

Final exam questions – Chemical process design and control, MSc level

(mandatory subject of the final exam of MSc program in Chemical Engineering after 2024)

1. Illustrate the principles and levels of Douglas's hierarchical process design. How does each level inform the subsequent levels, and what types of process models would you use in each stage, and how?
2. Present the applications of optimization in chemical industries. Explain the decision variables, constraints, and objectives. Illustrate the key application areas of linear and nonlinear programming, and multi-objective optimization, all through a real example chosen by the examiner.
3. Multiloop control: MIMO system identification, loop pairing (RGA and NI), decoupling, including the derivation of the decoupler matrix. The steps will be presented in a case study given by the examiner.
4. Advanced process control techniques – focus on linear MPC. The role and importance of PID loops within the MPC.
5. Present the Tennessee-Eastman process (chemical reactions, flowsheets, and phases in each piece of equipment/pipe). Argue for its open-loop instability and present a multiloop control system that can stabilize the process.
6. Population balance models for the description of particulate processes in chemical engineering. Case study of well-mixed batch cooling crystallization with controlled temperature – the birth and coupling between the population and material balances.

The primary source is the students' lecture notes. For further support, contact the course lecturer.