

237d Theory and Practice in Bioseparation Engineering

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We describe a new undergraduate course in bioseparation engineering. The course is taught as a part of our concentration in Biotechnology and Biochemical Engineering, which has been designed to prepare chemical engineering graduates for careers with biotechnology and pharmaceutical companies and for further graduate work in these areas. The concentration includes the three required courses: Introduction to Biotechnology, Biochemical Engineering, Bioseparation Engineering as well as two elective bioscience courses. The bioseparation engineering course covers specialized unit operations that are not normally covered in regular chemical engineering courses, including sedimentation and centrifugation, membrane-based separations, adsorption and chromatography, precipitation, and crystallization. After a brief summary of the molecular properties of typical biomolecules, these operations are introduced in the order they typically would be conducted downstream of the initial manufacture of biotechnology products. Ancillary operations such as sterile processing, clean-in-place and regulatory aspects are briefly covered. In order to provide a practical exposure to bioseparations, the course also includes an experimental component where students, divided in teams, conduct and analyze experiments in membrane ultrafiltration and chromatography. The experiments are conducted focusing on engineering measurements of physical parameters needed for scale-up and design of processing units, much as they would be conducted in an industrial process development setting. Thus, each experiment also involves a design component where the students are asked to design a scaled-up process based on their experimental measurements. Spreadsheet-based analysis and simulation tools are provided to the students to aid in the various analysis and design tasks. The hands-on approach and the ability to examine real data illustrate the advantages and pitfalls of theory and provide a greater conceptual understanding of separation processes for biological molecules.