SEMINARIO 1 75 min

Overview of trends in the U.S. Chemical Engineering Curriculum

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In this talk we first give a general overview of major trends in Chemical Engineering in the United States in the last 3 decades, and show that significant diversification of jobs that has taken place for chemical engineering graduates. We also show how academic research over the last decade has had a strong push towards science, largely due to emergence of areas like nanotechnology and biotechnology, which has had an impact in the chemical engineering curriculum due to changes in the professional background of chemical engineering professors. Next we compare the curriculum at several universities including Carnegie Mellon, Minnesota and Princeton. Finally, we describe in detail the content of the major chemical engineering courses at Carnegie Mellon, and highlight the major changes that have taken place.

Role of Process Systems Engineering in Chemical Engineering

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In this talk we give a general overview of the nature of Process Systems Engineering, discuss some current major trends, and show how it fits in this Chemical Engineering and the role it might play in the future. After briefly reviewing the history of Chemical Engineering, we highlight how academic research over the last decade has had a strong push towards science, largely due to emergence of areas like nanotechnology and biotechnology, which has caused some disconnect between academia and industry. However, despite these trends, Process Systems Engineering (PSE) remains a core area in Chemical Engineering that one the one hand has expanded its scope from the process engineering level down to the molecular level, and up to the enterprise and global level. Furthermore, PSE is again regaining prominence due to the increasing importance of the areas of energy and sustainability. Traditionally, PSE has been subdivided into process design, process control and process operations. In this talk we argue why PSE is becoming broader in terms of scope due to future trends.

We describe three major trends in Process Systems Engineering that have emerged over the last decade and that can potentially help the industry to innovate and to remain competitive. First, we describe efforts for simultaneous product and process design, where the emphasis lies in tying the molecular structure of the products with the processing and macroscopic properties of the product. Second, we describe work that is aimed at modeling and optimizing processes for effectively exploiting fossil fuels like shale gas and

alternative sources like biomass. We also address the issue of efficiently managing natural resources such as water. Third, we describe research efforts in enterprise-wide optimization that are aimed at designing and operating supply chains for the process industry in which planning, scheduling and control can be integrated more effectively. We conclude that Process Systems Engineering is broadening its scope in order to address problems that are of current and future interest.

SEMINARIO 2 (60 min)

Challenges in the Application of Mathematical Programming Approaches to Enterprise-wide Optimization of Process Industries

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Enterprise-wide optimization (EWO) is a new emerging area that lies at the interface of chemical engineering and operations research, and has become a major goal in the process industries due to the increasing pressures for remaining competitive in the global marketplace. EWO involves optimizing the operations of supply, production and distribution activities of a company to reduce costs and inventories. A major focus in EWO is the optimization of manufacturing plants as part of the overall optimization of the supply chain. Major operational items include production planning, scheduling, and control. This talk provides an overview of major modeling and computational challenges in the development of deterministic and stochastic linear/nonlinear mixed-integer optimization models for planning and scheduling for the optimization of plants and entire supply chains that are involved in EWO problems. We address the following major challenges in this area: a) multi-scale optimization, b) linear vs. nonlinear models, c) handling of uncertainty and disruption, d) multiobjective and multilevel optimization. We illustrate these challenges in areas such as industrial gases, petroleum processing, and chemical process networks. These problems have been addressed in collaboration with industry, and have led to substantial economic savings.