Engineering Mechatronics

source: stepenterprise.wordpress.com

program and course information
fall semester 2023-2024

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Introduction

"Mechatronics is a coordinated, and concurrently developed, integration of mechanical engineering with electronics and intelligent computer control in the design and manufacture of products and processes" (Bolton, 2015).

Figure 1 puts this definition into perspective.
The specialization 'Mechatronics' in the HZ Engineering program, focusses on the development and realization of products and machines in a small series that can be produced for the professional market.
Such a product or machine is often the result of multi-disciplinary teamwork, where (junior) specialists work together.

In the previous years of your study you have gained a lot of basic and in-depth knowledge and skills; this Mechatronics program challenges you to apply it, extend it and develop yourself towards a professional bachelor of Engineering.

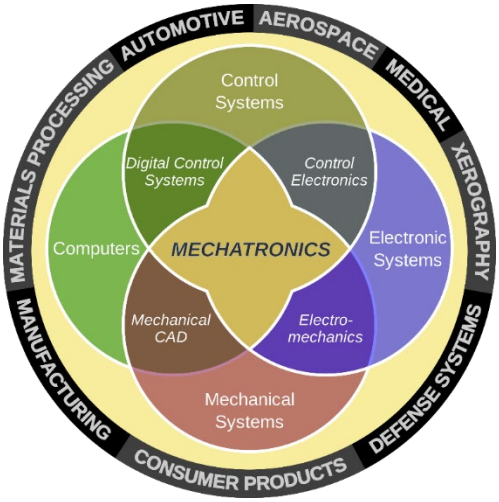

Figure 1 source: https://en.wikipedia.org/wiki/Mechatronics

Course information
This document provides you with basic information about the courses that are part of the Mechatronics specialization program. On the next page you will find a table with an overview of the courses, followed by the details of each course. Details include course title and code, teachers, a summary, course material, required pre-knowledge and information about the examination and planning.
The Schedule information in this document is intended for planning the course lectures and lab sessions. Note that the student schedule in MyHZ (log in on https://hz.nl) and the course schedule handed out by the teacher will be decisive!

Study load
For every course the number of credits are stated. 1 European credit (ec) = 28 study hours on average. This includes lectures, lab. sessions, home study, project work, course preparations and regular exams. Based on the total study load of one semester and the number of weeks available, the student should spend 40 hours per week on average.

Manage yourself
However, the 'average student' does not exist! Sometimes it will take more or less time to master a subject or to finish a task.
As a final year student, you must be able to manage your own study: prepare for lectures and project activities, plan your tasks, make appointments, communicate and be active.
Reflecting on what you have learned and how to improve for next time is a continuous process to advance to the next level!

Course overview

course title	code	credits	study load
Control systems engineering	CU04448	7.5	210
Electrical drive technology	CU04449	7.5	210
Mechanisms design	CU73015	5.0	140
Mechatronics project	CU73016	6.25	175
Design methodology	CU17603	1.25	35
Project week	CU15639	1.25	35
Applied research [a]	CU17606	1.25	35
Graduation preparation [b]	CU11023	1.25	35
	in total	30	840

[a] Only for Dutch students who will graduate at HZ

[b] Only for international students who will graduate at HZ

Course title: Control Systems Engineering

Course code: CU04448 **Credits:** 7.5 ec

Summary:
This course covers the control and feedback control of systems and processes.
After a (brief) refreshment of the basic feedback control system theory we will start with the modelling process in both the frequency domain and the time domain. After that we focus on the design criteria for controlled systems. For simulation purposes we will use the program Matlab.
The Control theory will be applied in this course by using the Intelligent control theory to perform motion based actions with a Raspberry Pi by means of the script language Python.

Teaching material:
Required:

- Hardware for Intelligent control:
  - Raspberry Pi 4 Model B v1.2 - 4GB, housing (for instance the official red-white housing)
  - official white power supply 5.1V/3A USB-C
  - white micro-HDMI to HDMI-cable of 1 meter
  - micro SD-card of 16GB with NOOBS version 3.x (see for supplies for instance: https://www.kiwi-electronics.nl/raspberry-pi-4-model-b-plus-basic-pack-red-white-4gb)
- Control Systems Engineering; N.S. Nise; 9780470646120; 6th edition; John Wiley & Sons
- Matlab-Simulink, student license offered by HZ University of Applied Sciences
- Gürocak, H. (2016); 9781118350812; Industrial motion control: Motor selection, drives, controller tuning, applications; Wiley

Required pre-knowledge (at the start of this course):
- Basic knowledge and skills in computer programming (C, C++)
- Basic knowledge and skills in microcomputer engineering, analog and digital electronics
- Basic control systems course passed
- Knowledge and skills in mathematics
  - differential equations
  - Laplace transforms
  - Imaginary numbers

Examination:

	exam	subject	factor (%)	required min. grade	
1	assignment	Part 1/2 - Intelligent control	20	5.5	group
2	assignment	Part 2/2 - Intelligent control	20	5.5	group
3	written exam	Part 1/2 - Control theory	30	5.5	individual
4	assignment	Part 2/2 - Control theory	30	5.5	individual

Schedule:

activity	repetition	timeslots[1]/group[2]	required room
lab exercises	4 half-day sessions groups of max. 10 students	4 x 2	RC103
assignment			
lecture	Weekly	1	
lecture	weekly	1	

[1] one timeslot is equal to 90 minutes [2] in parallel with lab exercises of CU04449

Course title: Electrical Drive Technology

Course code: CU04449 **Credits:** 7.5 ec

Summary:
A drive planning engineer needs knowledge about the operation of electrical drives. Both the mechanical and the electrical properties must be known. In this course you will learn how to design a complete electrical drive, including the speed control. The emphasis will be upon the squirrel cage motor and the speed control with frequency converters. The course starts with a quick review of the necessary electrical engineering knowledge.
Theory will be applied in laboratory exercises.

Teaching material:
Required:

- Electrical Machines, Drives and Power systems; Th. Wildi; 9781292024585; Prentice Hall 2013

Required pre-knowledge (at the start of this course):

- Basic electrical drive technology course passed

Examination:

	exam	subject	factor (%)	required min. grade	
1	written exam	Partial test review of electrical engineering	50	5.5	individual
2	written exam	Final test Electrical drives	50	5.5	individual

Schedule:

activity	repetition	timeslots[1]/group	required room
lecture	weekly	1	
lab exercises	4 half-day sessions groups of max. 12 students[2]	2	RC104

[1] one timeslot is equal to 90 minutes [2] in parallel with lab exercises of CU04448

Course title: Mechanisms Design

Course code: CU73015 **Credits:** 5.0 ec

Summary:
This course in mechanisms deals with the kinematics (and some basic dynamics) of planar mechanisms. Subjects are: analysis of velocities (both graphical and analytical), analysis of accelerations (mostly graphical) of different parts of a given mechanism, an introduction to dynamics of mechanisms and some basic cam design.

Teaching material:
Required:
- Reader; approx. € 15,00; via teacher

Required pre-knowledge (at the start of this course):
- working knowledge and skills in mathematics
  - Solving equations,
  - Integrate and differentiate equations,
  - Calculating with vectors,
  - Calculating with complex numbers

Examination:

	exam	subject	factor (%)	required min. grade	
1	lab report	SAM simulation and verification and 10 basic mechanisms	50	5,5	individual
2	written exam	All Mechanisms	50	5,5	individual

Schedule:

activity	repetition	timeslots[1]	required room
lecture	weekly	1	

[1] one timeslot is equal to 90 minutes

Course title: Mechatronics Project

Course code: CU73016 **Credits:** 6.25 ec

Summary:
During this course you will be faced with a (real life) problem that is too extensive to solve all by yourself. To get the job done at all, you will apply the project approach, involving an integrated way of working as a team within a more or less complex but flexible framework. The project within this course involves a level 3 assignment or problem:

- Integration of existing knowledge, insight and skills within a process of research, design or problem solution in the domain of engineering
- The project process contributes to the development of students professional competences
- The project result is usable and valuable for the client.

Appendix 1 states the requirements for an (external) assignment and client.

Required pre-knowledge (at the start of this course):

- Design methodology
- Project management

Teaching material:
Required:

- materials for experiments, prototyping (bought by student, school or client)

Examination:

	exam	subject	factor (%)	required min. grade	
1	report	research proposal	10	55	group
2	report	final report	40	55	group
3	presentation	project results	25	55	group
4	assessment	self/peer assessment	25	55	individual

Schedule:

activity	repetition	timeslots[1]	required room
kick-off	once, second week	2	
project work	weekly	2 x 2	project room
progress	weekly	1	
final presentation	once, last week	2 x 2	

[1] one timeslot is equal to 90 minutes

Course title: Project week

Course code: CU15639 **Credits:** 1.25 ec

Summary:
During this one week (five work days full time) course you will be faced with a real life problem from an external client. To get the job done you will apply the project approach, involving an integrated way of working as a team.
Teams will be built with students from all programs of the Technology, Water and Environment domain

Teaching material:
Required:

- materials for experiments, prototyping (bought by student, school or client)

Required pre-knowledge (at the start of this course):

- n/a

Examination:

	exam	subject	factor (%)	required min. grade	
1	report	assignment	100	55	group
2	attendance	>90% present	condition	tick off	individual

Schedule:

activity	repetition	timeslots	required room
teamwork	Monday - Thursday	9:00 – 17:00	several
presentation	Friday	9:00 – 17:00	several

Details about examination and schedule will be communicated separately by the Project week coordinator.

Course title: Design Methodology

Course code: CU17603 **Credits:** 1.25 ec

Summary:
You are already familiar with several methodologies for product design, like Delft Design Methodology, Timmers & van der Waals, Design of Technical Innovations (Oskam-method). Different methods have different properties that determines when and where they can be applied. When you create a mechatronic design in a team (of specialists) you need a suitable methodology to efficiently go from requirements to final product, including the design and selection of mechanisms, materials, drives, sensors, actuators, control, software, data and telecommunication, energy supply and so on. In this course we will discuss the methodology of Systems Engineering (applied in the V-model) that can be suitable for such a multi-disciplinary design of mechatronic products and processes.
We will also discuss what method to choose for what kind of problem.

Teaching material:
Required:
- Reader; provided by the teacher

Required pre-knowledge (at the start of this course):
- Design methodology in any method

Examination:

	exam	subject	factor (%)	required min. grade	
1	report	personal design guide	100	55	individual

Schedule:

activity	repetition	timeslots[1]	required room
lecture, discussion	week number: 1	2: only the first timeslot with teachers 2 on a later day, without teachers	*
lecture, discussion	week number: 2	2: only the first timeslot with teachers 2 on a later day, without teachers	*
lecture, discussion	week number: 3	2: only the first timeslot with teachers 2 on a later day, without teachers	*
lecture, discussion	week number: 4	2: only the first timeslot with teachers 2 on a later day, without teachers	*
feedback	week number: 6	1	*

[1] one timeslot is equal to 90 minutes
* room with movable tables, preferably GW-building, ground floor

Course title: Applied Research

Course code: CU17606 **Credits:** 1.25 ec

Special requirements: Only compulsory for Dutch students

Summary:
Contemporary societal developments and changes raise new questions and problems that are usually very complex in nature. Graduates of higher professional education are expected to be able to approach these in an increasingly integrated and multidisciplinary manner. Therefore you will also increasingly cross boundaries of your professional field and venture into other areas of specialization. The labor market therefore demands not only specialists, but also seeks generalists. The HZ strives to ensure that you are entering the job market well-equipped.
All classes are geared towards teaching the knowledge and skills you need to set up and write a Research Proposal for the graduation phase. Competence level: 3.

Teaching material:
Required:
- Baarda, B. (2014). Dit is onderzoek! Houten: Wolters Noordhoff bv Groningen.

Required pre-knowledge (at the start of this course):
- n/a

Examination:

	exam	subject	factor (%)	required min. grade	
1	Research proposal review	Applied research, competence level, assessment framework, problem analysis, problem definition, theoretical framework, method, planning, communicative quality	100	55	individual

Schedule:

Lecture week	subjects	Time-slots[1]	required room
Q2-2	Applied research, assessment framework, research proposal	1	
Q2-4	Assessment framework, methodology, problem analysis, problem definition, Theoretical framework.	1	
Q2-6	Research design, communicative quality	1	

[1] one timeslot is equal to 90 minutes
[a] timeslots connected

Course title: Graduation Preparation

Course code: CU11023 **Credits:** 1.25 ec

Special requirements: Only available for international students

Summary:
This course is intended for international Engineering-students to guide them in finding a company and a Thesis assignment. It is includes writing a CV and a Letter of Application, interview training, understanding about competences and portfolio and writing a Start document.
Part 1: Orientation and Application;
After orientation on the Thesis by attending and evaluating some Thesis presentations and reports, a training will start on four major topics: evaluate your competences, write your resume (cv), write a letter of application, interview training
Part 2: Project preparation; define the thesis assignment, set-up the research project, find resources, write a Start document.

Teaching material:
Required:
- Notebook (paper) and pen to make notes

Required pre-knowledge (at the start of this course):
- n/a

Examination:

	exam	subject	factor (%)	required min. grade	
1	documents	CV, LoA, Start document	100	55	individual
2	attendance	active participation	0	tick-off	individual

Schedule:

activity	repetition	timeslots[1]	required room
lecture	every week	1	

[1] one timeslot is equal to 90 minutes

Bibliography

Bolton, W. (2015). *Mechatronics, a multidisciplinary approach (6 ed.).* Pearson Education Limited.

Appendix 1

Requirements for (external) projects suitable for Mechatronics:
Mechatronic content (mechanical, electrical, control, informational);
The requested result and the functionality of the prototype is explicitly described;
Materialization is part of the result;
It is feasible that the results can be delivered by the student team within one semester (September – January);
It is feasible that the entire project (from problem analysis to prototype) can be finished by the student team within 120 work hours per student (normally a student team consists of 3 or 4 persons);
The client is dedicated to this assignment and the student team;
The client is available for communication on a regular (at least weekly) basis (in person, by telephone, email, Skype, et cetera);
The client is able to communicate in English;
The client is committed to spend e.g. 1 hour / week (on average);
The client is committed to pay for the hardware of the prototype (proof of concept);

For Internal projects: the project will deliver benefit for the Engineering curriculum or for longer running projects from edge-academies.

Provided by the client:

- a clear description of the problem
- description of the result and prototype
- what are the client's objectives
- the success and failure factors for this project
- how to communicate and when