

Course Title: Advanced Process Control

Target Group: Graduate students, Engineers and Researchers

Modules: 6

Course Outline:

- **Module I: Training in SCILAB**

- Introduction to SCILAB
- Understanding SCILAB's built-in functions
- Introduction to Matrices
- Scripts and functions; Conditional statements and loops
- Solving linear equations and numerical integration
- Solving single and a system of non-linear equations
- Solving single and a system of differential equations
- Linear and non-linear regression
- Linear programming
- Non-Linear programming

- **Module II: Overview of Process Control**

- Introduction to control theory nomenclature
- Control structure Selection and controllers
- Models for control
 - * First principles models for control
 - * Input-Output models for control
- Laplace transformations in control
- Programming/Hands-on session implementing techniques in SCILAB

- **Module III: Transfer-function Models and Controllers**

- Introduction to transfer function models
- Analysis of transfer function models
- Initial and final value theorems
- Controllers and analysis of closed-loop transfer functions with emphasis on P,PI and PID controllers
- Routh test
- Programming/Hands-on session implementing techniques in SCILAB

- **Module IV: Controller Tuning**

- Tuning based on stability
 - * Zieger-Nichols tuning methods

- Tuning based on performance
 - * Inverse response
 - * Unstable systems
 - * Internal model control
- Time delay
 - * Smith predictor
 - * Nyquist stability
- Skogestad's parameter tuning rules
- Programming/Hands-on session implementing techniques in SCILAB

● **Module V: Introduction to Controller Performance Assessment**

- Introduction
- Non-oscillatory data analysis
- Generalized Hurst exponent
- Data-based diagnosis of sluggish and aggressive tuning
 - * Deterministic methods
 - Idle index
 - Area index
 - R-index
 - Combined method
 - * Methods suitable for systems driven by stochastic disturbances
 - Impulse response curve method
 - Relative damping index
 - Hurst exponent
- Programming/Hands-on session implementing techniques in SCILAB

● **Module VI: Controller Performance Assessment**

- Oscillatory Data-analysis
- Oscillation detection
- Empirical mode decomposition based methods
- Control valves and stiction
- Stiction diagnosis
- Root cause analysis algorithm to identify single source of oscillation