JÖNKÖPING UNIVERSITY
School of Engineering

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Student Competence for IPC

Programme: Master of Science in Industrial Product Development, 300 credits

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The Industrial Product Development program aims to provide students with a broad and integrated Master of Science degree that includes deep insights into both product development and production development, as well as logistics, which provides a unique position in the labor market. During the program, they gain broad knowledge in computer tools, digital systems, industrial economics, logistics, industrial production systems, sustainable product development, materials in products and manufacturing processes, design elements, integrated product and production development, project management, quality and innovation management, purchasing and marketing, human factors in product development, data analysis, supply chain design, intercultural challenges in engineering, customized materials, and a number of elective courses. They have also studied mathematics, statistics, mechanics, solids and thermodynamics, and energy technology.

When students go out to work in private or public sector businesses during semester 6, they have the same extensive education as university engineers have when they begin their degree project. The students have had the following content within each course:

Project management and group dynamics

- Values and behaviors
- Intercultural communication
- Leadership and employee relations
- Conflicts
- Group dynamics
- Projects as a form of work
- The role of the project manager
- Needs analysis and specifications
- Project planning
- Meeting techniques
- Follow-up and evaluation

Computer tools in the product development process

- Basic knowledge of Word, PowerPoint and MS-project
- Advanced training in Excel (table management, diagrams, pivot tables, programming)
- Basic drawing techniques and drawing standards, dimensioning with tolerances
- Methodology and tools in solid modeling
- Modeling of components and assemblies
- Creation of 2D drawings from 3D data
- Simpler CAE/analysis of 3D data using software

Industrial economics

- Strategy and responsibility (the company, the company's role, responsibility and business models)
- Innovation and entrepreneurship (creativity and industrial economics, commercialization)
- Financing (capital needs and capital commitment)
- Organization and management (organizational forms, quality development)
- Production (competitive and innovative production, controlling and planning production systems)
- Financial and operational management (profit planning, product costing, budgeting and investment assessment, financial reporting and analysis)

Materials in product and manufacturing process

- Material selection and identification (metals, polymers, ceramics)
- Material testing
- Manufacturing methods for forming, machining, joining and coating final product
- Basic relationship between manufacturing method, material properties and product requirements

Digital systems

- Technical solutions for digital communication
- Information management e.g. data, databases, protocols, storage, structuring
- Digital networks and architectures, structures, hierarchies
- Internet of Things
- Cloud solutions
- Applications in products and processes
- Security aspects

Construction elements

- Bearing types and selection of deep groove ball bearings
- Belt, tooth, and chain transmissions
- Shaft couplings (friction coupling)
- Brakes
- Various joints (screw, rivet, shaft, press, shrink and welded joints)
- Springs
- Shafts
- Seals
- Various mechanisms (link, four-link and scissor mechanisms)

Thermodynamics and energy technology

- Basic and advanced thermodynamics
- Transport phenomena (heat transport, mass transport, and momentum transport)
- Some examples (applications) in thermodynamics and transport phenomena

Industrial production systems

- Design of production systems
- Process and layout selection, flow analysis, material handling, bottleneck and queue theory
- Lean production
- Measurements of productivity and simultaneous development of method, utilization and performance
- Measurement and analysis of total productivity in machines and equipment and how maintenance is organized to achieve higher availability
- Strategic perspectives and how these affect the production system

Integrated product and production development

- Overview of global product development processes
- Methods for production and Assembly-Appropriate design
- Methods, principles, tools and workflows to strengthen collaboration between product development and production
- Cost analysis
- Methods to support creativity in product and production development

Logistics

- Analyzing logistics key performance indicators
- Costs and capital utilization
- Inventory level analysis
- Order quantities
- Basic materials management methods

Human factors engineering

- Human prerequisites for product and work design: physiology, load, physical aspects, cognition
- Anthropometry
- Sociotechnical systems: theoretical basis, system models and applications
- Work organization and the impact of different work organizational solutions
- Development methods and design of system interfaces between humans and technology
- Automation – allocation of functions between humans and technology
- Risk analysis
- Swedish work environment legislation: framework law, regulations and system supervision

The basics of sustainable supply chains

- Logistics and Supply Chain Management
- Introduction to sustainability
- Sustainability and freight transport
- Sustainable warehousing
- Sustainable product design, production and packaging
- Sustainable purchasing and procurement
- Reverse logistics and recycling
- Social and ethical sustainability
- Strategic issues in sustainable supply chains

Quality and innovation management

- Quality and innovation concepts
- Basic understanding of variation
- Operations management from a quality, environmental and innovative perspective
- Construction, interpretation, use and revision of management standards within quality (ISO 9001), innovation (ISO 56000) and environment (ISO 14001)
- Methods and tools for quality and innovation management
- Quality and customer-centered product and process planning
- Methods and tools for risk analysis

Mechanics and strength theory 1

- Newtonian mechanics, the concept of force, static equilibrium, exposure, moments
- Center of mass, center of gravity, Coulomb friction
- Deformation relations, material relations, elongation, stress
- Analysis of bar structures

Mechanics and strength theory 2

- Particle kinematics
- Particle kinetics, work and energy, impulse and momentum, impact
- Rigid body planar kinematics, rigid body planar kinetics
- Analysis of 3D Dynamics in SolidWorks Motion Analysis

Mechanics and strength theory 3

- Beam theory
- Principal stress and effective stress
- Linear fracture mechanics
- Fatigue design

Mathematical statistics

- Basic probability theory
- Descriptive statistics
- Identifying correlations
- Investigating relationships, analyzing measurement data and evaluating the results

Algebra

- Linear systems of equations, Gaussian elimination
- Vector algebra with geometric applications
- Matrices and matrix algebra
- Determinants with applications
- Bases and changes of basis
- Eigenvalues and eigenvectors, diagonalization, Markov processes
- Use of computer software for vector and matrix calculations

One-variable analysis

- Definition of elementary functions
- General theory of functions
- Equations and inequalities, complex numbers
- The concept of limit values
- Continuity
- Definition of the derivative with geometric interpretation, differentiation rules
- Applications of the derivative such as optimization problems and graphing
- Introduction to numerical equation solving
- Primitive functions and integrals, integration methods
- Taylor’s formula, series expansions
- Ordinary differential equations

Multivariable analysis

- Curves and surfaces in implicit and parametric form (especially quadratic curves and surfaces)
- Basis topological concepts, polar, cylindrical and spherical coordinates
- Functions of several variables and their graphs, level curves and surfaces. MATLAB as a visualization tool
- Limits and continuity, partial derivatives
- Gradient, differentiability, directional derivatives and linearization
- The chain rule, the navel operation, rotation and divergence. Higher-order derivates, Laplace equation and wave equation, changes of variables
- Taylor polynomials of order 2, analysis of stationary points and identification of local extrema
- Optimization on compact domains, optimization under constraints
- Calculation of double and triple integrals by repeated integration and changes of variables
- Basic concepts in vector analysis, curve and surface integrals, conservative fields and potentials
- Green's theorem, Gauss's divergence theorem, Stokes' theorem