Code: ING-IND/16	**Credits: 9**
Matter: Technologies and Systems for Industry 4.0	
Main language of instruction: Italian	
Other language of instruction: English	

Teaching Staff

Head instructor
Prof. Stefano Guarino – stefano.guarino@unicusano.it

Introduction

1. *Objective of the course:*

The deals with the technologies and tools of modern industry 4.0. The course describes innovative technologies and production processes, framing the great challenges of the Factory of the Future and the role assumed by the human factor. During the course, the main problems of the different production processes, the processing phases of a product, the materials in modern industry will be discussed. Approaches, methodologies of analysis and useful tools in the design of a modern production process will be discussed also according to a sustainable industry.

Objectives

2. *Course Structure:*

The Technologies and Systems for Industry 4.0 course has the following objectives:
- Analyze the characteristics of a modern production process, the systems that compose it and their integration;
- Study the recent innovation of transformation processes for sustainability;
- Study the modern automation techniques, industrial robotics and the Internet of Things;
- Illustrate industrial information systems and process control;
- Acquire skills in the design of a modern production process.

Competencies:

The expected learning outcomes are:
A. <u>Knowledge and understanding</u>: At the end of the course, the student will have acquired the necessary knowledge to orient themselves in the main thematic areas of Industry 4.0. Furthermore, through the e-tivities, the student will

acquire the ability to make basic design choices related to industrial systems and their integration.

B. <u>Applying knowledge and understanding</u>: At the end of the course, the student will have developed ability to apply the skills acquired to distinguish modern transformation processes and related fields of use. The students will also be able to analyze the role and effectiveness of production tools that use innovative technologies and systems, framing their sustainability, costs and benefits.

C. <u>Making judgments</u>: The student will be able to focus on the functioning of a modern industrial process and to highlight its advantages and critical aspects, identifying the most appropriate choice for the specific case analyzed.

D. <u>Communication skills</u>: The student will be endowed with the technical-scientific language needed to interact with other experts in the discipline, and with decision makers in industry.

E. <u>Learning skills</u>: At the end of the course, the student will be able to learn new solutions and apply the knowledge acquired to solve different problems related to the design and analysis of modern industrial manufacturing processes.

<u>Syllabus</u>

3. *Programme of the course:*

Subject 1. Automation in Production Processes.
Introduction, Automation, Computerized Numerical Control, Adaptive Control, Material Handling and Movement, Industrial Robots, Sensor Technologies, Assembly Systems, Design for assembly, Assembly, disassembly and maintenance.

Subject 2. Computer-Aided Manufacturing.
Introduction, Manufacturing Systems, Computer Integrated manufacturing, Computer-Aided Design and Engineering, Computer-Aided Manufacturing, Computer-Aided Process Planning, Computer simulation of production processes and systems, Group Technology.

Subject 3. Product design and process selection in a competitive environment.
Introduction, Product Design, Product Quality and Life Expectancy, Life Cycle Assessment and Sustainable Manufacturing, Material Selection for Product, Material Replacement, Production Process Capability, Process Selection, Production Costs and Cost Reduction.

Subject 4. Additive Manufacturing.
Introduction, The main additive manufacturing technologies, Binder Jetting (BJ), Fused Deposition Modelling (FDM), StereoLithography Apparatus (SLA), Direct Light Processing (DLP), Selective Laser Sintering (SLS), Selective Laser Melting (SLM), Laser

Engineered Net Shaping (LENS), Material Jetting (MJ), Electron Beam Melting (EBM), Laminated Object Manufacturing (LOM).

Subject 5. Industry 4.0: Technologies for Manufacturing Systems.
Introduction, Reference Model for I4.0, Le Key Technologies di I4.0, Internet of Things, Cloud Computing, Big Data, Simulation, Augmented Reality, Additive Manufacturing, Horizontal and Vertical Systems Integration, Autonomous Robot, Cybersecurity, 6.4 The Smart Factory di I4.0, Cyber-Physical Systems, Internet of Services
Etivity 1

Evaluation system and criteria
The exam consists a written test useful for verifying the ability to analyze and rework the concepts acquired. The evaluation of the e-tivity from 0 to 3 points is carried out, in itinere, during the course. The written test includes a series of questions assessed from a minimum of 0 to a maximum of 27 points and requires a reworking of the theoretical and practical concepts studied during the course. The expected learning outcomes regarding subject knowledge and communication skills are assessed by the written test, while the ability to apply them, the ability to draw conclusions and the ability to self-learn are assessed in itinere through the e-tivities.

Bibliography and resources

4. *Materials to consult:*
Notes written by the instructor are available in English. The notes cover the course contents and examination programme.

5. *Recommended bibliography:*
- Manufacturing Engineering and Technology - Serope Kalpakjian., Steven R. Schmid – Ed Prentice Hall