UNIVERSITY OF PANNONIA

SUBJECT DATASHEET

Semester:	2010/11/1
Subject:	Advanced Synthesis and Design of Process Systems
Code:	VEMKFO4253A
Responsible department:	Department of Process Engineering
Responsible department code:	MKFO
Responsible lecturer:	dr. Béla Lakatos

Educational objectives:

An introduction to the design problems of chemical engineering systems and presentation of some advanced methods and computer tools applicable for designing such systems to meet optimal/sub-optimal technical and/or economical conditions: solution of some practical problems by computers.

Detailed content of the subject:

1. The principles of algorithmic synthesis and design. Definition of optimality and its properties. Static and dynamic optimization. MATLAB: Optimization Toolbox. 2. Definition and properties of dynamical systems. Qualitative criteria, constraints, penalty function. Feasible region of solutions and design variants. The concept of the optimizing design. 3. Linear programming and its computer-aided practice. Simplex method. Methods of iterative solutions. Dual problem. 4. The basic concepts of integer and programming. Dakin-theorem. The branch and bound method. Modelling of logic constraints and logic inferences. 5. Synthesis of linear systems. Mass and energy networks. Synthesis of component separation net-works for sharp separation. Product and production design. 6. Optimizing design of nonlinear systems. Nonlinear programming and its computer-aided practice. Methods of solving. Successive quadratic programming. 7. Geometric techniques for the synthesis of chemical reactor networks. The concept of attainable regions and its application in the design. 8. Synthesis and optimizing design of chemical reactors and reactor networks. Designing concentrated and distributed parameter systems. The case of multiphase reactors. 9. Synthesis and optimizing design of the fluid-solid disperse systems. Application of the population balance models. 10. Synthesis and optimizing design of crystallizers and crystallizer networks. Extractive, adductive, partial crystallization. 11. Synthesis and multilevel design of complex process systems. Synthesis - on the network level, design - on the process level. Optimization by using the principle of decomposition and coordination. 12. Multi-objective design. Pareto-ordering, Pareto-optimization. Selection of the main objectives and compromising between those. Methods of solution. 13. Synthesis and optimizing design of multiproduct batch plants. Single-product campaigns. Horizon constraints. 14. Synthesis and optimizing design of multiproduct batch plants. Mixed product campaigns. State-task network for scheduling. 15. Integration of the system design and the design of control system. Application of the multiobjecjective optimization.

Requirements:

Grading is based on one written midterm examination and one written final examination. Each written examination consists of 2 examination questions and 2-4 problems to be solved. The final mark is determined according to following table based on the weighted average of the points obtained for the midterm and the final written examination (ratio of midterm and final exam weights=0.33/0.67): % final mark above 85 excellent (5) 75-84 good (4) 65-74 medium (3) 50-64 pass (2) below 50 fail (1)

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Required and suggested references:

Biegler, L.T., I.E. Grossmann and A.W: Westerberg, 1997, Systematic Methods of Chemical Pro-cess Design. Prentice-Hall, Englewood Cliffs, New Jersey. Seider, W.D., J.D. Seader and D.R. Lewin, 1999, Process Design Principles. Synthesis, Analysis, Evaluation. John Wiley, New York. Blanchard, B.S. and W.J. Fabrycky, 1990, Systems Engineering and Analysis. (2nd Edition). Prentice Hall,Upper Saddle River, New Jersey. Kumar, A., 1981, Chemical Process Synthesis and Engineering Design. Tata McGraw-Hill, New Delhi. Bojarinov, A.I. és V.V. Kafarov, 1973, Optimalizálás a vegyiparban. Műszaki, Budapest. Hillier, F.S., G.J.Lieberman, 1994, Introduction to Operations Research. Holden Day, San Francis-co. Siirola, J.J., I.E. Grossmann and G. Stephanopoulos (Eds), 1990, Foundations of Computer-Aided Process Design. Elsevier, New York. Mahias, S., 1997, Production and Operations Analysis. IRWIN, Chicago.