**University of Minho**
School of Engineering
Department of Production and Systems

# English Classes

2025-2026

**University of Minho**
School of Engineering
Department of Production and Systems

UMinho is one of the youngest universities of Portugal and its first degrees were created almost 50 years ago. The Production and Systems area was one of the first created at that time to support the Engineering Curricula, mainly the Production Engineering degree.
The Department of Production and Systems (DPS) has been growing and, at the moment, we can offer you one PhD (the oldest in Portugal), six Master Degrees and one Bachelor. The DPS staff is responsible for almost two hundred curricular units in the different areas of Industrial Engineering Management.

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|---|---|
| **BACHELOR** | Bachelor in Industrial Engineering and Management |
| **MASTER** | Master in Industrial Management and Engineering |
| | Master in Engineering and Operations Management |
| | . Project and Innovation Management and Evaluation |
| | . Industrial Management |
| | . Logistics and Distribution |
| | Master in Engineering and Quality Management |
| | Master in Human Engineering |
| | Master in System Engineering |
| | Master in Engineering Project Management |

For courses formally taught in Portuguese, there might be the possibility to have access to bibliography, course materials, tutorial support and assessment in English. There is the option to develop research/project work with supervision in English or in a common language between the student and the tutor. The DPS also offers several courses in English.

Students can follow course units mainly from the following degrees and there are some specific study areas with lectures offered in English:

## 1st Semester / Autumn:

- Agile Management and Entrepreneurship - op
- Data classification and clustering techniques - op
- Financial Engineering - op
- Implementation and Certification of Quality Management Systems
- Introduction to Economics Engineering
- Manufacturing Processes and Systems
- Optimisation Methods in Industrial Context - op
- Production Management in the Digital Era
- Production Systems Organization
- Project Work
- Research Methods in Industrial and Systems Engineering
- Systems Optimization in Engineering

## 2nd Semester / Spring:

- Analytical Decision Support Systems
- Computer Aided Design and Computer Aided Manufacturing
- Concurrent and Collaborative Engineering
- Industry 4.0 - op
- Logistics and Supply Chain Management
- Numerical Methods
- Project Analysis in Industrial and Engineering Management
- Project Evaluation
- Project Work
- Strategic Management and Industrial Marketing
- Supply Chain Management
- Supply Chain Optimization

**60% to 100%** of the proposed workload should correspond to course units offered by the host study area.
**0% to 40%** of the proposed workload may correspond to course units offered by UMinho's course catalogue.

# 1ST SEMESTER / Autumn

**AGILE MANAGEMENT AND ENTREPRENEURSHIP -** (5 ECTS) – Op / Master in Industrial Engineering and Management, year 2 and Master in Operations Engineering and Management, year 2
Leonilde Varela, Associate Professor with Habilitation, leonilde@dps.uminho.pt, orcid.org/0000-0002-2299-1859

Agile management. Enterprise responsiveness, permanent and dynamic alignment with the market, rapid reconfigurability, competence management in the function of time and uncertainties. Methods and tool for agile management. Performance measures. Agile management of organizational, technological and human resources aspects. Group work, alliances and responsibilities empowerment. Learning organizations and chaos and complexity management in organizations as new forms of the agile management. Entrepreneurship. Concept and general framework. Knowledge management and ideas generation. Business plan grant. Project and investment evaluation. Strategic analysis and the market analysis. Project management. Quality management. Innovation management. Legal requirements for the creation and launching of an enterprise. Supporting infrastructures for creation of enterprises. Programmes for supporting creation of enterprises. Financing sources.

**DATA CLASSIFICATION AND CLUSTERING TECHNIQUES -** (5 ECTS) – Op / Master in Systems Engineering, year 2
Ana Cristina Braga, Assistant Professor with Aggregation, acb@dps.uminho.pt, orcid.org/0000-0002-1991-9418
Ana Rocha, Associate Professor, arocha@dps.uminho.pt, orcid.org/0000-0001-8679-2886

Regression Techniques: Simple and multiple linear regression; Nonlinear regression; Logistic regression. Classification Techniques: Performance measures; ROC Analysis. Data Grouping Techniques: Principal component analysis; Clustering validity indices; Clustering similarity measures; Clustering algorithms. Application of concepts and development of application examples through the use of the computational tool (R or Matlab).

**FINANCIAL ENGINEERING -** (5 ECTS) – Op / Master in Industrial Engineering and Management, year 1 and Master in Operations Engineering and Management, year 1
Jorge Cunha, Associate Professor, jscunha@dps.uminho.pt, orcid.org/0000-0002-6267-708X

Investment appraisal: concepts, methods and applications. Functioning of financial markets: main functions and characteristics, the determinants of interest rates and exchange rates. Financing decisions: Forms of financing; The financial structure of the company; Capital cost calculation; Cost of financing alternatives. Financial planning and analysis: The financial statements of companies; Financial analysis methods; The financial planning. Business valuation methods: The present value method; The equity method; The method of market multiples. Management control: definition and attributions; Planning, control, evaluation and reporting activities. Information and cost models for decision making; Activity-based costing systems. Budget control and analysis of deviations; Standard costing system. Performance measurement and evaluation systems; Balanced scorecard; dashboards; KPI definition. Contemporary practices and methods; concepts and applications.

**IMPLEMENTATION AND CERTIFICATION OF QUALITY MANAGEMENT SYSTEMS -** (5 ECTS) / Master in Engineering Quality Management, year 1
Paulo Sampaio, Assistant Professor with Habilitation, paulosampaio@dps.uminho.pt, orcid.org/0000-0002-0879-1084

Fundamentals. Definitions and Concepts. Portuguese Quality System. Quality management systems research. The ISO 9000 family of standards. Quality management systems implementation. Management systems integration. Methodologies for management systems auditing.

**INTRODUCTION TO ECONOMICS ENGINEERING -** (5 ECTS) / Bachelor Degree in Industrial Management Engineering, year 1
Jorge Cunha, Associate Professor, jscunha@dps.uminho.pt, orcid.org/0000-0002-6267-708X

INTRODUCTION: definition of economics; basic problems of economic organization; production possibilities frontier; microeconomics and macroeconomics. DEMAND AND SUPPLY MODEL: supply curve; demand curve; market equilibrium; determinants of demand and supply; practical uses of the model. DEMAND THEORY: demand for a product; the concept of demand elasticity; demand estimation. PRODUCTION THEORY: production organization and production function; production in the short- and long-term; returns to scale. COST THEORY: costs in the short- and long-term; costs and industry structure; cost-volume-profit analysis. MARKETS AND PRICE FORMATION: perfect competition; monopoly; comparison between both. PRICING POLICY: implementation and types of price discrimination. FINANCIAL MATHEMATICS: time value of money; capitalization and discounting processes; capital equivalence; nominal rate and effective rates. Applications of financial mathematics.

**MANUFACTURING PROCESSES AND SYSTEMS -** (5 ECTS) / Bachelor Degree in Industrial Management Engineering, year 2
Leonilde Varela, Associate Professor with Habilitation, leonilde@dps.uminho.pt, orcid.org/0000-0002-2299-1859

Machining system and manufacturing system definitions. Machining (manufacturing) processes classification. Machining (manufacturing) processes and their parameters, machine tools and tools per manufacturing process. Work-holding and positioning, and inspection tools. Tool's life-cycle.

Relationship between machining (manufacturing) processes and geometrical forms, surface quality, product classes and production volumes. Sequencing of the processes.

**OPTIMIZATION METHODS IN INDUSTRIAL CONTEXT -** (5 ECTS) – Op / Master in Industrial Engineering and Management, year 2
Ana Rocha, Associate Professor, arocha@dps.uminho.pt, orcid.org/0000-0001-8679-2886

Introduction to Optimization: Historical Evolution. Introduction to modeling. Nonlinear Continuous Programming: Definitions and basic concepts. Gradient Methods. Derivative-free methods. Optimal control of dynamical systems. Mixed-integer nonlinear programming: Definitions and basic concepts. Metaheuristics. Computational intelligence. Evolutionary Computation.

**PRODUCTION MANAGEMENT IN THE DIGITAL ERA -** (5 ECTS) / Master in Industrial Engineering and Management, year 2
Leonilde Varela, Associate Professor with Habilitation, leonilde@dps.uminho.pt, orcid.org/0000-0002-2299-1859

1. Notion of production, production system and cyber-physical production systems, their main components and ways of evaluating their performance. 2. Notion of production management, in its various functions, levels and components of production planning, programming and control. 3. Notion of collaboration and collaborative management: types, structure, components, visions and main associated concepts. 4. Main production and collaborative management practices. Interdependencies and functions underlying production and collaborative management. 5. Mechanisms, methods and techniques for production and collaborative management: agile, dynamic, integrated, based on group decision making and a set of diverse methods and techniques, including Artificial Intelligence and real-time based management approaches and techniques. 6. Case studies and use of specific software for different approaches to production and collaborative management.

**PRODUCTION SYSTEMS ORGANIZATION -** (5 ECTS) / Bachelor Degree in Industrial Management Engineering, year 3
Anabela Alves, Associate Professor, anabela@dps.uminho.pt, orcid.org/0000-0002-2926-4187

Production systems fundamentals and production paradigms. Introduction to the Lean Thinking paradigm and wastes types. Production systems configurations. Advantages and disadvantages of different configurations. Detailed design of production cells/lines. Clustering algorithms applied to Group Technology (e.g. DCA, ROC, ROC2). Balancing methods for multimodel lines and mixed model assembly lines (e.g. Ranked Positional Weight, Wild method, Bedworth method). Operating modes (e.g. Rabbit Chase, Bucket Brigades, Baton Touch, Working Balance, Toyota Sewing System). Skills matrix. Layouts methods (e.g. Systematic Layout Planning, method of fictitious sequences, CORELAP, CRAFT).

**PROJECT WORK -** (5 to 15 ECTS) / Various fields of study. All years.
Paulo Afonso, Assistant Professor, Erasmus Academic Coordinator, psafonso@dps.uminho.pt, orcid.org/0000-0003-3882-2491

There is the option to develop research/project work with supervision in English or in a common language between the student and the tutor.

**RESEARCH METHODS IN INDUSTRIAL AND SYSTEMS ENGINEERING -** (5 ECTS) / Master in Systems Eng., year 2 (not offered in 2025)
Carina Pimentel, Assistant Professor, carina.pimentel@dps.uminho.pt, orcid.org/0000-0003-4284-1628

1. General Introduction to Research: topic conceptualization; the investigation process; the research question; subsidiary research questions; objectives. 2. Critical review of the literature. 3. Deductive and inductive approaches. 4. Main Research Strategies: Case Studies; Experimentation; Action research; Surveys. 5. Choice of methods: mono, multiple and mixed; Time horizons: longitudinal and cross-sectional studies. 6. Methods of Collection and Treatment of Primary Data: questionnaires; focus groups, interviews, observation. 7. Secondary data. 8. Qualitative and quantitative data analysis. Validity and reliability of data. 9. Ethics. 10. Final Writing: how to write a thesis; how to write the bibliography; how to refer to the bibliography in the text; how to represent tables, charts and figures; structure of a thesis.

**SYSTEMS OPTIMIZATION IN ENGINEERING -** (5 ECTS) / Master in Systems Engineering, year 1
José António Oliveira, Assistant Professor, zan@dps.uminho.pt, orcid.org/0000-0002-6033-0760

1. Graph Theory for supporting Systems Optimisation in Engineering. 2. Network Model Optimisation Problems: Minimum Cost Spanning Tree; Shortest Path; Maximum Flow; Assignment; Transportation; Transshipment. 3. Knapsack, Cutting, and Packing Problems. 4. Facility Location Problems. 5. Optimisation Problems in Production Planning and Scheduling. 6. Routing Problems.

# 2ND SEMESTER / Spring

**ANALYTICAL DECISION SUPPORT SYSTEMS -** (5 ECTS) – Op / Master in Systems Engineering, year 1

Cláudio Alves, Full Professor, claudio@dps.uminho.pt, orcid.org/0000-0002-4017-1184

Analytical Decision Support Systems: classification, components and structure. Quantitative optimization methods and models based on mathematical programming. Linear programming: formulations, Simplex algorithm, sensitivity analysis, duality. Integer programming: formulations, solution methods. Heuristics and metaheuristics based on local search. Constraint Programming. Modelling languages and optimization software. Design of an Analytical Decision Support System. Case studies.

**COMPUTER AIDED DESIGN AND COMPUTER AIDED MANUFACTURING -** (5 ECTS) / Master in Industrial Eng. and Management, year 1

Leonilde Varela, Associate Professor with Habilitation, leonilde@dps.uminho.pt, orcid.org/0000-0002-2299-1859

Introduction product development and to Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) systems and their position within a production system. CAD: "drawing", models and modelling of products; modelling techniques, their characteristics and automatic generation of data for other production systems functionalities. CAM: Machine tools movements and coordinate system. Numerical Control systems: concepts, technologies and control architectures - NC, CNC, DNC and AC. Programming languages: ISO 6983 ("g", language), and high-level programming languages (APT and derivatives). Software CAD, CAM, CAD/CAM. Interoperability of CAD/CAM systems: integration architectures, data neutral formats, ISO STEP standard. CAD/CAM systems organization, management and design. Flexible Manufacturing Systems (FMS), Computer Integrated Manufacturing (CIM), Advanced Computer Aided Manufacturing systems.

**CONCURRENT AND COLLABORATIVE ENGINEERING -** (5 ECTS) / Master in Operations Engineering and Management, year 1

Leonilde Varela, Associate Professor with Habilitation, leonilde@dps.uminho.pt, orcid.org/0000-0002-2299-1859

Introduction: Historical development and classification of Simultaneous Engineering (SE), Concurrent Engineering (CE) and Collaborative Engineering (ColE) [CCE]. The CCE theo0retical framework: abstraction levels and organizational semiotics. Concurrent Engineering (CE) principles, definition and benefits. CE for products, manufacturing processes, business processes and organizations. Reference model of CE. Informal and formalized CE models (based on processes). Tools and technologies for CE: concepts of DFM, DFA, DFx, geometrical design patterns and technologies, pattern recognition and mapping, work groups, conflict management and resolution, negotiation protocols, videoconferencing and CSCW, QFD, knowledge engineering and management, artificial intelligence. Collaborative Engineering (ColE) principles, definitions and benefits. Learning models. Learning organizations and chaos and complexity management in organizations as the environments for ColE. Tools and technologies for ColE.

**INDUSTRY 4.0 -** (5 ECTS) – Op / Master in Systems Engineering, year 1

Leonilde Varela, Associate Professor with Habilitation, leonilde@dps.uminho.pt, orcid.org/0000-0002-2299-1859

Assimilate fundamentals of Industry 4.0 (I4.0) and the underlying cyber-physical production systems (CPPS). Use, in appropriate contexts, concepts of I4.0 and cyber-physical production systems. Use technical language in the field of I4.0 and CPPS. Apply literature review and problem analysis methodologies and approaches to I4.0 and CPPS, particularly from the perspective of production management. Critically analyze the applicability of different approaches underlying I4.0 and CPPS in different contexts and production environments. Develop a study project in the domain in focus, with a theme proposed by the students, through group work (exceptionally the project will be carried out through an individual project, depending on the number of students enrolled), through the application of experimental learning (learn by doing), in order to meet the objectives and teaching-learning methodology proposed to be used in this CU, based on the principles of active learning.

**LOGISTICS AND SUPPLY CHAIN MANAGEMENT -** (5 ECTS) / Bachelor Degree in Industrial Management Engineering, year 3

Sameiro Carvalho, Associate Professor, sameiro@dps.uminho.pt, orcid.org/0000-0001-7057-6775

Logistics and supply chain management: introduction; evolution and trends. Design of logistics networks: location models. Procurement process management. Warehousing and distribution management. Transportation planning and management.

**NUMERICAL METHODS -** (5 ECTS) / Bachelor Degree in Industrial Management Engineering, year 2

Senhorinha Teixeira, Associate Professor, st@dps.uminho.pt, orcid.org/0000-0002-7464-3944

Errors and stability. Numerical solving of nonlinear equations. Direct and iterative methods for solving linear systems. Numerical solving of nonlinear equation systems (Newton's method). Least squares approximation (linear model): polynomial and non-polynomial model. Polynomial interpolation: Newton's polynomial and splines. Numerical integration. Numerical solving of ordinary differential equations: with initial conditions (Runge-Kutta Method) and with boundary conditions (finite differences). Use of numerical computing software.

**PROJECT ANALYSIS IN INDUSTRIAL AND ENGINEERING MANAGEMENT -** (5 ECTS) / Bachelor in Industrial Eng. and Management, year 3

Paula Ferreira, Assistant Professor with Habilitation, paulaf@dps.uminho.pt, orcid.org/0000-0002-3712-4803

Introduction to project evaluation. Basic concepts for the investment project. Investment and corporate strategy. Project Evaluation. General considerations in the evaluation of investment projects: investment, profitability. Project appraisal indicators: minimum attractive rate of return, net present value, internal rate of return, payback time. Discount rate and cots of capital for the investment. Project financing. Project financial flows. Financial statements and investment project forms. Taxes. Cash-flows. Comparison and selection of investment projects. Projects with an equal lifetime. Projects with different lifetime. Projects with different investment dimensions. Decisions in the context of risk and uncertainty. Qualitative analysis. Sensitivity and scenario analysis. Probabilistic risk analysis
Introduction to socio-economic evaluation of projects.

**PROJECT EVALUATION -** (5 ECTS) / Master in Operations Engineering and Management, year 1

Jorge Cunha, Associate Professor, jscunha@dps.uminho.pt, orcid.org/0000-0002-6267-708X

Investment basics. Investment decisions and business strategy. Computation of a project's cash flows. Investment appraisal methods. Risk and uncertainty in project evaluation. The financing of the project. Complements of investment appraisal. The real options approach.

**PROJECT WORK -** (5 to 15 ECTS) / Various fields of study. All years.

Paulo Afonso, Assistant Professor, Erasmus Academic Coordinator, psafonso@dps.uminho.pt, orcid.org/0000-0003-3882-2491

There is the option to develop research/project work with supervision in English or in a common language between the student and the tutor.

**STRATEGIC MANAGEMENT AND INDUSTRIAL MARKETING -** (5 ECTS) / Master in Industrial Engineering and Management, year 1 and Master in Operations Engineering and Management, year 1

Paulo Afonso, Assistant Professor, psafonso@dps.uminho.pt, orcid.org/0000-0003-3882-2491

Strategy and its determinants. From strategic analysis to strategy formulation. Business model development. Strategy implementation and control. Marketing in the modern organization. Concepts of marketing. Marketing versus production orientation. Create value and customer satisfaction. Develop an effective marketing mix. Key characteristics of an effective marketing mix. Marketing and business performance. Distribution and development of channel systems. Case studies.

**SUPPLY CHAIN MANAGEMENT -** (5 ECTS) / Master in Industrial Engineering and Management, year 1 and Master in Operations Engineering and Management, year 1

Sameiro Carvalho, Associate Professor, sameiro@dps.uminho.pt, orcid.org/0000-0001-7057-6775

Concepts, principles and challenges of supply chain management. The strategic role of supply chain management. Integration in the Supply Chain. The whip effect on the transmission of information along the chain. Simulation game: Beer Game. Collaborative Strategies. Risk pooling, mass customization and postponement strategies. Supply chain design and configuration. Supply / purchasing, storage and transportation strategies. Analysis of logistics chain efficiency; methodologies and measures of performance.

**SUPPLY CHAIN OPTIMIZATION -** (5 ECTS) / Master in Operations Engineering and Management, year 1

José António Oliveira, Assistant Professor, zan@dps.uminho.pt, orcid.org/0000-0002-6033-0760

Models and methods (exact and heuristic) of Linear Integer Programming / Combinatorial Optimization for Supply Chain problems. Graphs and Complexity. Minimum Cost Spanning Tree Problem. Shortest Path Problem. Maximum Flow Problem. Assignment Problem. Chinese Postman Problem. Travelling Salesman Problem Vehicle Routing Problem.