# Transilvania University of Braşov, Romania

# Study program: Innovative Manufacturing Engineering

Faculty: Technological Engineering and Industrial Management
Study period: 2 years (master)

## 1st Year

### 1st semester

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| CNC programming | IFI.01.CNAC | 4 | 2 | - | 1 | - |

**Course description (Syllabus):** The place and role of the CN equipment within the numerical controlled machining processes; CN equipment. Hardware aspects; Co-ordinate systems used in numerical control; Geometrical and technological codes; Particular features of milling processes programming; Particular features of turning processes programming; Geometrical and technological processors. Postprocessors.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Advanced manufacturing technologies | IFI.01.TNPF | 5 | 2 | - | 2 | - |

**Course description (Syllabus):** CAD/CAM systems, a necessity for the design, implementation and operation of advanced manufacturing technologies; Advanced manufacturing technologies of finishing; Advanced manufacturing technologies of cold pressing; Rapid prototyping technologies; Rapid manufacturing technologies; Rapid Tooling technologies; Reverse Engineering technologies; Unconventional technologies; Manufacturing technologies of products from polymer matrix composites.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Programming of algorithms for manufacturing engineering | IFI.01.PAUI | 4 | 1 | - | 2 | - |

**Course description (Syllabus):** Visual LISP Environment; AutoLISP Programming Language Used in Manufacturing Engineering; Algorithms and Programs Used for Parametric Modelling of Products; Algorithms and Programs Used for Class of Products; Programming with Intelligent Objects.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Advanced production systems | IFI.01.SAPR | 4 | 2 | - | 1 | - |

**Course description (Syllabus):** Structure of advanced production systems; Current typologies and strategies of production processes; Configuration strategies of manufacturing flows; Stationary and dynamic operation of production systems; Utilization of stochastic models in dimensioning and deployment of production systems; CIM structures; Optimization of structure and operation of production systems; Advanced production systems.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Innovating and inventing in engineering | IFI.01.INIV | 4 | 1 | - | - | 2 |

**Course description (Syllabus):** Genesis, current and future of inventive; Creative synthesis – the basic means to accelerate scientific and technical progress; Universe of technical problems and universe of technical solutions; Structure and connections. Creative learning. Formulating creative themes; Techniques and methods used in inventive; Conduct meetings of creation; Conditions of patentability. Structure of an invention description; National and international legislation on industrial property.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Ethics and academic integrity | IFI.01.EISA | 4 | 1 | - | - | - |

**Course description (Syllabus): Introduction:** The EAI concepts. Ethics. University ethics. University responsibility. Charter of the Transilvania University of Brasov (UTBv). Regulations regarding the professional activity of students in UTBv. Intellectual property. Copyright (copyright) and related rights. Industrial property. Patents. Trademarks. Lack of integrity and academic ethics. Academic fraud, corruption and attempted academic corruption. Types of plagiarism.

2nd semester
Optional package: Computer Aided Manufacturing Engineering

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Advanced software for CAD modelling | IFI.02.MIPR | 6 | 3 | - | 1 | 1 |

**Course description (Syllabus):** Software Systems Used for Innovative Modeling; Products Modeling Strategies; Wireframe Modeling in PowerSHAPE Environment; 3D Modeling in PowerSHAPE Environment; Drafting in PowerSHAPE.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Modelling and simulation of flexible manufacturing systems | IFI.02.MSSF | 5 | 2 | - | 2 | - |

**Course description (Syllabus):** Definitions and classifications of flexible manufacturing systems and industrial robots; Robotized flexible manufacturing systems applications in: metal-cutting machining, deburring and material removing, joining-welding (arc , spot), gluing, assembling; Deterministic modeling and simulations of the robotic cells, cycling scheduling of the parts; Stochastic modeling and simulations of the robotic cells, s: queuing models, Monte Carlo simulation; Modeling and analysis of the using Petri nets.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Innovative technologies for cold forming | IFI.02.TIDP | 5 | 2 | - | 1 | 1 |

**Course description (Syllabus):** Peculiarity of flexible manufacturing automation for cold forming; Cutting sheet metal parts with NC guillotine shears; Manufacturing on sheet punching centres, laser cutting machines and abrasive water jet machines; Flexible technologies for bending of sheet metal; Flexible technologies for cup drawing of sheet metal; Manufacturing by incremental sheet forming Manufacturing of sheet metal by superplastic forming; Unconventional technologies for processing sheet metal by cold plastic deformation.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Maintenance techniques | IFI.02.MPMT | 3 | 1 | - | 1 | - |

**Course description (Syllabus):** The steps needed for the recovery of a technical system; Maintenance processes: welding maintenance, metallization maintenance, maintenance with adhesives, galvanic maintenance, maintenance by conventional and unconventional machining; Maintenance methods: at nominal dimensions; by the replacement of the segment; by plastic deformation; by adding material; by compensation; by hard alloys deposition; by remnant plastic deformation.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| 3D measurement technologies | IFI.02.TM3D | 3 | 1 | - | 1 | - |

**Course description (Syllabus):** Presentation of main training and certification aspects regarding the coordinate metrology; Components of a coordinate measuring machine (CMM); Structure configurations for the CMM; Modular

devices for the CMM; Software products for controlling the CMM; Fundamentals of measuring with the CMM with applications for various types of dimensional quality characteristics.

Optional package: Advanced manufacturing systems

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Optimization of advanced manufacturing systems | IFI.O3.OSAF | 6 | 2 | - | 2 | - |

**Course description (Syllabus):** General problems on modeling, simulation, and optimization of advanced manufacturing systems; Methods and techniques of modeling and simulation of a flexible manufacturing system; Concept of optimization: the formulation of an optimization problem, the concept of flexible optimization; Methods for optimization of flexible structures: multi-objective optimization, multi-attribute optimization - fuzzy decision models, optimization algorithms; Decision models in the design of flexible manufacturing systems; Optimizations in advanced manufacturing systems; Optimizing material flows in architecture of flexible manufacturing system.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Robust design of advanced manufacturing systems | IFI.O3.PRSP | 5 | 2 | - | 2 | - |

**Course description (Syllabus):** Design of robust systems; Introduction to the method of arrays of experiments; Quality loss function; Signal to noise ratio; Taguchi methods in robust design; ANOVA dispersions analysis; Taguchi arrays for products; Simultaneous multi-criteria optimization; Analysis of robust systems performance.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Reconfigurable manufacturing systems | IFI.O3.SPRC | 5 | 2 | - | 2 | - |

**Course description (Syllabus):** Novel trends in production. Progress in the field of reconfigurable production systems (RPS) Characteristics of reconfigurable machine-tools (RMT); Design of RMT: criteria, evaluation of machine configuration, trends; Components if RMT: mechanical, electronic, software; Optimization of a RMT; Costs of a RMT; Tendencies in the conceiving of a RMT.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Fluidic driving systems | IFI.O3.SFLA | 6 | 3 | - | 2 | - |

**Course description (Syllabus):** Hydraulic drives: hydraulic generators and motors; main and auxiliary hydro-static apparatus; sensors; hydraulic and electro-hydraulic circuits; Pneumatic drives: pneumatic generators and motors; adjustment and control elements of pneumatic power; control apparatus; synthesis of control circuits; applications in driving and control of advanced production systems

# 2<sup>nd</sup> Year

1st semester

Optional package: Computer Aided Manufacturing Engineering

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Advanced CAM systems | IFI.O1.03.SCAM | 5 | 2 | - | 1 | 1 |

**Course description (Syllabus):** Presentation of the most used CAM software packages: Pro/Engineer, Catia, PowerMill, Solid Works; Advanced techniques for complex part modeling using Pro/Engineer – surface modeling; defining the workpiece and tools for NC turning and milling using Pro/E; roughing and finishing strategies for turning and milling using Pro/E; NC program generation using Pro/E; Modern manufacturing technologies – High Speed

Machining;  STL file generation for RP machining; Rapid Prototyping techniques using the software Magics and SLM AutoFab.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Design systems for innovative manufacturing | IFI.O1.03.FINO | 5 | 2 | - | 2 | 1 |

**Course description (Syllabus):** Basic techniques for part modeling using CATIA; Advanced techniques for complex part modeling using CATIA – surface modeling; Parts assembling; Defining the workpiece and tools for NC milling; roughing strategies; finishing strategies; NC program generation.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| CAPP algorithms and programming | IFI.O1.03.CAPP | 5 | 2 | - | 2 | - |

**Course description (Syllabus):** Strategies in Product Engineering; CAPP Systems; Intelligent Functions used in CAPP Systems; CAPP Systems Based on Intelligent Objects; Algorithms and Programs Used for CAPP Systems.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Enterprise data management with ERP | IFI.O1.03.MIRI | 5 | 2 | - | 2 | - |

**Course description (Syllabus):** Evolution and development of ERP systems; Structure of an ERP; SAP system modules; Production Planning (SAP PP) Module; Material Management (SAP MM) module; Project System (SAP PS) module.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Management and resources for research projects | IFI.O1.03.MRPC | 4 | 2 | - | - | 2 |

**Course description (Syllabus):** Basics of research and innovation activities; Human resources for research; Sources and databases for research documentation; Classification of research projects; Main structure of a research project; Models of research projects; Research methodology; Budget of a research project; Principles of project management and dissemination.

Optional package: Advanced manufacturing systems

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Simulation and modelling of human-machine system | IFI.O3.SMSM | 5 | 2 | - | 2 | - |

**Course description (Syllabus):**  General aspects of modeling and simulation; Steps of production system simulation; Modeling and simulation of waiting processes; Modeling and simulation of stock generation; Fuzzy models; Dynamic modeling and simulation; Prognosis models and techniques; Modeling and simulation of flexible production systems.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Advanced logistics | IFI.O3.SELA | 5 | 2 | - | 2 | 1 |

**Course description (Syllabus):** Fundamentals of Robotics; Industrial robots programming; Fundamentals of Material Handling; Design of material handling equipment; Analysis of material handling system; Fundamentals of Manufacturing Systems Design; Manufacturing System CAD; Simulation of logistic system.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Programmable logic controllers | IFI.O3.AMPR | 5 | 2 | - | 2 | - |

**Course description (Syllabus):** Basics of industrial automation; Components of industrial automation; Introduction to programmable sequential controllers; Programming using LDR (LADDER DIAGRAM); Programming using STL (STATEMENT LIST); On-line connection to programmable sequential controllers.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Computer aided programming of advanced manufacturing systems | IFI.03.PASP | 5 | 2 | - | 2 | - |

**Course description (Syllabus):** Assisted control of production systems; Characteristics of assisted programming software; Principles and classification of assisted programming systems; Hardware and software architectures; Information system for assisted programming; Integrated software for programming of production system for revolution and complex bodies; Open-source and freeware software for assisted programming and simulation; Optimization of capabilities of advanced production systems.

| Course title | Code | No. of credits | Number of hours per week | | | |
|---|---|---|---|---|---|---|
| | | | course | seminar | laboratory | project |
| Data acquisition and analysis | IFI.02.APDT | 4 | 2 | - | 2 | - |

**Course description (Syllabus):** Issue of research in mechanical engineering; Mathematics processing an experimental data. Errors of measurement; Sensors, transducers, tensor marks. Sensors for robotics. Overview, classification, use; Numerical analogue converters. Analogue digital converters; Acquisition and data processing.  Card acquisition data; Structure of data acquisition.  Multiplexing signals. Sampling signals. Sampling circuits.