Module description of Mechanical Engineering S3 *Introduction Product Engineering*

Exchange program Autumn 2021 – 2022

Fontys Hogeschool Engineering

Revisions

Rev	Date	Description
01	01-02-2019	Baseline program Product Engineering

Module : Selection of Engineering Materials
Code : MEAPM2
Size : 5 EC (140 hours)

Main objectives/goals

- To prepare the student for the proper functioning in the real profession with respect to doing technologically substantiated by material selection and determination of material handling within a complete development process (with the establishment of the Technical Requirements, preparing formulas for design and check calculations, the read and interpret data sheets of materials by manufacturers or suppliers).
- Interactive, during contact hours, to go through a complete design process, with a focus on the impact of the choice of materials and choice of the material treatment to the manufacture of and the use in a product.

Content of the module

- Pick material data from "real" sources (e.g. data sheets from suppliers) for calculations of strength and effective stiffness (with the influence of inter alia load duration and temperature) in tension or compression, bending and/or torsion (or creep etc.; however, no fatigue); standards; Non-Dutch jargon (esp. English).
- Material properties/behaviour by means of material-handling (e.g. a hardening treatment), and influence shaping (e.g. by "notching"), in order to create a mechanically metal better suited for the functioning of the product, or for a production process.
- Completely free choice of material and material handling to design a functioning product as light as possible; material group selection with the aid of The Ashby method (with, among others, using CES EduPack), and refinement of the choice of data sheets and technological understanding of material handling.
- En passant: corrosion aspects and tribological aspects of materials.
- In practicals: first plastics identification (3x2 hours), then heat treating a carbon steel based on a technologically substantiated treatment plan (1x4 hours).

Prerequisite requirement

Production and Materials 1 and 2 (PM1t and PM2t; so entire propedeutic material of PM), and Constructions and Mechanics 2 (CM2t; strength of materials, inter alia, establishment of a VLS and working with "forget-me-nots"), or equivalent knowledge.

Module : Introduction Energy Theory & Fluid Mechanics
Module code : EXMEBEP1
Size : 5 EC (140 hours)

Main objectives/goals

The student is able to:

- Acquire basic knowledge in frictionless fluid mechanics.
- Solve simple flow problems of mechanical devices.
- Understand and interpret mechanical processes in which fluid dynamics is important.
- Acquire basic knowledge for the calculation of heat transfer by radiation, convection and conduction.
- Understand a number of important thermodynamic concepts which are used in energy conversion by using an application example. Concepts such as temperature, pressure, volume, work, heat, internal energy, yields, enthalpy.
- Perform simple thermodynamic calculations by using the first principle law.
- Describe how several energetic machineries work.
- Apply the acquired thermodynamic knowledge and calculations on devices and machinery that associate with the area of the mechanical engineer.
- Calculate the convective heat transfer coefficient in forces convection and natural convection.
- Calculate fins, applied with increase of heat transfer surface.
- Calculate the process in a heat exchanger.
- Calculate time-dependent behaviour in heat transport.

Content of the module

- Fluid mechanics
- Heat transfer with a specific focus on the area of conduction, convection and radiation at energy conversion and energy transfer.
- Thermodynamics
- Various energy systems

Prerequisite requirement

None.

Module : Dynamics

Module code : MEACM3

Size : 4 EC (140 hours)

Main objectives/goals

The student is:

- Being able to analyze structures that have more support than is required for static equilibrium.
- Being introduced to constructional aspects of bearings.
- Being able to determine the life span of bearings.
- Being introduced to the schematization of a structure.
- Being able to generate and substantiate the choices made in constructions.
- Obtaining skills of methodical designs and being able to evaluate and draw a structure of a machine component.
- Being able to dimension shaft, hubs and bearings.
- Being able to determine the safety factor (load, material, design notch).

Content of the module

Theory:

- Static indeterminate structures.
- Strength and permitted voltage.
- Roller bearing and -bearings.

Practice:

- Static indeterminate structures.
- Practical Drawing.
- Shaft calculation (in combination with theoretical lessons).

Prerequisite requirement

Statics (CM1) and Mechanics of Materials (CM2). Also basic knowledge regarding integrating and the use of Matlab is of advantage. The module offers room (56 hours) for self study to fill in certain efficiencies.

Module : Modelling & Simulation

Module code : EXMEAMS

Size : 5 EC (140 hours)

Main objectives/goals

Modeling technical systems and simulation with Matlab Simulink.

- Validation of model.
- Recognizing basic systems from their dynamic behaviour.
- Creating 1st order and 2nd order differential equation.
- Solving DV with Matlab Simulink.
- Making clear graphs with Matlab.
- Make analysis and report from model and simulation.

Content of the module

The module is a first acquaintance and introduction to modelling and simulating of systems from various fields.

Prerequisite requirement

General mathematics, statics and mechanics of materials. If not available it is expected that Exchange students gain these skills independently during this module.

Module : Dynamic Behaviour of Systems

Module code : EXMEADG1

Size : 5 EC (140 hours)

Main objectives/goals

The student is able to:

- Identify different design aspects and translate these aspects into design questions from a given design problem
- Translate the design questions into an integral simplified system model(s)
- Work in the frequency domain and is able to use tools (such as Fast Fourier Transformation and/or Laplace transformations) to predict the behavior of a design
- Use appropriate simulation tools in order to translate the system model into a computer model that can be used to simulate and define design parameters
- Make an integral optimized system design using the system and computer models.
- Describe and summarize all design aspects into a professional report

Content of the module

In modern design assignments engineers need to take an integrated approach during which the choice of materials, statics, dynamic behavior and thermal aspects need to be taken into consideration.

In this module using a design case students will learn how to take a system wide approach taking mechanics, thermal and material aspects into account. To this end modern software tools and system design tools will be used to iteratively come to an optimal design solution.

Groups of 2 students will work on several assignments during which knowledge on different subjects such as Matlab Simulink/Simscape, working in the frequency domain, designing for statics, dynamics and thermal behavior will be explored. In the end the student will be able to use these elements combined in order to come to an integrated optimized system model and design solution of a given or chosen design case.

Prerequisite requirement

- Knowledge of mechanical static calculations including setting up and analyzing a free body diagram
- Knowledge of mechanics of materials such as calculating bending stresses, moments of inertia
- Basic materials knowledge (material types, material stresses/strain, E-modulus, Hooke's law)
- Knowledge on basic thermodynamics (ideal gas law, thermodynamic laws), heat conduction/convection/radiation and fluid mechanics
- Background knowledge in the use of Matlab

The module offers room (56 hours) for self-study to fill in certain efficiencies

Module : Project and Professionalization

Module code : PP4P

Size : 6 EC (168 hours)

Main objectives/goals

- Get acquainted with company assignments for orientation.
- Collaborate in a (multidisciplinary) group.
- Applying systematic product development using
- Build and test a designed system or product.

Content of the module

This module consists of a project that is being executed with a team of around 6-8 team members. Team members can be from the mechanical engineering department but also from the electronic or mechatronic department.

Project assignments are provided by either companies or Fontys research groups and comprise of real-life problems and/or design questions which the project team needs to solve/answer.

Students work on the entire design cycle starting from defining the requirements – making a design – building a proof of concept and finally validating the design and consequently requirements. Besides technical skills students work on developing skills such as team work and group dynamics, reporting, project management skills and presentation.

Prerequisite requirement

Experience with basic reporting and presentation skills. Knowledge of system engineering and project management is an advantage.