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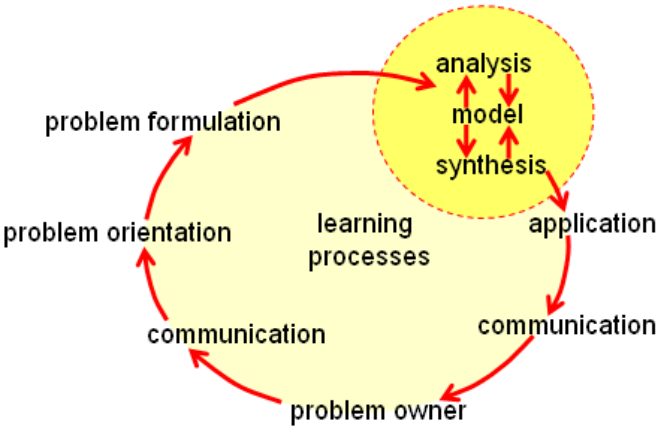
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1 Exam Regulations

These regulations stipulate the following:

1. The rules of conduct for students in written and digital exams and modular exams, insofar as these are not laid down in the Student Charter and the Education and Examination Regulations or related regulations.
2. The rules of conduct for students in review sessions and discussions of exams and modular exams, insofar as these are not laid down in the Student Charter and the Education and Examination Regulations or related regulations.

1 Code of Conduct for students during exams

The facilities provided by HAN for students with respect to exams and modular exams are laid down in the Student Charter and Education and Examination Regulations or related regulations. There is a code of conduct for students. In addition to general provisions, this code of conduct also contains provisions governing the conduct of students at exam venues. These exam regulations contain additional provisions regarding student behaviour during written and digital exams in particular.

Behaviour

The student:

1. follows the instructions given by the supervisor and treats him/her with respect;
2. behaves in such a way that he/she does not disturb other students at any time during the exam or when entering or leaving the exam venue. The student is must be silent before, during and after the exam when in and near the room where the exam is being held;
3. contacts the supervisor a.s.a.p. if anything is unclear before and/or during the exam.

Identification and admission

The student:

1. reports to the supervisor 15 minutes before the start of the exam at the exam room;
2. will only be admitted to the HAN exam if they can identify themselves with a valid student card or a valid proof of identity. This means:
   - a passport;
   - a European identity card;
   - a Dutch driving licence;
   - a European driving licence;
   - a Dutch residence permit.
3. if a student is sitting for a national exam they may only identify themselves with proof of identity;
4. must place his/her valid student card or other form of identification at the top right-hand corner of the desk during the exam so the supervisor can check his/her identity;
5. will have their name checked off the attendance list by the supervisor to confirm his/her participation in the exam;
6. must immediately inform the supervisor if they are not listed on the attendance list. That student will only be given the opportunity to participate in the exam if the course department or school has given prior approval for additions to the attendance list.

Theft/loss of identification

If the student is unable to show identification due to theft or loss, they can apply for a certificate of registration at the Exams Office, which will give them admission to the exam venue. This certificate will only be issued if the student can show the original police report and/or official request to the municipal authorities for new identity papers. The study needs to apply for the certificate well in advance of the exam.

Before the start of the exam

The student:

1. may only place items needed to complete an exam on/next to the table;
2. may not ±unless expressly stated otherwise ±have any of the following in their possession during the exam: digital data carriers or equipment with an integrated digital data carrier, such as USB flash drives, calculators, special watches, special glasses, special earphones, etc.;
3. may not wear a watch. A clock is provided in all exam venues;
4. may not ±unless expressly stated otherwise ±use the following resources during the exam: hard-copy versions of dictionaries, law books, textbooks, etc.; if these resources are permitted, they may be checked by the supervisors;
5. must put their coat, scarf, hat, bags, cases, mobile phone(s), smartphone(s), digital data carrier(s) and any equipment with an integrated digital data carrier(s) in the place specified by the supervisor;
6. must turn off mobile phones, smartphones, etc. before putting them away;
7. must write their name, student number, class/group and other details requested by the supervisor on all exam documents at the start of the exam. The student must also write his/her name on any note paper he/she uses;
8. will not have direct access to the exam venue after the actual start of the exam. Students who do not make it to the exam venue on time are still allowed to enter the exam venue 30 minutes after the actual start of the exam and are allowed to sit the exam for the remainder of the exam time. The supervisor makes a note of which students are late. Students strictly observe instructions given by the supervisors regarding where they are allowed to sit and they do not disturb students who have already started the exam.

During the exam

The student:

1. may not take toilet breaks during exam sessions of 120 minutes or less. During exams that last longer than 120 minutes, students may take a toilet break after 120 minutes if accompanied by a supervisor. Exceptions are possible for all exams in cases of physical discomfort, provided the supervisor is notified no later than 15 minutes before the start of the exam or immediately upon entry when arriving 30 minutes after the start of the exam;
2. may not leave or submit their work during the first 30 minutes of the actual start of an exam (to prevent disruption to other students and/or irregularities); If there are any students who enter the exam venue 30 minutes after the start, any students who want to

leave may only do so after the late students have started their exam;

3. will be given access to additional exam facilities if they are entitled to those facilities in accordance with a study contract or a decision to that effect by the board of examiners. These facilities apply if the student has registered for the exam well in advance;
4. may not consume any food during exams that last less than 150 minutes; students may consume food during exam sessions of 150 minutes or longer if this does not cause a nuisance to fellow students;
5. may only consume drinks from a resealable bottle/container;
6. must use the writing materials specified on the cover sheet (black or blue pen or lead pencil) to complete the exam;
7. must ensure that multiple-choice forms are filled in correctly and according to the instructions given by the supervisor;
8. may not copy an exam or parts thereof in any way or take the exam or its contents outside the exam venues in any manner.

Resources

The student:

1. may not use resources other than those permitted. The permitted resources will be announced in advance by the course department and will be listed on the exam cover sheet;
2. must ensure that resources do not have notes, etc. on them unless the exam cover sheet states that this is permitted.

Suspected irregularity

The student:

1. will be referred to Part 2 of the degree statute (the education and examination regulations), and Part 3, chapter 3, of the degree statute (the regulations of the board of examiners) for provisions concerning irregularities or fraud, penalties for irregularities or fraud and confiscation of evidence;
2. will be permitted by the supervisor to complete the exam in the event of a reasonable suspicion of an irregularity or fraud an G Z L O O V L J Q W K H µ) R U P I R U V X V S H L U U H J X O D U L W \ R U I U D X G ¶ I LWORO HFR QLIQ UEP\ **W K H** \ VKXDSYHHU Y/ LHVHRQU L W

Handing in exam documents

The student:

1. checks before handing in the exam script and assignment(s) whether their name, student number, class/group number and any other details requested by the supervisor have been written correctly on all of the exam documents to be submitted;
2. submits all the exam documents including used and unused note paper to the supervisor and signs the attendance list for confirmation;
3. makes sure everything is left neat and tidy before leaving the exam venue.

2 Code of conduct for students during review/discussion sessions of assessed exam work

There is a code of conduct for students. In addition to general provisions, this code of conduct also contains provisions governing the conduct of students at exam venues.
Below are additional regulations regarding the review of assessed exam work, hereafter referred to DV µUHYLHZ¶

Before the review: Only students who have taken part in the exam for which the review is organised may be present in the classroom. A lecturer and a supervisor will be present during the review.

Behaviour

The student:

1. follows the instructions given by the supervisor and treats him/her with respect;
2. should behave in such a way that he/she does not disturb other students at any time during the review or when entering or leaving the room in which the review takes SODFH KHUHDIWHU UHIHUUHG WR DV WKH µURRP¶
3. must contact the supervisor a.s.a.p. if anything is unclear during the review.

Identification and admission

The student:

1. must show the supervisor a valid student card or another valid form of identification:
   - a passport;
   - a European identity card;
   - a Dutch driving licence;
   - a European driving licence;
   - a Dutch residence permit.

   If the student cannot show a student card or a valid form of identification, they will not be allowed to take part in the review/discussion.
   In the case of theft or loss of the identity document, the student can apply for a certificate of enrolment at the Exams Office, which will give them admittance to the room. This certificate will only be issued if the student can show the original police report and/or official request to the municipal authorities for new identity papers.
2. should have their name checked off the attendance list by the supervisor to confirm their participation in the review/discussion;
3. must place their valid student card or other form of identification at the top right-hand corner of the desk during the review/discussion so the supervisor can check their identity.

Start and resources

The student:

1. must ensure they have a copy of their answer sheet (yellow carbon copy) when reviewing a multiple-choice exam with OMR answer sheet;
2. may only place on the table the permitted resources that are listed on the review cover sheet or that are announced by the supervisor at the start of the review;
3. may not ±unless expressly stated otherwise ±have any of the following in his/her possession during the review: digital data carriers or equipment with an integrated digital data carrier, such

as mobile phone, smartphone, USB flash drive, calculator, special watch, special glasses, special earphones, etc.;

4. must put their coat, scarf, hat, bags, cases, mobile phone(s), smartphone(s), digital data carrier(s) and any equipment with an integrated digital data carrier(s) in the place specified by the supervisor;
5. must ensure their mobile phone(s), smartphone(s) or other digital data carrier(s) and any equipment with integrated digital data carrier(s) are switched off before putting them away;
6. must carefully complete all requested details on the protest form.

During the review/discussion

The student:

1. may not take a toilet break during the review;
2. may not eat anything during the review;
3. may only consume drinks from a resealable bottle/container;
4. may only place one or more of the following permitted documents on the table:
   a. assessment form
   b. yellow carbon copy (of the multiple-choice exam with OMR answer sheet)
   c. exam script
5. may not make any annotations or amendments to the completed exam script. If the student does this anyway, it is reported to the board of examiners as an irregularity.
6. may not copy or take with them any model answers or assignments. Neither may students copy their own exam scripts and/or those of other students.
7. may not copy an exam or parts of an exam in any way or take the exam or its contents outside the exam venues by any other means.

Suspected irregularity

You can refer to the applicable provisions in Part 2 of the degree statute (the education and examination regulations) and Part 3, chapter 3, of the degree statute (the regulations of the board of examiners) for the applicable provisions concerning irregularities or fraud, sanctions for irregularities or fraud and confiscation of evidence.

Submitting reviewed (assessed) exam work

The student:

1. submits all the exam documents received for review to the supervisor and signs the attendance list to confirm this;
2. must make sure everything is left neat and tidy before leaving the room.

3 Final provisions

Unforeseen circumstances

In exceptional situations and cases not provided for by these regulations and in which an immediate decision is necessary, the decision will be taken by:

a. the head of the exams office (in so far as this is within the powers of the exams office);
b. the examiner (in so far this is within their powers);
c. the chair of the board of examiners (in so far as this is within their powers);
d. the supervisor, in consultation with the coordinating supervisor if it is not possible to wait until one of the above authorised people is present.

The interested parties will be informed of the decision as soon as possible.

Complaints and appeals concerning decisions and pro cedures of the exams office

For more on this, see these HAN regulations:

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4 Appendix

Formulier geconstateerde vermoedelijke onregelmatig heid of fraude
Form for suspected irregularity/fraud

Naam surveillant Name of supervisor

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De surveillant grijpt in geval van een redelijk vermoeden van een onregelmatigheid of fraude direct in. Hij laat de student onder voorbehoud het tentamen afmaken en neemt alle bescheiden in waarmee de vermoedelijke onregelmatigheid/fraude heeft plaatsgevonden. De surveillant vult dit formulier in en levert dit met alle bescheiden na afloop van het tentamen direct in bij de coördinator-surveillant. De student ontvangt een kopie van het ingevulde formulier. Via het Tentamenbureau gaat het formulier vervolgens naar de examencommissie. De examencommissie neemt contact op met de student.

The supervisor intervenes immediately in case of a suspected irregularity or fraud. He or she provisionally allows the student to finish the exam, and seizes all documents that he or she suspects are involved in the suspected irregularity/fraud. The supervisor fills in this form and submits it to the coordinating supervisor along with all accompanying items immediately after the exam. The student in question receives a copy of the completed form. The form is then sent to the Board of Examiners via the exams office. The Board of Examiners will contact the student.

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Degree Statute forš Z D • š Œ [•Course Ce

Engineering Systems

of HAN University of Applied Sciences academic year 2022-2023

Part 2 Education and Examination Regulations (EER)
chapter 6
Course catalogue

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1.1. Outline of the curriculum

T Z ‰ Œ } (• •] } v o u • š offered as a full-time and a part-time degree course and covers 90 EC. 60 credits for the teaching phase, 30 of which are targeted at the study track, and 30 credits of the program are offered to all students jointly and 30 EC for the major project.
The full-time programme takes approximately 18 months, including the major project, based on a weekly study load of 40 hours and a break during the summer. Part-time takes approximately t years, based on a weekly study load of 20 hours, including the major project. The degree is divided in modules of 15 EC.

The D • š Œ [• P Œ Engineering Systems offers 2 compulsory modules:

- Applied Control and
- Systems Modelling

We offer you the following elective modules grouped by tracks:

Tracks	Elective modules
AS Automotive Systems:	Advanced Vehicle Dynamics Advanced Controller Design Hydrogen technology Innovations in Powertrains Sustainable Fuel Engines and Emissions Smart Infrastructure Smart Vehicles
CES Control & Embedded Systems	Advanced Controller Design Big Data & Small Data Distributed Systems
SE Sustainable Energy	Hydrogen Technology Smart Power Supply Sustainable Energy Systems (mandatory for SE
	Theoretical part of Big Data & Small Data : can followed by students AS and SE during the electives or together with the major project.

1.2. Competences / final qualifications and the Dublin descriptors

The competences (final qualifications) for the Master are defined as follows:

	Final qualification	Description
C1	Analysing and defining problems	To be able to critically analyse the engineering problem through active communication with the problem owner, to translate this a problem formulation, feasible solution approaches and scientifically valid conclusions and recommendations, to be communicated again to the problem owner.
C2	Design	To be able to systematically translate the engineering problem model at an abstract level, (i.e. reducing it to its essentials in te of model and problem requirements) and to validate results against the real life situation and problem formulation.
C3	Testing	To be able to systematically translate the engineering problem concrete level, and to validate results against the real life situat and problem formulation.
C4	Managing work processes:	To be able to put engineering activities within the perspective o engineering company processes, including quality control principles. To be able to incorporate the economical (cost) and societal (safety, sustainability) consequences in the design or development process.
C5	Conducting research	To have gained specialized scientific knowledge and skills in th field of engineering.
C6	Communication and collaboration	To be able to work on a problem within a multidisciplinary conte in an industrial environment. To be able to work on a problem i an international engineering context in an industrial environmer
C7	Professional developmer	To be able, through self Œ (o š] } v U š }] u ‰ Œ } À } professional acting

And the following Dublin descriptors:

	Dublin descriptor	Description
DD1	Knowledge and understanding	Provides a basis or opportunity for originality in developing or applying ideas often in a research context.
DD2	Applying knowledge an understanding	Through problem solving abilities applied in new or unfamiliar environments within broader (or multidisciplinary) context.
DD3	Making judgements	Demonstrates the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete data.
DD4	Communication	Of their conclusions and underpinning knowledge and rationale (restricted scope) to specialist and non-specialist audiences (monologue).
DD5	Learning skills	Study in a manner that may be largely self-directed or autonomous.

The modules (mentioned on page 3) consists of a number of units of study. All these study units relate to the qualifications (page 4) we intend to teach you. The description relates the content of individual study unit to the qualifications, through the test criteria of the assessment of the study unit. These test criteria are included in the description as the learning outcomes. This relation between the criteria study unit, the qualifications and the Dublin descriptors are summarized in Assessment why and how. As all modules together cover all qualifications, a completion of the modules with sufficient mark entitles you to receive the degree Master of Science (MSc.).

1.3. Modules and the units of study

Below you find a schematic overview that gives you an overall impression of the degree program. It also describes the elective units in the degree program.

Units of study: mandatory (60 EC)

M SM	Module Systems Modelling			
Teaching Term	Semester 1			
Overview units of study	Units of Study		EC	study load
	M SM AP	Applied Physics	2.0	56
	M SM IM	Introduction Modelling	2.0	56
	M SM PMS	Practice Modelling and Simulation	2.0	56
	M SM EBM	Energy Based Modelling	2.0	56
	M SM SI	System Identification	2.0	56
	M SM MP	Systems Modelling Minor Project including Research Sk	5.0	140
			15	420

M AC	Module Applied Control			
Teaching Term	Semester 1 / Semester 2			
Overview units of study	Units of Study		EC	study load
	M AC FC	Feedback Control	4.0	112
	M AC ACS	Apply Control Strategy	2.0	56
	M AC CI	Controller Implementation	2.0	56
	M AC MSO	Multivariable systems and optimizations	2.0	56
	M CD MP	Applied Control Minor Project	5.0	140
			15	420

M MAJP	Module Major Project			
Teaching Term	Semester 1 / Semester 2			
Overview units of study	Units of Study		EC	study load
	M MAJP MP	Major Project	28	784
	M MAJP MWP	Managing Work Processes	2	56
			30	840

Modules and units of study: electives

Track Automotive:

a. Advanced Vehicle Dynamics & Control

M AVD	Module Advanced Vehicle Dynamics			
Teaching Term	Semester 1 / Semester 2			
Overview units of study	Units of Study /		EC	study load
	M AVD T	Advanced Vehicle Dynamics Theory	7.5	210
	M AVD CS	Advance Vehicle Dynamics Capita Selecta	2.5	70
	M AVD MP	Advanced Vehicle Dynamics Minor Project	5.0	140
			15	420

M ACD	Module Advanced Controller Design			
Teaching Term	Semester 2			
Overview units of study	Units of Study		EC	study load
	M ACD T	Advanced Controller Design Theory	7.5	210
	M ACD CS	Advanced Controller Design Capita Selecta	2.5	70
	M ACD MP	Advance Control Minor Project	5.0	140
			15	420

b. Green Mobility

M IPT	Module Innovations in Powertrains			
Teaching Term	Semester 1 / Semester 2			
Overview units of study	Units of Study		EC	study load
	M IPT T	Innovations in Powertrains Theory	7.5	210
	M IPTCS	Innovations in Powertrains Capita Selecta	2.5	70
	M IPTMP	Innovations in Powertrains Minor Project	5.0	140
			15	420

M HT	Module Hydrogen Technology			
Teaching Term	Semester 2			
Overview units of study	Units of Study		EC	study load
	M HT T	Hydrogen Technology Theory	7.5	210
	M HT CS	Hydrogen Technology Capita Selecta	2.5	70
	M HT MP	Hydrogen Technology Minor Project	5.0	140
			15	420

M SFEE	Module Sustainable Fuel, Engines and Emissions			
Teaching Term	Semester 2			
Overview units of study	Units of Study		EC	study load
	M SFEE T	Sustainable Fuel Engines and Emissions T	5.0	140
	M SFEE I	Sustainable Fuel Engines and Emissions CS	5.0	140
	M SFEE MP	Sustainable Fuel Engines and Emissions Minor Project	5.0	140
			15	420

c. Smart Mobility

M SI	Module Smart Infrastructure			
Teaching Term	Semester 2			
Overview units of study	Units of Study		EC	study load
	M SI T	Smart Infrastructure Theory	7.5	210
	M SI CS	Smart Infrastructure Capita Selecta	2.5	70
	M SI MP	Smart Infrastructure Minor Project	5.0	140
			15	420

M SV	Module Smart Vehicles			
Teaching Term	Semester 1 / Semester 2			
Overview units of study	Units of Study		EC	study load
	M SV T	Smart Vehicles Theory	7.5	210
	M SV CS	Smart Vehicles Capita Selecta	2.5	70
	M SV MP	Smart Vehicles Minor Project	5.0	140
			15	420

Track Control & Embedded Systems:

M ACD	Module Advanced Controller Design			
Teaching Term	Semester 2			
Overview units of study	Units of Study		EC	study load
	M ACD T	Advanced Controller Design Theory	7.5	210
	M ACD CS	Advanced Controller Design Capita Selecta	2.5	70
	M ACD MP	Advance Control Minor Project	5.0	140
			15	420

M BDSD	Module Big Data & Small Data			
Teaching Term	Semester 1 / Semester 2			
Overview units of study	Units of Study		EC	study load
	M BD DCML	Data Collection and machine learning	7.5	210
	M BD ASI	Apply Systems Identification (Capita Selecta)	2.5	70
	M BD MP	Big Data & Small Data Minor Project	5.0	140
			15	420

M DS	Module Distributed Systems			
Teaching Term	Semester 2			
Overview units of study	Units of Study		EC	study load
	M DS T	Distributed Systems Theory	7.5	210
	M DS CS	Distributed Systems Capita Selecta	2.5	70
	M DS MP	Distributed Systems Minor Project	5.0	140
			15	420

Track Sustainable Energy:

M HT	Module Hydrogen Technology			
Teaching Term	Semester 2			
Overview units of study	Units of Study		EC	study load
	M HT T	Hydrogen Technology Theory	7.5	210
	M HT CS	Hydrogen Technology Capita Selecta	2.5	70
	M HT MP	Hydrogen Technology Minor Project	5.0	140
			15	420

M SPS	Module Smart Power Supplies			
Teaching Term	Semester 2			
Overview units of study	Units of Study		EC	study load
	M SPS EN	Energy Management	2.5	70
	M SPS PC	Power Control	2.5	70
	M SPS PQ	Power Quality	2.5	70
	M SPS AM	Asset Management	2.5	70
	M SPS MP	Smart Power Supplies Minor Project	5.0	140
			15	420

M SES	Module Sustainable Energy Systems			
Teaching Term	Semester 1			
Overview units of study	Units of Study		EC	study load
	M SES T	Sustainable Energy Technology	5.0	140
	M SES I	Energy System Integration	5.0	140
	M SES MP	Sustainable Energy Minor Project	5.0	140
			15	420

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Module code AEA MES M AC	Applied Control
Degree program	Master Engineering Systems
Target Group	All students, mandatory
Coordinating Lecturer	Richard Kaandorp
Registering for educational components	In case of first semester: week 0 Week 2.3 / 2.4 in case of joining the module in semester 2 Week 4.3 / 4.4 in case of joining the module in semester 1
Professional Task	Design and test a controller
Professional Products	Models
Credits / Study load	15 EC / 420 hours
Relationship with and entry requirements concerning examinations	Simultaneously to the Module Systems Modelling or (for part time students) after taking classes Systems Modelling
General Description	In this module the student will gain knowledge on designing a PID, lag-lead or digital controller. Furthermore, the usefulness a specific control strategy will be discussed using different papers. This strategy can solve problems that can occur wher using the classical control theory. Finally, when having various options for defining a controller, an optimal path would be helpful. This can reduce cost for example and makes it neces to define an objective function. The theory learned will be implemented in a platform and run a practical setup. The student learns to design a controller for a practical setup the following design steps and tasks: x Creating a feedback controller x Analysing an uncontrolled system x Applying an advanced control strategy x Applying a controlled system
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Units of study	Feedback Control (4 EC) Apply Control Strategy (2 EC) Controller Implementation (2 EC) Multivariable systems and optimizations (2 EC) Applied Control Project (5 EC)

Unit of Study (UoS) AEA MES M AC FC	Feedback Control
General Information	
Long name of unit of study	Feedback Control
Short name of unit of study	Feedback Control
Alluris unit of study name	Feedback Control
Code for unit of study OSIRIS	AEA MES M AC FC
Alluris unit of study code	M AC FC
Teaching Term	Semester 1 Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	4 EC / 112 hours
Study hours (contact hours)	38 contact hours + 3 contact hours exam
Entry requirements	It is expected that the student has mastered basic mathematic skills specifically 1st and 2nd order differential equations, matrix calculations and calculations with complex numbers.
Content and organization	
General description	In this course students will learn how to design a PID, lag-lead digital controller. A variety of processes is used to illustrate th design procedure. The controllers will be presented in functional block diagrams and within the time, Laplace and frequency domain. Specific techniques are used, such as notch filtering, wind-up preventi and Smith predictor. Also, a digital controller will be designed.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Nise N.S., Control Systems Engineering, John Wiley & Sons Handouts Specific articles about control structures
Recommended literature	-
Required software	Matlab, Simulink
Cohesion Relationship	Units of study: Applied Control Module: Systems Modelling
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Self-study, Working on assignments and exercises, Modelling with Matlab-Simulink

	Work Forms: Lectures, review exercises, discussion
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design of controllers
Assessment dimensions / learning outcomes	Dimensions of assessment: - Knowledge and understanding (analysing and defini problems, design of controllers) - Applying knowledge and understanding (design of controllers) - Making judgements (design of controllers) The student can analyse the physical system (first and secon order, higher order) and/or a model (linear/ nonlinear, SISO/MIMO). The student can apply techniques such as Pole/zero-plot and step/ramp responses in order to determine the requirements the controlled system. The student can agree on specifications (stability, offset, settli time, overshoot, phase and gain margin) of the controller with the client. The student can apply techniques such as Bode plots (open l closed loop) and Nyquist diagrams in order to determine the requirements of the controlled system. The student can model components in the digital control loop and make use of sampling and conversions to agree on specifications of the controller. (M AC FC HTE)
Assessment criteria	M AC FC WE assessment criteria: The student will be assessed on answering the questions: x clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of t literature studied x without irrelevant additional information x using correct equations and models for the situation (f example when to use linear or nonlinear models) x using correct units for quantities in equations, graph labels, etc. M AC FC HTE assessment criteria: The student will be assessed on the criteria mentioned on the evaluation form. (next page)
Information for each exam and modular exam	

Examinations	Exam name	MES AC FC written exam	MES AC FC Home taken exam
	Exam code	AEA MES AC FC W	AEA MES AC FC HTE
	Registering for re-exam from 01-02-2023 OSIRIS	Week 3.5 / 3.6 Week 4.12 for August	Week 4.5 / 4.6 Week 4.12 for August
	Deregistering for exams	Till date of exam	
	Exam week	Week 1.9 / 3.9	Week 2.9 and 4.9
	First examiner	Richard Kaandorp / Nico Bouwman / Stefan Sterkenburg / Hatim Mala	
	Exam method	Written exam	Home taken exam
	Permitted resources	Open book exam Book Nise Computer with Matlab-Simulink	Everything, but all results must be the • š µ v š [• } Á work
	Number of examiners	1	1
	Assessment	mark	mark
	Pass mark	55	
	Minimal result	45	45
	Weight	1	1
	Reassessment	1	1
	Compensation	yes	
	Review	Week 2.4 and 4.4	Evaluation form week 3.4 and 4.12
Other information			
Required classroom	Regular classroom		

Feedback Control part 2: Digital Control

Evaluation and Awarding Marks
Name: Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y
Student number: Y Y Y Y Y Y Y Y Y Y Y

	Mark	Motivation	Weight factor
Applying knowledge and understanding C1Analysing en defining problems C2 Design The student can apply the basics of discrete signal processing of linear time-invariant systems (z-transform discrete transfer function, difference equation). The student can derive the frequency behaviour of a discrete (control) system. The student can design a discrete control system using sampling principles, the theorem of Shannon and z-transform. The student can apply Tustin and Euler approximations. The methods and techniques are properly used. The student shows sufficient analytical skills to master the problem at hand.			1
Making judgments C2 Design The student can assess the stability and transient response behaviour of discrete systems. The student is able to correctly interpret the quality of the results.			1
Mark total			

Date: Signature examiner:

Unit of Study (UoS) MES M AC ACS	Apply Control Strategies
General Information	
Long name of unit of study	Apply Control Strategies
Short name of unit of study	Apply Control Strategies
Alluris unit of study name	Apply Control Strategies
Code for unit of study OSIRIS	AEA MES M AC ACS
Alluris unit of study code	M AC ACS
Teaching Term	Semester 1 (term 2) Semester 2 (term 4)
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2 EC / 56 hours
Study hours (contact hours)	16 contact hours
Entry requirements	Simultaneously to the Module Systems Modelling or after taki classes Systems Modelling
Content and organization	
General description	In this course students learn how to design specific structures which there is interaction between control loops. The goal is t improve the transient response behavior. The control strategy (feedforward, cascade, compensation, override) is used for a limited amount of control goals. The students will work on a few case-studies that are based o scientific papers.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Handouts
Recommended literature	Scientific papers
Required software	MATLAB/Simulink
Cohesion Relationship	Units of study: Applied Control Module: Systems Modelling
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Self-study, warm-up tests, case studies Work forms: Lectures, interactive simulation exercises, assignments, reporting
Examinations	

Final Qualifications	C2 Design C5 Conducting Research	
Assessment dimensions / learning outcomes	Dimensions of assessment: - Applying knowledge and understanding (design of controllers and testing of controlled systems) - Making judgements (testing controlled systems) The student can apply control strategies such as feedforward, cascade, compensation and override with use of frequency-response and root-locus techniques.	
Assessment criteria	M AC ACS HTE assessment criteria: The student will be assessed on the criteria (the questions) mentioned on the evaluation form (next page)	
Information for each exam and modular exam		
Examinations	Exam name	MES AC ACS Home taken exa
	Exam code	AEA MES AC ACS
	Registering for re-exam OSIR	Week 4.5 / 4.6 Week 4.12 for August
	Deregistering for exams	Till date of exam
	Exam week	Week 2.9 and 4.9
	First examiner	Richard Kaandorp / Dixon Devasia / Karl Wallkum
	Exam method	Home taken exam
	Permitted resources	Everything, but all results must š Z • š µ v š [• } Á v
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1
	Compensation	No
	Review	Evaluation form week 3.4 and 4.12
Other information		
Required classroom	Regular classroom	

Apply Control Strategies

Evaluation and Awarding Marks

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Unit of Study (UoS) AEA MES M AC CI	Controller Implementation (Capita Selecta)
General Information	
Long name of unit of study	Controller Implementation
Short name of unit of study	Controller Implementation
Alluris unit of study name	Controller Implementation
Code for unit of study OSIRIS	AEA MES M AC CI
Alluris unit of study code	M AC CI
Teaching Term	Semester 1 Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2 EC / 56 hours
Study hours (contact hours)	16 contact hours
Entry requirements	Simultaneously to the Module Systems Modelling or after taki classes Systems Modelling
Content and organization	
General description	In this course the implementation and evaluation of a controlle on different platforms (SIL, PIL, HIL) or for an application in vehicle dynamics control is set up. It is important to structure t program to keep a good overview. Also, safety should be take into account. The programs Labview and Matlab Simulink can downloaded from internet. For PLC the Codesys software is provided. After a short introduction, a practical example is worked out and tested.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Lecturing material and hand-outs available on Onderwijs Onli
Recommended literature	-
Required software	Matlab, Simulink, Simmechanics, Labview, PLC, Hantune
Cohesion Relationship	Units of study Systems Modelling Units of study Applied Control
Compulsory participation	Yes
Activities and/or instructional formats	Home study, working on practical assignments Work forms: Lectures, interactive simulation exercises, assignments, reporting
Examinations	

Final Qualifications	C3 Testing controlled system	
Assessment dimensions / learning outcomes	Dimensions of assessment: - Applying knowledge and understanding (testing of controlled systems) - Making judgements (testing of controlled systems) - Communication (testing) - Learning skills (testing The student can implement, test and evaluate a controller on appropriate specific platform (e.g. SIL, PIL, HIL) for thermodynamic, hydraulic, mechanic processes or an applica in vehicle dynamics and can check whether control specificati are met.	
Assessment criteria	M AC CI HTE assessment criteria: The student will be assessed on the criteria mentioned on the evaluation form (next page)	
Information for each exam and modular exam		
Examinations	Exam name	MES AC CI home taken exam
	Exam code	AEA MES AC CI HTE
	Registering for re-exam OSIRIS	Week 4.5 / 4.6 Week 4.12 for August
	Deregistering for exams	Till date of exam
	Exam week	Week 2.10 and 4.10
	First examiner	Richard Kaandorp / Nico Bouwman Karl Wallkum Hand in: MES AC supervisors of M
	Exam method	Home taken exam
	Permitted resources	Everything, but all results must be š Z • š µ v š [• } Á v Á } Œ
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1
	Compensation	No
	Review	Evaluation form in week 3.4 and 4.1
Other information		
Required classroom	Control Systems lab	

Controller Implementation,Evaluation and Awarding Marks

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Unit of Study (UoS) AEA MES M AC MSO	Multivariable systems and optimization
General Information	
Long name of unit of study	Multivariable systems and optimization
Short name of unit of study	Multivariable systems and optimization
Alluris unit of study name	Multivariable systems and optimization
Code for unit of study OSIRIS	AEA MES M AC MSO
Alluris unit of study code	M AC MSO
Teaching Term	Semester 1 (term 1) Semester 2 (term 3)
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2 EC / 56 hours
Study hours (contact hours)	16 contact hours and 3 contact hours exam
Entry requirements	It is expected that the student has mastered basic mathematic skills specifically differential equations and matrix calculations
Content and organization	
General description	This course covers the essential concepts of linear systems a control methodologies based on state-space models with (possibly) multiple inputs and multiple outputs. First, several structural properties are considered, such as input-output stability, internal stability, controllability and observability. Secondly, feedback strategies based on the state and the out are studied, and includes the notions of stabilizability and detectability, as well as the design of state observers and dynamic compensators. In the last part of the course, the theo of linear quadratic regulators (LQR) and the application of cos functions is introduced to optimally tune the feedback controllers. Computations, analysis and control designs will be mainly performed usingD š o – • ^ } v š Œ } o ^ Ç • š u • d } to real-life systems. This course is complementary to the cour ^ & l } v š Œ } o _ U] X X U • š š • ‰ u function based analysis and design. Time-domain versus frequency domain approachd } P š Z Œ Á] š Z š Z } µ } v š Œ } o _ š Z] • } µ Œ • Á] o o (} Œ u š Z • world of control systems engineering and beyond.

Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Nise N.S., Control Systems Engineering, John Wiley & Sons Handouts / Manuals
Recommended literature	
Required software	MATLAB/Simulink
Cohesion Relationship	Units of study Systems Modelling Units of study Applied Control
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Working on practical assignments Work forms: Lectures, interactive simulation exercises, assignments
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design
Assessment dimensions / learning outcomes	Dimensions of assessment: - Knowledge and understanding (analysing control systems) - Applying knowledge and understanding (designing control systems the student is able to x identify whether a system is fully controllable, stabilizable, observable, detectable, and can check internal and input-output stability using state-space models; x design pole-placement controllers and state observers x specify a cost function and to design an optimal dynan compensator.
Assessment criteria	The student will be assessed on answering the questions: x clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of t literature studied x without irrelevant additional information x using correct equations and models for the situation (f example when to use linear or nonlinear models) x using correct units for quantities in equations, graph labels, etc. x
Information for each exam and modular exam	

Examinations	Exam name	MES AC MSO written exam
	Exam code	AEA MES AC MSO WE
	Registering for re-exam OSIRIS	Week 3.5 / 3.6 Week 4.12 for August
	Deregistering for exams	Till date of exam
	Exam week	Week 1.9 and 3.9
	First examiner	Dimitri Jeltsema / Richard Kaandorp
	Exam method	Written exam
	Permitted resources	Reader, lecture slides, computer with Matlab-Simulink
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1
	Compensation	No
	Review	Week 2.4 and week 4.4
Other information		
Required classroom	Regular classroom	

Unit of Study (UoS) AEA MES M AC MP	Applied Control Minor Project
General Information	
Long name of unit of study	Applied Control Minor Project
Short name of unit of study	Applied Control MP
Alluris unit of study name	Applied Control Minor Project
Code for unit of study OSIRIS	AEA MES M AC MP
Alluris unit of study code	M AC MP
Teaching Term	Semester 1 Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to regi for the educational components you wish to follow. See Part 3 Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] } v U Æ u more information.
Credits/study load	5 EC / 140 hours
Study hours (contact hours)	28 contact hours and 4 contact hours presentation
Entry requirements	Simultaneously to the Module Systems Modelling or after taking classes Systems Modelling
Content and organization	
Professional task	Development of a controller
(Professional) products	Controller implementation, documentation/presentation
General description	The Project serves to challenge the students to apply their knowledge and skills on a real-life problem, in correspondence w a subset of the final qualifications. The project covers the followi topics: x The problem to be solved requires an understanding and active analysis of distinctive disciplines. x The project will always include the step from a real-life problem to a more abstract representation of the problem x physical system: PN-plot, bode, step responses, linear/nonlinear; Control goals; Requirements: Stability, Offset, Settling time, Overshoot, Phase and gain margin; SISO/MIMO; system engineering x Controller design: [analog] PID, lead, lag, anti-windup, smith predictor, bumpless transfer. [digital] Euler/Tustin, zoh, sampling, PWM, bang-bang.

	The problem analysis will result in a problem solution to be translated in such terms that conclusions can be drawn based or extent the problem has been solved and objectives fulfilled. Part of the project is the peer review: In a peer review session th contribution of the group members to the project is determined b the group members themselves. The focus is on content and collaboration. Ideally the supervisor (tutor) is also present, but th is not strictly necessary. Students should be aware of their own functioning within the project group, so should arrange peer feedback within their project group regularly (at least twice during the project).
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Project Management, A Practical Approach, Roel Grit, Noordhoff Uitgevers, ISBN 9789001790929 Report Writing for readers with little time, Rien Elling, Bas Andew Noordhoff Uitgevers, ISBN 9789001812591
Recommended literature	-
Required software	Matlab Simulink
Cohesion Relationship	Units of study Applied Control
Compulsory participation	Yes
Activities and/or instructional formats	Research Work Forms: Lectures, Assignment
Examinations	
Final Qualifications	C1Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Assessment dimensions / learning outcomes	Dimensions of assessment: - Applying knowledge and understanding (analysing and defining problems, design of controllers, testing of controlled systems, conducting research) - Making judgements (analysing and defining problems, design of controllers, testing of controlled systems, conducting research) - Communication (managing work processes, communica and collaboration)

	- Learning skills (professional development) Learning outcomes: The student presents a clear justification of the project approach The student plans effectively. The student carries out a project based on a real-life problem in which model development and analysis as well as experimental validation are essential parts by applying knowledge and understanding and making judgements based on analysis and validation techniques. The student structures the working process in the engineering domain and is able to effectively communicate the core findings i structured and convincing way. The student is able to systematically search for information, such e.g. models, and judge its relevance. The student communicates the project findings in a clear and structured manner with colleague, customers and the wider publi in oral and written forms. The content has been reviewed by pee and/or supervisor. The student reflects on his/her role in the project and on his/her professional development. The student can design and create an analog and/or digital feedback controller for linear physical system choosing appropria techniques (applying anti-windup and bumpless transfer scheme selecting resolution and sample rate).
Assessment criteria	The student will be assessed on the criteria mentioned on the evaluation forms. The result of the MP is determined by 3 exams 1. Project Plan: For the Project Plan a pass or no pass will be defined by the examiner. The project plan has to be sufficient before starting the execution of the project. 2. Group Contribution: For the contribution of the individual student to the group a pass no pass will be defined by the examiners. The examiners can us outcome of the peer review, but also can deviate from it. 3. Report and Presentation: For the Report and Presentation a group mark will be given by th examiners. The individual student mark is equal to the group ma ‰ Œ } À] š Z š š Z Group Contribution is sufficient (pass). the Group Contribution of the student is insufficient, no mark will given and the student is unable to finish the minor project.

Information for each exam and modular exam				
Examinations	Exam name	MES AC MP Project Plan	MES AC MP group contribution	MES AC MP R Report & Presentation
	Exam code	AEA MES AC MP PP	AEA MES AC MP GC	AEA MES AC MP RP
	Registering for re-exam OSIRIS	2.2 /4.2	-	4.10
	Deregistering for exams	Till date of exam		
	Exam week	1.9/ 3.9	2.9/2.10 and 4.9/4.10	
	First examiner: Richard Kaandorp / Nico Bouwman / Aishwarya Aswal / Hatim Mala			
	Exam method	Project Plan	Group contribution	Report & presentation
	Permitted resources: Everything, but all results must be the • š µ v š [• work v			
	Number of examiners:	1	At least 1	2
	Assessment	Pass	pass	Mark
	Pass mark	Pass	pass	55
	Minimal result	Pass	pass	55
	Weight	0	0	1
	Reassessment	1 (2.4 / 4.4)	1 (4.12)	
	Compensation	No		
	Review: Feedback after presentation / evaluation form in week 3 and 4.12			
Other information				
Required classroom	Control systems lab			

Project Applied Control: Project plan
Evaluation and Awarding Marks
Name, first v u Y Y Y

Project Applied Control: Report and Presentation
Evaluation and Awarding Marks

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Communication C4: Managing work processes C6: Communication and Collaboration The student can communicate his project findir and defend choices in a clear and structured manner in oral and written forms. The student is able to present the results to a problem owner. The student is able to work in a project team. The text is clearly understandable and in grammatically sound language. The formal requirements for literary sources ha been met.			1
Learning Skills C7: Professional development The student is able to reflect on his role in the project and on his professional development. Does the student display discernible eagerness tackle the task? The problem owner is involved adequately. The student shows problem solving skills. The student is self-reliant. The student reflects on the choices made.			1
Final Mark (group) For a pass all marks should be sufficient			

Date :

Name and signature examiner 1 :

Name and signature examiner 2 :

Module code AEA MES M SM	Systems Modelling
Degree program	Master Engineering Systems
Target Group	All students, mandatory
Coordinating lecturer	Frank Poelmans
Registering for educational components	In case of first semester education: week 0
Professional Task	Modelling Systems
Professional Products	Models
Credits / Study load	15 EC / 420 hours
Relationship with and entry requirements concerning examinations	First module after admission to the program (basic module)
General Description	In this module the student will gain knowledge on analysing physical systems in the mechanical, electrical and thermodynar fluid dynamic domains. Models for physical systems will be established by using white modelling and by using experimental data. Furthermore computer simulations of established models will b performed to analyse the systems behaviour. The models will be validated by collecting relevant datasets or designing a validation experiment. Finally the theory learned will be implemented in a modelling ca where the student also learns to evaluate relevant literature on modelling and learns to create a report and a presentation on t modelling-simulation-validation process.
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Units of study	Applied Physics (2 EC) Introduction Modelling (2 EC) Energy Based Modelling (2 EC) Practice Modelling and Simulation (2 EC) System Identification (2 EC) Systems Modelling Minor Project (5 EC)

Unit of Study (UoS) AEA MES M SM AP	Applied Physics
General Information	
Long name of unit of study	Applied Physics
Short name of unit of study	Applied Physics
Alluris unit of study name	Applied Physics
Code for unit of study OSIRIS	AEA MES M SM AP
Alluris unit of study code	M SM AP
Teaching Term	Term 1 Term 3
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. ^ W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2 EC / 56 hours
Study hours (contact hours)	16 contact hours + 3 contact hours exam
Entry requirements	It is expected that the student has mastered basic mathematics skills specifically differential equations.
Content and organization	
General description	The course Applied Physics (AP) covers the following topics: Mechanical systems: x Dynamics and kinematics of general motion of a body (translations, rotations, moment of inertia, transmissions energy conservation) x Vibrations with multiple DOF (free vibrations, excited vibrations) x 1st and 2nd order mechanical systems Electrical systems: x Electrical networks x Operational amplifier circuits x Electromechanical systems Thermodynamic/Fluid dynamic systems: x Energy balances, mass balances x Heat transfer, Bernoulli flow equation x 1st law and 2d law of thermodynamics x Reversible changes of ideal gas, thermodynamic diagra
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	x Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, International Student Version (2011) x Engineering Mechanics: Dynamics SI Edition,

	R.C. Hibbeler, 14th Edition, Pearson, ISBN 9781292088 x Norman S. Nise, Control Systems Engineering, 8th editi (EMEA edition), Wiley, ISBN 978-1-119-59013-2 x Reader Introduction Dynamics, E. Tazelaar et al, HAN, x Lecturing material available on Onderwijs Online
Recommended literature	x Transport Phenomena, The art of Balancing H. vd Akker, R.F. Mudde, Delft Academic Press, ISBN 9789065623584
Required software	-
Cohesion Relationship	Units of study Systems Modelling
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Self-study, Working on assignments and exercises Work Forms: Lectures
Examinations	
Final Qualifications	C1 Analysing and defining problems
Assessment dimensions / learning outcomes	Dimensions of assessment: - Knowledge and understanding (analysing and defining problems) The student is able to analyse moderately complex physical systems in the mechanical, electrical and/or thermodynamic/flu dynamic domains by describing the systems with differential equations. The system descriptions are found via white box modelling.
Assessment criteria	The student will be assessed on answering the questions: x clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of the literature studied x without irrelevant additional information x using correct equations and models for the situation (for example when to use linear or nonlinear models) x using correct units for quantities in equations, graph labels, etc.
Information for each exam and modular exam	

Examinations	Exam name	MES SM AP written exam
	Exam code	AEA MES SM AP WE
	Registering for re-exam from 01-02-2023 OSIRIS	Week 3.5 and 3.6 Week 4.12 in case of August
	Deregistering for exams	Till date of exam
	Exam week	Week 1.9 and 3.9
	First examiner	Frank Poelmans / Joke Westra Aishwarya Aswal
	Exam method	Written exam
	Permitted resources	Open book
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1
	Compensation	No
	Review	Week 2.4 and 4.4
Other information		
Required classroom	Regular classroom	

Unit of Study (UoS) AEA MES M SM IM	Introduction Modelling
General Information	
Long name of unit of study	Introduction Modelling
Short name of unit of study	Introduction Modelling
Alluris unit of study name	Introduction Modelling
Code for unit of study OSIRIS	AEA MES M SM IM
Alluris unit of study code	M SM IM
Teaching Term	Term 1 Term 3
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] Exau • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2 EC / 56 hours
Study hours (contact hours)	16 contact hours + 3 contact hours exam
Entry requirements	It is expected that the student has mastered basic mathematics skills specifically Differential equations, Linear algebra, Laplace transforms and Complex numbers.
Content and organization	
General description	The course Introduction Modelling (IM) covers the following topics: x Modelling goals, process definitions, data flow diagram x 4+1 step approach x Model equations and mathematical solutions x Conversion of differential equations into transfer functio x Model simulation (Simulink, pole-zero map, step-respor bode plot) x Conversion of differential equations into state space models x Process delays, nonlinear systems x Introduction to multi domain systems
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, International Student Version (2011) Norman S. Nise, Control Systems Engineering, 8th edition (EM edition), Wiley, ISBN 978-1-119-59013-2 Reader Introduction Dynamics, E. Tazelaar et al, HAN, 2016 Lecturing material available on Onderwijs Online

Recommended literature	-
Required software	Matlab, Simulink
Cohesion Relationship	Units of study Systems Modelling
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Self-study, Working on assignments, Simulation exercises, Cas studies Work Forms: Lectures
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design
Assessment dimensions / Learning outcomes	Dimensions of assessment: - Knowledge and understanding (analysing and defining problems) - Applying knowledge and understanding (Design physica systems) The student is able to analyse moderately complex physical systems in the mechanical, electrical and/or thermodynamic/flu dynamic domains by describing the systems with either differer equations, transfer functions, state-space models or Bode diagrams in order to determine the system characteristics and b able to perform computer simulations. The student is able to describe the system using methods like white box modelling or step response experiments assuming lowest possible complexi for the analysis of relevant system characteristics.
Assessment criteria	The student will be assessed on answering the questions: x clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of the literature studied x without irrelevant additional information x using correct equations and models for the situation (for example when to use linear or nonlinear models) x using correct units for quantities in equations, graph labels, etc.
Information for each exam and modular exam	

Examinations	Exam name	MES SM IM written exam
	Exam code	AEA MES SM IM
	Registering for re-exam from 01-02-2023 OSIRIS	Week 3.5 and 3.6 Week 4.12 in case of August
	Deregistering for exams	Till date of exam
	Exam week	Week 1.9 and 3.9
	First examiner	Richard Kaandorp / / Mitul Saini / Georges Jreij
	Exam method	Written exam
	Permitted resources	Open book
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1
	Compensation	No
	Review	Week 2.4 and 4.4
Other information		
Required classroom	Regular classroom	

Unit of Study (UoS) AEA MES M SM PMS	Practice Modelling and Simulation
General Information	
Long name of unit of study	Practice Modelling and Simulation
Short name of unit of study	Practice Modelling and Simulation
Alluris unit of study name	Practice Modelling and Simulation
Code for unit of study OSIRIS	AEA MES M SM PMS
Alluris unit of study code	SM PMS
Teaching Term	Term 1 / Term 3
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2 EC / 56 hours
Study hours (contact hours)	16 contact hours
Entry requirements	There are no further entry requirements after admission
Content and organization	
General description	PMS covers model assignments and simulations with Matlab-Simulink. x General software introduction in Matlab, Simulink x Simulation and analysis a system using different mode (i.e. differential equations, state-space and transfer functions) x Analysis of basic cases (exercises at HAN, home take each student separately) based on the domains treate in AP and IM (i.e. mechanical, electrical and thermodynamic/fluid dynamic) x Performing system verification and validation x Perform parametric analysis on systems for using loop x Creating an efficient connection between scripting and Simulink modelling x Effectively plotting relevant data
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Lecturing material and hand-outs available on Onderwijs Onli
Recommended literature	-
Required software	Matlab, Simulink
Cohesion Relationship	Units of study Systems Modelling
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Home study, working on practical assignments

	Work forms: Lectures, interactive simulation exercises, assignments, reporting, presentations	
Examinations		
Final Qualifications	C2 Design C3 Testing	
Assessment dimensions / Learning outcomes	Dimensions of assessment: Applying knowledge and understanding (design, testing) The student is able to analyse, model, verify and validate a gi system (in terms of differential equations) which can be from different application fields (i.e. mechanical, electrical and thermodynamic/fluid dynamic) in modelling software(e.g. Matlab, Simulink or similar tools). The student is able to convert the system into different models i.e. state-space and transfer function models. The verification is performed with logical inputs along with log references. The validation is done by importing, filtering and comparing relevant datasets with the model data and/or by performing sensitivity analysis on the system parameters.	
Assessment criteria	The student will be assessed on the criteria (questions) mentioned on the evaluation form. (next page)	
Information for each exam and modular exam		
Examinations	Exam name	MES SM PMS Home Taken Exam
	Exam code	AEA MES SM PMS
	Registering for re-exam from 01-02-2023 OSIRIS	Week 3.5 and 3.6 Week 4.12 in case of August
	Deregistering for exams	Till date of exam
	Exam week	Assignment: week 1.5 and 3.5 Hand in: week 1.9 and 3.9
	First examiner	Hatim Mala / Mitul Saini
	Exam method	Home taken exam
	Permitted resources	Everything, but all results must be š Z • š µ v š [• } Á v Á } Œ
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1
	Compensation	No
	Review	Evaluation form in week 2.4 and 4.4
Other information		
Required classroom	Regular classroom	

Practice Modelling and Simulation

Evaluation and Awarding Marks

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Unit of Study (UoS) AEA MES M SM EBM	Energy Based Modelling
General Information	
Long name of unit of study	Energy based Modelling
Short name of unit of study	Energy based Modelling
Alluris unit of study name	Energy based Modelling
Code for unit of study OSIRIS	AEA MES M SM EBM
Alluris unit of study code	M SM EBM
Teaching Term	Term 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2 EC / 56 hours
Study hours (contact hours)	16 contact hours and 3 contact hours exam
Entry requirements	It is expected that the student has mastered basic mathematic skills specifically differential equations and matrix calculations
Content and organization	
General description	The course Energy Based Modelling (EBM) covers the followi topics: x Introduction to Energy Based Modelling x Generalized variables and coordinate transformations x Energy and power functions x Euler-Lagrange equation x , u] o š } v [• ‰ Œ] v] ‰ o U , u] o š } v] v x Modelling complex systems in mechanical and electri domain x Modelling multi-domain systems
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Lecturing material and hand-outs, available on Onderwijs Onl
Recommended literature	-
Required software	-
Cohesion Relationship	Units of study Systems Modelling
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Self-study, Working on assignments and exercises Work Forms: Lectures
Examinations	

Final Qualifications	C1 Analysing and defining problems C2 Design C5 Conducting Research	
Assessment dimensions / Learning outcomes	Dimensions of assessment: - Knowledge and understanding (analysing and defining problems, conducting research) - Applying knowledge and understanding (design) The student is able to analyse complex mono-/multi-physical systems in the mechanical, electrical and/or thermodynamic/fluid dynamic domains by describing the syste with either differential and algebraic equations, transfer functions or state-space representations. The system descriptions are found via advanced white box modelling based on the internal energy of the system.	
Assessment criteria	The student will be assessed on answering the questions: x clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of t literature studied x without irrelevant additional information x using correct equations and models for the situation (f example when to use linear or nonlinear models) x using correct units for quantities in equations, graph labels, etc.	
Information for each exam and modular exam		
Examinations	Exam name	MES SM EBM written exam
	Exam code	AEA MES SM EBM
	Registering for re-exam from 01-02-2023 OSIRIS	Week 4.12
	Deregistering for exams	Till date of exam
	Exam week	Week 2.9
	First examiner	Dimitri Jeltsema / Frank Poelmans
	Exam method	Written exam
	Permitted resources	Calculator, handouts
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1 (August)
	Compensation	no
	Review	Week 3.4
Other information		
Required classroom	Regular classroom	

Unit of Study (UoS) AEA MES M SM SI	System Identification
General Information	
Long name of unit of study	System Identification
Short name of unit of study	System Identification
Alluris unit of study name	System Identification
Code for unit of study OSIRIS	AEA MES M SM SI
Alluris unit of study code	M SM SI
Teaching Term	Term 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ /tiZ/s^ Z Ed p o tions for Education, Exams and Modular Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2 EC / 56 hours
Study hours (contact hours)	16 contact hours
Entry requirements	There are no further entry requirements after admission to the program.
Content and organization	
General description	Topics: x Data use x Parameter estimation x Sensitivity analysis x Validation
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	x Reader System Modelling, Data Regression and Syste Identification, x Lecture notes, P. van Kan, HAN 2018 x Lecturing material available on Onderwijs Online
Recommended literature	-
Required software	Matlab
Cohesion Relationship	Units of study Systems Modelling
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Self-study, working on assignments Work forms: lectures
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C6 Communication and collaboration

Assessment dimensions / Learning outcomes	Dimensions of assessment: x Knowledge and understanding (Analysing and defining problems) x Applying knowledge and understanding (Design) x Communication (Reporting)) The student is able to demonstrate understanding of systems identification on an introductory level regarding data and mod structure. The student is able to estimate parameters in a linear/nonline systems model from real measurement data using (weighted) least-squares methods. The student is able to evaluate a model structure based on output data and goodness of fit. The student communicates the findings of the assignment in a clear and structured manner in written form.	
Assessment criteria	The student will be assessed on the criteria (questions) mentioned on the evaluation form. (next page)	
Information for each exam and modular exam		
Examinations	Exam name	MES SM SI Home Taken Exam
	Exam code	AEA MES SM SI
	Registering for re-exam from 01-02-2023 OSIRIS	Week 4.12
	Deregistering for exams	Till date of exam
	Exam week	Assignment: week 2.6 and 4.6 Hand in: week 2.9 and 4.9
	First examiner	Paul van Kan / Hatim Mala
	Exam method	Home taken exam
	Permitted resources	Everything, but all results must š Z • š µ v š [• } Á v
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1 (August)
	Compensation	No
	Review	Evaluation form in week 3.4
Other information		
Required classroom	Regular classroom	

System Identification

Evaluation and Awarding Marks
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Unit of Study (UoS) AEA MES M SM MP	Systems Modelling Minor Project
General Information	
Long name of unit of study	Systems Modelling Minor Project
Short name of unit of study	Systems Modelling MP
Alluris unit of study name	Systems Modelling Minor Project
Code for unit of study OSIRIS	AEA MES M SM MP
Alluris unit of study code	M SM MP
Teaching Term	Semester 1
Registering for educational components	For all education offered after 31 January 2023, you need to regi for the educational components you wish to follow. See Part 3 Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] } v U Æ u more information.
Credits/study load	5 EC / 140 hours
Study hours (contact hours)	28 contact hours and 4 contact hours presentation
Entry requirements	There are no further entry requirements after admission to the program.
Content and organization	
Professional task	Evaluate relevant literature and Analyse and validate the model
(Professional) products	Model Report (literature review) and presentation
General description	The students have to carry out an assignment, of which model development and analysis as well as experimental validation are essential parts. The Project serves to challenge the students to apply their knowledge and skills on a real-life problem, in correspondence w a subset of the final qualifications and the course discusses the s needed to perform a research project and includes performing a literature study. Part of the project is the peer review: In a peer review session th contribution of the group members to the project is determined b the group members themselves. The focus is on content and collaboration. Ideally the supervisor (tutor) is also present, but th is not strictly necessary. Students should be aware of their own functioning within the project group, so should arrange peer feedback within their project group regularly (at least twice during the project).
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	B. Hanington, B. Martin, Universal Methods of Design, Rockport Publishers Inc. 2012 Project Management, A Practical Approach, Roel Grit, Noordhoff Uitgevers, ISBN 9789001790929 Report Writing for readers with little time, Rien Elling, Bas Andew Noordhoff Uitgevers, ISBN 9789001812591
Recommended literature	-

Required software	Matlab Simulink
Cohesion Relationship	Units of study Systems Modelling
Compulsory participation	Yes
Activities and/or instructional formats	Research Work Forms: Lectures, Assignment
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Assessment dimensions / Learning outcomes	Dimensions of assessment - Knowledge and understanding (Conducting Research) - Applying knowledge and understanding (Analysing and defining problems, Design, Conducting Research) - Making judgements (Analysing and defining problems, Design, Conducting Research - Communication (Managing work processes, Communicat and Collaboration) - Learning skills (Professional development) Learning outcomes: The student presents a clear justification of the project approach The student plans effectively (M SM MP PP). The student carries out a project based on a real-life problem in which model development and analysis as well as experimental validation are essential parts by applying knowledge and understanding and making judgements based on analysis and validation techniques. The system descriptions are found via whi box modelling or step response experiments. The student structures the working process in the engineering domain and is able to effectively communicate the core findings i structured and convincing way. The student is able to systematically search for information, such e.g. models, and judge its relevance. The student communicates the project findings in a clear and structured manner with colleague, customers and the wider publi in oral and written forms. The content has been reviewed by pee and/or supervisor. The student reflects on his/her role in the project and on his/her professional development (M SM MP RP).

<table>
<tr><td>Assessment criteria</td><td colspan="4">The student will be assessed on the criteria mentioned on the evaluation forms. The result of the MP is determined by 3 exams
1. Project Plan:
For the Project Plan a pass or no pass will be defined by the examiner. The project plan has to be sufficient before starting the execution of the project.
2. Group Contribution:
For the contribution of the individual student to the group a pass no pass will be defined by the examiners. The examiners can us outcome of the peer review, but also can deviate from it.
3. Report and Presentation:
For the Report and Presentation a group mark will be given by th examiners. The individual student mark is equal to the group ma ‰ Œ } À] š Z š š Z • š µ v š [• ' Œ } µ ‰ } v š Œ the Group Contribution of the student is insufficient, no mark will given and the student is unable to finish the minor project.</td></tr>
<tr><td colspan="5">Information for each exam and modular exam</td></tr>
<tr><td rowspan="13">Examinations</td><td>Exam name</td><td>MES SM MP Project Plan</td><td>MES SM MP Group Contribution</td><td>MES SM MP RP Report & Presentation</td></tr>
<tr><td>Exam code</td><td>AEA MES SM MP PP</td><td>AEA MES SM MP GC</td><td>AEA MES SM MP DD</td></tr>
<tr><td>Registering for re-exam OSIRIS</td><td>Week 2.2</td><td>-</td><td>Week 4.5 / 4.6</td></tr>
<tr><td>Deregistering for exams</td><td colspan="3">Till date of exam</td></tr>
<tr><td>Exam week</td><td>Week 1.9</td><td>Week 2.10</td><td>Week 2.9/2.10 Report/Pres</td></tr>
<tr><td>First examiner</td><td colspan="3">Frank Poelmans</td></tr>
<tr><td>Exam method</td><td>Project Plan</td><td>Group contribution</td><td>Report and Presentation</td></tr>
<tr><td>Permitted resources</td><td colspan="3">À Œ Ç š Z] v P U µ š o o Œ • µ o š own work</td></tr>
<tr><td>Number examiners</td><td>1</td><td>At least 1</td><td>2</td></tr>
<tr><td>Assessment</td><td>Pass</td><td>Pass</td><td>mark</td></tr>
<tr><td>Pass mark</td><td>pass</td><td>Pass</td><td>55</td></tr>
<tr><td>Minimal result</td><td>pass</td><td>Pass</td><td>55</td></tr>
<tr><td>Weight</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Reassessment</td><td>1 (2.4)</td><td colspan="2">1 (4.12)</td></tr>
<tr><td>Compensation</td><td>No</td><td colspan="2">No</td></tr>
<tr><td>Review</td><td>Evaluation form in week 2.4</td><td colspan="2">Feedback after presentation / evaluation form in week 3.4 an 4.12</td></tr>
<tr><td colspan="5">Other information</td></tr>
<tr><td>Required classroom</td><td colspan="4">Regular classroom</td></tr>
</table>

Project Systems Modelling: Project plan

Evaluation and Awarding Marks
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Do the students display discernible keenness to tackle the task (initiative, deadline handling)? Is the problem owner involved adequately?			
Pass total For a pass all items should be sufficie			

Date :

Signature examiner :

Project Systems Modelling: Report and Presentation

Evaluation and Awarding Marks

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Collaboration Can the student communicate his project findings and defend choices in a clear and structured manner in oral and written forms? Is the student able to present the result to a problem owner? Is the student able to work in a project team? Is the text clearly understandable and in grammatically sound language? Have the formal requirements for literary sources been met?			
Learning Skills C7: Professional development is the student able to reflect on his role in the project and on his professional development? Does the student displays discernible eagerness to tackle the task? Is the problem owner involved adequately? Does the student show problem solving skills? Is the student self-reliant? Does the student reflect on the choices made?			
Final Mark (group) For a pass all marks should be sufficient			

Date :
Signature examiner 1 :
Signature examiner 2 :

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Module code AEA MES M ACD	Advanced Controller Design
Degree program	Master Engineering Systems
Target Group	Elective module
Coordinating lecturer	Dimitri Jeltsema
Registering for educational components	Week 2.3/2.4 in case of joining the module in semester 2 Week 4.3/4.4 in case of joining the module in semester 1
Professional Task	Analyse, synthesize and apply advanced control methods
Professional Products	Models
Credits / Study load	15 EC / 420 hours
Relationship with and entry requirements concerning examinations	Applied Control Systems Modelling
General Description	This module deals with modelling, analysis and control of nonlinear, time-varying and uncertain systems. This module learns the student to: x distinguish between linear and nonlinear systems properties; x decide when to apply linear and when to apply nonlinea theory; x determine several stability properties for nonlinear systems; x apply energy-based concepts for stabilization; x determine controllability and observability properties for nonlinear systems; x design linearizing feedback transformations; x formulate and synthesize optimal control problems; x apply robust, adaptive and predictive control methods; work in both continuous and discrete time settings.
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Units of study	Advanced Controller Design Theory (7.5 EC) Advanced Control Design Capita Selecta (2.5 EC) Advanced Control project (5.0 EC)

Unit of Study (UoS) AEA MES M ACD T	Advanced Controller Design Theory
General Information	
Long name of unit of study	Advanced Controller Design Theory
Short name of unit of study	Advanced Controller Design T
Alluris unit of study name	Advanced Controller Design Theory
Code for unit of study OSIRIS	AEA MES M ACD T
Alluris unit of study code	M ACD T
Teaching Term	Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	7.5 EC / 210 hours
Study hours (contact hours)	64 contact hours
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organization	
General description	The student learns how to apply several linear and nonlinear analysis and control techniques to different nonlinear processes and simulate them using Matlab.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Lecturing material (readers, papers and handouts) will be made available on Onderwijs Online
Recommended literature	-
Required software	Matlab / Simulink
Cohesion Relationship	Module Applied Control Module Systems Modelling Advanced Controller Design CS Advanced Controller Design MP
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Self-study, case-studies, working on practical assignments. Work forms: Lectures, interactive simulation exercises, assignments, reporting practical assignments.
Examinations	
Final Qualifications	C2 Design of controllers

Assessment dimensions / learning outcomes	Dimensions of assessment: - Knowledge and understanding (analysis) - Applying knowledge and understanding (design of controllers) The student is able to apply and evaluate various linear techniq applied to nonlinear systems. The student is able to carry out a basic analysis of nonlinear systems. The student is able to apply energy-based modelling and contr various real-life systems. ACD T HTE1 The student is able to apply adaptive, robust and optimal contr techniques to linear and nonlinear systems. The student is able carry out further analysis of nonlinear systems. (ACD HTE2)		
Assessment criteria	The student will be assessed on the criteria (questions) mentio on the evaluation form. (next page)		
Information for each exam			
Examinations	Exam name	MES ACD T Home taken exam 1	MES ACD T Home taken exam 2
	Exam code	AEA MES ACD T HTE1	AEA MES ACD T HTE2
	Registering for re-exam OSIRIS	Week 4.12	Week 4.12
	Deregistering for exams	Till date of exam	
	Exam week	Week 3.9	Week 4.9
	First examiner	Dimitri Jeltsema / Hatim Mala / Aart-Jan d Graaf	
	Exam method	Home taken exam	Home taken exam
	Permitted resources	Everything, but all results must be the • š µ v š [• } Á v Á } Œ l	
	Number of examiners	1	1
	Assessment	Mark	Mark
	Pass mark	55	
	Minimal result	45	45
	Weight	1	1
	Reassessment	1 (August)	1 (August)
	Compensation	yes	
	Review	Evaluation form in week 3.4	Evaluation form in week 4.12
Other information			
Required classroom	Regular classroom + H2.04		

Theory classes of advanced controller design
Evaluation and Awarding Marks
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Unit of Study (UoS) AEA MES M ACD CS	Advanced Controller Design Capita Selecta
General Information	
Long name of unit of study	Advanced Controller Design Capita Selecta
Short name of unit of study	Advanced Controller Design CS
Alluris unit of study name	Advanced Controller Design Capita Selecta
Code for unit of study OSIRIS	AEA MES M ACD CS
Alluris unit of study code	M ACD CS
Teaching Term	Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. S W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ laµ Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2.5 EC / 56 hours
Study hours (contact hours)	32 contact hours
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organisation	
General description	Study various linear and nonlinear control techniques and ap š Á } ‰ Œ š] µ o Œ } v • ~ • š µ v š [• } Á v setup designed in the Minor Project.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	To be decided during class, depending on the subject.
Recommended literature	To be decided during class, depending on the subject.
Required software	-
Cohesion Relationship	Module Applied Control Module Systems Modelling Advanced Controller Design T Advanced Controller Design MP
Compulsory participation	Yes
Activities and instructional formats	Self-study, case studies Work forms: Lectures, interactive simulation exercises, assignments, reporting
Examinations	
Final Qualifications	C5 Conducting research

Assessment dimensions / Learning outcomes	Dimensions of assessment: - knowledge and understanding (conducting research and Professional Development) - Applying knowledge and understanding (conducting research) - Making judgements (conducting research) - Communication (conducting research) - Learning skills (conducting research) The student shows how to implement and evaluate control methodologies in a real-life environment.	
Assessment criteria	The student will be assessed on the criteria mentioned on th evaluation form.	
Information for each exam		
Examinations	Exam name	MES ACD home taken exam
	Exam code	AEA MES ACD CS
	Registering for re-exam from 01-02-2023 OSIRIS	week 4.10
	Deregistering for exams	Till date of exam
	Exam week	Week 4.9
	First examiner	Dimitri Jeltsema / Hatim Mala / Aart-Jan de Graaf
	Exam method	Home taken exam: Article
	Permitted resources	Everything, but all results u µ • š š Z • š µ v work
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1 (Week 4.12)
	Compensation	No
	Review	Evaluation form in week 4.1(
Other information		
Required classroom	Regular classroom / H2.04	

Advanced Controller Design: Capita Selecta

Evaluation and Awarding Marks

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Unit of Study (UoS) AEA MES M ACD MP	Advanced Controller Design Minor Project
General Information	
Long name of unit of study	Advanced Controller Design Minor Project
Short name of unit of study	Advanced Controller Design MP
Alluris unit of study name	Advanced Controller Design Minor Project
Code for unit of study OSIRIS	AEA MES M ACD MP
Alluris unit of study code	M ACD MP
Teaching Term	Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š]] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	5.0 EC / 140 hours
Study hours (contact hours)	64 contact hours and 4 contact hours presentation
Entry requirements	Joined classes in Applied Control and Systems Modelling Successfully finished the exams of the minor projects Systems Modelling and Applied Control.
Content and organisation	
Professional task	Synthesis of a control system in incremental steps
(Professional) products	Controller implementation Project documentation, Presentation
General description	The project serves to challenge the students to apply their knowledge and skills on a real-life problem, in correspondence with a subset of the final qualifications. The problem to be solve requires application of advanced control theory to real-life problems. Part of the project is the peer review: In a peer review session contribution of the group members to the project is determined the group members themselves. The focus is on content and collaboration. Ideally the supervisor (tutor) is also present, but t is not strictly necessary. Students should be aware of their own functioning within the project group, so should arrange peer feedback within their project group regularly (at least twice duri the project).
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Project Management, A Practical Approach, Roel Grit, Noordho Uitgevers, ISBN 9789001790929 Report Writing for readers with little time, Rien Elling, Bas Andeweg, Noordhoff Uitgevers, ISBN 9789001812591
Recommended literature	-
Required software	Matlab / Simulink. Students will build their own Arduino-based control system. Please reserve (approximately) 100 euro to ord the required components and materials.

Cohesion Relationship	Module Applied Control Module Systems Modelling Advanced Controller Design T and CS
Compulsory participation	Yes
Activities and/or instructional formats	Research Work Forms: Lab sessions and assignments Development of a control system.
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Assessment dimensions / Learning outcomes	Assessment dimensions: x Applying knowledge and understanding (analysing and defining problems, design, testing, conducting research) x Making judgements (analysing and defining problems, des testing, conducting research) x Communication (managing work processes, communicatio and collaboration) x Learning skills (professional development) Learning outcomes: The student presents a clear justification of the project approac The student plans effectively. The student carries out a project based on a real-life problem i which model development and analysis as well as experimenta validation are essential parts by applying knowledge and understanding and making judgements based on analysis and validation techniques. The student structures the working process in the engineering domain and is able to effectively communicate the core findings a structured and convincing way. The student is able to systematically search for information, su as e.g. models, and judge its relevance. The student communicates the project findings in a clear and structured manner with colleague, customers and the wider pub in oral and written forms. The content has been reviewed by pe and/or supervisor. The student reflects on his/her role in the project and on his/he professional development.

	The student evaluates, justifies and applies various linear and nonlinear analysis and control techniques for a given process.		
Assessment criteria	The student will be assessed on the criteria mentioned on the evaluation forms. The result of the MP is determined by 2 exams 1. Group Contribution: For the contribution of the individual student to the group a pas or no pass will be defined by the examiners. The examiners can use the outcome of the peer review, but als can deviate from it. 2. Report and Presentation: For the Report and Presentation a group mark will be given by the examiners. The individual student mark is equal to the P Œ } µ ‰ u Œ l ‰ Œ } À] š Z š š Z • š µ v š sufficient (pass). If the Group Contribution of the student is insufficient, no mark will be given and the student is unable to finish the minor project.		
Information for each exam			
Examinations	Exam name	MES ACD MP Group Contribution	MES ACD MP Documentation and Defence
	Exam code	AEA MES ACD M GC	AEA MES ACD MP DD
	Registering for re-exam from 01-02-2023 OSIRIS	-	Week 4.10
	Deregistering for exams	Till date of exam	
	Exam week	Week 4.9 / 4.10	
	First examiner	Dimitri Jeltsema / Hatim Mala / Aart-Ja de Graaf	
	Exam method	Group contribution	Documentation / presentation
	Permitted resources	Everything, but all results must be the • š µ v š [• } Á v Á } Œ l	
	Number of examiners	At least 1	2
	Assessment	Pass	Mark
	Pass mark	Pass	55
	Minimal result	Pass	55
	Weight	0	1
	Reassessment	-	1 (Week 4.12)
	Compensation	No	
	Review	Feedback after presentation / evaluation form in week 4.12	
Other information			
Required classroom	Control systems lab (H2.04)		

Advanced Controller Design: Project Documentation and Presentation,
Evaluation and Awarding Marks

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Module code AEA MES M AVD	Advanced Vehicle Dynamics
Degree program	Master Engineering Systems
Target Group	Elective module
Coordinating lecturer	Saskia Monsma
Registering for educational components	Week 2.3/2.4 in case of joining the module in semester 2 Week 4.3/4.4 in case of joining the module in semester 1
Professional Task	Model and validate linear and nonlinear vehicle dynamics
Professional Products	Project plan Report Model + data Presentation (progress and final)
Credits / Study load	15 EC / 420 hours
Relationship with and entry requirements concerning examinations	Systems Modelling and Applied Control
General Description	The module covers: modelling and validation of vehicle dynamics: linear and nonline steady state and non-steady state, without and with (driver) control, emphasizing tires, driver, passenger cars, articulated vehicles and motorcycles.
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Units of study	Advanced Vehicle Dynamics Theory 7.5 EC Advanced Vehicle Dynamics Capita Selecta 2.5 EC Advanced Vehicle Dynamics Minor Project 5.0 EC

Unit of Study (UoS) AEA MES M AVD T	Advanced Vehicle Dynamics Theory
General Information	
Long name of unit of study	Advanced Vehicle Dynamics Theory
Short name of unit of study	Advanced Vehicle Dynamics T
Alluris unit of study name	Advanced Vehicle Dynamics Theory
Code for unit of study OSIRIS	AEA MES M AVD T
Alluris unit of study code	M AVD T
Teaching Term	Semester 1 / Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	7.5 EC / 210 hours
Study hours (contact hours)	64 contact hours + 3 contact hours exam (written exam AVD1 and 20 minutes oral exam AVD2)
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organisation	
General description	The study unit covers modelling of vehicle dynamics: linear and nonlinear, steady state and non-steady state, without and with (driver) control, emphasizing tires, driver, passenger cars, articulated vehicles and motorcycles.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Readers, book chapters, papers and lecturing material and han outs, all available on Onderwijs Online
Recommended literature	Alessandro Genta and Giancarlo Genta, Road Vehicle Dynamic Fundamentals of Modeling and Simulation, 2016, World Scienti ISBN 9814713430, 9789814713436 Joop P. Pauwelussen, Essentials of Vehicle Dynamics, 2014, Butterworth-Heinemann, ISBN: 9780081000366 R.J. Jagacinski, J.M. Flach, Control Theory for Humans, ISBN nr. 0805822925 V. Cossalter, Motorcycle Dynamics, 2nd edition (2006), ISBN nr. 97 t 1 t 4303 t 0861 t 4 P.Sweatman (ed.), PBS Explained, Performance Based Standar for Road Transport Vehicles, Report Australian Road Transport Suppliers Association (2003)
Required software	Matlab/Simulink

Cohesion Relationship	Module Applied Control Module Systems Modelling Advanced Vehicle Dynamics CS Advanced Vehicle Dynamics MP
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Self-study, Working on assignments Work Forms: Lectures (flipped classroom)
Examinations	
Final Qualifications	C1 Analysing and defining problems
Assessment dimensions / learning outcomes	Dimensions of assessment: x Knowledge and understanding (analysing and defining problems) The student is able to analyse, synthesize and evaluate (AVD V x linear and nonlinear tire dynamics and models, including main influences like load transfer, combined slip, cambe suspension characteristic x steady state vehicle handling based on the single-track vehicle model including nonlinear tire models x vertical vehicle dynamics related to road input The student is able to analyse, synthesize and evaluate (AVD C x steady state and non-steady state dynamics of tires, passenger vehicles, articulated vehicles and motorcycle x closed-loop driver vehicle system dynamics and modelli with the preview driver model.
Assessment criteria	The student will be assessed (M AVD WE and M AVD OE) on answering the questions: x clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of the literature studied x without irrelevant additional information x using correct equations and models for the situation (for example when to use linear or nonlinear models) x using correct units for quantities in equations, graph labels, etc. M AVD WE and M AVD OE: The WarmUp Test result given by lecturer during the lecturing of the theory determines 20% of the score of the written (re-) exam M AVD WE and 20% of the oral

	(re-)exam M AVD OE. There are no separate WarmUp Tests f re-exams.		
Information for each exam			
Examinations	Exam name	MES AVD T written exam	MES AVD T oral exam
	Exam code	AEA MES AVD T W	AEA MES AVD T OE
	Registering for re-exam from 01-02-2023 OSIRIS	Week 3.5 and 3.6 Week 4.12	Week 4.5 and 4.6 Week 4.12
	Deregistering for exams	Till date of exam	
	Exam week	Week 1.9 / 3.9	Week 2.9 / 4.9
	First examiner	Saskia Monsma / Thymen Kamerling / Ka Kural / Mitul Saini / Rene Gerritsen	
	Exam method	Written exam	Oral exam
	Permitted resources	Simple scientific calculator	none
	Number of examiners	1	2
	Assessment	Mark	Mark
	Pass mark	55	
	Minimal result	45	45
	Weight	1	1
	Reassessment	1	1
	Compensation	yes	
	Review	Week 2.4 / 4.12	Feedback after presentation / evaluation form week 3.4 and 4.12
Other information			
Required classroom	Regular classroom / ARLA		

Advanced Vehicle Dynamics T (oral part)

Evaluation and Awarding Marks
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Unit of Study (UoS) AEA MES M AVD CS	Advanced Vehicle Dynamics Capita Selecta
General Information	
Long name of unit of study	Advanced Vehicle Dynamics Capita Selecta
Short name of unit of study	Advanced Vehicle Dynamics CS
Alluris unit of study name	Advanced Vehicle Dynamics Capita Selecta
Code for unit of study OSIRIS	AEA MES M AVD CS
Alluris unit of study code	M AVD CS
Teaching Term	Semester 1 / Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. S W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2.5 EC / 56 hours
Study hours (contact hours)	16 contact hours
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organisation	
General description	The theory of AVD is deepened and extended with relevant, actual topics, for example: - vehicle modelling and simulation - control applications in AVD - tire design and performance - race car data analysis - scientific papers on AVD This will be done with different work forms, for example: - guest lectures from industry and/or research - modelling and simulation assignments - review and presentation of scientific papers - workshops
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Handouts
Recommended literature	-
Required software	Matlab/Simulink
Cohesion Relationship	Module Applied Control Module Systems Modelling Advanced Vehicle Dynamics T Advanced Vehicle Dynamics MP

Compulsory participation	Yes	
Activities and/or instructional formats	Self-study, case studies Work forms: Lectures, interactive simulation exercises, assignments, reporting	
Examinations		
Final Qualifications	C2 Design C5 Conducting Research	
Assessment dimensions / Learning outcomes	Dimensions of assessment: x Knowledge and understanding (conducting research) x Applying knowledge and understanding (conducting research) The student has gained a deepened and /or applied scientifi knowledge and skills in the topics covered in this Capita Sel	
Assessment criteria	The student will be assessed on the criteria mentioned on th evaluation form.	
Information for each exam		
Examinations	Exam name	MES AVD CS Article
	Exam code	AEA MES AVD CS
	Registering for re-exam from 01-02-2023 OSIRIS	Week 4.10
	Deregistering for exams	Till date of exam
	Exam week	Week 2.9 and 4.9
	First examiner	Saskia Monsma / Mitul Saini / Thymen Kamerling / Karel Kura
	Exam method	Home taken exam
	Permitted resources	Everything, but all results must š Z • š µ v š [• } Á v
	Number of examiners	1
	Assessment	Mark (= mean of all assignmen marks)
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1
	Compensation	No
	Review	Review week 3.3 / 4.12
Other information		
Required classroom	Regular classroom	

Advanced Vehicle Dynamics: Capita Selecta, Evaluation and Awarding Marks
Name, first v u Y Y Y

Unit of Study (UoS) AEA MES M AVD MP	Advanced Vehicle Dynamics Minor Project
General Information	
Long name of unit of study	Advanced Vehicle Dynamics Minor Project
Short name of unit of study	Advanced Vehicle Dynamics MP
Alluris unit of study name	Advanced Vehicle Dynamics Minor Project
Code for unit of study OSIRIS	AEA MES M AVD MP
Alluris unit of study code	M AVD MP
Teaching Term	Semester 1 / Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	5 EC / 140 hours
Study hours (contact hours)	20 contact hours and 4 contact hours presentation
Entry requirements	Joined classes in Applied Control and Systems Modelling Successfully finished the exams of the minor projects Systems Modelling and Applied Control.
Content and organisation	
Professional task	Model and validate linear and nonlinear vehicle dynamics
(Professional) products	Model, report, presentation and defence
General description	Students have to carry out an assignment including a literature survey, of which model development and analysis as well as (vehicle instrumentation and) experimental validation and parameter identification are essential parts. Examples are: x To improve a chassis design through damper adjustment x To derive and validate an experimental way to identify and analyse driver control parameters (gains, lead- and lag time delay time,..) Part of the project is the peer review: In a peer review session contribution of the group members to the project is determined the group members themselves. The focus is on content and collaboration. Ideally the supervisor (tutor) is also present, but t is not strictly necessary. Students should be aware of their own functioning within the project group, so should arrange peer feedback within their project group regularly (at least twice duri the project).
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Project Management, A Practical Approach, Roel Grit, Noordho Uitgevers, ISBN 9789001790929 Report Writing for readers with little time, Rien Elling, Bas Andeweg, Noordhoff Uitgevers, ISBN 9789001812591

Recommended literature	-
Required software	Matlab/Simulink
Cohesion Relationship	Module Applied Control, Module Systems Modelling Advanced Vehicle Dynamics T Advanced Vehicle Dynamics CS
Compulsory participation	Yes
Activities and/or instructional formats	Research Work Forms: Lectures, assignment, lab/testing guidance, supervisor meetings
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Assessment dimensions / learning outcomes	Dimensions of assessment: x Applying knowledge and understanding (Analysing and defining problems, Design, Conducting Research) x Making judgements (Analysing and defining problems, Des Conducting Research x Communication (managing work processes, communicatio and collaboration) x Learning skills (professional development) Learning outcomes: The student presents a clear justification of the project approac The student plans effectively. The student carries out a project based on a real-life problem i which model development and analysis as well as experimenta validation are essential parts by applying knowledge and understanding and making judgements based on analysis and validation techniques. The student structures the working process in the engineering domain and is able to effectively communicate the core findings a structured and convincing way. The student is able to systematically search for information, su as e.g. models, and judge its relevance. The student communicates the project findings in a clear and structured manner with colleague, customers and the wider pub in oral and written forms. The content has been reviewed by pe and/or supervisor. The student reflects on his/her role in the project and on his/he professional development.

<table>
<tr><td>Assessment criteria</td><td colspan="4">The student will be assessed on the criteria mentioned on the evaluation forms. The result of the MP is determined by 3 exams
1. Project Plan:
For the Project Plan a pass or no pass will be defined by the examiner. The project plan has to be sufficient before starting t execution of the project.
2. Group Contribution:
For the contribution of the individual student to the group a pas or no pass will be defined by the examiners. The examiners ca the outcome of the peer review, but also can deviate from it.
3. Report and Presentation:
For the Report and Presentation a group mark will be given by examiners. The individual student mark is equal to the group m ‰ Œ } À] š Z š š Z • š µ bu šo n is s E fi c ie nt (p as s
If the Group Contribution of the student is insufficient, no mark will be given and the student is unable to finish the minor proje</td></tr>
<tr><td colspan="5">Information for each exam</td></tr>
<tr><td rowspan="15">Examinations</td><td>Exam name</td><td>MES AVD MP Project Plan</td><td>MES AVD MP Group Contribution</td><td>MES AVD MP Doc. & defence</td></tr>
<tr><td>Exam code</td><td>AEA MES AVD MP PP</td><td>AEA MES AVD MP GC</td><td>AEA MES AVD MP DP</td></tr>
<tr><td>Registering for re-exam from 01-02-2023 OSIRIS</td><td>Week 2.2/4.2</td><td>-</td><td>Week 4.10</td></tr>
<tr><td>Deregistering for exams</td><td colspan="3">Till date of exam</td></tr>
<tr><td>Exam week</td><td>Week 1.9/3.9</td><td colspan="2">Week 2.9/2.10 and 4.9/4.10</td></tr>
<tr><td>First examiner</td><td colspan="3">Saskia Monsma / Thymen Kamerling / Mitul Saini / Rene Gerritsen</td></tr>
<tr><td>Exam method</td><td>PP and presentation</td><td>Group contribution</td><td>Documentation / defence</td></tr>
<tr><td>Permitted resources</td><td colspan="3">Everything, but all results must be the • š µ v š [• w ork Á v</td></tr>
<tr><td>Number of examiners</td><td>2</td><td>At least 1</td><td>2</td></tr>
<tr><td>Assessment</td><td>Pass</td><td>pass</td><td>Mark</td></tr>
<tr><td>Pass mark</td><td>Pass</td><td>pass</td><td>55</td></tr>
<tr><td>Minimal result</td><td>Pass</td><td>pass</td><td>55</td></tr>
<tr><td>Weight</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Reassessment</td><td colspan="2">1, 2.4 / 4.4</td><td>1, week 4.12</td></tr>
<tr><td>Compensation</td><td colspan="3">No</td></tr>
<tr><td>Review</td><td colspan="3">Feedback after presentation / evaluation for</td></tr>
<tr><td colspan="5">Other information</td></tr>
<tr><td>Required classroom</td><td colspan="4">Regular classroom and lab</td></tr>
</table>

Project Advanced Vehicle Dynamics: Project plan
Evaluation and Awarding Marks
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Project Advanced Vehicle dynamics: Project Documentation and Defence,
Evaluation and Awarding Marks
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Module code AEA MES M BDSD	Big Data & Small Data
Degree program	Master Engineering Systems
Target Group	Elective module
Coordinating lecturer	Dixon Devasia
Registering for educational components	Week 2.3 / 2.4 in case of joining the module in semester 2 Week 4.3 / 4.4 in case of joining the module in semester 1
Professional Task	Collect dataset, interpret features of dataset and create prediction model
Professional Products	Models
Credits / Study load	15 EC / 420 hours
Relationship with and entry requirements concerning examinations	Module Systems Modelling
General Description	The module covers the following tasks: x Collect a relevant dataset x Interpret the features of the dataset x Offline create prediction model using either system identification techniques or supervised machine learni x Evaluate the model
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Units of study	Data Collection and machine learning (7,5 EC) Capita Selecta in Machine learning (2.5 EC) Project Big Data & Small Data (5 EC)

Unit of Study (UoS) AEA MES M BDSD T	Big Data and Small Data Theory
General Information	
Long name of unit of study	Big Data and Small Data Theory
Short name of unit of study	Big Data and Small Data T
Alluris unit of study name	Big Data and Small Data Theory
Code for unit of study OSIRIS	AEA MES M BDSD T
Alluris unit of study code	M BDSD T
Teaching Term	Semester 1 Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. S W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	7.5 EC / 210 hours
Study hours (contact hours)	80 contact hours
Entry requirements	Joined classes in Systems Modelling and Applied Control
Content and organisation	
General description	The students have to carry out assignments in which they le how to clean up a dataset so that it is directly usable for prediction purposes. Furthermore students will analyse the data within the dataset and find e.g. correlation among variables. The student also learns how to make prediction models usin large number of supervised machine learning algorithms. Th student can apply these models to datasets and knows the advantages and disadvantages of the different methods.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Coursera course: Machine learning (Andrew NG)
Recommended literature	-
Required software	Matlab Simulink
Cohesion Relationship	Module Applied Control Module Systems Modelling Big Data and Small Data CS Big Data and Small Data MP
Compulsory participation	No, but attendance will be registered

Activities and/or instructional formats	Working on applied assignments using a simulation environment Work forms: Lectures, flipped classroom, assignments
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing
Assessment dimensions / Learning outcomes	Dimensions of assessment: - Knowledge and understanding (Analysing and defini problems, design and testing algorithms) - Applying knowledge and understanding (design) - Making judgements (testing) The student formulates a question on what they want to achieve with the dataset (BDSD HTE1) The student judges if the dataset contains enough data and data contains the right features to answer the formulated question. He or she knows how to deal with missing or erroneous data and can scale that dataset if necessary and select test and validation sets (BDSD HTE1) The student interprets the features of the dataset. He or she able to use clustering techniques line K-means and look for correlation between data and use PCA (BDSD HTE1) The student can apply supervised machine learning techniq for predictive analysis like linear regression, logistic regressi and neural networks and motivate why they chose that particular technique. (BDSD HTE1) The student can evaluate and compare models by picking a relevant metric like e.g. R^2 (BDSD HTE1) The student can apply supervised machine learning techniq for predictive analysis like techniques from System Identification. (BDSD HTE2)
Assessment criteria	The student will be assessed on the criteria (questions) mentioned on the evaluation form. (next page)
Information for each exam and modular exam	

Examinations	Exam name	MES BDSD T home taken exam 1	MES BDSD T home taken exam 2
	Exam code	AEA MES BDSD HTE1	AEA MES BDSD HTE2
	Registering for re-exams from 01-02-2023 OSIRIS	Week 3.5 and 3.6 Week 4.12	Week 4.5 and 4.6 Week 4.12
	Deregistering for exams	Till date of exam	Till date of exam
	Exam week	Week 1.9 and 3.9	Week 2.9 and 4.9
	First examiner	Marijn Jongerden / Hatim Mala / Saskia Monsma / Dixon Devasia / Aishwarya Aswal	
	Exam method	Home taken exam	Home taken exam
	Permitted resources	Everything, but all results must be th • š µ v š [• } Á v Á } Œ l	
	Number of examiners	1	1
	Assessment	Mark	Mark
	Pass mark	55	
	Minimal result	45	45
	Weight	3	1
	Reassessment	1	1
	Compensation	yes	
	Review	Evaluation form in week 2.4 and 4.4	Evaluation form in week 3.4 and 4.12
Other information			
Required classroom	Regular classroom		

Big Data and Small Data: Data Collection and Machine Learning, Evaluation and Awarding Marks

Name, first v u Y Y Y

Unit of Study (UoS) M BDSD CS	Big Data and Small Data Capita Selecta
General Information	
Long name of unit of study	Big Data and Small Data Capita Selecta
Short name of unit of study	Big Data and Small Data CS
Alluris unit of study name	Big Data and Small Data Capita Selecta
Code for unit of study OSIRIS	AEA MES M BDSD CS
Alluris unit of study code	M BDSD CS
Teaching Term	Semester 1 Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2.5 EC / 56 hours
Study hours (contact hours)	16 contact hours
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organisation	
General description	Critical review of literature on machine learning in a certain application area
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Scientific papers
Recommended literature	-
Required software	Matlab, Simulink,
Cohesion Relationship	Module Applied Control Module Systems Modelling Big Data and Small Data T Big Data and Small Data MP
Compulsory participation	No, but attendance will be registered
Activities and instructional formats	Self-study, case studies Work forms: Lectures, reporting / presentations
Examinations	
Final Qualifications	C5 Conducting Research
Assessment dimensions / Learning outcomes	Dimensions of assessment: - knowledge and understanding (conducting research) - Applying knowledge and understanding

	- Making judgements (conducting research) The student can critically review work of others on machine learning applications and suggest how to improve the work.	
Assessment criteria	The student will be assessed on the criteria mentioned on the evaluation form. (next page)	
Information for each exam and modular exam		
Examinations	Exam name	MES BDSD CS Article
	Exam code	AEA MES BDSD CS
	Registering for re-exam from 01-02-2023 OSIRIS	Week 4.10
	Deregistering for exams	Till date of exam
	Exam Week	Week 2.9 / 4.9
	First examiner	Marijn Jongerden / Hatim Mala / Dixon Devasia / Aishwarya Aswal/Trung Nguyen
	Exam method	Home taken exam
	Permitted resources	Everything, but all results must be the • š µ v š [• } Á v Á } Œ l
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1
	Compensation	no
	Review	Evaluation form in week 3.4 and 4.12
Other information		
Required classroom	Regular classroom	

Big Data and Small Data: Capita Selecta

Evaluation and Awarding Marks

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Unit of Study (UoS) M BDSD MP	Big data and Small Data Minor Project
General Information	
Long name of unit of study	Big Data and Small Data Minor Project
Short name of unit of study	Big Data and Small Data MP
Alluris unit of study name	Big Data and Small Data Minor Project
Code for unit of study OSIRIS	AEA MES M BDSD MP
Alluris unit of study code	M BDSD MP
Teaching Term	Semester 1 / Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	5 EC / 140 hours
Study hours (contact hours)	32 contact hours and 4 contact hours presentation
Entry requirements	Joined classes in Applied Control and Systems Modelling Successfully finished the exams of the minor project Systems Modelling
Content and organisation	
Professional task	Create a predictive model
(Professional) products	A predictive model, Project documentation, Presentation
General description	The Project serves to challenge the students to apply their knowledge and skills on a real-life problem, in correspondenc with a subset of the final qualifications. The project covers the following topics: - Analysing data of a real life problem - Developing a prediction model for this problem. The problem analysis will result in a problem solution to be translated in such terms that conclusions can be drawn based the extent the problem has been solved and objectives fulfille Part of the project is the peer review: In a peer review sessio the contribution of the group members to the project is determined by the group members themselves. The focus is c content and collaboration. Ideally the supervisor (tutor) is also present, but that is not strictly necessary. Students should be

	aware of their own functioning within the project group, so should arrange peer feedback within their project group regula (at least twice during the project).
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Project Management, A Practical Approach, Roel Grit, Noordh Uitgevers, ISBN 9789001790929 Report Writing for readers with little time, Rien Elling, Bas Andeweg, Noordhoff Uitgevers, ISBN 9789001812591
Recommended literature	-
Required software	Matlab, Simulink, R, python, SPSS
Cohesion Relationship	Module Applied Control Module Systems Modelling Big Data and Small Data T Big Data and Small Data CS
Compulsory participation	Yes
Activities and/or instructional formats	Research Work Forms: Lectures, Assignment Analysing data and creation of a predictive model using techniques from system identification and/or machine learning
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Assessment dimensions / Learning outcomes	Dimensions of assessment: - Applying knowledge and understanding (analysing and defining problems, design, testing, conducting researc - Making judgements (analysing and defining problems, design, testing, conducting research) - Communication (managing work processes, communication and collaboration) - Learning skills (professional development) Learning outcomes: The student presents a clear justification of the project approa The student plans effectively.

	The student carries out a project based on a real-life problem which model development and analysis as well as experiment validation are essential parts by applying knowledge and understanding and making judgements based on analysis and validation techniques. The student structures the working process in the engineering domain and is able to effectively communicate the core findin in a structured and convincing way. The student is able to systematically search for information, s as e.g. models, and judge its relevance. The student communicates the project findings in a clear and structured manner with colleague, customers and the wider public in oral and written forms. The content has been reviewe by peers and/or supervisor. The student reflects on his/her role in the project and on his/h professional development. The student can make a motivated choice of which machine learning techniques he/she uses. The student can evaluate and compare models by picking a relevant metric like e.g. R^2
Assessment criteria	The student will be assessed on the criteria mentioned on the evaluation forms. The result of the minor project is determined by 2 exams 1. Group Contribution: For the contribution of the individual student to the group a pa or no pass will be defined by the examiners. The examiners c use the outcome of the peer review, but also can deviate from 2. Documentation and defence For the Report and Presentation a group mark will be given by the examiners. The individual student mark is equal to the P Œ } µ ‰ u Œ l ‰ Œ } À] š Z š š Z • š µ v š sufficient (pass). If the Group Contribution of the student is insufficient, no mark will be given and the student is unable to finish the minor project.
Information for each exam and modular exam	

Examinations	Exam name	MES BDSD MP Group contribution	MES BDSD MP Report and defence
	Exam code	AEA MES BDSD MP GC	AEA MES BDSD MP DP
	Registering for re-exam from 01-02-2023	-	4.10
	Deregistering for exams	Till date of exam	
	Exam week	Week 2.9/2.10 and 4.9/4.10	
	First examiner	Marijn Jongerden / Dixon Devasia / Aishwarya Aswal / Saskia Monsma/	
	Exam method	Group contribution	Documentation / defence
	Permitted resources	Everything, but all results must be th • š µ v š [• } Á v Á } Œ l	
	Number of examiners	2	2
	Assessment	Pass	Mark
	Pass mark	Pass	55
	Minimal result	Pass	55
	Weight	0	1
	Reassessment	1 week 4.12	
	Compensation	No	
	Review	Feedback after presentation / evaluation form in week 3.4 and 4.12	
Other information			
Required classroom	Regular classroom		

Big Data & Small Data: Project Documentation and Defence, Evaluation and Awarding Marks

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Module AEA MES M DS	Distributed Systems
Degree program	Master Engineering Systems
Target Group	Elective module
Coordinating lecturer	Aart-Jan de Graaf
Registering for educational components	Week 2.3 / 2.4 in case of joining the module in semester 2
Professional Task	Design, implement, verify, and test distributed embedded contr systems
Professional Products	Minor Project: Project plan, Report, Presentation Theory: Design Capita Selecta: Article
Credits / Study load	15 EC / 420 hours
Relationship with and entry requirements concerning examinations	x A basic level of programming experience, preferably in the programming language x Systems Modelling
General Description	The module provides an understanding of the principles on whi distributed embedded systems are based, such as architectura design, protocols, algorithms, fault handling, and maintenance. The key principle is real-time behaviour and how this affects quality requirements (resource limited reasoning). These principles are applied during a minor project that follows values and principles of agile software development and uses t programming language.
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Units of study	This module consists of the following 3 units: Distributed Systems Theory (7.5 EC) Distributed Systems Capita Selecta (2.5 EC) Distributed Systems Minor project (5.0 EC)

Unit of Study (UoS) AEA MES M DS T	Distributed Systems Theory
General Information	
Long name of unit of study	Distributed Systems Theory
Short name of unit of study	Distributed Systems T
Alluris unit of study name	Distributed Systems Theory
Code for unit of study OSIRIS	AEA MES M DS T
Alluris unit of study code	M DS T
Teaching Term	Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. Se W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	7.5 EC / 210 hours
Study hours (contact hours)	64 contact hours + 3 contact hours exam
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organization	
General description	The course provides the design concepts and principles of distributed embedded systems, such as architectural design, re time aspects, protocols, fault handling, and maintenance.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Kopetz, H. (2011). Real-time systems: design principles for distributed embedded applications. Springer Science & Business Media. Lecturing materials and hand-outs on OnderwijsOnline
Recommended literature	Pfeiffer, O., Ayre, A., & Keydel, C. (2016). Embedded networking with CAN and CANopen. Copperhill Media. Tanenbaum, A. S., & Van Steen, M. (2007). Distributed systems: principles and paradigms. Prentice-Hall. https://www.distributed-systems.net/index.php/books/distributed-systems-3rd-edition-2017/
Required software	MATLAB/Simulink
Cohesion Relationship	Module Systems Modelling Module Applied Control Distributed Systems CS Distributed Systems MP

Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Self-study, case-studies, working on assignments and exercise Work forms: Lectures, lab exercises
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing
Assessment dimensions / learning outcomes	Dimensions of assessment: Knowledge and understanding (analysing and defining problem Applying knowledge and understanding (Design and Testing) Learning outcomes: x The student is able to relate an abstract design model to a digital implementation of a simple control application x The student knows how design decisions affect efficiency, scalability, and maintenance of distributed systems. x The student knows time related aspects of real-time behaviour, such as order, measurement, synchronization, a scheduling. x The student knows the characteristics of real-time communication and how to use a time-triggered protocol. x The student designs a fault tolerant distributed system. x The student interprets electrical and protocol specifications, such as CAN or FlexRay, and relates this to the design.
Assessment criteria	The student will be assessed on answering the questions (WE) x clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of the literature studied x without irrelevant additional information x using correct equations and models for the situation (for example when to use linear or nonlinear models) x using correct units for quantities in equations, graph labels, etc. The student will be assessed (HTE) on the criteria mentioned o the evaluation form.
Information for each exam	

Examinations	Exam name	MES DS T home taken exam	MES DS T oral exam
	Exam code	AEA MES DS T HTI	AEA MES DS T OE
	Registering for re-exam from 0102-2023 OSIRIS	Week 4.12	Week 4.12
	Deregistering for exams	Till data of exam	
	Exam week	Week 3.9	Week 4.9
	First examiner	Aart-Jan de Graaf, Dixon Devasia / Nikhil Muthakana	
	Exam method	Home taken exam	oral exam
	Permitted resources	Everything, but all results must be the • š µ v š [• } Á	Simple scientific calculator
	Number of examiners	1	2
	Assessment	Mark	Mark
	Pass mark	55	
	Minimal result	45	45
	Weight	1	1
	Reassessment	1 (August)	1 (August)
	Compensation	Yes	
	Review	Evaluation form week 4.4	4.12
Other information			
Required classroom	Regular classroom		

Theory classes of Distributed Systems
Evaluation and Awarding Marks
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Unit of Study (UoS) AEA MES M DS CS	Distributed Systems Capita Selecta
General Information	
Long name of unit of study	Distributed Systems Capita Selecta
Short name of unit of study	Distributed Systems CS
Alluris unit of study name	Distributed Systems Capita Selecta
Code for unit of study OSIRIS	AEA MES M DS CS
Alluris unit of study code	M DS CS
Teaching Term	Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2,5 EC / 70 hours
Study hours (contact hours)	32 contact hours
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organisation	
General description	The course explores the use of distributed systems in contemporary applications, such as the Internet of Things, M2M solutions, the cyber physical world, and systems-of-systems. This exploration is achieved by means of a literature study, with literature from papers, articles, blogs and/or other relevant resources. The results are presented in a literature study report
Required literature • Œ] ‰ š] } v } (Z o u š Œ] o [	To be decided during class, depending on the subject.
Recommended literature	To be decided during class, depending on the subject.
Required software	-
Cohesion Relationship	Module Applied Control Module Systems Modelling Distributed Systems MP Distributed Systems T
Compulsory participation	Yes
Activities and/or instructional formats	Self-study, case studies Work forms: Lectures, interactive simulation exercises, assignments, reporting
Examinations	
Final Qualifications	C5 Conducting research C6 Communication and collaboration

Assessment dimensions / Learning outcomes	Dimensions of assessment: - Applying knowledge and understanding (Conducting Research) - Making judgements (conducting research) - Communication (conducting research) x The student is aware of distributed systems in one or more contemporary applications. x The student finds and selects relevant scientific resources f selected topic. x The student determines the validity of a referenced resourc x The student writes a literature study report with a trailer, a main text, a conclusion, a discussion and references. x The student specifies references according a literacy stand	
Assessment criteria	The student will be assessed on the criteria (questions) mentio on the evaluation form.	
Information for each exam		
Examinations	Exam name	MES DS CS Presentation
	Exam code	AEA MES DS CS
	Registering for re-exam from 01-02-2023 OSIRIS	Week 4.10
	Deregistering for exams	Till date of exam
	Exam week	Week 4.6
	First examiner	Aart-Jan de Graaf /Dixon Devasia Nikhil Muthakana
	Exam method	Home taken exam: Article
	Permitted resources	Everything, but all results must be š Z • š µ v š [• } Á v Á } Œ
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1 (4.12)
	Compensation	No
	Review	Feedback after presentation Evaluation form week 4.9
Other information		
Required classroom	Regular classroom	

Distributed Systems Capita Selecta, Evaluation and Awarding Marks

	Mark	Motivation	Weight factor
The trailer C6: Communication and Collaboration Does the trailer describe the essence of the article a does the trailer advertise further reading of the article?			1
The main text C5: Conducting research C6: Communication and Collaboration Introduction: contains problem description, hypothesis/research questions that you evaluate in the article and the structure of your story. Are the reasons for choosing this specific subject clarified in the article?			1
Methodology used and research undertaken C5: Conducting research C6: Communication and Collaboration Are design/research/development questions elaborated logically? Is the article structured logically? Are the reasoning and the results based on literatur from the professional domain? Is the difference between fact and opinion sufficient clear?			1
Discussion and conclusion C5: Conducting research C6: Communication and Collaboration about the conclusion: Do the conclusions provide the answer to the resea questions in the introduction? Do the conclusions result from the described theory and the elaborated experiments? about the discussion Does the author return to the aim of the research? Does the author reflect critically on his/her own work			1
References C6: Communication and Collaboration Have the formal requirements for literary sources been met?			1
Mark total			

Date : Signature examiner :

Unit of Study (UoS) M DS MP	Distributed Systems Minor Project
General Information	
Long name of unit of study	Distributed Systems Minor Project
Short name of unit of study	Distributed SystemsMP
Alluris unit of study name	Distributed Systems Minor Project
Code for unit of study OSIRIS	AEA MES M DS MP
Alluris unit of study code	M DS MP
Teaching Term	Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See Part ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] } v U Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	5 EC / 140 hours
Study hours (contact hours)	20 contact hours and 4 contact hours presentation
Entry requirements	Joined classes in Applied Control and Systems Modelling Successfully finished the exams of the minor project Systems Modelling.
Content and organisation	
Professional task	Design, implement, verify and test distributed embedded syster
(Professional) products	Documentation / presentation / defence Source code
General description	In this course students will design, implement, verify, and test t principles of distributed systems in a project. The project appro follows the values and principles of agile software developmen and uses the C programming language. Part of the project is the peer review: In a peer review session contribution of the group members to the project is determined the group members themselves. The focus is on content and collaboration. Ideally the supervisor (tutor) is also present, but t is not strictly necessary. Students should be aware of their own functioning within the project group, so should arrange peer feedback within their project group regularly (at least twice duri the project).
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Project Management, A Practical Approach, Roel Grit, Noordho Uitgevers, ISBN 9789001790929 Report Writing for readers with little time, Rien Elling, Bas Andeweg, Noordhoff Uitgevers, ISBN 9789001812591

	Kopetz, H. (2011). Real-time systems: design principles for distributed embedded applications. Springer Science & Business Media.
Recommended literature	Pfeiffer, O., Ayre, A., & Keydel, C. (2016). Embedded networking with CAN and CANopen. Copperhill Media.
Required software	Matlab, simulink, C
Cohesion Relationship	Applied Control Systems Modelling Distributed Systems CS Distributed Systems T
Compulsory participation	Yes
Activities and/or instructional formats	Two students working together in a group, progress meetings with supervisor
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Assessment dimensions / learning outcomes	Dimensions of assessment: - Applying knowledge and understanding (analysing and defining problems, design, testing, conducting research principles of distributed systems in C) - Making judgements (analysing and defining problems, design, testing, conducting research of principles of distributed systems)) - Communication (managing work processes, communication and collaboration) - Learning skills (professional development) Learning outcomes (general): The student presents a clear justification of the project approac The student plans effectively. The student carries out a project based on a real-life problem ir which model development and analysis as well as experimenta validation are essential parts by applying knowledge and understanding and making judgements based on analysis and validation techniques.

	The student structures the working process in the engineering domain and is able to effectively communicate the core findings a structured and convincing way. The student is able to systematically search for information, suc as e.g. models, and judge its relevance. The student communicates the project findings in a clear and structured manner with colleague, customers and the wider pub in oral and written forms. The content has been reviewed by pe and/or supervisor. The student reflects on his/her role in the project and on his/her professional development. Learning outcomes (specific): The student applies the values and principles of agile software development. The student designs a distributed embedded system for a given problem description. The student justifies the real-time aspects of the designed distributed embedded system. The student implements the designed distributed embedded system by using the C programing language and selected hard platforms, tests the design, and demonstrates the realization. The student shows by means of test reports the fault tolerance capabilities of the implemented distributed system. The student reports realistically about efficiency, scalability, and maintenance of the implemented distributed system. The student uses a protocol standard, such as CANopen or Fle for transferring data between embedded systems.
Assessment criteria	The student will be assessed on the criteria mentioned on the evaluation forms. The result of the MP is determined by 3 exams 1. Project Plan: For the Project Plan a pass or no pass will be defined by the examiner. The project plan has to be sufficient before starting t execution of the project. 2. Group Contribution: For the contribution of the individual student to the group a pas or no pass will be defined by the examiners. The examiners ca the outcome of the peer review, but also can deviate from it. 3. Report and Presentation: For the Report and Presentation a group mark will be given by examiners. The individual student mark is equal to the group m ‰ Œ } À] š Z š š Z • š µ v š [• ' Œ } µ ‰ } v š If the Group Contribution of the student is insufficient, no mark will be given and the student is unable to finish the minor projec

Information for each exam				
Examinations	Exam name	MES DS MP Project Plan	MES DS MP Group Contribution	MES DS MP Report and Presentation
	Exam code	AEA MES DS MP PP	AEA MES DS MP GC	AEA MES DS MP RP
	Registering for re-exam from 01-02-2023 OSIRIS	4.2	-	Week 4.10
	Deregistering for exams	Till date of exam		
	Exam week	3.9	Week 4.9/4.10	
	First examiner	Aart-Jan de Graaf / Dixon Devasia / Nikhil Muthakana		
	Exam method	Project Plan	Group Contribution	Doc. and presentation
	Permitted resources	Everything, but all results must be the • š µ v š [• } Á v Á } Œ l		
	Number of examiners	1	At least 1	2
	Assessment	Pass	pass	Mark
	Pass mark	Pass	pass	55
	Minimal result	Pass	pass	55
	Weight	0	0	1
	Reassessment	4.4	-	1 (Week 4.12)
	Compensation	No		
	Review	Feedback after presentation / evaluation form in week 4.12		
Other information				
Required classroom	Regular class room			

Project Distributed Systems: Project plan, Evaluation and Awarding Marks

	Pass	Motivation	Weight factor
Applying knowledge and understanding C1: Analysing and defining problems C2: Design C5: Conducting Research Do the candidates show understanding about the topic? Has the problem been clearly defined? Is the background relevant to the problem Is the project objective clear and correct?			1
Making judgments C1: Analysing and defining problems C2: Design C5: Conducting Research Have the students presented a clear justification for their approach? Have reliable sources been used to come up with an approach? Do the students account for different alternatives before finalizing the approach			1
Communication C4: Managing work processes C6: Communication and Collaboration Are the students able to guide their own work and that of others? Do the students plan effectively? Do the students show clarity in the explanation?			1
Learning Skills C7: Professional development Do the students display discernible keenness to tackle the task (initiative, deadline handling)? Is the problem owner involved adequately			1
Pass total For a pass all items should be sufficie			

Date :

Signature examiner :

Distributed Systems: Report and Presentation Evaluation and Awarding Marks
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Module AEA MES M HT	Hydrogen Technology
Degree program	Master Engineering Systems
Target Group	Elective module
Coordinating lecturer	Bram Veenhuizen
Registering for educational components	Week 2.3/2.4 in case of joining the module in semester 2 Week 4.4/4.4 in case of joining the module in semester 1
Professional Task	Understand, analyze and contribute to technical and societal aspects of hydrogen technology and the interactions.
Professional Products	Project plan (project) Report (project and capita selecta) Presentation (progress and final) Test plan and test report (project) if appropriate
Credits / Study load	15 EC / 420 hours
Relationship with and entry requirements concerning examinations	Applied Control Systems Modelling
General Description	The Module H2 focuses on the role hydrogen can play in the energy transition. We will mainly focus on decentralized system ranging from electrolysers and fuel cell stacks to internal combustion engines running on hydrogen. System design, integration and control will be important aspects, but also safety and other standards will be addressed. A separate course on s working with hydrogen is part of the module. Applications will range from static sustainable energy storage to mobile applicat in cars, trucks and inland shipping. All main design aspects will covered, mainly by using model based design techniques. The student will get familiar with analyzing and performing technical- and economical calculations on energy systems. Next to that the student will learn how to apply and understand relevant state-of-the art scientific literature. The students will wo in a project to apply the knowledge, application skills and insigh acquired during the lectures. The student will get the opportunit to perform lab experiments.
Final Qualifications	C1 Analyzing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Units of study	Hydrogen Technology Theory (7.5 EC) Hydrogen Technology Capita Selecta (2.5 EC) Hydrogen Technology Project (5 EC)

Unit of Study (UoS) AEA MES M HT T	Hydrogen Technology Theory
General Information	
Long name of unit of study	Hydrogen Technology Theory
Short name of unit of study	Hydrogen Technology T
Alluris unit of study name	Hydrogen Technology Theory
Code for unit of study OSIRIS	AEA MES M HT T
Alluris unit of study code	M HT2 T
Teaching Term	Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š]] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	7.5 EC / 210 hours
Study hours (contact hours)	64 contact hours + 6 contact hours exam (2 written exams)
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organization	
General description	The course Hydrogen technology covers the following topics: x Role of hydrogen in the energy transition (Storage (MH, LH LOHC) x Applications of hydrogen x Hydrogen systems (engines, combustion, FC, DCDC, heat etc.), modelling, Energy management and sizing x Safety course on working with hydrogen x Rules and regulations (Automotive, Stationair) x Hydrogen sources (Electrolysis, Gas reforming, Biological sources) x Aspects of Process technology x Electrochemistry and thermodynamics (Bindingsenthalpie, Catalyse and Elektroliet) x Heat production and use x System durability
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Fuel Cell Handbook / 7th Edition 2004 Atkins, P. and Jones, L., Chemical Principles: The Quest for Ins W. H. Freeman. Lecturing materials and hand-outs on Onderwijs Online
Recommended literature	Not applicable

Required software	Matlab Simulink
Cohesion Relationship	Module Systems Modelling Module Applied Control Hydrogen Technology CS Hydrogen Technology MP
Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Lectures, Self-study, Working on assignments, discussion of literature
Examinations	
Final Qualifications	C1 Analysing and defining problems
Assessment dimensions / learning outcomes	Dimensions of assessment: x Knowledge and understanding (analysing and defining problems), analysis, fundamentals and applications Learning outcomes: The student x has developed knowledge and understanding of the fundamentals of hydrogen, its practical applications and role in the energy transition. x Is able design on a concept level, able to analyse and suggest improvements on system level for hydrogen ba energy systems x Can apply rules and regulations for system design Has practical knowledge on how to work with hydrogen accordi to safety regulations
Assessment criteria	The student will be assessed on answering the questions: x Clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of the literature studied x Without irrelevant additional information x Using correct equations and models for the situation

Information for each exam				
Examinations	Exam name	MES HT T home taken exam	MES HT T Written exam 1	MES HT T Written exam 2
	Exam code	AEA MES HT T HTE	AEA MES HT T WE1	AEA MES HT WE2
	Registering for re-exam from 01-02-2023 OSIRIS	Week 4.12	Week 4.12	Week 4.12
	Deregistering for exams	Till data of exam		
	Exam week	4.6	3.9	4.9
	First examiner	Bram Veenhuizen, Georges Jreij, Leo Pol Rik Catau		
	Exam method	Home taken exam	Written exam	Written exam
	Permitted resources	Everything, but all results must be the • š µ v š own work	Open book	
	Number of examiners	1	1	1
	Assessment	Mark	Mark	Mark
	Pass mark	55		
	Minimal result	45	45	45
	Weight	1	1	1
	Reassessment	1 (August)		
	Compensation	Yes		
	Review	Evaluation form week 4.12	Review Week 4.4	Review week 4.12
Other information				
Required classroom	Regular classroom			

Hydrogen Technology - HTE

Evaluation and Awarding Marks
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Unit of Study (UoS) AEA MES M HT CS	Hydrogen Technology Capita Selecta
General Information	
Long name of unit of study	Hydrogen Technology Capita Selecta
Short name of unit of study	Hydrogen Technology CS
Alluris unit of study name	Hydrogen Technology Capita Selecta
Code for unit of study OSIRIS	AEA MES M HT CS
Alluris unit of study code	M HT2 CS
Teaching Term	Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š RIS Regulations for Education, Exams and Modular Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2,5 EC / 70 hours
Study hours (contact hours)	32 contact hours and 1 contact hour presentation
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organisation	
General description	Relevant literature is provided and papers are discussed in a journal club.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Handouts and papers
Recommended literature	-
Required software	-
Cohesion Relationship	Systems Modelling Applied Control Hydrogen Technology MP Hydrogen Technology T
Compulsory participation	Yes
Activities and/or instructional formats	Self-study, discussion of literature. Work Forms: Lectures, Colloquia
Examinations	
Final Qualifications	C5 Conducting Research
Assessment dimensions / Learning outcomes	Dimensions of assessment: - Knowledge and understanding (conducting research) - Making judgements (conducting research)

	- Communication (conducting research) - Learning skills (conducting research) Learning outcomes: The student is able to understand scientific literature and prese and discusses the contents with fellow students while providing relevant context.	
Assessment criteria	The student will be assessed on the criteria (questions) mentio on the evaluation form.	
Information for each exam		
Examinations	Exam name	MES HT CS Presentation
	Exam code	AEA MES HT CS
	Registering for re-exam from 01-02-2023 OSIRIS	Week 4.10
	Deregistering for exams	Till date of exam
	Exam week	3.9
	First examiner	Bram Veenhuizen / Chris Huijboo
	Exam method	Presentation and defence
	Permitted resources	Everything, but all results must be š Z • š µ v š [• } Á v Á } Œ
	Number of examiners	2
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1 (4.12)
	Compensation	No
	Review	Feedback after presentation Evaluation form week 4.4
Other information		
Required classroom	Regular classroom	

Hydrogen Technology Capita Selecta

Evaluation and Awarding Marks

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Unit of Study (UoS) M HT MP	Hydrogen Technology Minor Project
General Information	
Long name of unit of study	Hydrogen Technology Minor Project
Short name of unit of study	Hydrogen TechnologyMP
Alluris unit of study name	Hydrogen Technology Minor Project
Code for unit of study OSIRIS	AEA MES M HT MP
Alluris unit of study code	M HT2 MP
Teaching Term	Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š]] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	5 EC / 140 hours
Study hours (contact hours)	32 contact hours and 4 contact hours presentation
Entry requirements	Joined classes in Applied Control and Systems Modelling Successfully finished the exams of the minor projects Systems Modelling and Applied Control.
Content and organisation	
Professional task	The professional task consists of: - Design a hydrogen based Energy system, make a mod and simulate output - Perform tests on a hydrogen based energy system - Determine economic and social, legal viability and safety of hydrogen based energy system(s)
(Professional) products	Project plan, Report and Presentation/Defence
General description	The Project serves to challenge the students to apply their knowledge and skills on a real-life problem, in correspondence with a subset of the final qualifications. The project covers the following topics: x The problem to be solved requires an understanding a active analysis of distinctive disciplines. x The project will always include the step from a real-life problem to a more abstract representation of the problem. Required results are described under the professional product section. The problem analysis will result in a problem solution be translated in such terms that conclusions can be drawn bas on the extent the problem has been solved and objectives fulfil

	Part of the project is the peer review: In a peer review session contribution of the group members to the project is determined the group members themselves. The focus is on content and collaboration. Ideally the supervisor (tutor) is also present, but t is not strictly necessary. Students should be aware of their own functioning within the project group, so should arrange peer feedback within their project group regularly (at least twice duri the project).
Required literature / description of Z o Œ v] v P u š Œ] o [	Project Management, A Practical Approach, Roel Grit, Noordho Uitgevers, ISBN 9789001790929 Report Writing for readers with little time, Rien Elling, Bas Andeweg, Noordhoff Uitgevers, ISBN 9789001812591
Recommended literature	-
Required software	MATLAB/Simulink
Cohesion Relationship	Applied Control Systems Modelling Hydrogen Technology CS Hydrogen Technology T
Compulsory participation	Yes
Activities and/or instructional formats	Research Work Forms: Assignments, lectures
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Assessment dimensions / learning outcomes	Dimensions of assessment - Applying knowledge and understanding (Analysing and defining problems, Design, Conducting Research) - Making judgements (Analysing and defining problems, Design, Conducting Research - Communication (managing work processes, communication and collaboration) - Learning skills (professional development)

	Learning outcomes (general): The student presents a clear justification of the project approac The student plans effectively. The student carries out a project based on a real-life problem ir which model development and analysis as well as experimenta validation are essential parts by applying knowledge and understanding and making judgements based on analysis and validation techniques. The student structures the working process in the engineering domain and is able to effectively communicate the core findings a structured and convincing way. The student is able to systematically search for information, suc as e.g. models, and judge its relevance. The student communicates the project findings in a clear and structured manner with colleague, customers and the wider pub in oral and written forms. The content has been reviewed by pe and/or supervisor. The student reflects on his/her role in the project and on his/her professional development. Learning outcomes (specific): The student can critique on and analysis of problems in the fiel energy system design, system simulation and testing, feasibility study. The student evaluates energy models and make informed decisions based on scenario information. The student creates a proposal for improvement on an analyse and evaluated energy system or plan a new design for an ener system; taking into account use of renewable resources, energy efficiency and environmental sustainability.
Assessment criteria	The student will be assessed on the criteria mentioned on the evaluation forms. The result of the MP is determined by 3 exams 1. Project Plan: For the Project Plan a pass or no pass will be defined by the examiner. The project plan has to be sufficient before starting t execution of the project. 2. Group Contribution: For the contribution of the individual student to the group a pas or no pass will be defined by the examiners. The examiners ca the outcome of the peer review, but also can deviate from it. 3. Report and Presentation: For the Report and Presentation a group mark will be given by examiners. The individual student mark is equal to the group m ‰ Œ } À] š Z š š Z • š µ v š [• ' Œ } µ ‰ (pass) š

	If the Group Contribution of the student is insufficient, no mark will be given and the student is unable to finish the minor projec			
Information for each exam				
Examinations	Exam name	MES HT MP Project Plan	MES HT MP Group Contribution	MES HT MP Report and Presentation
	Exam code	AEA MT HT MP PP	AEA MES HT MP GC	AEA MES HT MP RP
	Registering for re-exam from 01-02-2023 OSIRIS	4.2	-	Week 4.10
	Deregistering for exams	Till date of exam		
	Exam week	Week 4.9/4.10		
	First examiner	Bram Veenhuizen / Georges Jreij		
	Exam method	Project Plan	Group Contribution	Report & presentation
	Permitted resources	Everything, but all results must be the • š µ v š [• } Á v Á } Œ l		
	Number of examiners	1	At least 1	2
	Assessment	Pass		Mark
	Pass mark	Pass		55
	Minimal result	Pass		55
	Weight	0		1
	Reassessment	1 (Week 4.12)		
	Compensation	No		
	Review	Feedback after presentation / evaluation forr in week 3.4 and 4.12		
Other information				
Required classroom	Regular class room			

Project Hydrogen Technology: Project plan, Evaluation and Awarding Marks
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Hydrogen Technology: Report and Presentation
Evaluation and Awarding Marks
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Module AEA MES M IPT	Innovation in Powertrains
Degree program	Master Engineering Systems
Target Group	Elective module
Coordinating lecturer	Ad Oomen
Registering for educational components	Week 2.3 / 2.4 in case of joining the module in semester 2 Week 4.3 / 4.4 in case of joining the module in semester 1
Professional Task	Understand, analyse and contribute to innovations in electric hybrid and fuel cell powertrains
Professional Products	Minor Project: Project plan, Report, Presentation Theory: Model and report Capita Selecta: Presentation
Credits / Study load	15 EC / 420 hours
Relationship with and entry requirements concerning examinations	Applied Control Systems Modelling
General Description	In this module the student will gain knowledge on analysing innovative powertrains concerning performance, energy efficien environmental sustainability, costs or any other relevant aspect Theory:In the theory part the student will gain knowledge of the physics required for analysing powertrains. The working princip of the powertrain, its subsystems and components will be studi The student will model powertrains using grey box models. Attention will be paid to relevant control aspects of powertrains regarding optimization of energy efficiency in hybrid systems. T student will learn the physical implications of the concept choic made. Project:The student will implement the theory learned in a modelling project having the appropriate level of detail and showing the powertrain layout, relations between components and powertrain output. Validation will be done using experimen data.
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Units of study	This module consists of the following 3 units: Innovation in powertrains Theory (7.5 EC) Innovation in powertrains Capita Selecta (2.5 EC) Innovation in powertrains Minor Project (5 EC)

Unit of Study (UoS) AEA MES M IPT T	Innovation in Powertrains Theory
General Information	
Long name of unit of study	Innovation in Powertrains Theory
Short name of unit of study	Innovation in Powertrains T
Alluris unit of study name	Innovation in Powertrains Theory
Code for unit of study OSIRIS	AEA MES M IPT T
Alluris unit of study code	M EHFP T
Teaching Term	Semester 1 / Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] } Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	7.5 EC / 210 hours
Study hours (contact hours)	64 contact hours + 6 contact hours exam (2 written exams)
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organization	
General description	The course covers the following topics: x The vehicle powertrain as a system x Main powertrain functions x Powertrain subsystems and components x Powertrain modelling and model validation x Optimization of energy efficiency x Analysis on environmental sustainability x Control aspects of powertrains
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	x Mehrdad Ehsani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Third edition, ISBN 9781138330498 x Lecturing materials and hand-outs on OnderwijsOnline
Recommended literature	x Lino Guzzella, Antonio Sciarretta, Vehicle Propulsion systems, Third edition, Print ISBN 9783642359125 and online ISBN 9783642359132
Required software	MATLAB/Simulink, AME-sim Laptop with sufficient internal memory
Cohesion Relationship	Module Systems Modelling Module Applied Control Innovations in Powertrains CS Innovations in Powertrains MP

Compulsory participation	No, but attendance will be registered
Activities and/or instructional formats	Lectures, Self-study, Working on assignments
Examinations	
Final Qualifications	C1 Analysing and defining problems
Assessment dimensions / learning outcomes	Dimensions of assessment: - Knowledge and understanding (analysing and defining problems) The student analyses advanced and innovative configurations c complete vehicle powertrain and is able to make conceptual design choices concerning it. The student uses relevant white box or grey box modelling methods to determine the physical model of a vehicle powertra The student understands relevant control aspects of powertrain regarding optimization of energy efficiency. (WE1 and WE2) The student is able to analyse a problem in the field of automot powertrains by using state of the art Computer Aided Engineeri (CAE) tools. The student is able to create an optimized solution for an automotive powertrain. (HTE)
Assessment criteria	The student will be assessed on answering the questions: x clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of the literature studied x without irrelevant additional information x using correct equations and models for the situation (for example when to use linear or nonlinear models) x using correct units for quantities in equations, graph labels, etc. M IPT WE1 and WE2: The WarmUp Test result given by the le during the lecturing of the theory determines 20% of the score c the written (re-) exams. For re-exams the WarmUp Test result of the ‰ Œ À] } µ • š š u ‰ š v } o } v P Œ } µ v š • X [
Information for each exam	

Examinations	Exam name	MES IPT T home taken exam	MES IPT T Written exam 1	MES IPT T Written exam 2
	Exam code	AEA MES IPT T HTE	AEA MES IPT T WE1	AEA MES IPT WE2
	Registering for re-exam from 0102-2023 OSIRIS	Week 4.5 / 4.6 Week 4.12	Week 3.5 / 3.6 Week 4.12	Week 4.5 / 4.6 Week 4.12
	Deregistering for exams	Till data of exam		
	Exam week	Week 2.7 / 4.7	Week 1.9 / 3.9	Week 2.9 / 4.9
	First examiner	Ad Oomen / Bram Veenhuizen / Aishwary Aswal / Thymen Kamerling		
	Exam method	Assignment CAE	Written exam	Written exam
	Permitted resources	CAE	Everything, but all results u µ • š š Z • š µ v work	
	Number of examiners	1	1	1
	Assessment	Mark	Mark	Mark
	Pass mark	55		
	Minimal result	45	45	45
	Weight	1	2	2
	Reassessment	1	1	1
	Compensation	Yes		
	Review	Evaluation form week 4.12/3.4	Review Week 4.4 / 2.4	Review week 4.12 / 3.4
Other information				
Required classroom	Regular classroom			

Innovation in powertrains - HTE

Evaluation and Awarding Marks
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Unit of Study (UoS) AEA MES M IPT CS	Innovation in Powertrains Capita Selecta
General Information	
Long name of unit of study	Innovations in Powertrains Capita Selecta
Short name of unit of study	Innovations in PowertrainsCS
Alluris unit of study name	Innovations in Powertrains Capita Selecta
Code for unit of study OSIRIS	AEA MES M IPT CS
Alluris unit of study code	M EHFP CS
Teaching Term	Semester 1 Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	2,5 EC / 70 hours
Study hours (contact hours)	16 contact hours
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organisation	
General description	Make a thorough comparative analysis of a peer reviewed scientific paper(s) on innovations in drive lines.
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	-
Recommended literature	-
Required software	-
Cohesion Relationship	Module Applied Control Module Systems Modelling Innovations in Powertrains T Innovations in Powertrains MP
Compulsory participation	Yes
Activities and/or instructional formats	Self-study, Instruction on demand, reporting, presenting
Examinations	
Final Qualifications	C5 Conducting Research

Assessment dimensions / Learning outcomes	Dimensions of assessment: - Knowledge and understanding (conducting research) - Making judgements (conducting research) - Communication (conducting research) The student is able to analyse a scientific paper on innovations powertrains and to identify its strengths and potential shortcomings. The student is able to formulate a proposal for extending or enhancing the analysed scientific research. The student understands the role of powertrain innovations and developments in the perspective of the modern, evolving societ	
Assessment criteria	The student will be assessed on the criteria (questions) mentio on the evaluation form.	
Information for each exam		
Examinations	Exam name	MES IPT CS Presentation
	Exam code	AEA MES IPT CS
	Registering for re-exam from 01-02-2023 OSIRIS	Week 4.10
	Deregistering for exams	Till date of exam
	Exam week	Week 2.1 / 4.1
	First examiner	Ad Oomen / Bram Veenhuizen / Aishwarya Aswal/ Thymen Kamerling
	Exam method	Presentation and defence
	Permitted resources	Everything, but all results must be the • š µ v š [• } Á v Á } Œ l
	Number of examiners	2
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1 (4.12)
	Compensation	No
	Review	Feedback after presentation Evaluation form week 2.8 / 4.8
Other information		
Required classroom	Regular classroom	

Innovation in powertrains - Capita Selecta

Evaluation and Awarding Marks

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Unit of Study (UoS) AEA MES M IPT MP	Innovation in Powertrains Minor Project
General Information	
Long name of unit of study	Innovation in Powertrains Minor Project
Short name of unit of study	Innovation in PowertrainsMP
Alluris unit of study name	Innovation in Powertrains Minor Project
Code for unit of study OSIRIS	AEA MES M IPT MP
Alluris unit of study code	M EHFP MP
Teaching Term	Semester 1 / Semester 2
Registering for educational components	For all education offered after 31 January 2023, you need to register for the educational components you wish to follow. See W Œ š ï Z K ^ / Z / ^ Z P µ o š] } v • (} Œ µ š] Æ u • [(} Œ u } Œ] v (} Œ u š] } v X
Credits/study load	5 EC / 140 hours
Study hours (contact hours)	20 contact hours and 4 contact hours presentation
Entry requirements	Joined classes in Applied Control and Systems Modelling Successfully finished the exams of the minor projects Systems Modelling and Applied Control.
Content and organisation	
Professional task	Conducting literature research Modelling and validation
(Professional) products	Project plan Model Report Presentation
General description	The students have to carry out an assignment of which model development and analysis as well as experimental validation ar essential parts. The Project serves to challenge the students to apply their knowledge and skills on a real-life problem, in correspondence with a subset of the final qualifications and the course discusses the skills needed to perform a research proje and includes performing a literature study. Part of the project is the peer review: In a peer review session contribution of the group members to the project is determined the group members themselves. The focus is on content and collaboration. Ideally the supervisor (tutor) is also present, but t is not strictly necessary. Students should be aware of their own functioning within the project group, so should arrange peer feedback within their project group regularly (at least twice duri the project).
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	Project Management, A Practical Approach, Roel Grit, Noordhc Uitgevers, ISBN 9789001790929

	Report Writing for readers with little time, Rien Elling, Bas Andeweg, Noordhoff Uitgevers, ISBN 9789001812591
Recommended literature	-
Required software	MATLAB/Simulink, AMEsim
Cohesion Relationship	Applied Control Systems Modelling Innovations in Powertrains CS Innovations in Powertrains T
Compulsory participation	Yes
Activities and/or instructional formats	Research Work Forms: Assignment
Examinations	
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Assessment dimensions/ learning outcomes	Dimensions of assessment - Applying knowledge and understanding (analysing and defining problems, design, conducting research) - Making judgements (analysing and defining problems, Design, Conducting Research - Communication (managing work processes, communication and collaboration) - Learning skills (professional development) Learning outcomes: The student presents a clear justification of the project approac The student plans effectively. The student carries out a project based on a real-life problem ir which model development and analysis as well as experimenta validation are essential parts by applying knowledge and understanding and making judgements based on analysis and validation techniques.

	The student structures the working process in the engineering domain and is able to effectively communicate the core findings a structured and convincing way. The student is able to systematically search for information, su as e.g. models, and judge its relevance. The student communicates the project findings in a clear and structured manner with colleague, customers and the wider pub in oral and written forms. The content has been reviewed by pe and/or supervisor. The student reflects on his/her role in the project and on his/he professional development. The student is able to analyse a real life problem concerning powertrains. The student is able to create a model for a powertrain problem and to perform a relevant analysis. The student is able to validate modelling results against the rea life situation and problem definition. The student is able to formulate a proposal for improvement of powertrain problem and is able to make an assessment of its viability taking into account energy efficiency and environmenta sustainability using proper techniques like prototyping, modellir or analysis.
Assessment criteria	The student will be assessed on the criteria mentioned on the evaluation forms. The result of the MP is determined by 3 exams 1. Project Plan: For the Project Plan a pass or no pass will be defined by the examiner. The project plan has to be sufficient before starting t execution of the project. 2. Group Contribution: For the contribution of the individual student to the group a pas or no pass will be defined by the examiners. The examiners ca the outcome of the peer review, but also can deviate from it. 3. Report and Presentation: For the Report and Presentation a group mark will be given by examiners. The individual student mark is equal to the group m ‰ Œ } À] š Z š š Z • š µ v š [• ' Œ } µ ‰ } v š If the Group Contribution of the student is insufficient, no mark will be given and the student is unable to finish the minor proje
Information for each exam	

Examinations	Exam name	MES IPT MP Project Plan	MES IPT MP Group Contribution	MES IPT MP Documentation and defence
	Exam code	AEA MES IPT MP PP	AEA MES IPT MP GC	AEA MES IPT MP DP
	Registering for re-exam from 01-02-2023 OSIRIS	2.2 / 4.2	-	Week 4.10
	Deregistering for exams	Till date of exam		
	Exam week	1.9 / 3.9	Week 2.9/2.10 and 4.9/4.10	
	First examiner	Ad Oomen / Bram Veenhuizen / Aishwarya Aswal / Thymen Kamerling		
	Exam method	Project Plan	Group Contribution	Documentation / presentation
	Permitted resources	À Œ Ç š Z] v P U µ š o o Œ • µ o š own work		
	Number of examiners	At least 1	At least 1	2
	Assessment	Pass	pass	Mark
	Pass mark	Pass	pass	55
	Minimal result	Pass	pass	55
	Weight	0	0	1
	Reassessment	1 (2.4 / 4.4)	1 (Week 4.12)	
	Compensation	No		
	Review	Feedback after presentation / evaluation form in week 3.4 and 4.12		
Other information				
Required classroom	Regular class room			

Minor Project Innovations in Powertrains: Project plan
Evaluation and Awarding Marks
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Innovation in powertrains - Minor Project Project Documentation and defence
Evaluation and Awarding Marks
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Module AEA MES M PCD	Process Development
Degree program	Master Engineering Systems
Target Group	Elective module
Coordinating lecturer	Stef Tiggeloven
Registering for educational components	Not applicable
Professional Task	(Re)design and improve manufacturing processes
Professional Products	(Re)design and improvement of manufacturing processes
Credits / Study load	15 EC / 420 hours
Relationship with and entry requirements concerning examinations	Applied Control Systems Modelling
General Description	In this module students will learn and apply lean principles and methods for the design, operational control and improvement of manufacturing processes. The focus of the module is on the des and planning & control of manufacturing system. The use of new technology to support Lean Manufacturing plays an important rol in the module: as well new manufacturing as Industry 4.0 techn. Students will gain the knowledge and ability to apply importa Lean principles, methods and techniques, in combination new technologies, to (re-)design manufacturing processes. Discrete simulation, supporting the modelling and analysis of a system, is part of the course as well as the quality control methods. Next to this, students will gain knowledge on various top-down and botto up Continuous Improvement methods and tools (routines) to be applied in manufacturing companies. Students will apply this knowledge in an improvement project industry related projects where they use the (PDCA) A3 methodology and reporting method. This methodology consists o context analysis, describing the current state, formulating objectives, future state design, implementation planning and follo up design. Students will also learn to search for relevant scientifi literature which supports their improvement project. They will lea to link this literature to practice.
Final Qualifications	C1 Analysing and defining problems C2 Design C3 Testing C4 Managing work processes C5 Conducting research C6 Communication and collaboration C7 Professional development
Units of study	Process Development Operations Design (4 EC) Process Development Operations Planning and Control (3.5 EC) Process Development Capita Selecta (2.5 EC) Process Development Minor Project (5.0 EC)

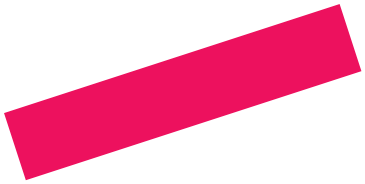
Unit of Study (UoS) AEA MES M PCD OD	Operations Design
General Information	
Long name of unit of study	Operations Design
Short name of unit of study	Operations Design
Alluris unit of study name	Operations Design
Code for unit of study OSIRIS	AEA MES M PCD OD
Alluris unit of study code	M PCD OD
Teaching Term	Semester 1
Registering for educational components	Not applicable
Credits/study load	4 EC / 112 hours
Study hours (contact hours)	32 contact hours + 3 contact hours exam
Entry requirements	Joined classes in Systems Modelling
Content and organization	
General description	The course focuses on the design of manufacturing processes contains the following topics: x Lean Introduction : Customer value and key lean principles x Value Stream Analysis and Design x Key Factory Physic laws: Little law, Utilization law, bottlene principle x Manufacturing Strategy (Product Profiling, Performance Importance Matrix, Policy Deployment) x Factory Flow Analysis, Layout Types, Clustering Methods, Multi criteria decision making x Process and LEAN4.0 Technologies
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	x Operations Management, Nigel Slack, Alistair Brandon-Jon and Robert Johnston, 9e edition (2019). Another Textbook Operations Management, which also focuses on master lev is fine. In the module, references will be made to this particular text book. x d Z > v ^] Æ ^] P u W } l š d } } o } } l _ À David Rowlands, Mark Price and John Maxey. ISBN 978-0-144119-3 (available electronically on O.O) x Learning to See Value Stream Mapping to Create Value an eliminate Muda, van Mike Rother and John Shook, ISBN/E 9780966784305 (available on O.O) x The Lean Toolbox, John Bicheno, 5th edition, ISBN 9780956830753 x Reader Applied Manufacturing Management: papers + she used in the classes.
Recommended literature	-
Required software	-

Cohesion Relationship	Module Systems Modelling Module Applied Control Study units Process Development	
Compulsory participation	No, but attendance will be registered	
Activities and/or instructional formats	Lectures, Self-study, Working on assignments	
Examinations		
Final Qualifications	C1 Analysing and defining problems with respect to process de C2 Design of a manufacturing process/system	
Assessment dimensions learning outcomes	Dimensions of assessment: x Knowledge and understanding (analysing and defining problems) x Applying Knowledge and understanding: Application of lean and operations management methods The student is able to analyse and design (manufacturing) processes.	
Assessment criteria	The student will be assessed on answering the questions: x clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of the literature studied x without irrelevant additional information x using correct equations and models for the situation (for example when to use linear or nonlinear models)	
Information for each exam		
Examinations	Exam name	MES PCD OD Written exam
	Exam code	AEA MES PCD OD
	Registering for re-exam from 01-02-2023 OSIRIS	3.5 / 3.6
	Deregistering for exams	Till data of exam
	Exam week	1.9
	First examiner	Stef Tiggeloven
	Exam method	Written exam
	Permitted resources	Open book
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1 (3.9)
	Compensation	no
	Review	Review week 2.4
Other information		
Required classroom	Regular classroom	

Unit of Study (UoS) AEA MES M PCD OPC	Operations Planning and Control
General Information	
Long name of unit of study	Operations Planning and Control
Short name of unit of study	Operations Planning and Control
Alluris unit of study name	Operations Planning and Control
Code for unit of study OSIRIS	AEA MES M PCD OPC
Alluris unit of study code	M PCD OPC
Teaching Term	Semester 1
Registering for educational components	Not applicable
Credits/study load	3.5 EC / 98 hours
Study hours (contact hours)	32 contact hours and 3 hours written exam
Entry requirements	Joined classes in Applied Control and Systems Modelling
Content and organisation	
General description	The course focuses on the design of planning and control syste for manufacturing processes and contains the following topics: x Topic related to methods of planning & control (medium theories):Inventory Control x MRP x JIT t planning & control methods x Production Activity Control / Job Shop Control Topic which concern basic knowledge needed for developing planning & control systems for a particular situation (basic theories): x Push / Pull control principles x TQM and Quality Control (including statistics) x Factory Physics À Œ]] o] š Ç U <] v P • u v [• x Discrete Simulation
Required literature / • Œ] ‰ š] } v } (Z o u š Œ] o [	x Operations Management, Nigel Slack, Alistair Brandon-Jo and Robert Johnston, 9e edition (2019), or another basic t book on Operations Management, which also focuses on master level educations. In the module, references will be made to this particular text book. x The Lean Six Sigma Pocket } } o } } l _ À v D] Z o David Rowlands, Mark Price and John Maxey. ISBN 978-0 144119-3 x The Lean Toolbox, John Bicheno, 5th edition, ISBN 9780956830753 x Reader Applied Manufacturing Management (papers + she used in the classes
Recommended literature	-
Required software	-
Cohesion / Relationship	Units of study Process Development

Compulsory participation	No, but attendance will be registered	
Activities and/or instructional formats	Self-study, Working on assignments Work Forms: Lectures and teamwork	
Examinations		
Final Qualifications	C1 Analysing and defining problems with respect to process de C2 Design of a planning and control system for a manufacturin process	
Assessment dimensions / Learning outcomes	Dimensions of assessment: x Knowledge and understanding (analysing and defining problems) x Applying Knowledge and understanding (Application of lear and operations management methods for designing the planning and control for manufacturing processes) The student is able to design and to perform a planning and control system for manufacturing processes.	
Assessment criteria	The student will be assessed on answering the questions: clearly and to the point, including sufficient relevant explanation and depth, comparable with the depth of the literature studied without irrelevant additional information	
Information for each exam		
Examinations	Exam name	MES PCD OPC Written exam
	Exam code	AEA MES PCD OPC
	Registering for re-exam from 01-02-2023 OSIRIS	4.5/4.6
	Deregistering for exams	Till date of exam
	Exam week	2.9
	First examiner	Stef Tiggeloven
	Exam method	Written exam
	Permitted resources	Open book
	Number of examiners	1
	Assessment	Mark
	Pass mark	55
	Minimal result	55
	Weight	1
	Reassessment	1 (4.9)
	Compensation	No
	Review	Review week 3.4
Other information		
Required classroom	Regular classroom	

Unit of Study (UoS) AEA MES M PCD CS	Process Development Capita Selecta
General Information	
Long name of unit of study	Process Development Capita Selecta
Short name of unit of study	Process Development CS
Alluris unit of study name	Process Development Capita Selecta
Code for unit of study OSIRIS	



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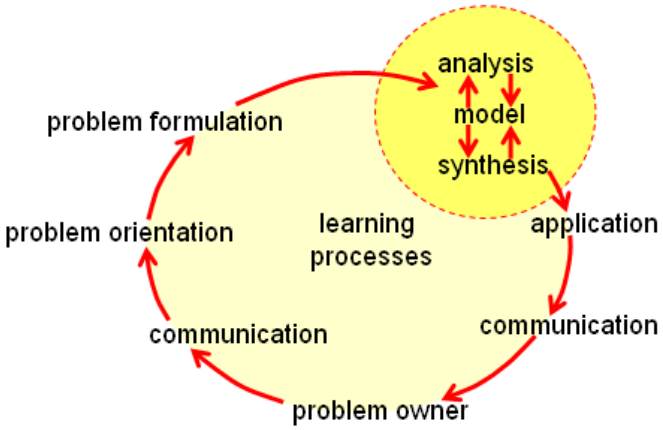
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