Centre for
Process
Systems
Engineering

PSE Education & Training at Imperial

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London

PSE Education

- PSE component at undergraduate level
- PSE component at graduate level
  - PSE Core
  - PSE Domain Applications

PSE at Undergraduate Level

- PSE central to UG training throughout four years
- PSE 1st year
  - Process Analysis
  - First-Year Design (systems thinking problem solving)
- PSE 2nd Year
  - Process Dynamics & Control [+project]
  - Computing (numerical methods)

PSE at Undergraduate Level

- PSE 3rd year
  - Strategy for Process Design
  - Projects – synthesis, techno-socio-economic
- PSE 4th Year
  - The Design Project
  - Teams of 8-10 students – 12 week

PSE at Graduate Level

- PSE Electives offered also to (3rd and) 4th Year students
- PSE core component
  - Dynamic Modelling
  - Advanced Optimization & Control
  - Advanced Operations
- PSE domain applications
  - Modelling of Biological Systems
  - Modelling Fluid Phase Equilibria
  - MSc in Energy Futures - across engineering/Imperial

PSE Core 1 – Dynamic Modelling

- Why model (justification), what is the relation between models & experimental evidence, how to model
- Derive detailed mathematical models – transient behaviour
  - Lumped and distributed
  - Batch and continuous
- Mathematical issues for systems with sets of ODEs and AEs - DAEs
- Dynamic Simulation & Optimization

PSE Core 2 – Optimization I

- Nonlinear Optimization
- Modelling with 0-1 variables
- Mixed Integer Linear Programming
- Mixed Integer Non-linear Programming
- Optimization under uncertainty – Process Flexibility
- Applications
  - Heat Exchanger Networks
  - Project

PSE Core 2 – Optimization II

- Multi-parametric Programming
  - mp-LP, mp-QP, mp-MILP
- Model Predictive Control – (some) fundamentals
- Explicit/Multi-Parametric MPC
  - ‘Classical’ mp-MPC
  - Robust & Hybrid mp-MPC
- Applications
  - Simultaneous Design & Control
  - Project

PSE Core 3 – Operations I

- (Basic) issues in batch & discontinuous operations
- Optimal Operation of batch/semi-continuous processes
  - Parameter estimation of dynamic systems
  - (Basics of) Design of experiments in dynamic systems
- Control issues in batch systems
  - Modelling and validation of sequential control systems
  - Project

PSE Core 3 – Operations II

- Planning and scheduling
  - Multi-product and multi-purpose plants
  - State Task Network representation
- Plant design/retrofit for operation
  - Batch design formulation
  - Flexibility – dealing with uncertain demands
- Project

PSE Domain 1 – Biological Systems

- Interlinks biological principles of cellular physiology with modelling & tools for analysis
- Physiology of healthy and disease states
- Modelling of feedback control mechanisms
- Cell signalling (molecules, receptors, pathways)
- Modelling of reaction networks
  - Metabolic Flux Analysis
- Cell cycle regulation & population modelling

PSE Domain 2 – Molecular Systems

- Introduction to modelling fluid phase equilibria
- Statistical thermodynamics
- Molecular simulation (MC and MD)
- Equations of state
- Implications in process modelling

PSE Domain 3 – Energy Systems

- Faculty/Imperial wide initiative & MSc course
- ‘Clean Fossil Fuel’ module
- ‘Analysis of Energy Systems’ module
- Projects

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