Competence coverage	matrix			G	ieneral	Course	es		С	ourses	Relate	ed to th	ne Mair	n Subje	ect	Mass r's Diss tatio
											tems	(0				talio
GHENT UNIVERSITY Master of Science in Ele	ectromechanical Engineering		ives		E037121 Displacement Pumps, Compressors and IC Engine Fundamentals			E076221 Manufacturing Planning and Control		E007920 Computer Control of Industrial Processes	E005722 Modelling and Simulation of Dynamical Systems	E036900 Dynamics of Electrical Machines and Drives		E008420 Servo Systems and Industrial Robots		
Control Engineering an	d Automation		E036130 Controlled Electrical Drives	es	t Pumps, (	natronics	ibrations	g Planning	ns	ntrol of In	d Simulatio	Electrical I	stems	ıs and Ind	onics	ertation
Academic year 2021-20	22		trolled Ele	E037321 Turbomachines	olacement	E019331 ICT and Mechatronics	E040670 Mechanical Vibrations	nufacturin	E005220 Linear Systems	nputer Co	delling and	amics of I	E004021 Nonlinear Systems	vo System	E030520 Power Electronics	E091103 Master's Dissertation
Legend:			130 Con	321 Turk	121 Disp ie Funda	331 ICT	670 Mec	221 Mar	220 Line	920 Con	722 Moc	900 Dyn	021 Non	420 Sen	520 Pow	103 Mas
T=teaching methods E=evaluation methods			E036	E037	E037 Engin	E019	E040	E076	E005	E007	E002	E036	E004	E008	E030	E091
Competences in one/more scientific	Master and apply advanced knowledge in the own engineering discipline in solving complex problems.	T 11 E 11			T E	T E	T E	T E	T E	T E		T E	T E	T E	T E	T E
discipline(s)	Apply Computer Aided Engineering (CAE) tools and advanced communication instruments in a creative and purposeful way.	T 4 E 3				E			Т	T E		T E	Т			
	Have a thorough insight in the interactions between different electromechanical parts and energy conversions of complex	T 9 E 9	T E		T E	T				T	T E	Т		T	T E	T
	systems.		_								_	E		E		E
	Have a thorough knowledge of measurement techniques, sensors, actuators and ICT and the ability to apply the knowledge.	E 6			E	E	Т			E				E	E	E
	Be familiar with the management of companies and operations.	T 3 E 1						T E						Т	Т	
	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.	T3 E3		E	E											E
	Specifically for main subject 'Electrical Power Engineering': Have a thorough insight in the production, distribution, conversion and use		T E									T E				T E
	of electrical power and apply the knowledge to complex problems.  Specifically for main subject 'Mechanical Construction': Have a	T 1	H													Т
	thorough insight in the design, behaviour and manufacturing of constructions and machines and apply the knowledge to complex problems.  Specifically for main subject 'Control Engineering and Automation':	E1	T			Т			Т		Т	_	Т		Т	E
	Have a thorough insight in the design and behaviour of control loops and of system dynamics and apply the knowledge to complex problems.	E 8	Ē			Ē			Ē	E	Ē	E	Ē		•	E
	Specifically for main subject 'Maritime Engineering': Have a thorough insight in the design, construction, functioning and exploitation of maritime systems.	T 1 E 1														E
Scientific competences	Analyse complex problems and translate them into concrete research questions.	T 6 E 6				T E	T E		T E	T E					T E	T
	Consult the scientific literature as part of the own research.	T 3 E 4				E				T E		T E				T
	Select and apply the appropriate models, methods and techniques.	T 12 E 12	T E			T	T E	T E	T E	T	T E	T	T E	T E	T E	T
	Develop and validate mathematical models and methods.	Т7	_			Т	Т	Т	Т	Т	_	_	Т	_	Т	_
	Interpret research findings in an objective and critical manner.	E 7				E	E	Е	Е	T			T		T	Ţ
ntellectual	Independently form an opinion on complex situations and problems, and defend this point of view.	E 5	Ţ			Е		Т		T E		T	T E		Е	T
competences	Apply knowledge in a creative, purposeful and innovative way to	E 5	E				Т			Т		E T				T
	research, conceptual design and production.  Critically reflect on one's own way of thinking and acting, and	E 5 T 4				E T	Е			E T	Т	E				T
	understand the limits of one's competences.  Stay uptodate with the evolutions in the discipline to elevate the	E 4 T 4	т			E				Е	E	Т				E
	own competences to expert level.	E 3	E									E				Е
	Readily adapt to changing professional circumstances.	T 3 E 2 T 10	Т			T	_			Т		Т		_	T E T	E
Competences in cooperation and	Have the ability to communicate in English about the own field of specialisation.	E 10	Ė		E	E	E		E	Е		Е		E	E	E
communication	Project management: have the ability to formulate objectives, report efficiently, keep track of targets, follow the progress of the project,	T 7 E 7			E	E				E	E	E			E	E
	Have the ability to work as a member of a team in a multi	Т 3				T				T					T	
	disciplinary workingenvironment, as well as being capable of taking on supervisory responsibilities.	E 3				E				Е					E	
	Report on technical or scientific subjects verbally, in writing and using graphics.	T 7 E 8	T E		T E	E	T E			T E		T E			T E	E
Societal competences	Act in an ethical, professional and social way.	T 4 E 3	T E		Т					T E						T E
	Recognize the most important business and legal aspects of the own engineering discipline.	T 1						Т								
	Understand the historical evolution of the own engineering discipline and its social relevance.	T 2 E 1				Т										T
Profession-specific	Master the complexity of technical systems by using system and process models.	T 13 E 13	T E		T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T E	T
competence		T 5	<u> </u>		_	Т	_	_	Т			Т		_	Т	Т
	Synthesize incomplete, contradictory or redundant data into useful					E T			Е			Е			E T	T
	information.  Possess sufficient ready knowledge and understanding to evaluate	E 3 T 10	Т	Т		E T	Т			Т		Т	Т	Т	E T	E
	the results of complex calculations, or make approximate estimates.	E 9	E	E		E				E		E	E	E	E	E
	Pay attention to entire life cycles of systems, machines, and processes.	T 3 E 1	Т			Т									T E	

#### Competence coverage matrix

GHENT UNIVERSITY Master of Science in Control Engineering a			E036130 Controlled Electrical Drives	Turbomachines	<ul><li>1 Displacement Pumps, Compressors and IC Fundamentals</li></ul>	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
Legend: T=teaching methods E=evaluation methods			E036130	E037321	E037121 Engine Fu	E019331 ICT	E040670	E076221	E005220	E007920	E005722	E036900	E004021	E008420	E030520	E091103
Profession-specific competence	Pay attention to sustainability, energyefficiency, environmental cost, use of raw materials and labour costs.	T 5 E 3	т		Т							T E		T E	T E	
	Pay attention to all aspects of reliability, safety, and ergonomics.	T 5 E 4	Т			T E						T E		T E	T E	
	Have insight into and understanding of the importance of entrepreneurship.	T 2 E 1												Т	T E	
	Show perseverance, innovativeness, and an aptitude for creating added value.	T 3 E 3				T E									T E	T E
	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				Т		T E		T E	T E	E
	Be familiar with the energy efficiency of (electrical, mechanical anthermal) energy conversion systems and distribution systems.	T 7 E 5	T E	T E	Т							T E		Т	T E	1 E
			W 15	W 3	W 11	W 22	W 10	M Z	W 9	W 21	W 6	W 20	W 9	W 13	W 25	W 2

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 terug	gevonden 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 choser according to the needs of the application.
E019331 ICT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Calculate the margin to cavitation for a pump installation and if necessary propose the required adaptations.  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
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	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

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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.

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Course	Teaching methods	Evaluation methods	Course learning outcome
loot: leer- en evaluatievormen voorafgegaan door ** werden niet terugg	gevonden in de studiefiche		
019331 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
005220 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.
007920 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).
036900 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.
004021 Nonlinear Systems	seminar: coached exercises		Drawing a bifurcation diagram and phase portrait

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# EMingwELME1.1 Have a thorough insight in the interactions between different electromechanical parts and energy conversions of complex systems.

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systems.			
Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terugge	evonden 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	practicum	report	Analyse and interpret measurements on positive displacement machinery.
Engine Fundamentals E019331 ICT and Mechatronics	avided celf etcal:	witten eveningtion	Understanding the recogning and commentions behind correct data bondling and interpretation information and
EU19331 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  E036900 Dynamics of Electrical Machines and Drives  E008420 Servo Systems and Industrial Robots	lecture seminar project  lecture seminar: practical PC room classes seminar: coached exercises project  lecture self-reliant study activities	oral examination report  written examination report open book examination  written examination	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.  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.  Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing
E030520 Power Electronics	lecture seminar practicum	written examination with open questions report	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  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	simulation 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.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	ggevonden 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.

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#### EMingwELME1.3 Be familiar with the management of companies and operations.

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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		
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

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EMingwELME1.4 Specifically for main subject 'Mechanical Energy Engineering': Have a thorough insight in mechanical and thermodynamical	Competences in one/more scientific discipline(s)
anagen, aangagalana figid dynamiaa baat teenafar and aanghyatian and annig tha kraayladea ta aanglay nyahlama	

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	ggevonden 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.

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#### EMingwELME1.5 Specifically for main subject 'Electrical Power Engineering': Have a thorough insight in the production, distribution,

Competences in one/more scientific discipline(s) << conversion and use of electrical power 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 Understanding the differences and similarities between space vectors and time phasors for sinusoidal and non-sinusoidal supply E036130 Controlled Electrical Drives open book examination seminar: coached exercises Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits for practicum 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 Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of written examination seminar: practical PC room classes report induction machines; seminar: coached exercises open book examination modelling of synchronous machines. Understanding the dynamic behaviour of DC machines, induction and synchronous machines. project 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 Define, study and analyse the research problem in a specific domain. master's dissertation oral examination Give proof of independency, motivation, dedication, drive to innovation and creativity, initiative and perseverance. assignment 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.

topical study, research and the

Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search,

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.

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•	achines and apply the knowledge to	o complex problems.	ugh insight in the design, behaviour and manufacturing Competences in one/more scientific discipline
Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** v	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.

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### EMingwELME1.7 Specifically for main subject 'Control Engineering and Automation': Have a thorough insight in the design and behaviour of Competences in one/more scientific discipline(s)

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terugg	evonden 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 supp Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits f 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, equivaled 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	written examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and
	seminar	report skills test	machine learning Represent simple motion systems with matrix groups and realize their limitations
	project lecture	oral examination	Discriminate between different task organizations: layers, parallel threads, object oriented
	locidio	oral examination	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	written examination with open	Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a
	seminar: coached exercises	questions	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	report	To evaluate when model-based and non-model based control should/can be applied.
	lecture		To apply simplifying techniques to complex systems and to analyze the effects of these simplifying assumptions.
	group work		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	s lecture	oral examination	Insight in how to model a complicated system: simplest possible accurate system model.
2000122 Medelling and emidiation of Dynamical Cyclems	seminar	report	Develop system models for systems having asynchronous events using automata and Petri nets.
	project		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
E020000 Dunamics of Floatwicel Machines and Drives	la atura	witten average at an	validate.
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes	written examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling of induction machines;
	seminar: coached exercises	open book examination	modelling of synchronous machines.
	project	•	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	written examination	Being comfortable with intrinsically nonlinear notions
200 1021 Hollimodi Oyotoffio	seminar: coached exercises	open book examination	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		INSIGHTS: Understanding voltage and current waveforms
	seminar		CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite
	practicum		SKILLS:electronic and thermal aspects
F004402 Masterla Discontation	lecture	and aversionalis	Define study and analyse the research marklanding a specific description
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.
		aosigninent	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.
			Oritically analysis formulate at the superior and/an analysis and the superior of an analy (literature analysis)
			Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search,
			topical study, research and the

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#### EMingwELME1.8 Specifically for main subject 'Maritime Engineering': Have a thorough insight in the design, construction, functioning and Competences in one/more scientific discipline(s) << exploitation of maritime systems. Course learning outcome Course Teaching methods **Evaluation methods** Noot: leer- en evaluatievormen voorafgegaan door \*\* werden niet teruggevonden in de studiefiche E091103 Master's Dissertation master's dissertation oral examination 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. assignment 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.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet te	ruggevonden 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 conter 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/estimate 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.

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<<	EMingwALG2.2 Consult the scientific literature as part of the own research.
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Scientific competences

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	gevonden 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.

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<<	EMingwALG2.3 Select and apply the appropriate models, methods and techniques.	Scientific competences
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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terugge	evonden 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 supp Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits f 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, equivaled 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
E040670 Mechanical Vibrations	guided self-study	oral examination	mechatronic system  Modelling of rotating and non-rotating mechanical systems based on Langrange's technique.
	seminar: coached exercises lecture		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	distinguish and correctly apply methods and tools for planning production and inventory at strategic, tactical and operational level
E005220 Linear Systems	lecture seminar: coached exercises	written examination with open questions	assess the usefulness of the different methods and tools for shop floor control in varying situations  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/estimate 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 develop a mathematical model formulation through signal processing techniques (identification methods).
E005722 Modelling and Simulation of Dynamical Systems	lecture lecture	oral examination	Insight in how to model a complicated system: simplest possible accurate system model.
	seminar project	report	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.

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#### EMingwALG2.4 Develop and validate mathematical models and methods.

EMingwALG2.4 Develop and validate mathematical models and methods.			nd methods.	Scientific competences	
Course		Teaching methods	Evaluation methods	Course learning outcome	
Noot: leer- en	evaluatievormen voorafgegaan door ** werden niet teru	uggevonden in de studiefiche			
E019331 I	CT 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 N	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 M	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	
	inear 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 C	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 N	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 P	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	

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EMingwALG2.5 Interpret research findings in an objective and critical manner.
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Scientific competences

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	uggevonden 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.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	ggevonden 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, equivaler 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.

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<<	EmiligwALG3.2 Apply kilowledge	· • •		rch, conceptual design and production.	Intellectual competences
Course		Teaching methods	Evaluation methods	Course learning outcome	
Noot: leer- er	n evaluatievormen voorafgegaan door ** werden niet terug	gevonden in de studiefiche			
	CT and Mechatronics	Only evaluation	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling and inte machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object orie Understand basic communication techniques: setting up communication, choosing in 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 Propose, analyze, select and implement hard- and software solutions for sensing and mechatronic system	ented formation channel and information content  y on the ICT side d actuation in a newly encountered
E040670 N	Mechanical Vibrations	seminar: coached exercises	oral examination	Perform a modal analysis and formulate structural modifications for continuous and a Apply model structure preserving reduction techniques.  Design of vibration isolation and vibration absorption devices.	discrete systems.
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 ap To apply simplifying techniques to complex systems and to analyze the effects of the To be able to develop a mathematical model formulation through signal processing to To critically assess the choice for trade-off between performance of closed loop and 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 To identify the interactions between sub-processes and to understand the effect of the total process.	se simplifying assumptions. echniques (identification methods). robustness to disturbances and process em dynamics.
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 induction machines; modelling of synchronous machines.  Understanding the dynamic behaviour of DC machines, induction and synchronous nuderstanding the concepts of local stability, static and dynamic stability, input-output control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in	nachines. It stability, field orientation and vector
E091103 N	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 Self-assessment with adequate and critical self-correction and objectivity. Communicate adequately on the research, the results and problems, present and fou laypeople. Render and synthesise the results concisely. Critically analyse, formulate, study, execute and/or process different aspects in the extopical study, research and the reflection on the research, experiments, experimentations, designs, simulations, resulting an appropriate methodology, in accordance with the applicable scientific norms	ind them, both to colleagues as to xecution of research (literature search, llts, conclusions,).

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#### EMingwALG3.3 Critically reflect on one's own way of thinking and acting, and understand the limits of one's competences.

ntellectual com	petences
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EMingwALG3.3 Critically reflect on	one's own way of think	ing and acting, and underst	and the limits of one's competences.	Intellectual competences
Course	Teaching methods	Evaluation methods	Course learning outcome	
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terugge	evonden 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 in machine learning Represent simple motion systems with matrix groups and realize their limitations Discriminate between different task organizations: layers, parallel threads, object of Understand basic communication techniques: setting up communication, choosing 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 propose, analyze, select and implement hard- and software solutions for sensing a mechatronic system	oriented g information channel and information content ent ially on the ICT side
E007920 Computer Control of Industrial Processes	group work	report	To critically assess the choice for trade-off between performance of closed loop ar model variations.	nd robustness to disturbances and 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 Develop system models for systems having asynchronous events using automata Use of computer platforms for the implementation of simulation programs. Design model based controllers for continuous time and discrete time system mod Use of data driven models for regression and classification. To be able to implement mathematical models of continuous systems for simulatic routines. Use of Euler-Lagrange and Hamiltonian methods. Use of compositionality, abstraction, hierarchy to develop mathematical models of simulation, to reduce and to validate.	and Petri nets.  dels.  on purposes using numerical integration
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 creative Self-assessment with adequate and critical self-correction and objectivity.  Communicate adequately on the research, the results and problems, present and laypeople.  Render and synthesise the results concisely.  Critically analyse, formulate, study, execute and/or process different aspects in the topical study, research and the reflection on the research, experiments, experimentations, designs, simulations, reflection an appropriate methodology, in accordance with the applicable scientific norresponding to the process of the second and the second and the research, experiments, experimentations, designs, simulations, reflection and appropriate methodology, in accordance with the applicable scientific norresponding to the second and the secon	found them, both to colleagues as to execution of research (literature search, esults, conclusions,).

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	gevonden 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.

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#### EMingwALG3.5 Readily adapt to changing professional circumstances. <<

questions

assignment

oral examination

laypeople.

report simulation

Teaching methods

guided self-study

guided self-study

master's dissertation

seminar project

lecture

seminar

lecture

practicum

Noot: leer- en evaluatievormen voorafgegaan door \*\* werden niet teruggevonden in de studiefiche

Course

E019331 ICT and Mechatronics

E030520 Power Electronics

E091103 Master's Dissertation

Intellectual competences **Evaluation methods** Course learning outcome Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and 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 INSIGHTS: Understanding voltage and current waveforms written examination with open CONCEPTS: simple designs of converters and passive components inductors and transformers with ferrite SKILLS:electronic and thermal aspects 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.

Communicate adequately on the research, the results and problems, present and found them, both to colleagues as to

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.

Critically analyse, formulate, study, execute and/or process different aspects in the execution of research (literature search,

Self-assessment with adequate and critical self-correction and objectivity.

Render and synthesise the results concisely.

topical study, research and the

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Course Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	Teaching methods ggevonden in de studiefiche	Evaluation methods	Course learning outcome
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 supportant of the differences and similarities between space vectors and (time) phasors, voltage and temperature limits starting, restraints with
	practicum		classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced ar 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, equival 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 chose according to the needs of the application.
E019331 ICT and Mechatronics	guided self-study seminar project	written examination report skills test	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
	lecture	oral examination	Discriminate between different task organizations: layers, parallel threads, object oriented Understand basic communication techniques: setting up communication, choosing information channel and information conten 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/estimated to the controller without and checking if a linear stationary system is observable; designing a Luenberger state observer/estimated to the controller without and checking if a linear stationary system is observable; designing a Luenberger state observer/estimated to the controller without and checking if a linear stationary system is observable; designing a Luenberger state observer/estimated to the controller without and checking if a linear stationary system is observable; designing a Luenberger state observer/estimated to the controller without and checking if a linear stationary system is observable; designing a Luenberger state observer/estimated to the controller without and checking if a linear stationary system is observable; designing a Luenberger state observer/estimated to the controller without and checking if a linear stationary system is observable; designing a Luenberger state observer/estimated to the controller without and checking if a linear stationary system is observable; designing a Luenberger state observer/estimated to the controller without and checking it a linear stationary system is observed to the controller without and checking it a linear stationary system is observed to the controller without and checking it as a linear stationary system is observed to the controller without and checking it as a linear stationary system is observed to the controller without and checking it as a linear stationary system is observed to the controller without and checking it as a linear stationary system is observed to the controller without and checking it as a linear stationary system is observed to the controller without and checking it as a linear stationary system is observed to the controller without and
E007920 Computer Control of Industrial Processes	group work	report	Understanding when, and checking if a linear stationary system is controllable; stabilising it using linear state feedback.  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	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.
	project		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
E008420 Servo Systems and Industrial Robots	lecture self-reliant study activities	written examination	subtransient dynamics of machines; pulsating loading of machines; voltage surges in machines.  Understand how basic components of robot and servo systems work, specifically aspects related to the hardware and information processing
	seminar practicum		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 foods dynamics on a food 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	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	lecture 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.

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#### EMingwALG4.2 Project management: have the ability to formulate objectives, report efficiently, keep track of targets, follow the progress of the Competences in cooperation and communication

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Course	project,	Teaching methods	Evaluation methods	Course learning outcome
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voot. ieer- er	n evaluatievormen voorafgegaan door ** werden niet terugge	vonden in de studienche		
	Displacement Pumps, Compressors and IC Engine Fundamentals	practicum	report	Analyse and interpret measurements on positive displacement machinery.
E019331 I	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 I	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 I	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 I	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 I	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.

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## EMingwALG4.3 Have the ability to work as a member of a team in a multidisciplinary workingenvironment, as well as being capable of taking on Competences in cooperation and communication supervisory responsibilities.

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supervisory responsibilities.	<b>-</b> 1: 4 1	<b>-</b> 1	
Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet tert	uggevonden 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

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<b>&lt;&lt;</b>	EMingwALG4.4 Report on technic	ai or scientific subjects verb	any, in writing and using gr	aphics. Competences in cooperation and communication
Course		Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en e	evaluatievormen voorafgegaan door ** werden niet terug	gevonden in de studiefiche		
E036130 C	ontrolled 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, equivalen 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
	isplacement Pumps, Compressors and IC ngine Fundamentals	practicum	report	Analyse and interpret measurements on positive displacement machinery.
	CT 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 M	lechanical 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 C	omputer 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 D	ynamics of Electrical Machines and Drives	project	report	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling 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 Po	ower 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 M	laster'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.

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#### < EMingwALG5.1 Act in an ethical, professional and social way. Societal competences

ewingwalds. Fact in an ethical,	professional and social way	•	Societal competences
Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	ggevonden 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.

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EMingwALG5.2 Recognize the most important business and legal aspects of the own engineering discipline.

Societal competences

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

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### EMingwALG5.3 Understand the historical evolution of the own engineering discipline and its social relevance.

Societal competences

Course	Teaching methods	Evaluation methods	Course learning outcome		
Noot: leer- en evaluatievormen voorafgegaan door ** we	rden 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.		

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terugge			
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 supp Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits f 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, equivale 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	written examination	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and
	seminar project lecture	report skills test oral examination	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	written examination	analyse and control complex production systems by using mathematical models
E005220 Linear Systems	seminar: coached exercises lecture	written examination with open	quantify the impact of variability on the performance of a production system  Knowing and understanding the consequences of the linearity and stationarity of a system; calculating the state trajectory of a
	seminar: coached exercises	questions	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	<u> </u>	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 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

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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.

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#### EMingwALG6.2 Reconcile conflicting specifications and prior conditions in a highquality and innovative concept or process.

Profession-s	pecific	competence
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< EMingwALG6.2 Reconcile conflic	ting specifications and prior	conditions in a highquality	and innovative concept or process.	Profession-specific competend
Course	Teaching methods	Evaluation methods	Course learning outcome	
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	gevonden 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 a machine learning Represent simple motion systems with matrix groups and realize their limitation Discriminate between different task organizations: layers, parallel threads, objuit Understand basic communication techniques: setting up communication, choose Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task manage Understand how basic components of complex mechatronic systems work, es Propose, analyze, select and implement hard- and software solutions for sens mechatronic system	ons ect oriented esing information channel and information content gement specially on the ICT side
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 transier induction machines; modelling of synchronous machines.  Understanding the dynamic behaviour of DC machines, induction and synchrounderstanding the concepts of local stability, static and dynamic stability, inpu control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage su	onous machines. it-output stability, field orientation and vector
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 SKILLS:electronic and thermal aspects	s and transformers with ferrite
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 created self-assessment with adequate and critical self-correction and objectivity.  Communicate adequately on the research, the results and problems, present a laypeople.  Render and synthesise the results concisely.  Critically analyse, formulate, study, execute and/or process different aspects in topical study, research and the reflection on the research, experiments, experimentations, designs, simulation Find an appropriate methodology, in accordance with the applicable scientific	and found them, both to colleagues as to  n the execution of research (literature search, ns, results, conclusions,).

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#### EMingwALG6.3 Synthesize incomplete, contradictory or redundant data into useful information.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werd	en 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.

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Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet teru	ggevonden 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 supportant Gaining insight into the differences and similarities between space vectors and (time) phasors, voltage and temperature limits starting, restraints with
	practicum		classical starting methods, power electronic starting methods, voltage and speed control, current and torque control, forced an 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 or
			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
E037321 Turbomachines	practicum	written examination	and their characteristics  Calculate the flow in a turbomachine using one-dimensional analysis
	seminar: coached exercises		
E019331 ICT and Mechatronics	guided self-study seminar	written examination report	Understanding the reasoning and assumptions behind correct data handling and interpretation, information extraction and machine learning
	project lecture	skills test oral examination	Represent simple motion systems with matrix groups and realize their limitations  Discriminate between different task organizations: layers, parallel threads, object oriented
	lecture	oral examination	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	written examination	Calculation of transient phenomena in electrical circuits; calculation of transients via modelling of of DC machines; modelling o induction machines;
	seminar: coached exercises	Тороп	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	written examination	Using graphical and analytical techniques to investigate dynamical behaviour
	seminar: coached exercises	open book examination	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
E008420 Servo Systems and Industrial Robots	looturo	written examination	Conducting a stability study with linear and nonlinear methods  Discriminate between manipulator and joint space configuration
5000420 Servo Systems and industrial Robots	lecture self-reliant study activities	WITHER EXAMINATION	Know the typical aspects of drives, sensors and controllers used in robot and servo control
	seminar		Propose, analyze, select and implement hard- and software solutions for robot and servo systems.
	practicum		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.
030520 Power Electronics	guided self-study	written examination with open	INSIGHTS: Understanding voltage and current waveforms
	seminar practicum lecture	questions report simulation	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.

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### EMingwALG6.5 Pay attention to entire life cycles of systems, machines, and processes.

Profession-specific competence

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werde	n 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, equivaler 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

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EMingwALG6.6 Pay attention to s	ustainability, energyetticiency,	environmental cost, use	of raw materials and labour costs.	Profession-specific competence
Course	Teaching methods	Evaluation methods	Course learning outcome	
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	gevonden in de studiefiche			
E036130 Controlled Electrical Drives	lecture seminar: coached exercises		Understanding the differences and similarities between space vectors and time phase Gaining insight into the differences and similarities between space vectors and (time starting, restraints with classical starting methods, power electronic starting methods, voltage and speed corload commutation in VSI and CSI, differences and similarities between controlled drives and servo drives, small commutator machines versus DC commutator machines, small versus large induction machines, small versus 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 no circuits for inverters, V/F supply, vector control and field orientation, DTC (direct torque control), servo drives, hystereis motor, stepping motors and their characteristics	phasors, voltage and temperature limits for atrol, current and torque control, forced and all versus large commutator machines, AC us large synchronous machines, effects of modulation principles for inverters, equivalen
E037121 Displacement Pumps, Compressors and IC Engine Fundamentals	lecture		Explain trends in engine design, fuel choice and emission legislation and explain why according to the needs of the application.  Choose a suitable pump, compressor or internal combustion engine type depending 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 induction machines; modelling of synchronous machines.  Understanding the dynamic behaviour of DC machines, induction and synchronous r Understanding the concepts of local stability, static and dynamic stability, input-output control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage surges in	nachines. It stability, field orientation and vector
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 aspinformation processing Know the typical aspects of drives, sensors and controllers used in robot and servo of Propose, analyze, select and implement hard- and software solutions for robot and solution 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	pects related to the hardware and 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 tr SKILLS:electronic and thermal aspects	ansformers with ferrite

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<<	EMingwALG6.7 Pay attention to all aspects of reliability, safety, and ergonomics.
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Profession-specific competence

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet terug	gevonden 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 wersus 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
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
E036900 Dynamics of Electrical Machines and Drives	lecture seminar: practical PC room classes seminar: coached exercises project	written examination report open book examination	mechatronic system  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

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#### EMingwALG6.8 Have insight into and understanding of the importance of entrepreneurship.

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Profession-specific competence

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet t	eruggevonden 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

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#### EMingwALG6.9 Show perseverance, innovativeness, and an aptitude for creating added value.

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Profession-specific competence

Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** wel	rden 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.

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<<	EMingwELME6.1 Integrate the advanced knowledge of mechanical and electrical systems and ICT in order to design, implement and exploit technological innovations.			Profession-specific competer	
Course	_	Teaching methods	Evaluation methods	Course learning outcome	
Noot: leer- en e	evaluatievormen voorafgegaan door ** werden niet terug	gevonden in de studiefiche			
E019331 IC	CT and Mechatronics	guided self-study seminar project lecture	written examination report skills test oral examination	Understanding the reasoning and assumptions behind correct data handling ar machine learning Represent simple motion systems with matrix groups and realize their limitation Discriminate between different task organizations: layers, parallel threads, objet Understand basic communication techniques: setting up communication, choose Design and implement computer-based motion control strategies Name relevant techniques and recognize the dangers for multiple-task manage Understand how basic components of complex mechatronic systems work, esperopose, analyze, select and implement hard- and software solutions for sensi mechatronic system	ns ect oriented sing information channel and information content ement pecially on the ICT side
E007920 Co	omputer Control of Industrial Processes	lecture		To understand the effect of analog-to-digital and digital-to-analog converters or	n system dynamics.
E036900 Dy	ynamics of Electrical Machines and Drives	project seminar: practical PC room classes seminar: coached exercises	report	Calculation of transient phenomena in electrical circuits; calculation of transien induction machines; modelling of synchronous machines.  Understanding the dynamic behaviour of DC machines, induction and synchronous understanding the concepts of local stability, static and dynamic stability, input control, transient and subtransient dynamics of machines; pulsating loading of machines; voltage suitable controls.	nous machines. t-output stability, field orientation and vector
E008420 Se	ervo 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 Po	ower 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 SKILLS:electronic and thermal aspects	
≣091103 Ma	aster'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 cre Self-assessment with adequate and critical self-correction and objectivity.  Communicate adequately on the research, the results and problems, present a laypeople.  Render and synthesise the results concisely.  Critically analyse, formulate, study, execute and/or process different aspects in topical study, research and the reflection on the research, experiments, experimentations, designs, simulations Find an appropriate methodology, in accordance with the applicable scientific re-	and found them, both to colleagues as to  the execution of research (literature search, s, results, conclusions,).

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EMingwELME6.2 Be familiar with systems.	the energy efficiency of (electr	ical, mechanical and ther	mal) energy conversion systems and distribution Profession-specific competence
Course	Teaching methods	Evaluation methods	Course learning outcome
Noot: leer- en evaluatievormen voorafgegaan door ** werden niet ter	uggevonden 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.

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