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COURSE: Integrated Production Systems

ACADEMIC YEAR: 2019/2020

TYPE OF EDUCATIONAL ACTIVITY: Characterizing

TEACHER: Paolo Renna

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mobile (optional):

Language: Italian

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ECTS: 9

n. of hours: 81  
lessons: 48  
practice: 34

Campus: Potenza  
Dept./School: Scuola di Ingegneria  
Program: Master's Degree in  
Mechanical Engineering

Semester: I°

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#### EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

##### EDUCATIONAL GOALS

The student, at the end of the course, will have acquired knowledge and practical methodologies for the development and simulation of machining on CNC machines. Students will be able to analyze the results of simulations conducted and to optimize the operating parameters in order to obtain higher performance results. The students will be able to perform the function of analysis of production systems, in order to develop procedures for the integration optimization of the same.

##### EXPECTED LEARNING OUTCOMES

The goal is to develop in students the skills and expertise needed to oversee a production system and be able to locate the production system best suited to the specific application. After completing this course we will ask the student to:

- know the structure of modern means of production, machine tools and CNC measurement; the student will have acquired knowledge and methodologies for automated part program creation for some turning and milling machine tool Numerical Control, with particular reference to the CAD / CAM systems.
- know the main measures of performance and flexibility of the main production systems.
- know the main heuristic techniques, mathematical and simulative for the analysis and design of complex production systems.
- know the structure and components of the main production systems, identifying what are the design techniques and the most appropriate analysis;
- know the main steps for the development, data analysis and analysis of the numerical results of a simulation project with particular reference to production systems.

##### knowledge and understanding

The student, at the end of the course, will have acquired knowledge and methodologies to address and solve the problems related to the analysis and design of production systems with various degrees of automation.

##### applying knowledge and understanding

The student will have acquired knowledge and methodologies for automated part program creation for some turning and milling machine tool Numerical Control, with particular reference to the CAD / CAM systems. The student will have acquired knowledge and methodologies for the analysis and design of production systems by means of optimizing mathematical methodologies, descriptive and simulation its spaces.

##### making judgements

The student will acquire an integrated view of problems related to manufacturing production, with a focus on improving standards of performance.

##### communication skills

The student will be able to communicate with competence and command of the language on design techniques and

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analysis of production environments of topics related to integrated production systems.

learning skills

The student will be able to perform the development of application examples of modeling of parts and translation of programs for numerical control machine tools with the use of software for the part-program generation for simple turning and milling operations.

The student will be able to perform the development of application examples of the design, analysis and modeling of manufacturing environments and their simulation with specialized software.

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PRE-REQUIREMENTS

Students must have acquired and assimilated the following knowledge provided by the courses of "Mechanical Technology":

- Knowledge and application of the chip removal machining concepts: determination tool path optimization of cutting parameters, calculation of costs and times;
  - technical industrial design knowledge.
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SYLLABUS

SECTION I: Automated manufacturing systems

- I.1. Overview: automation in modern industrial applications
- I.2. Numerical Control
  - I.2.a. Components of numerical control machines
  - I.2.b. Movements and motors of a numerical control machine
  - I.2.c. Tools management
  - I.2.d. Dimensional measurement and other services
  - I.2.e. Closed loop control and sensors
  - I.2.f. Numerical control management
  - I.2.g. Numerical control programming
- I.3. Material Handling: Automated Guided Vehicle (AGV)
  - I.3.a. Overview of AGVs
  - I.3.b. Characteristics and structure of AGVs
  - I.3.c. Control and management of AGVs
  - I.3.d. Industrial Conveyor
- I.4. Integration tools in advanced manufacturing systems
  - I.4.a. FMS, FAL e RMS
  - I.4.b. Cellular manufacturing systems
  - I.4.c. Design and control of integrated manufacturing systems
  - I.4.d. Local Network of manufacturing systems

SECTION II: Integration tools

- II.1. II CAD-CAM software programming for numerical control machines; BOBCAM software;
- II.1. II Computer Aided Process Planning: variant and generative CAPP;
- II.3. Group technology e cellular production systems
  - II.3.a. Code and classification of parts
  - II.3.b. Production Flow Analysis: the cluster Identification
  - II.3.c. cellular manufacturing systems applications
  - II.3.d. Design of cellular manufacturing systems

SECTION III: Manufacturing systems

- III.1 Overview and classification of manufacturing systems
  - III.2 Single station manufacturing system
  - III.3 Cellular manufacturing systems
  - III.4 Flexible manufacturing systems
  - III.5. Assembly lines
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- III.5.a Transfer lines and similar automated manufacturing systems
  - III.5.b. Applications of automated production lines
  - III.5.c. Analysis of transfer lines with no internal storage
  - III.5.d. Analysis of transfer lines with storage buffer
  - III.6. Manual Assembly lines
    - III.6.a. Overview of assembly lines
    - III.6.b. Assembly lines for single product
    - III.6.c. Design methodologies for assembly lines
    - III.6.d. Flexible assembly lines
    - III.6.e. Design methodologies for flexible assembly lines

#### SECTION IV: Design and analysis methodologies for automated manufacturing systems

- IV.1. Performance measures in automated manufacturing systems
- IV.2. Overview of static allocation in manufacturing systems
  - IV.2.a. Static allocation to design manufacturing systems
  - IV.2.b. Static allocation to analyze manufacturing systems
- IV.3. Mathematical descriptive methods
  - IV.3.a. Stochastic processes
  - IV.3.b. Overview of Markov queuing systems
  - IV.3.c. Queuing network
  - IV.3.d. Jackson Network and Mean Value Analysis
- IV.4. Design and analysis by discrete event simulation
  - IV.4.a. Overview of discrete event simulation
  - IV.4.b. Simulations: languages and software
  - IV.4.c. Simulation models with Rockwell ARENA

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#### TEACHING METHODS

The course includes 81 hours of teaching between lessons and exercises. In particular it is provided 48 hours of lectures and 34 hours of tutorials in the classroom / laboratory.

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#### EVALUATION METHODS

Development of individual technical and interview elaborated. The final grade is the overall assessment of the elaborate technical and oral test, is not the arithmetic mean of the two trials. You can access the oral exam if the coach is judged processed with a rating of at least 18. The oral test evaluates globally the skills acquired by the student (on all subjects of the program) and the elaborate technical design choices made for that reason you can not discuss the elaborate technical after delivery and before the oral examination. The undercutting of oral test does not involve the drawing up of a new technical report.

#### Coherence of the learning check mode with the expected learning outcomes:

The individual technical report allows to deepen the critical spirit of the student for the analysis and design of production systems with a focus on improving standards of performance. In addition, the individual technical papers can deepen the use of the proposed software tools during the course as a support to a process of design and analysis of a production system.

The oral test allows to evaluate the implications of the choices made in the elaborate technical, giving reasons for the choices made. In addition, the oral test evaluates the ability to communicate competently and technical language properties the main design issues and analysis of complex production systems.

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#### TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

##### **Reference Texts:**

- On line lectures materials on: <https://sites.google.com/site/tecnologiaunibas/>
- F. Giusti e M. Santochi, Tecnologia Meccanica e Studi di Fabbricazione, Casa Editrice Ambrosiana, Milano;
- F. Grimaldi, "CNC Macchine utensili a controllo numerico", HOEPLI;



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### Supplementary Material

- <https://sites.google.com/site/tecnologiaunibas/>
- N. Viswanadham, Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall; 4. F. S.
- Hillier, G. J, Liebermann, "Introduction to Operations Research", McGraw Hill; 5. Kelton, Sadowski, Sadowski, 1998,
- "Simulating with ARENA" McGrawHill; 6. A. Li Calzi, 1999, Ingegneria Gestionale, EPOS. 7.
- "Design and Evaluating Value Added Services in Manufacturing E-Marketplace" Eds. Bruccoleri, M., Perrone, G. and Renna, P., Springer ISBN: 1-4020-3151-3.

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### INTERACTION WITH STUDENTS

At the beginning of the course, after describing the objectives, program and methods of verification, the teacher provides students educational materials on the website indicated. Simultaneously, it collects a list of students who intend to enroll in the course, together with name, serial number and email.

Office hours are published on the web page <https://sites.google.com/site/tecnologiaunibas/> e <https://sites.google.com/site/paolorena/home/didattica/orari-di-ricevimento>, with the relative indications (office or lab). The teacher is available for a contact with the students, through their email or discussion blog on the website: <http://paolorena.blogspot.it>.

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### EXAMINATION SESSIONS (FORECAST)<sup>1</sup>

06/02/2020, 27/02/2020, 6/03/2020, 17/04/2020, 15/05/2020, 19/06/2020, 17/07/2020, 11/09/2020, 16/10/2020, 13/11/2020, 18/12/2020

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SEMINARS BY EXTERNAL EXPERTS    YES     NO X

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### FURTHER INFORMATION

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<sup>1</sup> Subject to possible changes: check the web site of the Teacher or the Department/School for updates.