Competence coverage matrix

Master of Science in Electromechanical Engineering

Control Engineering and Automation

Academic year 2021-2022

Legend:
 T=teaching methods
 E=evaluation methods

Column key (course codes):

Code	Course	Group
C1	E036130 Controlled Electrical Drives	General Courses
C2	E037321 Turbomachines	General Courses
C3	E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	General Courses
C4	E019331 ICT and Mechatronics	General Courses
C5	E040670 Mechanical Vibrations	General Courses
C6	E076221 Manufacturing Planning and Control	General Courses
C7	E005220 Linear Systems	Courses Related to the Main Subject
C8	E007920 Computer Control of Industrial Processes	Courses Related to the Main Subject
C9	E005722 Modelling and Simulation of Dynamical Systems	Courses Related to the Main Subject
C10	E036900 Dynamics of Electrical Machines and Drives	Courses Related to the Main Subject
C11	E004021 Nonlinear Systems	Courses Related to the Main Subject
C12	E008420 Servo Systems and Industrial Robots	Courses Related to the Main Subject
C13	E030520 Power Electronics	Courses Related to the Main Subject
C14	E091103 Master's Dissertation	Master's Dissertation

Competences in one/more scientific discipline(s)

Competence	T/E	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Master and apply advanced knowledge in the own engineering discipline in solving complex problems.	T 11			T	T	T	T	T	T		T	T	T	T	T
	E 11			E	E		E	E	E		E	E	E	E	E
Apply Computer Aided Engineering (CAE) tools and advanced communication instruments in a creative and purposeful way.	T 4							T	T		T	T			
	E 3				E				E		E				
Have a thorough insight in the interactions between different electromechanical parts and energy conversions of complex systems.	T 9	T		T	T				T	T	T		T	T	T
	E 9	E		E	E				E	E	E		E	E	E
Have a thorough knowledge of measurement techniques, sensors, actuators and ICT and the ability to apply the knowledge.	T 7			T	T	T			T				T	T	T
	E 6			E	E				E				E	E	E
Be familiar with the management of companies and operations.	T 3						T						T	T	
	E 1						E								
Specifically for main subject 'Mechanical Energy Engineering': Have a thorough insight in mechanical and thermodynamical energy conversions, fluid dynamics, heat transfer and combustion and apply the knowledge to complex problems.	T 3		T	T											T
	E 3		E	E											E
Specifically for main subject 'Electrical Power Engineering': Have a thorough insight in the production, distribution, conversion and use of electrical power and apply the knowledge to complex problems.	T 3	T									T				T
	E 3	E									E				E
Specifically for main subject 'Mechanical Construction': Have a thorough insight in the design, behaviour and manufacturing of constructions and machines and apply the knowledge to complex problems.	T 1														T
	E 1														E
Specifically for main subject 'Control Engineering and Automation': Have a thorough insight in the design and behaviour of control loops and of system dynamics and apply the knowledge to complex problems.	T 9	T			T			T	T	T	T	T		T	T
	E 8	E			E			E	E	E	E	E			E
Specifically for main subject 'Maritime Engineering': Have a thorough insight in the design, construction, functioning and exploitation of maritime systems.	T 1														T
	E 1														E

Scientific competences

Competence	T/E	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Analyse complex problems and translate them into concrete research questions.	T 6				T	T		T	T					T	T
	E 6				E	E		E	E					E	E
Consult the scientific literature as part of the own research.	T 3				T				T		T				T
	E 4				E				E		E				E
Select and apply the appropriate models, methods and techniques.	T 12	T			T	T	T	T	T	T	T	T	T	T	T
	E 12	E			E	E	E	E	E	E	E	E	E	E	E
Develop and validate mathematical models and methods.	T 7				T	T	T	T	T			T	T		
	E 7				E	E	E	E	E			E	E		
Interpret research findings in an objective and critical manner.	T 4				T				T			T	T	T	T
	E 5				E				E			E	E	E	E

Intellectual competences

Competence	T/E	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Independently form an opinion on complex situations and problems, and defend this point of view.	T 6	T					T		T		T	T			T
	E 5	E							E		E	E			E
Apply knowledge in a creative, purposeful and innovative way to research, conceptual design and production.	T 4					T			T		T				T
	E 5				E	E			E		E				E
Critically reflect on one's own way of thinking and acting, and understand the limits of one's competences.	T 4				T				T	T					T
	E 4				E				E	E					E
Stay update with the evolutions in the discipline to elevate the own competences to expert level.	T 4	T			T						T				T
	E 3	E									E				E
Readily adapt to changing professional circumstances.	T 3				T									T	T
	E 2													E	E

Competences in cooperation and communication

Competence	T/E	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Have the ability to communicate in English about the own field of specialisation.	T 10	T		T	T	T		T	T		T		T	T	T
	E 10	E		E	E	E		E	E		E		E	E	E
Project management: have the ability to formulate objectives, report efficiently, keep track of targets, follow the progress of the project,...	T 7			T	T				T	T	T			T	T
	E 7			E	E				E	E	E			E	E
Have the ability to work as a member of a team in a multidisciplinary working environment, as well as being capable of taking on supervisory responsibilities.	T 3				T				T				T		
	E 3				E				E				E		
Report on technical or scientific subjects verbally, in writing and using graphics.	T 7	T		T	T	T			T		T			T	T
	E 8	E		E	E	E			E		E			E	E

Societal competences

Competence	T/E	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Act in an ethical, professional and social way.	T 4	T		T					T						T
	E 3	E							E						E
Recognize the most important business and legal aspects of the own engineering discipline.	T 1						T								
Understand the historical evolution of the own engineering discipline and its social relevance.	T 2				T										T
	E 1														E

Profession-specific competence

Competence	T/E	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Master the complexity of technical systems by using system and process models.	T 13	T		T	T	T	T	T	T	T	T	T	T	T	T
	E 13	E		E	E	E	E	E	E	E	E	E	E	E	E
Reconcile conflicting specifications and prior conditions in a high quality and innovative concept or process.	T 5				T			T			T			T	T
	E 5				E			E			E			E	E
Synthesize incomplete, contradictory or redundant data into useful information.	T 3				T									T	T
	E 3				E									E	E
Possess sufficient ready knowledge and understanding to evaluate the results of complex calculations, or make approximate estimates.	T 10	T	T		T	T			T		T	T	T	T	T
	E 9	E	E		E				E		E	E	E	E	E
Pay attention to entire life cycles of systems, machines, and processes.	T 3	T			T									T	
	E 1													E	

Competence coverage matrix

GHENT UNIVERSITY

Master of Science in Electromechanical Engineering

Control Engineering and Automation

Academic year 2021-2022

Legend:
 T=teaching methods
 E=evaluation methods

Profession-specific competence		T/E	E036130 Controlled Electrical Drives	E037321 Turbomachines	E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	E019331 ICT and Mechatronics	E040670 Mechanical Vibrations	E076221 Manufacturing Planning and Control	E005220 Linear Systems	E007920 Computer Control of Industrial Processes	E005722 Modelling and Simulation of Dynamical Systems	E036900 Dynamics of Electrical Machines and Drives	E004021 Nonlinear Systems	E008420 Servo Systems and Industrial Robots	E030520 Power Electronics	E091103 Master's Dissertation
Pay attention to sustainability, energyefficiency, environmental cost, use of raw materials and labour costs.		T 5 / E 3	T		T							T / E		T / E	T	
Pay attention to all aspects of reliability, safety, and ergonomics.		T 5 / E 4	T			T / E						T / E		T / E	T / E	
Have insight into and understanding of the importance of entrepreneurship.		T 2 / E 1												T	T / E	
Show perseverance, innovativeness, and an aptitude for creating added value.		T 3 / E 3				T / E								T / E	T / E	T
Integrate the advanced knowledge of mechanical and electrical systems and ICT in order to design, implement and exploit technological innovations.		T 6 / E 5				T / E				T		T / E		T / E	T / E	T / E
Be familiar with the energy efficiency of (electrical, mechanical and thermal) energy conversion systems and distribution systems.		T 7 / E 5	T / E	T	T							T / E		T	T / E	T
			W 15 / E 12	W 3 / E 3	W 11 / E 8	W 22 / E 23	W 10 / E 8	W 7 / E 5	W 9 / E 8	W 21 / E 20	W 6 / E 6	W 20 / E 20	W 9 / E 8	W 13 / E 10	W 25 / E 23	W 29 / E 29

<< **EMingwALG1.1 Master and apply advanced knowledge in the own engineering discipline in solving complex problems.**   *Competences in one/more scientific discipline(s)*

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	lecture seminar practicum	report	Execute thermodynamic analyses of displacement machines and calculate performance parameters. Choose a suitable pump, compressor or internal combustion engine type depending on the application and determine its basic dimensions. Analyse and interpret measurements on positive displacement machinery. Explain trends in engine design, fuel choice and emission legislation and explain why a specific engine design would be chosen according to the needs of the application. Calculate the margin to cavitation for a pump installation and if necessary propose the required adaptations.
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	guided self-study seminar: coached exercises lecture	oral examination	Modelling of rotating and non-rotating mechanical systems based on Langrange's technique. Apply model structure preserving reduction techniques. Identify modal parameters from an experiment Design of vibration isolation and vibration absorption devices. Perform a modal analysis and formulate structural modifications for continuous and discrete systems. Calculate vibration levels of mechanical structures subjected to dynamic loads.
E076221 Manufacturing Planning and Control	lecture seminar: coached exercises practicum	written examination	distinguish and correctly apply methods and tools for planning production and inventory at strategic, tactical and operational level assess the usefulness of the different methods and tools for shop floor control in varying situations
E005220 Linear Systems	lecture seminar: coached exercises	written examination with open questions	Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a linear stationary system. Designing the optimal combination of optimal controller and optimal state estimator. Designing a Kalman-Bucy filter under output noise. Understanding and working with expectations, covariance matrices, and optimal linear estimators. Designing an optimal controller without and with input perturbations. Understanding when, and checking if a linear stationary system is observable; designing a Luenberger state observer/estimator. Understanding when, and checking if a linear stationary system is controllable; stabilising it using linear state feedback.
E007920 Computer Control of Industrial Processes	group work lecture	report	To apply simplifying techniques to complex systems and to analyze the effects of these simplifying assumptions.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E004021 Nonlinear Systems	guided self-study seminar: coached exercises	written examination open book examination	Being comfortable with intrinsically nonlinear notions Drawing a bifurcation diagram and phase portrait Recognizing typical behaviour of nonlinear systems (multiple equilibrium points, limit cycles, chaos, ...) Examine nonlinear systems in a creative and critical manner Recognize and identify the most important bifurcations for parametrized systems Qualitatively and quantitatively analysing nonlinear systems Conducting a stability study with linear and nonlinear methods Using graphical and analytical techniques to investigate dynamical behaviour

E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum	written examination	Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion. Discriminate between manipulator and joint space configuration
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	Only evaluation	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E005220 Linear Systems	seminar: coached exercises		Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a linear stationary system. Designing the optimal combination of optimal controller and optimal state estimator. Designing a Kalman-Bucy filter under output noise. Understanding and working with expectations, covariance matrices, and optimal linear estimators. Designing an optimal controller without and with input perturbations. Understanding when, and checking if a linear stationary system is observable; designing a Luenberger state observer/estimator. Understanding when, and checking if a linear stationary system is controllable; stabilising it using linear state feedback.
E007920 Computer Control of Industrial Processes	group work lecture	report	To evaluate when model-based and non-model based control should/can be applied. To be able to develop a mathematical model formulation through signal processing techniques (identification methods).
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E004021 Nonlinear Systems	seminar: coached exercises		Drawing a bifurcation diagram and phase portrait

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E036130 Controlled Electrical Drives	lecture	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	practicum	report	Analyse and interpret measurements on positive displacement machinery.
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E007920 Computer Control of Industrial Processes	group work lecture	report	To identify the interactions between sub-processes and to understand the effect of this interaction on the global performance of the total process.
E005722 Modelling and Simulation of Dynamical Systems	lecture seminar project	oral examination report	Insight in how to model a complicated system: simplest possible accurate system model. Develop system models for systems having asynchronous events using automata and Petri nets. Use of computer platforms for the implementation of simulation programs. Design model based controllers for continuous time and discrete time system models. Use of data driven models for regression and classification. To be able to implement mathematical models of continuous systems for simulation purposes using numerical integration routines. Use of Euler-Lagrange and Hamiltonian methods. Use of compositionality, abstraction, hierarchy to develop mathematical models of systems, to be able to implement for simulation, to reduce and to validate.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum	written examination	Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion. Discriminate between manipulator and joint space configuration
E030520 Power Electronics	lecture seminar practicum	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	practicum	report	Analyse and interpret measurements on positive displacement machinery.
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	seminar: coached exercises		Identify modal parameters from an experiment
E007920 Computer Control of Industrial Processes	group work lecture	report	To understand the effect of analog-to-digital and digital-to-analog converters on system dynamics. To be able to develop a mathematical model formulation through signal processing techniques (identification methods). To critically assess the choice for trade-off between performance of closed loop and robustness to disturbances and process model variations. To evaluate when model-based and non-model based control should/can be applied.
E008420 Servo Systems and Industrial Robots	lecture	written examination	Know the typical aspects of drives, sensors and controllers used in robot and servo control
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS: electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E076221 Manufacturing Planning and Control	lecture seminar: coached exercises practicum	written examination	indicate the strategic importance of production planning and control for a company assess the usefulness of the different methods and tools for shop floor control in varying situations distinguish and correctly apply methods and tools for planning production and inventory at strategic, tactical and operational level quantify the impact of variability on the performance of a production system analyse and control complex production systems by using mathematical models
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum		Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion. Discriminate between manipulator and joint space configuration
E030520 Power Electronics	guided self-study seminar practicum lecture		INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects

EMingwELME1.4 Specifically for main subject 'Mechanical Energy Engineering': Have a thorough insight in mechanical and thermodynamical *Competences in one/more scientific discipline(s)*
energy conversions, fluid dynamics, heat transfer and combustion and apply the knowledge to complex problems.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E037321 Turbomachines	guided self-study lecture	oral examination	Derive parameter choice and layout of fans, steam turbines, pumps, hydraulic turbines and wind turbines Derive basic functioning of turbomachines and the flow in their components
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	lecture seminar practicum	report	Execute thermodynamic analyses of displacement machines and calculate performance parameters. Choose a suitable pump, compressor or internal combustion engine type depending on the application and determine its basic dimensions. Analyse and interpret measurements on positive displacement machinery. Explain trends in engine design, fuel choice and emission legislation and explain why a specific engine design would be chosen according to the needs of the application. Calculate the margin to cavitation for a pump installation and if necessary propose the required adaptations.
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises practicum	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain.
			Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance.
			Self-assessment with adequate and critical self-correction and objectivity.
			Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople.
			Render and synthesise the results concisely.
			Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the
			reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…).
			Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E005220 Linear Systems	lecture seminar: coached exercises	written examination with open questions	Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a linear stationary system. Designing the optimal combination of optimal controller and optimal state estimator. Designing a Kalman-Bucy filter under output noise. Understanding and working with expectations, covariance matrices, and optimal linear estimators. Designing an optimal controller without and with input perturbations. Understanding when, and checking if a linear stationary system is observable; designing a Luenberger state observer/estimator. Understanding when, and checking if a linear stationary system is controllable; stabilising it using linear state feedback.
E007920 Computer Control of Industrial Processes	guided self-study lecture group work	report	To evaluate when model-based and non-model based control should/can be applied. To apply simplifying techniques to complex systems and to analyze the effects of these simplifying assumptions. To critically assess the choice for trade-off between performance of closed loop and robustness to disturbances and process model variations.
E005722 Modelling and Simulation of Dynamical Systems	lecture seminar project	oral examination report	Insight in how to model a complicated system: simplest possible accurate system model. Develop system models for systems having asynchronous events using automata and Petri nets. Use of computer platforms for the implementation of simulation programs. Design model based controllers for continuous time and discrete time system models. Use of data driven models for regression and classification. To be able to implement mathematical models of continuous systems for simulation purposes using numerical integration routines. Use of Euler-Lagrange and Hamiltonian methods. Use of compositionality, abstraction, hierarchy to develop mathematical models of systems, to be able to implement for simulation, to reduce and to validate.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E004021 Nonlinear Systems	guided self-study seminar: coached exercises	written examination open book examination	Being comfortable with intrinsically nonlinear notions Drawing a bifurcation diagram and phase portrait Recognizing typical behaviour of nonlinear systems (multiple equilibrium points, limit cycles, chaos, ...) Examine nonlinear systems in a creative and critical manner Recognize and identify the most important bifurcations for parametrized systems Qualitatively and quantitatively analysing nonlinear systems Conducting a stability study with linear and nonlinear methods Using graphical and analytical techniques to investigate dynamical behaviour
E030520 Power Electronics	guided self-study seminar practicum lecture		INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain.
			Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance.
			Self-assessment with adequate and critical self-correction and objectivity.
			Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople.
			Render and synthesise the results concisely.
			Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the
			reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…).
			Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	guided self-study seminar: coached exercises lecture	oral examination	Modelling of rotating and non-rotating mechanical systems based on Langrange's technique. Apply model structure preserving reduction techniques. Identify modal parameters from an experiment Design of vibration isolation and vibration absorption devices. Perform a modal analysis and formulate structural modifications for continuous and discrete systems. Calculate vibration levels of mechanical structures subjected to dynamic loads.
E005220 Linear Systems	lecture seminar: coached exercises	written examination with open questions	Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a linear stationary system. Designing the optimal combination of optimal controller and optimal state estimator. Designing a Kalman-Bucy filter under output noise. Understanding and working with expectations, covariance matrices, and optimal linear estimators. Designing an optimal controller without and with input perturbations. Understanding when, and checking if a linear stationary system is observable; designing a Luenberger state observer/estimator. Understanding when, and checking if a linear stationary system is controllable; stabilising it using linear state feedback.
E007920 Computer Control of Industrial Processes	group work	report	To apply simplifying techniques to complex systems and to analyze the effects of these simplifying assumptions.
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	Only evaluation	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E007920 Computer Control of Industrial Processes	guided self-study	report	To possess insight into the choice between model based control strategies and to apply them in practice.
E036900 Dynamics of Electrical Machines and Drives	lecture	open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises practicum	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	guided self-study seminar: coached exercises lecture	oral examination	Modelling of rotating and non-rotating mechanical systems based on Langrange's technique. Apply model structure preserving reduction techniques. Identify modal parameters from an experiment Design of vibration isolation and vibration absorption devices. Perform a modal analysis and formulate structural modifications for continuous and discrete systems. Calculate vibration levels of mechanical structures subjected to dynamic loads.
E076221 Manufacturing Planning and Control	lecture seminar: coached exercises practicum	written examination	distinguish and correctly apply methods and tools for planning production and inventory at strategic, tactical and operational level assess the usefulness of the different methods and tools for shop floor control in varying situations
E005220 Linear Systems	lecture seminar: coached exercises	written examination with open questions	Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a linear stationary system. Designing an optimal controller without and with input perturbations. Understanding when, and checking if a linear stationary system is observable; designing a Luenberger state observer/estimator. Understanding when, and checking if a linear stationary system is controllable; stabilising it using linear state feedback.
E007920 Computer Control of Industrial Processes	group work lecture	report	To be able to develop a mathematical model formulation through signal processing techniques (identification methods).
E005722 Modelling and Simulation of Dynamical Systems	lecture seminar project	oral examination report	Insight in how to model a complicated system: simplest possible accurate system model. Develop system models for systems having asynchronous events using automata and Petri nets. Use of computer platforms for the implementation of simulation programs. Design model based controllers for continuous time and discrete time system models. Use of data driven models for regression and classification. To be able to implement mathematical models of continuous systems for simulation purposes using numerical integration routines. Use of Euler-Lagrange and Hamiltonian methods. Use of compositionality, abstraction, hierarchy to develop mathematical models of systems, to be able to implement for simulation, to reduce and to validate.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E004021 Nonlinear Systems	guided self-study seminar: coached exercises	written examination open book examination	Using graphical and analytical techniques to investigate dynamical behaviour Qualitatively and quantitatively analysing nonlinear systems Conducting a stability study with linear and nonlinear methods
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum	written examination	Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion. Discriminate between manipulator and joint space configuration
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	guided self-study seminar: coached exercises lecture	oral examination	Modelling of rotating and non-rotating mechanical systems based on Langrange's technique. Apply model structure preserving reduction techniques. Identify modal parameters from an experiment Design of vibration isolation and vibration absorption devices. Perform a modal analysis and formulate structural modifications for continuous and discrete systems. Calculate vibration levels of mechanical structures subjected to dynamic loads.
E076221 Manufacturing Planning and Control	lecture seminar: coached exercises	written examination	analyse and control complex production systems by using mathematical models quantify the impact of variability on the performance of a production system
E005220 Linear Systems	lecture seminar: coached exercises	written examination with open questions	Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a linear stationary system. Designing the optimal combination of optimal controller and optimal state estimator. Designing a Kalman-Bucy filter under output noise. Understanding and working with expectations, covariance matrices, and optimal linear estimators. Designing an optimal controller without and with input perturbations. Understanding when, and checking if a linear stationary system is observable; designing a Luenberger state observer/estimator. Understanding when, and checking if a linear stationary system is controllable; stabilising it using linear state feedback.
E007920 Computer Control of Industrial Processes	group work lecture	report	To critically assess the choice for trade-off between performance of closed loop and robustness to disturbances and process model variations. To be able to develop a mathematical model formulation through signal processing techniques (identification methods).
E004021 Nonlinear Systems	guided self-study seminar: coached exercises	written examination open book examination	Using graphical and analytical techniques to investigate dynamical behaviour Conducting a stability study with linear and nonlinear methods
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	Only evaluation	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E007920 Computer Control of Industrial Processes	group work	report	To possess insight into the choice between model based control strategies and to apply them in practice. To apply simplifying techniques to complex systems and to analyze the effects of these simplifying assumptions. To be able to develop a mathematical model formulation through signal processing techniques (identification methods). To critically assess the choice for trade-off between performance of closed loop and robustness to disturbances and process model variations. To evaluate when model-based and non-model based control should/can be applied. To understand the effect of analog-to-digital and digital-to-analog converters on system dynamics. To identify the interactions between sub-processes and to understand the effect of this interaction on the global performance of the total process.
E004021 Nonlinear Systems	guided self-study seminar: coached exercises	written examination open book examination	Examine nonlinear systems in a creative and critical manner
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E076221 Manufacturing Planning and Control	lecture		assess the usefulness of the different methods and tools for shop floor control in varying situations
E007920 Computer Control of Industrial Processes	guided self-study lecture group work	report	To possess insight into the choice between model based control strategies and to apply them in practice. To critically assess the choice for trade-off between performance of closed loop and robustness to disturbances and process model variations.
E036900 Dynamics of Electrical Machines and Drives	project	report	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E004021 Nonlinear Systems	guided self-study seminar: coached exercises	written examination open book examination	Recognizing typical behaviour of nonlinear systems (multiple equilibrium points, limit cycles, chaos, ...)
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E019331 ICT and Mechatronics	Only evaluation	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	seminar: coached exercises	oral examination	Perform a modal analysis and formulate structural modifications for continuous and discrete systems. Apply model structure preserving reduction techniques. Design of vibration isolation and vibration absorption devices.
E007920 Computer Control of Industrial Processes	guided self-study lecture group work	report	To possess insight into the choice between model based control strategies and to apply them in practice. To apply simplifying techniques to complex systems and to analyze the effects of these simplifying assumptions. To be able to develop a mathematical model formulation through signal processing techniques (identification methods). To critically assess the choice for trade-off between performance of closed loop and robustness to disturbances and process model variations. To evaluate when model-based and non-model based control should/can be applied. To understand the effect of analog-to-digital and digital-to-analog converters on system dynamics. To identify the interactions between sub-processes and to understand the effect of this interaction on the global performance of the total process.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E007920 Computer Control of Industrial Processes	group work	report	To critically assess the choice for trade-off between performance of closed loop and robustness to disturbances and process model variations.
E005722 Modelling and Simulation of Dynamical Systems	lecture seminar project	oral examination report	Insight in how to model a complicated system: simplest possible accurate system model. Develop system models for systems having asynchronous events using automata and Petri nets. Use of computer platforms for the implementation of simulation programs. Design model based controllers for continuous time and discrete time system models. Use of data driven models for regression and classification. To be able to implement mathematical models of continuous systems for simulation purposes using numerical integration routines. Use of Euler-Lagrange and Hamiltonian methods. Use of compositionality, abstraction, hierarchy to develop mathematical models of systems, to be able to implement for simulation, to reduce and to validate.
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E019331 ICT and Mechatronics	guided self-study seminar project lecture		Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E019331 ICT and Mechatronics	guided self-study seminar project lecture		Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises practicum	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	lecture seminar practicum	report	Calculate the margin to cavitation for a pump installation and if necessary propose the required adaptations. Choose a suitable pump, compressor or internal combustion engine type depending on the application and determine its basic dimensions. Analyse and interpret measurements on positive displacement machinery. Explain trends in engine design, fuel choice and emission legislation and explain why a specific engine design would be chosen according to the needs of the application.
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	lecture	oral examination	Modelling of rotating and non-rotating mechanical systems based on Langrange's technique. Apply model structure preserving reduction techniques. Identify modal parameters from an experiment Design of vibration isolation and vibration absorption devices. Perform a modal analysis and formulate structural modifications for continuous and discrete systems. Calculate vibration levels of mechanical structures subjected to dynamic loads.
E005220 Linear Systems	lecture seminar: coached exercises	written examination with open questions	Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a linear stationary system. Designing the optimal combination of optimal controller and optimal state estimator. Designing a Kalman-Bucy filter under output noise. Understanding and working with expectations, covariance matrices, and optimal linear estimators. Designing an optimal controller without and with input perturbations. Understanding when, and checking if a linear stationary system is observable; designing a Luenberger state observer/estimator. Understanding when, and checking if a linear stationary system is controllable; stabilising it using linear state feedback.
E007920 Computer Control of Industrial Processes	group work	report	To be able to communicate and cooperate within a team, to manage a project towards the end-objectives and to report the obtained results in a critical objective assessment.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum	written examination	Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion. Discriminate between manipulator and joint space configuration
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course		Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*				
E037121	Displacement Pumps, Compressors and IC Engine Fundamentals	practicum	report	Analyse and interpret measurements on positive displacement machinery.
E019331	ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E007920	Computer Control of Industrial Processes	group work	report	To be able to communicate and cooperate within a team, to manage a project towards the end-objectives and to report the obtained results in a critical objective assessment.
E005722	Modelling and Simulation of Dynamical Systems	lecture seminar project	oral examination report	Insight in how to model a complicated system: simplest possible accurate system model. Develop system models for systems having asynchronous events using automata and Petri nets. Use of computer platforms for the implementation of simulation programs. Design model based controllers for continuous time and discrete time system models. Use of data driven models for regression and classification. To be able to implement mathematical models of continuous systems for simulation purposes using numerical integration routines. Use of Euler-Lagrange and Hamiltonian methods. Use of compositionality, abstraction, hierarchy to develop mathematical models of systems, to be able to implement for simulation, to reduce and to validate.
E036900	Dynamics of Electrical Machines and Drives	project seminar: practical PC room classes seminar: coached exercises	written examination report	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E030520	Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103	Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E007920 Computer Control of Industrial Processes	group work	report	To be able to communicate and cooperate within a team, to manage a project towards the end-objectives and to report the obtained results in a critical objective assessment.
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E036130 Controlled Electrical Drives	practicum	skills test	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	practicum	report	Analyse and interpret measurements on positive displacement machinery.
E019331 ICT and Mechatronics	Only evaluation	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	lecture seminar: coached exercises	report	Modelling of rotating and non-rotating mechanical systems based on Langrange's technique. Perform a modal analysis and formulate structural modifications for continuous and discrete systems.
E007920 Computer Control of Industrial Processes	group work	report	To be able to communicate and cooperate within a team, to manage a project towards the end-objectives and to report the obtained results in a critical objective assessment.
E036900 Dynamics of Electrical Machines and Drives	project	report	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	lecture		Explain trends in engine design, fuel choice and emission legislation and explain why a specific engine design would be chosen according to the needs of the application.
E007920 Computer Control of Industrial Processes	group work	report	To possess insight into the choice between model based control strategies and to apply them in practice. To apply simplifying techniques to complex systems and to analyze the effects of these simplifying assumptions. To be able to develop a mathematical model formulation through signal processing techniques (identification methods). To critically assess the choice for trade-off between performance of closed loop and robustness to disturbances and process model variations. To evaluate when model-based and non-model based control should/can be applied. To understand the effect of analog-to-digital and digital-to-analog converters on system dynamics. To identify the interactions between sub-processes and to understand the effect of this interaction on the global performance of the total process.
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E076221 Manufacturing Planning and Control	lecture		indicate the strategic importance of production planning and control for a company

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	guided self-study seminar project lecture		Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	practicum seminar	report	Execute thermodynamic analyses of displacement machines and calculate performance parameters. Choose a suitable pump, compressor or internal combustion engine type depending on the application and determine its basic dimensions. Analyse and interpret measurements on positive displacement machinery. Calculate the margin to cavitation for a pump installation and if necessary propose the required adaptations.
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	guided self-study seminar: coached exercises lecture	oral examination	Modelling of rotating and non-rotating mechanical systems based on Langrange's technique. Apply model structure preserving reduction techniques. Identify modal parameters from an experiment Design of vibration isolation and vibration absorption devices. Perform a modal analysis and formulate structural modifications for continuous and discrete systems. Calculate vibration levels of mechanical structures subjected to dynamic loads.
E076221 Manufacturing Planning and Control	lecture seminar: coached exercises	written examination	analyse and control complex production systems by using mathematical models quantify the impact of variability on the performance of a production system
E005220 Linear Systems	lecture seminar: coached exercises	written examination with open questions	Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a linear stationary system. Designing the optimal combination of optimal controller and optimal state estimator. Designing a Kalman-Bucy filter under output noise. Understanding and working with expectations, covariance matrices, and optimal linear estimators. Designing an optimal controller without and with input perturbations. Understanding when, and checking if a linear stationary system is observable; designing a Luenberger state observer/estimator. Understanding when, and checking if a linear stationary system is controllable; stabilising it using linear state feedback.
E007920 Computer Control of Industrial Processes	guided self-study lecture group work	report	To apply simplifying techniques to complex systems and to analyze the effects of these simplifying assumptions.
E005722 Modelling and Simulation of Dynamical Systems	lecture seminar project	oral examination report	Insight in how to model a complicated system: simplest possible accurate system model. Develop system models for systems having asynchronous events using automata and Petri nets. Use of computer platforms for the implementation of simulation programs. Design model based controllers for continuous time and discrete time system models. Use of data driven models for regression and classification. To be able to implement mathematical models of continuous systems for simulation purposes using numerical integration routines. Use of Euler-Lagrange and Hamiltonian methods. Use of compositionality, abstraction, hierarchy to develop mathematical models of systems, to be able to implement for simulation, to reduce and to validate.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E004021 Nonlinear Systems	guided self-study seminar: coached exercises	written examination open book examination	Being comfortable with intrinsically nonlinear notions Drawing a bifurcation diagram and phase portrait Recognizing typical behaviour of nonlinear systems (multiple equilibrium points, limit cycles, chaos, ...) Examine nonlinear systems in a creative and critical manner Recognize and identify the most important bifurcations for parametrized systems Qualitatively and quantitatively analysing nonlinear systems Conducting a stability study with linear and nonlinear methods Using graphical and analytical techniques to investigate dynamical behaviour
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum	written examination	Discriminate between manipulator and joint space configuration Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion.
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects

E091103 Master's Dissertation master's dissertation oral examination Define, study and analyse the research problem in a specific domain.
assignment Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance.
Self-assessment with adequate and critical self-correction and objectivity.
Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople.
Render and synthesise the results concisely.
Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the
reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…).
Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E005220 Linear Systems	lecture seminar: coached exercises	written examination with open questions	Designing an optimal controller without and with input perturbations. Designing a Kalman-Bucy filter under output noise.
E036900 Dynamics of Electrical Machines and Drives	project	report	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises practicum	open book examination skills test	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E037321 Turbomachines	practicum seminar: coached exercises	written examination	Calculate the flow in a turbomachine using one-dimensional analysis
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E040670 Mechanical Vibrations	seminar: coached exercises		Perform a modal analysis and formulate structural modifications for continuous and discrete systems. Apply model structure preserving reduction techniques. Identify modal parameters from an experiment Design of vibration isolation and vibration absorption devices.
E007920 Computer Control of Industrial Processes	guided self-study lecture group work	report	To evaluate when model-based and non-model based control should/can be applied. To apply simplifying techniques to complex systems and to analyze the effects of these simplifying assumptions. To be able to develop a mathematical model formulation through signal processing techniques (identification methods).
E036900 Dynamics of Electrical Machines and Drives	project seminar: practical PC room classes seminar: coached exercises	written examination report	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E004021 Nonlinear Systems	guided self-study seminar: coached exercises	written examination open book examination	Using graphical and analytical techniques to investigate dynamical behaviour Drawing a bifurcation diagram and phase portrait Recognizing typical behaviour of nonlinear systems (multiple equilibrium points, limit cycles, chaos, ...) Qualitatively and quantitatively analysing nonlinear systems Conducting a stability study with linear and nonlinear methods
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum	written examination	Discriminate between manipulator and joint space configuration Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion.
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E036130 Controlled Electrical Drives	lecture		Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E019331 ICT and Mechatronics	guided self-study seminar project lecture		Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises		Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	lecture		Explain trends in engine design, fuel choice and emission legislation and explain why a specific engine design would be chosen according to the needs of the application. Choose a suitable pump, compressor or internal combustion engine type depending on the application and determine its basic dimensions.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum	written examination	Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion. Discriminate between manipulator and joint space configuration
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E036130 Controlled Electrical Drives	lecture		Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum	written examination	Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion. Discriminate between manipulator and joint space configuration
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum		Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion. Discriminate between manipulator and joint space configuration
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning
			Represent simple motion systems with matrix groups and realize their limitations
			Discriminate between different task organizations: layers, parallel threads, object oriented
			Understand basic communication techniques: setting up communication, choosing information channel and information content
			Design and implement computer-based motion control strategies
			Name relevant techniques and recognize the dangers for multiple-task management
			Understand how basic components of complex mechatronic systems work, especially on the ICT side
			Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms
			CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite
			SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain.
			Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance.
			Self-assessment with adequate and critical self-correction and objectivity.
			Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople.
			Render and synthesise the results concisely.
			Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the
			reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…).
			Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
*Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche*			
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information content Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task management Understand how basic components of complex mechatronic systems work, especially on the ICT side Propose, analyze, select and implement hard- and software solutions for sensing and actuation in a newly encountered mechatronic system
E007920 Computer Control of Industrial Processes	lecture		To understand the effect of analog-to-digital and digital-to-analog converters on system dynamics.
E036900 Dynamics of Electrical Machines and Drives	project seminar: practical PC room classes seminar: coached exercises	report	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E008420 Servo Systems and Industrial Robots	practicum seminar	written examination	Design and implement computer-based robot motion control strategies Propose, analyze, select and implement hard- and software solutions for robot and servo systems.
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teruggevonden in de studiefiche			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises	open book examination	Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for starting, restraints with classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced and load commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small versus large commutator machines, AC commutator machines versus DC commutator machines, small versus large induction machines, small versus large synchronous machines, effects of power electronic supply on the machine and vice-versa, stepping motors versus classical motors Understanding the principle of current supply versus voltage supply, schemes and modulation principles for inverters, equivalent circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, shaded pole motor, p.m. excitation, hystereis motor, stepping motors and their characteristics
E037321 Turbomachines	guided self-study lecture	oral examination	Derive parameter choice and layout of fans, steam turbines, pumps, hydraulic turbines and wind turbines
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	lecture		Explain trends in engine design, fuel choice and emission legislation and explain why a specific engine design would be chosen according to the needs of the application. Choose a suitable pump, compressor or internal combustion engine type depending on the application and determine its basic dimensions.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines; modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. Understanding the concepts of local stability, static and dynamic stability, input-output stability, field orientation and vector control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities seminar practicum		Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing Know the typical aspects of drives, sensors and controllers used in robot and servo control Propose, analyze, select and implement hard- and software solutions for robot and servo systems. Design and implement computer-based robot motion control strategies Calculate inverse kinematics on a robot system Apply robot dynamics on a robot system Apply forward robot kinematics on a robot system Know the basic concepts in servo and robot systems to represent pose and motion. Discriminate between manipulator and joint space configuration
E030520 Power Electronics	guided self-study seminar practicum lecture	written examination with open questions report simulation	INSIGHTS: Understanding voltage and current waveforms CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects
E091103 Master's Dissertation	master's dissertation	oral examination assignment	Define, study and analyse the research problem in a specific domain. Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search, topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, results, conclusions,…). Find an appropriate methodology, in accordance with the applicable scientific norms of the specific field of study.