Virtual Ph.D. School – March 2021

Digitalization tools for the chemical and process industries

An introduction to data analytics, machine learning, digital twins and advanced process control

11th – 12th and 18th – 19th March 2021

The wide diffusion of IT technologies and broadband connectivity is fostering a revolution in industrial production processes. Industry 4.0 is introducing huge modifications in the design, operation and maintenance of chemical processes. Digitalization and data analytics are opening new opportunities for advanced process control, production planning, diagnostics, and safety of production systems, as well as for research and development addressing new processes and products. Future job opportunities will more and more require understanding of such panorama and mastering the prospects provided by this transformation.

This virtual school is organized by GRICU to provide Ph.D. students in Chemical Engineering an introduction to methods and tools for digitalization, data analytics and advanced process control. The school is open also to M.Sc. students in Chemical Engineering and to young professionals.

Conventional lectures, assignments and specific case-studies will be available to participants. A final round-table with company professionals from different fields will conclude the school.

Participation is free of charge, but registration by March 9th, 2021 at the following link is required to attend:
https://gricuschool2021.chem.polimi.it

PROVISIONAL SCHEDULE
(all times are CET)

DAY 1 – March 11th, 2021 (14:00 – 18:00)

Welcome and Introduction: *Prof. Maurizio Masi, Prof. Valerio Cozzani*

1.1 Data's Explosion and digitalization: the future we have ahead.
Prof. Maurizio Fermeglia

1.2 Fundamentals of statistics: the first step towards the data mining.
Prof. Massimiliano Grosso

1.3 Fundamentals of process dynamics and control in the perspective of digitalization.
Prof. Giacomo Antonioni

1.4 Introduction to the Design of Experiments (DoE).
Prof. Pierantonio Facco

DAY 2 – March 12th, 2021 (14:00 – 18:00)

Introduction. *Prof. Fabrizio Bezzo*

2.1 Data analytics for dimensionality reduction: Principal Component Analysis (PCA).
Prof. Massimiliano Grosso

2.2 Data analytics for regression and classification: Projection on Latent Structures (PLS).
Prof. Pierantonio Facco

2.3 Systems identification: linear methods.
Prof. Davide Fissore

2.4 Systems identification: subspace and nonlinear methods.
Prof. Riccardo Bacci Di Capaci

DAY 3 – March 18th, 2021 (14:00 – 18:00)

Introduction. *Prof. Gabriele Pannocchia*

3.1 Introduction to machine learning and potential applications to chemical engineering.
Prof. Massimiliano Villone

3.2 Artificial Neural Networks (ANN).
Prof. Davide Manca

3.3 Data reconciliation: what's the real operating condition?
Prof. Flavio Manenti

3.4 Unifying digitalization pillars: a digital twin demo.
Prof. Flavio Manenti

DAY 4 – March 19th, 2021 (14:00 – 18:00)

Introduction. *Prof. Flavio Manenti*

4.1 Model predictive control.
Prof. Davide Fissore

4.2 Steady-state Real-Time Optimization.
Prof. Gabriele Pannocchia

4.3 Dynamic Real-Time Optimization.
Prof. Gabriele Pannocchia

4.4 Round table: An Industrial Perspective on Digitalization.
Introduction by the Chairman of CAPE, EFCE's Working Party
Chairman: *Prof. Maurizio Fermeglia*
Speakers: *Dr. Tom Badgdwell* (Collaborative Systems Integration), *Dr. Gabriele Bano* (GlaxoSmithKline), *Dr. Mattia Vallerio* (BASF), *Dr. Maurizio Galardo* (AVEVA Schneider-Electric)

Scientific Committee

Prof. Giacomo Antonioni, University of Bologna
Prof. Riccardo Bacci di Capaci, University of Pisa
Prof. Fabrizio Bezzo, University of Padua
Prof. Valerio Cozzani, University of Bologna
Prof. Pierantonio Facco, University of Padua
Prof. Maurizio Fermeglia, University of Trieste
Prof. Davide Fissore, Polytechnic of Turin
Prof. Massimiliano Grosso, University of Cagliari
Prof. Gabriele Pannocchia, University of Pisa
Prof. Massimiliano Maria Villone, University "Federico II" of Naples
Prof. Davide Manca, Polytechnic of Milan
Prof. Flavio Manenti, Polytechnic of Milan

Organizing Committee

Prof. Fabrizio Bezzo, University of Padua
Prof. Valerio Cozzani, University of Bologna
Dr. Andrea Galeazzi, Polytechnic of Milan
Prof. Flavio Manenti, Polytechnic of Milan
Prof. Maurizio Masi, GRICU President
Prof. Gabriele Pannocchia, University of Pisa

Contacts and links
gricuschool2021@polimi.it
https://gricuschool2021.chem.polimi.it
www.gricu.it