

# Assessment plan for the curriculum of the Master's degree programme in Applied Mathematics, 2024-2025

Programme director: prof. dr. S. (Stephan) Trenn

Date advice Board of Examiners: June 5, 2024

Date approval Faculty Board:

## 1. Vision on assessment

1. Assessment evaluates the student's skills to formulate and justify mathematical statements.
2. Assessment stimulates the student's ability to recognize which real-world problems are amenable to mathematical analysis and to adjust existing mathematical concepts and methods to study these problems.
3. Assessment stimulates the development of both research and presentation skills in academic and professional contexts.

## 2. Assessment guidelines

*Please explain the general assessment procedures that are used in the programmes. For example, 4-eyes principle in test design, standardised grading forms, rubrics.*

1. All summative assessment is organized onsite; formative assessment can be organized either online or onsite.
2. The formative and summative assessment are designed by the course coordinator in such a way that the assessment covers all the intended learning outcomes of the course.
3. Summative assessments in the form of final exams are designed by the course coordinator and are peer reviewed by the second examiner in order to ensure that the exam assesses the course material representatively and sufficiently.
4. Summative assessments in the form of homework assignments are verified by additional in-person discussions.
5. When making use of software tools when writing assignments, the student must explain how these tools were used.

## 3. Learning outcomes of the degree programme

*Learning outcomes for the degree programme, further specified learning outcomes (where relevant) and/or specified for tracks within the degree programme. Please add extra rows if necessary.*

|    | <b>Learning Outcome</b><br><i>At the end of the programme, the graduate ...</i>                          |
|----|----------------------------------------------------------------------------------------------------------|
| A1 | has an understanding of the most important concepts of the field, [applying knowledge and understanding] |
| A2 | is able to contribute to the scientific advancement of a subfield of applied mathematics,                |

|    |                                                                                                                                                                                                                                                    |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | [applying knowledge and understanding]                                                                                                                                                                                                             |
| A3 | is able to use abstract thinking and mathematical modelling to get to the root of a problem and thus recognize whether existing methods are applicable, or to ascertain that new methods must be developed, [applying knowledge and understanding] |
| A4 | is able to function in multidisciplinary teams, [applying knowledge and understanding]                                                                                                                                                             |
| A5 | is familiar with the social and ethical aspects of applying mathematics in practice, [judgement]                                                                                                                                                   |
| A6 | understands the scientific relevance of problem definitions and results, and the validity of the scientific method, [judgement]                                                                                                                    |
| A7 | is able to communicate effectively ideas, problems and solutions with the mathematical, science and engineering communities. [communication]                                                                                                       |
| A8 | is able to express him- or herself well both orally and in writing, [communication]                                                                                                                                                                |
| A9 | is able to evaluate the scientific literature so as to keep their knowledge up to date. [learning]                                                                                                                                                 |
| T1 | has general knowledge of the theories, methods and techniques in the field of applied mathematics, [knowledge and understanding]                                                                                                                   |
| T2 | has specialized knowledge in at least one of the following subfields of applied mathematics:<br>[knowledge and understanding]<br>a. Computational Mathematics<br>b. Systems, Control and Optimization<br>c. Statistics                             |
| T3 | has wide experience with the mathematical modelling of problems from actual practice, [applying knowledge and understanding]                                                                                                                       |
| T4 | has extensive experience with using the relevant mathematical tools. [applying knowledge and understanding]                                                                                                                                        |

#### 4. Overview of assessment methods, test moments for course units, and examiners

*This table shows all the course units for each year of the programme and assessment methods. Please add extra rows if necessary.*

| Year                       | Period     | Course                                                                 | EC                         | Assessment methods       | Does (part of the) assessment have a formative function? | Test moment(s)<br>(e.g. mid-term, continuous assessment, exam week, etc) | First examiner             | Second examiner                                                                               |
|----------------------------|------------|------------------------------------------------------------------------|----------------------------|--------------------------|----------------------------------------------------------|--------------------------------------------------------------------------|----------------------------|-----------------------------------------------------------------------------------------------|
| <b>All Specializations</b> |            |                                                                        |                            |                          |                                                          |                                                                          |                            |                                                                                               |
| 1                          | 2A         | Mathematics and its Environment (WMMA013-05 )                          | 5                          | R, P, AST                | No                                                       | Exam week                                                                | prof. dr. J. Top           | dr. R. Szabó                                                                                  |
| 1                          | 2B         | Student Colloquium (WMMA029-05 )                                       | 5                          | R, P                     | No                                                       | Last lecture week                                                        | prof. dr. M.A. Grzegorzcyk | dr. J. Koellermeier, prof. dr. J.S. Müller, prof. dr. J.G. Peypouquet, prof. dr. O. Lorscheid |
| 2                          | Whole Year | Research Seminar in Applied Mathematics (WMMA050-05 )                  | 5                          | P                        | No                                                       | Exam week, Continuous                                                    | prof. dr. M.K. Camlibel    | prof. dr. R.W.C.P Verstappen                                                                  |
| 2                          | Whole year | Master Research Project in Applied Mathematics (WMMA901-35)            | 35                         | R, P                     | No                                                       | End of project, Continuous                                               | See list below (section 6) |                                                                                               |
| 2                          | Whole year | Internship Applied Mathematics (WMMA001-15)                            | 15                         | R, P                     | No                                                       | End of project, Continuous                                               | See list below (section 6) |                                                                                               |
| 1                          | 1A-2B      | Guided choice from Mastermath, at discretion of the Board of Examiners | See Mastermath regulations |                          |                                                          |                                                                          |                            |                                                                                               |
| 1                          | 2A-2B      | Neem Regie (TEM0110-24)                                                | 10                         | See MSc Lerarenopleiding |                                                          |                                                                          |                            |                                                                                               |

| Year                                            | Period | Course                                                          | EC | Assessment methods         | Does (part of the) assessment have a formative function? | Test moment(s)<br>(e.g. mid-term, continuous assessment, exam week, etc) | First examiner            | Second examiner            |
|-------------------------------------------------|--------|-----------------------------------------------------------------|----|----------------------------|----------------------------------------------------------|--------------------------------------------------------------------------|---------------------------|----------------------------|
| <b>Specialization: Systems and Optimization</b> |        |                                                                 |    |                            |                                                          |                                                                          |                           |                            |
| 1                                               | 1A     | Robust Control (WMMA021-05)                                     | 5  | WE, AST                    | Yes                                                      | Exam week, continuous (homework)                                         | dr. ir. H.J. van Waarde   | prof. dr. ir. B. Besselink |
| 1                                               | 1A-1B  | System and Control (Mastermath) (WMMA003-06)                    | 6  | see mastermath regulations |                                                          |                                                                          |                           |                            |
| 1                                               | 1B     | Calculus of Variations and Optimal Control (23/24) (WMMA056-05) | 5  | WE, AST                    | No                                                       | Exam week, continuous (homework)                                         | prof.dr.ir. Besselink     | prof. dr. M.K. Camlibel    |
| 1                                               | 1B     | Data-Based Analysis and Control (23/24) (WMMA058-05)            | 5  | WE, AST                    | No                                                       | Exam week, continuous (homework)                                         | dr. ir. H.J. van Waarde   | prof. dr. M.K. Camlibel    |
| 1                                               | 1B     | Iterative Algorithms (WMMA057-05)                               | 5  | R, P, AST                  | No                                                       | Exam week, continuous                                                    | prof. dr. J.G. Peypouquet | dr. C.A. Bertoglio         |
| 1                                               | 1B     | Model Reduction for Control (WMMA062-05)                        | 5  | WE, AST                    | Yes                                                      | Exam week, Continuous (homework)                                         | prof.dr.ir. B. Besselink  | dr. ir. H.J. van Waarde    |
| 1                                               | 2A     | Convex Analysis (24/25) (WMMA060-05)                            | 5  | WE, AST                    | No                                                       | Exam week, Continuous (homework)                                         | prof. dr. M. K. Camlibel  | prof. dr. J.G. Peypouquet  |
| 1                                               | 2A     | Evolution Equations (23/24) (WMMA059-05)                        | 5  | WE, AST                    | No                                                       | Exam week, Continuous (homework)                                         | prof. dr. J.G. Peypouquet | prof. dr. M. K. Camlibel   |

| Year | Period | Course                                             | EC                        | Assessment methods | Does (part of the) assessment have a formative function? | Test moment(s)<br>(e.g. mid-term, continuous assessment, exam week, etc) | First examiner | Second examiner |
|------|--------|----------------------------------------------------|---------------------------|--------------------|----------------------------------------------------------|--------------------------------------------------------------------------|----------------|-----------------|
| 1    | 2A     | Nonlinear Control Systems (WMSC003-05)             | 5                         | see MSc SC         |                                                          |                                                                          |                |                 |
| 1    | 1A-2B  | Guided choice courses from other specializations   | see other specializations |                    |                                                          |                                                                          |                |                 |
| 1    | 1A     | Introduction to Data Science (WMCS002-05)          | 5                         | See MSc CS         |                                                          |                                                                          |                |                 |
| 1    | 1A     | Robotics for IEM (WMIE005-05)                      | 5                         | See MSc IE         |                                                          |                                                                          |                |                 |
| 1    | 1B     | Fitting Dynamical Models to Data (WMIE007-05)      | 5                         | See MSc IE         |                                                          |                                                                          |                |                 |
| 1    | 2A     | Analysis and Control of Smart Systems (WMIE015-05) | 5                         | See MSc IE         |                                                          |                                                                          |                |                 |
| 1    | 2B     | Data-driven Optimization (WMME011-05)              | 5                         | See MSc ME         |                                                          |                                                                          |                |                 |

| <b>Specialization: Statistics and Data Science</b> |       |                                                                                                           |                                  |                   |     |                                  |                             |                             |
|----------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------|----------------------------------|-------------------|-----|----------------------------------|-----------------------------|-----------------------------|
| 1                                                  | 1A    | Contemporary Statistics with Applications (WMMA015-05)                                                    | 5                                | R, AST            | No  | Exam week, Continuous (homework) | prof. dr. M.A. Grzegorzczuk | dr. W.P. Krijnen            |
| 1                                                  | 1A    | Introduction to Data Science (WMCS002-05)                                                                 | 5                                | See MSc CS        |     |                                  |                             |                             |
| 1                                                  | 1A    | Statistical Genomics (23/24) (WMMA008-05)                                                                 | 5                                | AST, R            | No  | Exam week, Continuous (homework) | prof. dr. J.P. Trapman      | prof. dr. M.A. Grzegorzczuk |
| 1                                                  | 1B    | Mathematical Modelling and Statistical Analysis of the Spread of Infectious Diseases (23/24) (WMMA061-05) | 5                                | WE, P             | No  | Exam week, Continuous (homework) | prof. dr. J.P. Trapman      | dr. R. Szabó                |
| 1                                                  | 1B    | Topics in Probability and Statistics (WMMA039-05)                                                         | 5                                | WE, AST, R        | Yes | Exam week, Continuous (homework) | prof. dr. J.P. Trapman      | dr. S.A. Donderwinkel       |
| 1                                                  | 1B    | Fitting Dynamical Models to Data (WMIE007-05)                                                             | 5                                | See MSC IE        |     |                                  |                             |                             |
| 1                                                  | 1B    | Statistical Signal Processing (WMAS011-05)                                                                | 5                                | See MSc AS        |     |                                  |                             |                             |
| 1                                                  | 2A    | Statistical Consulting (24/25) (WMMA024-05)                                                               | 5                                | R, P              | No  | Exam week                        | prof. dr. J.P. Trapman      | dr. W.P. Krijnen            |
| 1                                                  | 1A-2B | <i>Guided choice courses from other specializations</i>                                                   | <i>see other specializations</i> |                   |     |                                  |                             |                             |
| 1                                                  | 1A.2  | <i>Data Science in Biomedicine (WMBM023-05)</i>                                                           | 5                                | <i>See MSc BM</i> |     |                                  |                             |                             |

|                                           |      |                                                             |   |            |     |                                  |                     |                                   |
|-------------------------------------------|------|-------------------------------------------------------------|---|------------|-----|----------------------------------|---------------------|-----------------------------------|
| 1                                         | 1B   | Advanced Machine Learning (WMAIo30-05)                      | 5 | See MSc AI |     |                                  |                     |                                   |
| 1                                         | 1B   | Neural Networks and Computational Intelligence (WMCS010-05) | 5 | See MSc CS |     |                                  |                     |                                   |
| 1                                         | 1B   | Pattern Recognition (for CS) (WMCS011-05)                   | 5 | See MSc CS |     |                                  |                     |                                   |
| 1                                         | 1B.3 | Big Data & Applications in Biomedicine (WMBMo25-05)         | 5 | See MSc BM |     |                                  |                     |                                   |
| 1                                         | 2A   | Nonlinear Control Systems (WMSC003-05)                      | 5 | See MSc SC |     |                                  |                     |                                   |
| 1                                         | 2B   | Astronomical Data Science (WMAS007-05)                      | 5 | See MSc AS |     |                                  |                     |                                   |
| 1                                         | 2B   | Data-driven Optimization (WMME011-05)                       | 5 | See MSc ME |     |                                  |                     |                                   |
| Specialization: Computational Mathematics |      |                                                             |   |            |     |                                  |                     |                                   |
| 1                                         | 1A   | Computational fluid dynamics (WMMA012-05)                   | 5 | WE, PR     | Yes | Exam week, Continuous (homework) | dr. ir. R. Luppés   | prof. dr. ir. R.W.C.P. Verstappen |
| 1                                         | 1A   | Model Reduction for PDE (24/25) (WMMA053-05)                | 5 | R, P, AST  | No  | Exam week, Continuous            | dr. J. Koellermeier | prof. dr. ir. R.W.C.P. Verstappen |
| 1                                         | 1A   | Multiscale Numerical Methods (23/24) (WMMA054-05)           | 5 | P, R, AST  | No  | Exam week, Continuous            | dr. J. Koellermeier | prof. dr. ir. R.W.C.P. Verstappen |
| 1                                         | 1B   | Finite Element Methods and Applications (WMMA051-05)        | 5 | WE, AST    | Yes | Exam week, Continuous            | dr. C.A. Bertoglio  | prof. dr. ir. R.W.C.P. Verstappen |

|   |       |                                                                    |                                 |                   |     |                       |                           |                     |
|---|-------|--------------------------------------------------------------------|---------------------------------|-------------------|-----|-----------------------|---------------------------|---------------------|
| 1 | 1B    | Iterative Algorithms (WMMA057-05)                                  | 5                               | R, P, AST         | No  | Exam week, continuous | prof. dr. J.G. Peypouquet | dr. C.A. Bertoglio  |
| 1 | 2A    | Numerical Bifurcation Analysis (23/24) (WMMA055-05)                | 5                               | WE, AST           | No  | Exam week, continuous | dr. ir. F.W. Wubs         | dr.ir. G. Tiesinga  |
| 1 | 2B    | Coupled Problems (24/25) (WMMA052-05)                              | 5                               | WE, AST           | Yes | Exam week, continuous | dr. C.A. Bertoglio        | dr. J. Koellermeier |
| 1 | 1A-2B | <i>Guided choice courses from other specializations</i>            | <i>see other specialization</i> |                   |     |                       |                           |                     |
| 1 | 1A    | <i>Introduction to Data Science (WMCS002-05)</i>                   | 5                               | <i>See MSc CS</i> |     |                       |                           |                     |
| 1 | 1B    | <i>Advanced Machine Learning (WMAI030-05)</i>                      | 5                               | <i>See MSc AI</i> |     |                       |                           |                     |
| 1 | 1B    | <i>Computational Solid Mechanics (WMME028-05)</i>                  | 5                               | <i>See MSc ME</i> |     |                       |                           |                     |
| 1 | 1B    | <i>Fitting Dynamical Models to Data (WMIE007-05)</i>               | 5                               | <i>See MSc IE</i> |     |                       |                           |                     |
| 1 | 1B    | <i>Neural Networks and Computational Intelligence (WMCS010-05)</i> | 5                               | <i>See MSc CS</i> |     |                       |                           |                     |
| 1 | 2A    | <i>Nonlinear Control Systems (WMSC003-05)</i>                      | 5                               | <i>See Msc SC</i> |     |                       |                           |                     |
| 1 | 2B    | <i>Data-driven Optimization (WMME011-05)</i>                       | 5                               | <i>See MSc ME</i> |     |                       |                           |                     |

*The abbreviations for the relevant teaching methods are explained in the legend of the table.*

*Examples of assessment methods include:*

- *Written Exam (WE)*
- *Multiple Choice (MC)*
- *Oral Exam (OR)*
- *Report (R)*
- *Presentation (P)*
- *Practical Work (PR)*
- *Assignment (AST)*

*The abbreviations for other master programmes are as follows:*

- *MSc AI: Artificial Intelligence*
- *MSc AS: Astronomy*
- *MSc BM: Biomedical Sciences*
- *MSc CS: Computer Science*
- *MSc IEM: Industrial Engineering and Management*
- *MSc ME: Mechanical Engineering*
- *MSc SC: Systems and Control*

5. Relationship between course units and details of the learning outcomes

Please note in the table below the course units per block in the programme. Indicate which learning outcomes are assessed in which courses by adding an X in the relevant cell. Please add extra rows if necessary.

**An X means that the learning outcome is explicitly assessed (not merely addressed) in the course.**

|                                          |                                                                 | Learning outcomes of the degree programme |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
|------------------------------------------|-----------------------------------------------------------------|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|
|                                          |                                                                 | A<br>1                                    | A<br>2 | A<br>3 | A<br>4 | A<br>5 | A<br>6 | A<br>7 | A<br>8 | A<br>9 | T<br>1 | T<br>2 | T<br>3 | T<br>4 |  |  |  |  |  |
| Period                                   | Course                                                          | Year 1 – compulsory courses               |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
| 2A                                       | Mathematics and its Environment (WMMA013-05 )                   |                                           |        |        |        | X      | X      |        | X      |        | X      |        |        |        |  |  |  |  |  |
| 2B                                       | Student Colloquium (WMMA029-05 )                                |                                           |        | X      |        |        | X      | X      | X      | X      | X      | X      | X      | X      |  |  |  |  |  |
| Specialization: Systems and Optimization |                                                                 |                                           |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
| 1A                                       | Robust Control (WMMA021-05)                                     | X                                         |        | X      | X      |        | X      | X      | X      |        | X      | X      |        |        |  |  |  |  |  |
| 1B                                       | Calculus of Variations and Optimal Control (23/24) (WMMA056-05) | X                                         |        | X      |        |        | X      |        |        |        | X      | X      |        | X      |  |  |  |  |  |
| 1B                                       | Data-Based Analysis and Control (23/24) (WMMA058-05)            | X                                         | X      | X      |        |        | X      | X      |        | X      |        | X      | X      | X      |  |  |  |  |  |
| 1B                                       | Iterative Algorithms (WMMA057-05)                               | X                                         |        |        |        |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |
| 1B                                       | Model Reduction for Control (WMMA062-05)                        | X                                         | X      | X      |        |        | X      | X      |        |        | X      | X      | X      | X      |  |  |  |  |  |

|                                                    |                                                                                                                             | Learning outcomes of the degree programme |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|
|                                                    |                                                                                                                             | A<br>1                                    | A<br>2 | A<br>3 | A<br>4 | A<br>5 | A<br>6 | A<br>7 | A<br>8 | A<br>9 | T<br>1 | T<br>2 | T<br>3 | T<br>4 |  |  |  |  |  |
| 2A                                                 | Convex Analysis<br>(24/25)<br>(WMMA060-05)                                                                                  | X                                         | X      | X      |        |        | X      | X      |        | X      | X      | X      | X      | X      |  |  |  |  |  |
| 2A                                                 | Evolution Equations<br>(23/24)<br>(WMMA059-05)                                                                              | X                                         | X      | X      |        |        | X      | X      |        | X      | X      | X      | X      | X      |  |  |  |  |  |
| 2A                                                 | Nonlinear Control<br>Systems<br>(WMSC003-05)                                                                                | X                                         | X      | X      | X      |        |        | X      |        |        | X      | X      | X      | X      |  |  |  |  |  |
| <b>Specialization: Statistics and Data Science</b> |                                                                                                                             |                                           |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
| 1A                                                 | Contemporary<br>Statistics with<br>Applications<br>(WMMA015-05)                                                             | X                                         | X      |        |        |        | X      | X      |        | X      | X      |        |        |        |  |  |  |  |  |
| 1A                                                 | Introduction to Data<br>Science (WMCS002-<br>05)                                                                            | X                                         | X      | X      |        |        | X      | X      | X      |        | X      | X      | X      |        |  |  |  |  |  |
| 1A                                                 | Statistical Genomics<br>(23/24)<br>(WMMA008-05)                                                                             | X                                         | X      |        | X      |        | X      | X      |        |        | X      |        |        |        |  |  |  |  |  |
| 1B                                                 | Mathematical<br>Modelling and<br>Statistical Analysis<br>of the Spread of<br>Infectious Diseases<br>(23/24)<br>(WMMA061-05) | X                                         | X      | X      |        |        | X      | X      | X      | X      | X      | X      | X      | X      |  |  |  |  |  |
| 1B                                                 | Topics in Probability<br>and Statistics<br>(WMMA039-05)                                                                     | X                                         | X      | X      |        |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |

|                                                  |                                                      | Learning outcomes of the degree programme |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
|--------------------------------------------------|------------------------------------------------------|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|
|                                                  |                                                      | A<br>1                                    | A<br>2 | A<br>3 | A<br>4 | A<br>5 | A<br>6 | A<br>7 | A<br>8 | A<br>9 | T<br>1 | T<br>2 | T<br>3 | T<br>4 |  |  |  |  |  |
| 1B                                               | Fitting Dynamical Models to Data (WMIE007-05)        | X                                         |        |        | X      |        | X      | X      |        |        | X      | X      | X      | X      |  |  |  |  |  |
| 1B                                               | Statistical Signal Processing (WMAS011-05)           | X                                         |        |        | X      |        | X      | X      |        |        | X      | X      | X      | X      |  |  |  |  |  |
| 2A                                               | Statistical Consulting (24/25) (WMMA024-05)          | X                                         |        | X      | X      | X      | X      | X      | X      |        |        |        |        |        |  |  |  |  |  |
| <b>Specialization: Computational Mathematics</b> |                                                      |                                           |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
| 1A                                               | Computational fluid dynamics (WMMA012-05)            | X                                         |        |        | X      |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |
| 1A                                               | Model Reduction for PDE (24/25) (WMMA053-05)         | X                                         | X      | X      |        |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |
| 1A                                               | Multiscale Numerical Methods (23/24) (WMMA054-05)    | X                                         | X      | X      |        |        | X      | X      |        |        | X      | X      | X      | X      |  |  |  |  |  |
| 1B                                               | Finite Element Methods and Applications (WMMA051-05) | X                                         |        |        | X      |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |
| 1B                                               | Iterative Algorithms (WMMA057-05)                    | X                                         |        |        |        |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |
| 2A                                               | Numerical Bifurcation Analysis (23/24) (WMMA055-05)  | X                                         | X      | X      |        |        | X      | X      |        |        | X      | X      |        | X      |  |  |  |  |  |

|                                          |                                                                 | Learning outcomes of the degree programme |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |  |
|------------------------------------------|-----------------------------------------------------------------|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|--|
|                                          |                                                                 | A<br>1                                    | A<br>2 | A<br>3 | A<br>4 | A<br>5 | A<br>6 | A<br>7 | A<br>8 | A<br>9 | T<br>1 | T<br>2 | T<br>3 | T<br>4 |  |  |  |  |  |  |
| 2B                                       | Coupled Problems<br>(24/25)<br>(WMMA052-05))                    | X                                         | X      | X      |        |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |  |
| Period                                   | Course                                                          | Year 1 Electives (if applicable)          |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |  |
| All Specializations                      |                                                                 |                                           |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |  |
| 2A+2B                                    | Neem Regie (Dutch)<br>(TEM0110-24)                              |                                           |        |        |        | X      |        |        | X      | X      |        |        |        |        |  |  |  |  |  |  |
| Specialization: Systems and Optimization |                                                                 |                                           |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |  |
| 1A                                       | Computational Fluid<br>Dynamics<br>(WMMA012-05)                 | X                                         |        |        | X      |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |  |
| 1A                                       | Contemporary<br>Statistics with<br>Applications<br>(WMMA015-05) | X                                         | X      |        |        |        | X      | X      |        | X      | X      |        |        |        |  |  |  |  |  |  |
| 1A                                       | Introduction to Data<br>Science (WMCS002-<br>05)                | X                                         | X      | X      |        |        | X      | X      | X      |        | X      | X      | X      |        |  |  |  |  |  |  |
| 1A                                       | Robotics for IEM<br>(WMIE005-05)                                |                                           |        |        | X      |        |        | X      |        |        |        |        | X      | X      |  |  |  |  |  |  |
| 1B                                       | Finite Element<br>Methods and<br>Applications<br>(WMMA051-05)   | X                                         |        |        | X      |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |  |
| 1B                                       | Fitting Dynamical<br>Models to Data<br>(WMIE007-05)             | X                                         |        |        | X      |        | X      | X      |        |        | X      | X      | X      | X      |  |  |  |  |  |  |
| 2A                                       | Analysis and Control<br>of Smart Systems<br>(WMIE015-05)        |                                           |        |        | X      |        |        | X      |        |        |        |        | X      | X      |  |  |  |  |  |  |

|                                                    |                                                              | Learning outcomes of the degree programme |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
|----------------------------------------------------|--------------------------------------------------------------|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|
|                                                    |                                                              | A<br>1                                    | A<br>2 | A<br>3 | A<br>4 | A<br>5 | A<br>6 | A<br>7 | A<br>8 | A<br>9 | T<br>1 | T<br>2 | T<br>3 | T<br>4 |  |  |  |  |  |
| 2A                                                 | Statistical Consulting (24-25)<br>(WMMA024-05)               | X                                         |        | X      | X      | X      | X      | X      | X      |        |        |        |        |        |  |  |  |  |  |
| 2B                                                 | Data-driven Optimization<br>(WMME011-05)                     |                                           | X      |        |        |        |        | X      |        |        |        | X      |        |        |  |  |  |  |  |
| <b>Specialization: Statistics and Data Science</b> |                                                              |                                           |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
| 1A                                                 | Cloud Computing and Cloud-based Applications<br>(WMCS032-05) |                                           |        |        |        |        |        |        |        |        | X      |        | X      |        |  |  |  |  |  |
| 1A                                                 | Computational fluid dynamics<br>(WMMA012-05)                 | X                                         |        |        | X      |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |
| 1A                                                 | Robust Control<br>(WMMA021-05)                               | X                                         |        | X      | X      |        | X      | X      | X      |        | X      | X      |        |        |  |  |  |  |  |
| 1A.2                                               | Data Science in Biomedicine<br>(WMBM023-05)                  |                                           |        |        |        |        |        |        |        |        | X      | X      | X      | X      |  |  |  |  |  |
| 1B                                                 | Advanced Machine Learning<br>(WMAI030-05)                    |                                           | X      |        |        |        |        |        |        |        | X      |        |        | X      |  |  |  |  |  |
| 1B                                                 | Data-based Analysis and Control (23/24)<br>(WMMA058-05)      | X                                         | X      | X      |        |        | X      | X      |        | X      |        | X      | X      | X      |  |  |  |  |  |
| 1B                                                 | Finite Element Methods and Applications<br>(WMMA051-05)      | X                                         |        |        | X      |        | X      | X      | X      |        | X      | X      | X      | X      |  |  |  |  |  |

|                                                  |                                                             | Learning outcomes of the degree programme |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
|--------------------------------------------------|-------------------------------------------------------------|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|
|                                                  |                                                             | A<br>1                                    | A<br>2 | A<br>3 | A<br>4 | A<br>5 | A<br>6 | A<br>7 | A<br>8 | A<br>9 | T<br>1 | T<br>2 | T<br>3 | T<br>4 |  |  |  |  |  |
| 1B                                               | Neural Networks and Computational Intelligence (WMCS010-05) |                                           | X      |        |        |        |        |        |        |        | X      |        |        | X      |  |  |  |  |  |
| 1B                                               | Pattern Recognition (for CS) (WMCS011-05)                   |                                           |        |        |        |        |        |        |        |        |        | X      |        | X      |  |  |  |  |  |
| 1B.3                                             | Big Data & Applications in Biomedicine (WMBM025-05)         |                                           |        |        |        |        |        |        |        |        |        | X      | X      | X      |  |  |  |  |  |
| 2A                                               | Nonlinear Control Systems (WMSC003-05)                      | X                                         | X      | X      |        |        | X      |        |        |        | X      | X      |        | X      |  |  |  |  |  |
| 2B                                               | Astronomical Data Science (WMAS007-05)                      |                                           |        |        |        |        |        |        |        |        |        | X      | X      |        |  |  |  |  |  |
| 2B                                               | Data-driven Optimization (WMME011-05)                       |                                           | X      |        |        |        |        | X      |        |        |        | X      |        |        |  |  |  |  |  |
| <b>Specialization: Computational Mathematics</b> |                                                             |                                           |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
| 1A + 1B                                          | Numerical Linear Algebra (MasterMath) (WMMA002-08)          | X                                         | X      | X      |        |        |        | X      |        |        | X      | X      |        | X      |  |  |  |  |  |
| 1A                                               | Contemporary Statistics with Applications (WMMA015-05)      | X                                         | X      |        |        |        | X      | X      |        | X      | X      |        |        |        |  |  |  |  |  |

|    |                                                             | Learning outcomes of the degree programme |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
|----|-------------------------------------------------------------|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|
|    |                                                             | A<br>1                                    | A<br>2 | A<br>3 | A<br>4 | A<br>5 | A<br>6 | A<br>7 | A<br>8 | A<br>9 | T<br>1 | T<br>2 | T<br>3 | T<br>4 |  |  |  |  |  |
| 1A | Introduction to Data Science (WMCS002-05)                   | X                                         | X      | X      |        |        | X      | X      | X      |        | X      | X      | X      |        |  |  |  |  |  |
| 1A | Robust Control (WMMA021-05)                                 | X                                         |        | X      | X      |        | X      | X      | X      |        | X      | X      |        |        |  |  |  |  |  |
| 1B | Advanced Machine Learning (WMAI030-05)                      |                                           | X      |        |        |        |        |        |        |        | X      |        |        | X      |  |  |  |  |  |
| 1B | Computational Solid Mechanics (WMME028-05)                  |                                           | X      |        |        |        |        |        |        |        |        | X      | X      |        |  |  |  |  |  |
| 1B | Data-based Analysis and Control (23/24) (WMMA058-05)        | X                                         | X      | X      |        |        | X      | X      |        | X      |        | X      | X      | X      |  |  |  |  |  |
| 1B | Fitting Dynamical Models to Data (WMIE007-05)               | X                                         |        |        | X      |        | X      | X      |        |        | X      | X      | X      | X      |  |  |  |  |  |
| 1B | Model Reduction for Control (WMMA062-05)                    | X                                         | X      | X      |        |        | X      | X      |        |        | X      | X      | X      | X      |  |  |  |  |  |
| 1B | Neural Networks and Computational Intelligence (WMCS010-05) |                                           | X      |        |        |        |        |        |        |        | X      |        |        | X      |  |  |  |  |  |
| 2A | Nonlinear Control Systems (WMSC003-05)                      | X                                         | X      | X      | X      |        |        | X      |        |        | X      | X      | X      | X      |  |  |  |  |  |
| 2A | Statistical Consulting (24/25) (WMMA024-05)                 | X                                         |        | X      | X      | X      | X      | X      | X      |        |        |        |        |        |  |  |  |  |  |

|            |                                                             | Learning outcomes of the degree programme |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
|------------|-------------------------------------------------------------|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|--|
|            |                                                             | A<br>1                                    | A<br>2 | A<br>3 | A<br>4 | A<br>5 | A<br>6 | A<br>7 | A<br>8 | A<br>9 | T<br>1 | T<br>2 | T<br>3 | T<br>4 |  |  |  |  |  |
| 2B         | Data-driven Optimization (WMME011-05)                       |                                           | X      |        |        |        |        | X      |        |        |        | X      |        |        |  |  |  |  |  |
| Period     | Course                                                      | Year 2 compulsory courses                 |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |  |
| Whole year | Research Seminar in Applied Mathematics (WMMA050-05 )       |                                           | X      | X      |        |        | X      | X      | X      | X      | X      | X      | X      | X      |  |  |  |  |  |
| Whole year | Master Research Project in Applied Mathematics (WMMA901-35) | X                                         | X      | X      |        | X      | X      | X      | X      | X      | X      | X      | X      | X      |  |  |  |  |  |
| Whole Year | Internship Applied Mathematics (WMMA001-15)                 | X                                         | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      | X      |  |  |  |  |  |

## 6. Examiners for Research Project and Internship

### *Specialization Computational Mathematics*

dr. C.A. Bertoglio  
dr. J. Koellermeier  
dr. ir. R. Luppés  
prof. dr. ir. R.W.C.P. Verstappen

### *Specialization Systems and Optimization*

prof. dr. ir. B. Besselink  
prof. dr. M.K. Camlibel  
prof. dr. J.G. Peypouquet  
prof. dr. S. Trenn  
dr. ir. H.J. van Waarde

### *Specialization Statistics and Data Science*

dr. G.F.Y. Bonnet  
dr. S.A. Donderwinkel  
prof. dr. M.A. Grzegorzczuk  
dr. W.P. Krijnen  
prof. dr. T. Müller  
dr. R. Szabó  
prof. dr. J.P. Trapman

The first examiner of a research project for a certain specialization must stem from the above list of examiners for that specific specialization. The second examiner of the research project can be any person from the above list (regardless of the specialization) or any examiners of the research project of the master's degree programme in mathematics.

On an individual basis the Board of Examiners can allow examiners of other degree programmes to act as examiner for the research project of the master's degree programme in applied mathematics as well.