS, …).

Course Objectives: Provide students with basic and advanced understanding of process optimization and how this can be applied to computer-aided flowsheeting, synthesis of batch processes, synthesis and design of heat exchanger and mass exchanger networks.

Course Outcomes and Relation to ABET Program Outcomes:
Upon successful completion of this course, the students should be able to understand:

1. Formulation of optimization problems at unit & process flowsheet levels
2. Tackle and analyse computer-aided flowsheeting problems
3. Flowsheet solution strategies: Sequential Modular Approach & Equation Oriented Approach
4. Basic algorithms for choosing tear streams and computation sequence in process flowsheet computation
5. Process flowsheet representation using sparse matrices algorithms
6. Batch process synthesis, design and scheduling
7. Concepts of heat and mass integration and how to design optimal heat & mass exchanger networks

Course Topics:

Topic	Description	Contact Hours
T.1	Review of process optimization, introduction to linear programing, introduction to nonlinear unconstrained and constrained optimization, applications to chemical engineering processes on the flowsheet level	**8**
T.2	Computer-aided steady state flowsheeting of chemical processes: Introduction to graph theory, matrix representation of digraphs, strategies for flowsheeting: The Sequential Modular Approach and the Equation Oriented Approach	**8**

T.3	Computational sequences in process flowsheet, partitioning with precedence ordering and output assignment, tearing and selection of design variables	**6**
T.4	Data storage and computation using sparse matrices	**2**
T.5	Introduction to design and scheduling of batch chemical processes	**4**
T.6	Process synthesis of heat exchanger networks	**8**
T.7	Process synthesis of mass exchanger networks	**8**

Computer Usage: Course work including assignments using MATLAB, available process simulation software and individual or group CAD research projects.

Attendance: Class attendance is mandatory where the UJ policy on absence is applicable.

Assessments: Exams and assignments.

Grading policy:

Term paper and/or research project & presentation	40 %
Midterm Exam	20 %
Final Exam	40 %
Total	100%

Instructor:

Instructor Name	Office	Ext.	E-mail
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References:

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2. Douglas, J. M. (1988). Conceptual process design of chemical processes, McGraw-Hill Book Co., New York.
3. Edgar T. F., Himmelblau D. M., Lasdon L. S., (2001). Optimization of chemical processes. McGraw-Hill Companies, Inc., New York.
4. Karimi, I.A., Srinivasan, R. (Eds.), (2012). 11th International Symposium on Process Systems Engineering - PSE2012. Elsevier, Amsterdam.
5. Ravindran A., Ragsdell K. M., Reklaitis G. V., (2006). Engineering Optimization: Methods and Applications. John Wiley & Sons, Inc., New Jersey.
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7. Seider, W. D., Seader, J. D. & Lewin, D. R. (1999). Process design principles, John Wiley & Sons, New York.
8. Smith, R. (2005). Chemical process design and integration, John Wiley & Sons, New York.
9. Turton R.,. Bailie R. C, Whiting W. B. & Shaeiwitz J. A., (2009). Analysis, synthesis, and design of chemical processes, Prentice Hall, PTR, New Jersey.
10. Warren D. Seider, J. D. Seader, Daniel R. Lewin, (2003). Product and Process Design Principles Synthesis, Analysis, and Evaluation. John Wiley and Sons, Inc.
11. Westerberg, A.W., Hutschison, H.P., Motard, R.L., Winter, P., (1979). Process flowsheeting. Cambridge University press, Cambridge.
12. Veverka, V.V., Madron, F., (1997). Material and energy balances in the process industries: From microscopic balances to large plants. Elsevier, Amsterdam.

For up to date information on computer-aided process chemical engineering, one can follow:
Computers & Chemical Engineering Journal: http://www.sciencedirect.com/science/journal/00981354
and the symposia:

1. 22nd European Symposium on Computer-Aided Process Engineering (ESCAPE)
2. International Symposium on Process System engineering 2012(PSE)
3. Process System Engineering-Asia 2013(PSE-Asia)
4. CHISA2012: International Congress of Chemical and Process Engineering