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# Computer-assisted production

## Finalità

Subject of the class is the study of manufacturing process simulation systems, CAM (Computer Aided Manufacturing) systems for CNC (Computerized Numerical Control) machine tool programming, and the integration of such systems into computer architectures including CAD (Computer Aided Design) systems for integrated product development.

In the first part of the class, information defining product, process and manufacturing system is identified and structured. The main functional requisites and the issues related to the design and development of computer-based tools for supporting manufacturing process planning are investigated. In the second part of the class a detailed analysis will be done concerning structure, internal mechanisms and implementation issues of CAD systems, CAM systems and manufacturing process simulation systems (with particular reference to casting and forming processes); and their integration into CIM (Computer Integrated Manufacturing) architectures.

## Programma

### Information technology for supporting manufacturing-related activities

The role of computer-based tools for supporting and integrating product development, and manufacturing process planning, simulation and control activities.

### CAD systems for product data modeling

Introduction to CAD systems. The role of CAD in product development. Part and assembly modelling. Representation and rendering of geometric primitives: bitmap graphics, 2D and 3D vector graphics, parametric curves and surfaces, solid modelling, variational and parametric modelling. Feature Technology, Group Technology, geometric and topologic constraints for representing assemblies. Computational geometry in CAD systems.

### Manufacturing process simulation systems

Theoretical and numeric modeling of manufacturing processes. Methods, techniques and systems for manufacturing process simulation. Integration with CAD systems.

### Architecture and operation of CNC (Computerized Numerical Control) machine tools

Automation of manufacturing processes and systems. Architecture of a CNC machine tool, axes, actuators and transducers, multi-axis machine tools, open-loop and closed-loop numerical control, interpolators, adaptive control. Architecture and operation of industrial robots.

### CNC part programming and CAD/CAM systems

Manual programming of CNC machine tools, G-code, Computer-assisted part programming with the APT language. Architecture and operation of CAM systems. Geometric primitives for part and tool modeling in CAM systems. Computational geometry in CAM systems for tool path generation and verification. Introduction to CAD/CAM integration. Parametric CAM systems and feature-based CAM systems.

Architecture and operation of a post-processor. Post-processor design and implementation. Tool path verification programs, machining process simulation and reconstruction of the machined surface.

### CAD, CAM and manufacturing process simulation in Computer Integrated Manufacturing environments

Introduction to CIM (Computer Integrated Manufacturing). The role of CAD/CAM systems, the role of manufacturing process simulation. Introductory notions on Product Data Definition (PDD), Product Data Management (PDM) and Computer Aided Process Planning (CAPP).

## Attività d'esercitazione

The laboratory activities will include the use of personal computers for running manufacturing process simulations and CAD/CAM systems. During lab activities, students, organized in groups will work at the modelling of an industrial product, and at planning the manufacturing process to produce it. Commercial CAD,CAM and simulation systems will be adopted. Group projects may involve the collaboration of industrial companies and will result in a final report.

## Modalità d'esame

The exams will consist in a written test and in an oral test, which will include also a discussion on the group project.

## Propedeuticità

Disegno Industriale, Tecnologia Meccanica

## Testi consigliati

C. MCMAHON, J.BROWNE: "CAD/CAM: Principles, Practice, and Manufacturing Management", Addison-Wesley Pub

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Co, 2nd edition, 1999.

K. LEE: "Principles of CAD/CAM/CAE Systems", Addison-Wesley Publishing; 1st edition ,1999.