UNICUSANO
ROME

Code: IIND-04/A **Credits: 9**
Course: Integrated Production Systems
Main language of instruction: Italian
Other language of instruction: English

Teaching Staff

Head instructor
Prof. Gennaro Salvatore PONTICELLI – gennaro.ponticelli@unicusano.it

Introduction

1. *Objective of the course:*

The course provides an in-depth study of the chip removal processes. Specifically, the main techniques will be covered, such as turning, milling and drilling, their optimization and their automation capability. Starting from the definition of Numerical Control (CN) of machine tools, the components, modules or processing cells will be described. The problems relating to mechanical processing with numerically controlled (CNC) machine tools and the related computer-assisted programming techniques will be analyzed (CAM software). This will be followed by a description of industrial robots and their integration with CNC machine tools to create automated processing cells. Basic tools will be provided to know how to manage production flows within an industrial reality and to control the progress of production, verifying its agreement with the pre-established plans.

Objectives

2. *Course Structure:*

- Introduction
- Definition of turning, milling and drilling operations
- Optimization of chip removal processes
- CNC machines classification
- Manual programming of CNCs
- Integrated production systems
- CAM simulations

Competencies:

A. Knowledge and understanding:

The student will acquire the knowledge related to the fundamentals of integrated production systems and machine tool programming. Furthermore, through the Etivities, the student will acquire the ability to formulate and solve problems relating to the design of complex industrial processes.

B. Applying knowledge and understanding:

The student will develop the ability to apply the skills acquired to solve problems inherent to integrated production processes. He will also be able to interpret the results obtained in the sizing of a production process in terms of engineering feasibility and sustainability of the identified solution.

C. Making judgements:

The student will be able to focus on the functioning of a complex production process and highlight its advantages and critical aspects, identifying the most appropriate choice for the specific case.

D. Communication skills:

The student will be able to propose a correct and understandable technical-scientific language that allows to express clearly and without ambiguity the technical knowledge acquired in the context of the topics proposed and analysed.

E. Learning skills:

At the end of the course, the student will be able to learn new solutions and apply the knowledge acquired to resolve the issues related to the design and analysis of industrial production processes.

Syllabus

3. *Programme of the course:*

Subject 1 – Optimization of chip removal processes

Lesson 1. Introduction.
Lesson 2. Turning I.
Lesson 3. Turning II.
Lesson 4. Drilling.
Lesson 5. Milling.
Lesson 6. Optimization of single-pass operations.
Lesson 7. Optimization of combined operations.
Lesson 8. Optimization of multiple-pass operations.
Lesson 9. Processing cycle.

Subject 2 – CNC machine tools
Lesson 1. Introduction.
Lesson 2. Characteristics and functions of CNCs.
Lesson 3. Interpolation of CNCs.
Lesson 4. Classification of CNCs.
Lesson 5. Technical specifications of CNCs elements.
Lesson 6. Transducers.

Subject 3 – CNC programming and Robots
Lesson 1. Introduction.
Lesson 2. Instructions.
Lesson 3. Part-Program.
Lesson 4. Automatic programming.
Lesson 5. CAM programming.
Lesson 6. Introduction to the robotic systems.

Subject 4 – Integrated production systems
Lesson 1. Flexible Manufacturing Systems.
Lesson 2. Holonic and Just-In-Time production systems.
Lesson 3. Lean prodcution.
Lesson 4. Artificial intelligence.
Lesson 5. Sustainable manufacturing.

Subject 5 – CAM simulation
Lesson 1. Introduction.
Lesson 2. CAM simulation with software.

Evaluation system and criteria

The examination consists of a written test. This includes:
- 5 open-ended questions (for a total of 14 out of 30 marks).
- 2 numerical exercises (for a total of 10 out of 30 marks).

In addition, three e-tivities, consisting of numerical problems, are compulsory. These need to be sent to the instructor in advance of the examination. The first two e-tivities counts 1.5 marks while the third 3 marks for a total of 6 out of 30 marks.

Bibliography and resources

4. *Materials to consult*

Notes written by the instructor are available in Italian.

5. *Recommended bibliography*

Suggested readings are:

- S. Kalpakjian, «Manufacturing Engineering and Technology», Addison-Wesley
- F. Gabrielli, I. Rosolino, F. Micari, «Analisi e tecnologia delle lavorazioni meccaniche», McGraw-Hill Education
- P. Radhakrishnan, S. Subramanyan, V. Raju, «CAD/CAM/CIM», New Age International Pvt Ltd Publishers