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"Medical Engineering and Physics" study programs

**INTERNSHIP on Design and Technology**

Methodical guidelines

**1. Introduction**

Design and technology internship is the final stage of the internship system. After the internship, the student should formulate the topic of his/her engineering project. The internship includes two parts:

* practice on design and manufacturing of mechanical equipment / devices,
* practice on the design and manufacture of electrical / electronic equipment / devices

**2. The objectives, tasks, and place of the internship**

**2.1. Practice on design and manufacturing of mechanical equipment/devices**

Objectives:

* To strengthen knowledges and skills required to design medical mechanical equipment / devices
* To develop competence to design mechanical equipment / devices.

Tasks:

* To acquire skills required to work with intermediate level 2D/3D CAD software (INVENTOR, SOLID WORKS, SOLID EDGE);
* To acquire skills required to work with advanced level CAD software (CATIA, Pro/INGENIER, Siemens NX /former UNIGRAPHICS/ CAD/CAM/CAE suite);
* To get acquainted with the technological cycle of medical device (basically mechanical) design from idea to pilot prototype;
* To acquire skills to use specific international, national and institutional regulation and requirements (e.g. “Requirements for Medical devices” etc.) in the design and development process;
* To get acquainted with the requirements and standards for the design documentation, and design documentation handing to the manufacturing unit (as handled at medium-sized EU company);
* To get acquainted with the practices and measures implemented at the place of internship to comply with the requirements of quality systems (e.g., ISO-9000),
* To get acquainted with the structure of modern SMEs (small or medium-sized enterprises), its administration and operation, as well as understand conditions for its orientation towards (innovative and knowledge – based) product export);
* To get acquainted with medical technology project management in SMEs

Duration: 4 weeks

Place: design and manufacturing companies

**2.2. Practice on Design and manufacture of electrical / electronic equipment**

Objectives:

* To strengthen knowledges and skills required to design medical electric / electronic equipment / devices
* To develop competence to design electric/ electronic equipment / devices.

Tasks:

* To acquire skills required to design medical electric / electronic equipment, using modern CAD software;
* To get acquainted with the operating area and products of the innovative design enterprise;
* To get acquainted with the technological cycle of medical device (basically electronic) design from idea to pilot prototype;
* To acquire skills to use specific international, national and institutional regulation and requirements (e.g. “Requirements for Medical devices” etc.) in the design and development process;
* To get acquainted with the requirements and standards for the design documentation, and design documentation handing to the manufacturing unit (as handled at medium-sized EU company);
* To get acquainted with the practices and measures implemented at the place of internship to comply with the requirements of quality systems (e.g., ISO-9000),
* To get acquainted with the structure of modern SMEs (small or medium-sized enterprises), its administration and operation, as well as understand conditions for its orientation towards (innovative and knowledge – based) product export);
* To get acquainted with medical technology project management in SMEs
* To perform a full cycle of one (simple) device development, according to the company adopted standards. The developed device description / documentation should be included in th internship report.

Duration: 4 weeks

Place: design and manufacturing companies

***The two parts may be united as 8-week internship at one place of internship****.*

**3. Requirements for students entering the internship**

Students should have basic knowledge on:

* the theoretical foundations of physics, mechanics, chemistry and electrical engineering;
* electronic components and their application - resistors, capacitors, chokes, semiconductors (diodes, transistors), active (analog) circuits (amplifiers, comparators), digital circuits (logic elements, memory circuits, microprocessors and microcomputers, user programmable logic), optoelectronic elements, indicators, and displays, power sources (batteries, accumulators, power supplies, voltage converters);
* sensors (electrical measurement of non-electrical quantities);
* mechanical, hydraulic, pneumatic (etc.) devices and actuators
* information technologies;
* standards and standardization and its role in the design of medical devices;
* conformity assessment procedures for medical devices (at least EC requirements) and regulatory enactments of the Republic of Latvia (Cabinet Regulation No. 581) in the field of medical devices;
* occupational safety, fire safety and radiation safety.

Students should have basic skills on:

Use of locksmith tools (screwdriver, wrench, pliers, drill, files, etc.);

use of electronic measuring instruments (multimeter, oscilloscope, etc.),

soldering (at least at beginner level)

work with a computer (skills in any programming language and / or any CAD software will give student an advantage when setting up internship);

at least one foreign language (preferably English, level, sufficient for the reading of technical texts);

drawing.

***Prior to the start of the internship, all students must have a work safety and fire safety briefing, documented by the signature of the student.***

**4. Tasks for internship**

**4.1. Practice on design and manufacturing of mechanical equipment/devices**

1. Project organization and documentation management:

* project portfolio organization,
* preparation of technical documents,
* preparation of technical proposals,
* preparation of technical tasks,
* preparation of technical meetings’ minutes,
* development of the project implementation schedules,
* elaboration of user manuals.

2. 3D design

* creation of a spatial model of the components /parts
  + concepts of plans and spatial axes,
  + choice of work plans,
  + sketching, symmetrical and asymmetrical sketches,
  + interconnections between sketch elements,
  + creation of spatial elements,
  + use of spatial functions,
  + skills to work with a library of standard spatial elements,
  + parameterization of spatial details,
  + assigning model properties (material selection, attribute assignment, etc.).
* creation of assembly model:
  + determining the interrelationship between individual parts
  + creation of assembly nodes,
  + creation of welded structures,
  + representation of mechanical processing of welded structures,
  + representation of mechanical processing of assembled structures,
  + creation of parametric assembly structures.
  + creation of welded joints in spatial models:
  + format selection,
  + selection and creation of basic views (scaling),
  + cuts, extracted elements (necessity and sufficiency),
  + assignment of dimensions,
* creation of a parametric assembly design that reflects different operating conditions of the mechanism,
* preparation of a presentation.

3. 2D design

* Parts:
* format selection,
* selection and creation of basic views (scaling)
* cuts, extracted elements (necessity
* assignment of dimensions,
* automatic,
* manual,
* tolerances and fits,
* deviation of shape and surface positions,
* application of surface roughness,
* deviations in shape and surface position,
* selection and assignment of heat treatment, rust
* choice of organic and galvanic coatings
* workpiece selection and sizing
* Assembly drawings:
  + format selection,
  + selection and creation of basic views (scaling),
  + cuts, extracted elements (necessity and sufficiency),
  + formats of dimensions,
  + general dimensions,
  + connection dimensions,
  + installation dimensions
* Fit tolerances
* Specifications
  + selection and sizing of the workpiece,
  + catalogues and libraries of standards and ready-to-use products,
  + search and selection of necessary elements,
  + calculations required for product development,
  + fasteners, pneumatic and hydraulic cylinders, valves, sensors, electric motors, frequency converters, control systems, guide and bearing calculations and selection, springs, bolt-nut, gear boxes etc.
* Creation of views of the working conditions of the mechanism.
* Technological analysis – assessment of the convenience and easiness of fitting

4. Information libraries.

5. Design of hydraulic and pneumatic circuits, elaboration of cycle operation diagram.

6. Basic of finite element analysis, use of ANSYS, KOSMOWORKS, NASTRAN software.

7. Assembly group / device design:

* Acceptance of technical tasks,
* preparation of LAYOUT solution variants,
* selection of optimal options,
* construction development,
* design approval,
* design of individual parts,
* preparation of purchase orders for standard and outsourced products,
* getting acquainted with the technological preparation for manufacturing,
* acquaintance with technical control processes.

**4.1.1. An example schedule of internship**

|  |  |
| --- | --- |
| Task | Weeks |
| Company tour. Work safety and fire safety briefing. Project organization and documentation management. | 0.5 |
| 3D design | 1 |
| 2D design / drawing | 1 |
| Information libraries.  Design of hydraulic and pneumatic circuits, elaboration of cycle operation diagram  Basic of finite element analysis, use of ANSYS, KOSMOWORKS, NASTRAN | 0.5 |
| Assembly group / device design | 1 |
| **Total** | **4** |

**4.1.2. Specific requirements for Internship report**

In addition to the requirements included in the General Guidelines, the internship report must describe:

* project organization and documentation management,
* 3D model, its presentation printout,
* 2D drawings,
* schemes, cycle operation diagrams, part/component analysis with FEM methods,
* copies of developed drawings.

**4.2. Practice on Design and manufacture of electrical / electronic equipment**

1. Development of device schematics and design.

2. Device prototype layout assembly.

3. Device prototype layout testing, research, and tuning

**4.2.1. An example schedule of internship**

|  |  |
| --- | --- |
| Task | Weeks |
| Company tour. Work safety and fire safety briefing. Project organization and documentation management. | 0.5 |
| Development of device schematics and design | 1 |
| Device prototype layout assembly | 1 |
| Device prototype layout testing, research, and tuning | 1.5 |
| **Total** | **4** |

**4.2.2. Specific requirements for Internship report**

In addition to the requirements included in the General Guidelines, the internship report must describe:

* problem statement, description or possible solution, analysis of prototype schematics,
* Requirements Specification (RS),
* design solution, design description,
* circuit schematics solution (block diagram, principal electrical circuit, boards drawing, interconnections, etc.),
* description of the assembled prototype layout (if applicable) or assessment of (existing) construction/design
* necessary changes in the existing construction/design
* sketch project for a new design,
* selection and specification of materials and components with justification (BOM - Bill of Materials),
* description of technical implementation (PR - Production Requirements and ASM - Assembly Manual).
* describe the topic of the potential engineering project chosen during the internship.