Assessment plan Master Industrial Engineering and Management (IEM) 2022-2023

Introduction

This assessment plan is a systematic description of the type of assessment used in the various modules of the Master's Degree Programme Industrial Engineering and Management. This assessment plan fits within the assessment policy of the Faculty of Science and Engineering [1], and the protocol used by the Board of Examiners of the degree programme [2].

The assessment plan is based on:

1. The (appendices of the) Teaching and Examination regulations of the degree programme;
2. The description of the various modules of the degree programme in the digital course catalogue *Ocasys*, including:
   - Objective of the module;
   - Course content;
   - Lecturers and examiners;
   - Assessment method used;
   - Lecture format.

Assessment plan

The assessment plan contains the following items:

1. Mission and objectives of the degree programme
2. Learning outcomes of the degree programme
3. An overview of examiners and assessment type used for all modules in the IEM master's programme. The following types of assessments are distinguished in this scheme:
   - *Examples of assessment modes include:*
   - *Written exam with open questions (WE)*
   - *Written exam with multiple-choice questions (MC)*
   - *Oral exam (OR)*
   - *Report (R)*
   - *Presentation (P)*
   - *Interim test (IT)*
   - *Assignment (AST)*
   - *Practical work (PR)*
   - *Other assessment mode to be specified (ALT)*
4. A list of lecturers qualified to supervise IEM master's (design and research) projects, including the IEM specialization of each supervisor;
5. A matrix describing the relation between the various modules of the programme and the specified learning outcomes of the degree programme. The specified learning outcomes have been described in the Critical Reflection (2016) of the Master's degree programme Industrial Engineering and Management.

[1] FSE Quality Assurance Manual, 2018-2019;
https://myuniversity.rug.nl/infonet/medewerkers/fse/education/quality-assurance/documenten/quality-assurance-manual-fse.pdf

[2] Protocol for the duties and powers of the Board of Examiners of the Faculty of Science and Engineering (2014)
https://myuniversity.rug.nl/infonet/medewerkers/fse/education/policy-quality-education/documents/fmns-protocol-board-of-examiners.pdf

Mission and objectives of the degree programme
The mission of the Industrial Engineering and Management master's degree programme is "to educate industrial engineers who innovate with technological solutions for managerial/business problems".

This mission is translated into the following objectives of the master's degree programme Industrial Engineering and Management:

1. The programme aims to teach students the knowledge, skills and understanding in the field of industrial engineering and management to (re)design (complex) technological processes and products in a managerial/business context, i.e. including implementation of the (re)design and evaluation of the implementation.
2. The programme aims to prepare students for an academic career in industrial engineering and management-oriented research or a career as an industrial engineer.
3. The programme aims to give students an academic training with respect to:
   - Autonomous critical thinking and acting;
   - Scientific communication in English.

Learning outcomes of the Master's degree programme Industrial Engineering and Management
After the master's degree programme students have:
1. The knowledge to describe complex and advanced technological processes and products in a managerial/business context.
2. The understanding to diagnose the functionality and performance of such processes and products in a multi-disciplinary way (e.g. technological, managerial and form viewpoint of various stake-holders).
3. The skills to (re)design, implement and then evaluate such processes and products.
4. The knowledge, understanding and skills for doing research, i.e. applying industrial engineering methodologies in research.
5. The knowledge, understanding and skills for life-long learning (including information retrieval and ICT-use) needed to function autonomously.
6. The skills to think critically and communicate scientifically about ideas and solutions with engineers and managers.
7. The knowledge and understanding of advanced technology, managerial/business sciences and mathematics to do research and to enter a PhD-program in Industrial Engineering or a related discipline.
8. Professional skills for managerial, societal and ethical behaviour when applying technology.

Examiners and assessment type of modules in the degree programme

PTL track				
Module	**ECTS**	**Course coordinator/ First examiner**	**Second examiner**	**Examination type**
Foundations of Logistics Systems Engineering (WMIE002-05)	5	prof. dr. D. Bauso	*S.G. Ramirez Juarez, M*	R, WE
Robotics for IEM (WMIE005-05)	5	dr. R. Reyes Baez	*prof. dr. ir. B. Jayawardhana*	R, WE
Technology Based Entrepreneurship (WMIE006-05)	5	dr. A.J. Frederiks	*dr. S.R. White*	AST, WE
Simulation of Logistic Systems (WMIE012-05)	5	dr. ing. A. Hübl	*prof. dr. D. Bauso*	AST, PR, WE
Surface Engineering and Coating Technology (WMIE013-05)	5	prof. dr. Y. Pei	*dr. A.G.P. Kottapalli*	AST, R, WE
Analysis and Control of Smart Systems (WMIE015-05)	5	prof. dr. C. De Persis	*dr. N. Monshizadeh Naini*	WE
Sustainability Industrial Practise (WMIE027-05)	5	dr. ir. G.H. Jonker	*TBD*	AST, P, R
Systems Engineering (WMIE021-05)	5	dr. N.B. Szirbik	*TBD*	IT, P, AST
4 PTL Electives	20	Various		VAR
Master's Design Project IEM (WMIE901-25)	25	See table: IEM Master's Supervisors		OE, P, R, PR
Research Methodology (WMIE025-05)	5	dr. ing. H. Kloosterman	*dr. A.J. Bosch*	OE, R
Master's Research Project IEM (WMIE901-30)	30	See table: IEM Master's Supervisors		P, R, PR

PTL electives				
Module	**ECTS**	**Course coordinator/ First examiner**	**Second examiner**	**Examination type**
CFD for Engineers (WMCE013-05)	5	dr. ir. P.D. Druetta	*prof. dr. F. Picchioni*	AST, WE, R
Characterisation of Materials (WMPH021-05)	5	dr. G.R. Blake	*Prof. dr. M.S. Pchenitchnikov*	WE
Compressible Flows (WMCE008-05)	5	dr. ir. P.D. Druetta	*prof. dr. F. Picchioni*	AST, WE, R
Data-driven Optimization (WMME011-05)	5	dr. A.K. Cherukuri	*prof. dr. D. Bauso*	AST, WE
Device Physics (WMPH050-05)	5	prof. dr. ir. B.J. van Wees	*prof. dr. T. Banerjee*	P, R, WE
Engineering Design Integration (WMIE029-05)	5	prof. dr. ir. D. Lentink	*TBD*	
Fitting Dynamical Models to Data (WMIE007-05)	5	prof. dr. ir. B. Jayawardhana	*Prof. dr. M. Cao*	WE
Game Theory with Engineering Applications (WMIE009-05)	5	prof. dr. D. Bauso	*S.G. Ramirez Juarez, M*	P, R, WE

Introduction to Optimization (WMIE031-05)	5	prof. dr. J.G. Peypouquet	*prof. dr. M.K. Camlibel*	AST, PR, WE
Introduction to Stochastic Programming (WMIE019-05)	5	dr. A.K. Cherukuri	*prof. dr. D. Bauso*	WE, AST
Mathematical Modelling (WMIE033-05)	5	prof. dr. ir. R.W.C.P. Verstappen	*dr. ir. B. Besselink*	AST
Mechanical Properties (WMPH023-05)	5	prof. dr. ir. E. van der Giessen	*prof. dr. ir. P.R. Onck*	AST, PR, P, R
MEMS, NEMS and Nanofabrication (WMIE010-05)	5	dr. A.G.P. Kottapalli	*prof. dr. Y. Pei*	WE, IT
Modeling and Control of Complex Nonlinear Engineering Systems (WMMA020-05)	5	dr. ir. B. Besselink	*prof. dr.ir. J.M.A. Scherpen*	AST, WE
Multiscale Contact Mechanics and Tribology (WMIE011-05)	5	prof. dr. A. Vakis	*F. Maresca, PhD*	AST, WE
Numerical Mathematics 1 (WMIE032-05)	5	dr. C.A. Bertoglio	*dr. ir. F.W. Wubs*	PR, WE
Optimization in Engineering Systems (WMIE026-05)	5	dr. N. Monshizadeh Naini	*prof. dr. C. De Persis*	AST, WE
Product Design by the Finite Element Method (WMIE003-05)	5	dr. ir. A.A. Geertsema	*dr. ir. F.W. Wubs*	AST

SPE-Track				
Module	**ECTS**	**Course coordinator/ First examiner**	**Second examiner**	**Examination type**
Bioprocesses for Engineers (WMIE028-05)	5	prof. dr. G.J.W. Euverink	*dr. J. Krooneman*	R
Interfacial Engineering (WMCE003-05) [option A]*	5	dr. P. Raffa	*prof. dr. F. Picchioni*	AST, WE
Catalysis for Engineers (WMCE002-05) [option B]*	5	prof. dr. ir. H.J. Heeres	*prof. dr. P.P. Pescarmona*	WE
Technology Based Entrepreneurship (WMIE006-05)	5	dr. A.J. Frederiks	*dr. S.R. White*	AST, WE
Circular Polymers (WMCE017-05)	5	prof. dr. R. Duchateau	*prof. dr. F Picchioni*	
Advanced Product Engineering (WMCE007-05)	5	prof. dr. F. Picchioni	*R.K. Bose, PhD*	P, R
Sustainability Industrial Practise (WMIE027-05)	5	dr. ir. G.H. Jonker	*TBD*	AST, P, R
Systems Engineering (WMIE021-05)	5	dr. N.B. Szirbik	*prof. dr.ir. M. Cao*	AST, P
4 SPE electives	20	Various		VAR
Master's Design Project IEM (WMIE901-25)	25	See table: IEM Master's Supervisors		OE, P, R, PR
Research Methodology (WMIE025-05)	5	dr. ing. H. Kloosterman	*dr. A.J. Bosch*	OE, R
Master's Research Project IEM (WMIE901-30)	30	See table: IEM Master's Supervisors		P, R

* Students choose either option A or B as a mandatory course. Students can take the other course as an SPE elective (CE specialization) as well.

SPE electives				
Module	**ECTS**	**Course coordinator/ First examiner**	**Second examiner**	**Examination type**
Advanced Instrumentation and Analytics in Biotechnology (WMIE023-05)	5	prof. dr. G.J.W. Euverink	*dr. J. Krooneman*	R
Advanced Polymer Processing (WMCE006-05)	5	D. Parisi, PhD	*prof. dr. F. Picchioni*	AST, WE, R
Bio-based Products (WMCE001-05)	5	prof. dr. P.J. Deuss	*J. Xie*	P, R
Bioprocess Technology (WMIE018-05)	5	prof. dr. G.J.W. Euverink	*dr. J. Krooneman*	AST, P
Catalysis for Engineers (WMCE002-05)	5	prof. dr. ir. H.J. Heeres	*prof. dr. P.P. Pescarmona*	WE
CFD for Engineers (WMCE013-05)	5	dr. ir. P.D. Druetta	*prof. dr. F. Picchioni*	AST, R, WE
Compressible Flows (WMCE008-05)	5	dr. ir. P.D. Druetta	*prof. dr. F. Picchioni*	AST, WE, R
Design of Industrial Catalysts (WMCE009-05)	5	prof. dr. P.P. Pescarmona	*dr. V. Kyriakou*	P, R
Engineering Design Integration (WMIE029-05)	5	prof. dr. ir. D. Lentink	*TBD*	
Interfacial Engineering (WMCE003-05)	5	dr. P. Raffa	*prof. dr. F. Picchioni*	AST, WE
Microfluidics (WMME020-05)	5	prof. dr. J. Yue	*prof. dr. G.J.W. Euverink*	P, R
Particulate Products (WMCE004-05)	5	prof. dr. ir. K. van der Voort Maarschalk	*prof. dr. F. Picchioni*	PR, WE
Product Focused Process Design (WMCE011-05)	5	prof. dr. J.G. Peypouquet	*dr.ir. J.G.M. Winkelman*	OR, R

*For courses owned by other degree programmes, please refer to their assessment plans for more information.

IEM Master's Design Project Supervisors

Title	**Initials**	**Last Name**	**Research group/ Department**	**UTQ***
dr.	A.J.	Bosch	Design group	Yes
dr.ir.	A.A.	Geertsema	Design group	
dr. ing.	A.	Hübl	Design group	
dr.ir.	G.H.	Jonker	Design group	Yes
dr. ing.	H.	Kloosterman	Design group	
ir.	T.M.	Kousemaker	Design group	
PhD	G.K.H.	Larsen	Design group	
PhD	M.	Muñoz Arias	Design group	
dr. ir.	T.H.J.A.	Sleutels	Design group	

*UTQ = University Teaching Qualification

IEM Master's Research Project Supervisors

Title	Initials	Last Name	Research group/ Department	Research Institute	UTQ*
PhD	M.I.	Acuautla Meneses	Discrete Technology and Production Automation	ENTEG	
prof. dr. ir.	P.	Avgeriou	Software Engineering	JBI	Yes
prof. dr.	D.	Bauso	Optimization and Decision Systems	ENTEG	
PhD	R.K.	Bose	Product Technology	ENTEG	
prof. dr. ir.	M.	Cao	Discrete Technology and Production Automation	ENTEG	Yes
PhD	A.K.	Cherukuri	Optimization and Decision Systems	ENTEG	
prof. dr.	C.	De Persis	Smart Manufacturing Systems	ENTEG	Yes
dr.	P.L.	Deuss	Chemical Technology	ENTEG	
prof. dr. ir.	M. van	Duin	Product Technology	ENTEG	
prof. dr.	G.J.W.	Euverink	Products and Processes for Biotechnology	ENTEG	Yes
dr.	A.J.	Frederiks	University of Groningen Centre of Entrepreneurship	University College	
prof. dr.	A.J.	Groen	University of Groningen Centre of Entrepreneurship	University College	
prof. dr. ir.	H.J.	Heeres	Chemical Technology	ENTEG	Yes
dr. ing.	A.	Hübl	Design group		
prof. dr.	B.	Jayawardhana	Discrete Technology and Production Automation	ENTEG	Yes
dr.	E.	Jurak	Bioproduct Engineering	ENTEG	
prof. dr.	N.	Kalantar-Nayestanaki	Research Unit Nuclear & Hadron Physics	ESRIG	
prof. dr. ir.	B.J.	Kooi	Nanostructured Materials and Interfaces	ZIAM	Yes
PhD	J.	Kosinka	Scientific Visualization and Computer Graphics	JBI	
dr.	A.G.P.	Kottapalli	Advanced Production Engineering	ENTEG	
dr.	J.	Krooneman	Products and Processes for Biotechnology	ENTEG	progress
dr.	A.O.	Krushynska	Computational Mechanical and Materials Engineering	ENTEG	
prof. dr.	M.J.E.C.	Maarel, van der	Aquatic Biotechnology and Bioproduct-technology	ENTEG	Yes
dr.	N.	Monshizadeh Naini	Smart Manufacturing Systems	ENTEG	
dr.	M.	Muñoz Arias	Computational Physics	ZIAM	
prof. dr. ir.	P.R.	Onck	Micromechanics	ZIAM	Yes
prof. dr.	Y.	Pei	Advanced Production Engineering	ENTEG	Yes
dr.	P.P.	Pescarmona	Product Technology	ENTEG	Yes
prof. dr.	F.	Picchioni	Product Technology	ENTEG	Yes
PhD	G.	Portale	Macromolecular Chemistry & New Polymeric Materials	ZIAM	
prof. dr. ir.	J.	Post	Advanced Production Engineering	ENTEG	
drs.	W.A.	Prins	Advanced Production Engineering	ENTEG	
dr.	P.	Raffa	Product Technology	ENTEG	
dr.	R.	Ribas Gomes	Advanced Production Engineering	ENTEG	
prof. dr. ir.	J.M.A.	Scherpen	Discrete Technology and Production Automation	ENTEG	Yes

dr. ir.	T.H.J.A.	Sleutels	Products and Processes for Biotechnology	ENTEG	
prof. dr.	A.	Vakis	Advanced Production Engineering	ENTEG	Yes
PhD	S.R.	White	University of Groningen Centre of Entrepreneurship	University College	
prof. dr.	M.J.H.	Witjes		Faculty of Medical Sciences	
dr. ir.	J.G.M.	Winkelman	Chemical Technology	ENTEG	
dr.	J.	Yue	Chemical Technology	ENTEG	Yes

*UTQ = University Teaching Qualification

Relation between the learning outcomes and the curriculum

There are two tracks within the Master's degree programme IEM:
1. Production Technology and Logistics (PTL)
2. Sustainable Process Engineering (SPE; previously Product and Process Technology; PPT).

The tracks on the one hand provide students with the opportunity to gain specialist knowledge in a specific technological field, and on the other hand globally divide their future field of work.
In order to specify the learning outcomes of the programme for these track, we distinguish four competence area's (general academic skills are assimilated into these competence area's).

General competence area's (applicable for all tracks):
E: Industrial engineering (outcomes 1, 4, 5, 6, 7, 8)
M: Managerial and business sciences (outcomes 6, 7, 8)

Competence area per track:
P: Production Technology and Logistics (PTL) (outcomes 2, 3)
S: Sustainable Process Engineering (SPE) (outcomes 2, 3)

The specification of the learning outcomes of the programme for each competence area is as follows:
Industrial engineering (E)
In the area of industrial engineering students have:
E1. Knowledge and understanding of (advanced) design and engineering theories.
E2. Skills to apply engineering and technology concepts for solving theoretical (research) and practical (industrial/managerial) problems.
E3. Skills to justify and communicate about their problem-solving approach from a multidisciplinary point of view.

Managerial and business science (M)
In the area of managerial and business sciences students have:
M1. Sufficient knowledge and understanding of managerial and business sciences to enter PhD programs in Industrial Engineering (and related fields).
M2. Skills to choose and apply organizational (including information), psychological, financial and marketing methods and concepts for adequately solving real-life business problems.
M3. Skills to implement, justify and communicate about their problem-solving approach from a multidisciplinary point of view.

Production technology and logistics (P)
In the area of production technology and logistics students have:
P1. Advanced knowledge and understanding of production technology and logistical engineering, to enter PhD programs in IEM related to production technology and logistical engineering.
P2. Skills to analyse, (re)design, and implement (innovative) solutions for (complex) discrete products and production system problems, taking into account realistic industrial constraints (economic, safety, manufacturability, sustainability etc.).
P3. Skills to effectively operate as employee (technologist, market analyst/developer, manager) in the discrete product engineering, production engineering and logistical engineering business; both at commercial production and support (services) level.

Sustainable Process Engineering (S)
In the area of sustainable process engineering students have:
S1. Advanced knowledge and understanding of (bio)chemical engineering, chemical product engineering and biotechnology to enter PhD programs in (Bio)Chemical Product or Process Design and Engineering or Biotechnology.
S2. Skills to analyse real-life industrial (bio)chemical process and product design problems and to develop solutions on the basis of the scientific fundamentals used in these disciplines.
S3. Skills to effectively operate as employee (technologist, market analyst/developer, manager) in the (bio)chemical processing and production businesses or biotechnology businesses; both at commercial production and support (services) level.

In the tables below, ❁ represents a major contribution to the learning outcome, and ✳ a minor contribution to the learning outcome.

Specialization PTL	**E1** Design & Engineering theories (K)	**E2** Apply engineering & technology concepts (S)	**E3** Justify and communicate (S)	**M1** Management and business sciences (K)	**M2** Choose/apply Business methods/concepts (S)	**M3** Implement, justify and communicate (S)	**P1** Production technology and logistics (K)	**P2** Analysis. design & implement solutions (S)	**P3** Effectively operate in Business (S)	**S1** Chemical (product) engineering (K)	**S2** Analysis. design & implement solutions (S)	**S3** Effectively operate in Business (S)
Sustainable Industrial Practice	❁	❁	❁		❁	❁						
Technology Based Entrepreneurship				❁	❁	❁		❁	❁			
Systems Engineering	❁	❁	❁					❁				
Master's Design Project IEM		❁	❁		❁	❁		❁	❁			
Master's Research Project IEM		❁	❁		❁	❁		❁	❁			
Research Methodology			✳	✳	✳	✳						
Foundations of Logistic Systems Engineering	❁	❁		❁	❁							
Simulation of Logistic Systems	❁	❁	❁	❁	❁	❁	❁	❁	❁			
Robotics for IEM	❁	❁					❁	❁				
Surface Engineering & Coating Technology	❁	❁					❁	❁				
Analysis and Control of Smart Systems	❁	❁					❁	❁				
Electives												

K =knowledge, S = Skills

Specialization SPE	**E1** Design & Engineering theories (K)	**E2** Apply engineering & technology concepts (S)	**E3** Justify and communicate (S)	**M1** Management and business sciences (K)	**M2** Choose/apply Business methods/concepts (S)	**M3** Implement, justify and communicate (S)	**P1** Production technology and logistics (K)	**P2** Analysis. design & implement solutions (S)	**P3** Effectively operate in Business (S)	**S1** Chemical (product) engineering (K)	**S2** Analysis. design & implement solutions (S)	**S3** Effectively operate in Business (S)
Sustainable Industrial Practice	❁	❁	❁		❁	❁						
Technology Based Entrepreneurship				❁	❁	❁					❁	❁
Systems Engineering	❁	❁	❁								❁	
Master's Design Project IEM		❁	❁		❁	❁					❁	❁
Master's Research Project IEM		❁	❁		❁	❁					❁	❁
Research Methodology			❁	❁	❁	❁						
Interfacial Engineering	❁	❁								❁	❁	❁
Bio-based products	❁	❁								❁	❁	
Microfluidics	❁	❁								❁	❁	
Product Focused Process Design	❁	❁								❁	❁	
Advanced Product Engineering	❁	❁		❁	❁					❁	❁	❁
Electives												

K = knowledge, S = Skills