Course Title: Statistical Methods for Industrial Process Monitoring	**Number of Units**
SSD : SECS-S/02	**CFU: 6**

Course aims:
Statistical Methods for Industrial Process Monitoring is a methodological – applicative course whose aim is to train students on statistical tools for monitoring of complex technological systems. Applications and case studies are addressed to train students on Total Quality Management, to formulate and define strategies for quality control and monitoring in industry in order to support decision making process in a big data framework.

Course Description
The Multivariate Quality-Control Problem. Overview and Learning Objectives. Description of Multivariate Data. Descriptive statistics and graphical displays. The geometry of a multivariate sample. Sample mean, covariance and correlation. Generalized variance and total variance. The metric induced by the covariance matrix. Data representation and dimensional reduction. The analysis of the covariance structure. *Inference about mean vectors*. The multivariate normal distribution, the Wishart distribution, the F distribution. Hotelling T^2 test. Confidence regions and simultaneous comparisons of component means. The Bonferroni method for multiple comparisons. Family-wise Error Rate (FWER) and False Discovery Rate (FDR). Comparisons of several multivariate means. Inference for Linear Models. *Elements of classical Statistical Process Control*. Control Charts for variables. Control Charts for attributes. Number of samples and sampling frequency. Sample size and control effectiveness. Warning limits and CUSUM control chart, Moving Average control chart, EWMA control chart. Process Capability Analysis. Engineering examples through software environment R. *Engineering approach to modern Process Monitoring and Control.* The Hotelling T^2 Control Chart. The Multivariate EWMA Control Chart. Regression Adjustment. Control Charts for Monitoring Variability. Latent Structure Methods. Principal Component Regression (PCR). Partial Least-Squares (PLS). Regression control charts. Engineering examples through software environment R. *Introduction to Functional data analysis and control charts for statistical monitoring of functional data*. Functional data analysis. Statistical monitoring of functional data. Industrial case studies and applications.

Assumed Background: Probability and Statistics

Assessment methods: Individual written test and its oral discussion