

**These examination regulations have been worded carefully to be up to date; however, errors cannot be completely excluded. The official German text available at the Examinations Office is the version that is legally binding.**

**Note:** Students who started their studies before the latest amendment came into effect are requested to also comply with previous amendments and the respective transitory provisions.

**Degree Programme and Examination Regulations for the  
Elite Master's Degree Programme in Advanced Optical  
Technologies at the Faculty of Engineering of  
Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)  
– FPO MAOT –  
Dated 2 October 2007**

amended by statutes of  
3 September 2009  
11 August 2010  
9 March 2011  
26 July 2013  
8 July 2014  
8 March 2016  
16 January 2018  
6 August 2019

Based on Section 13 (1)(2), Section 43 (5), Section 58 (1) and Section 61 (2)(1) of the Bavarian Higher Education Act (Bayerisches Hochschulgesetz, BayHSchG), FAU enacts the following degree programme and examination regulations:

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## **Part 1: General Provisions**

### **Preamble**

FAU offers an Elite Master's degree programme in Advanced Optical Technologies (MAOT) as part of the Elite Network of Bavaria.

### **Section 34 Scope**

The degree programme and examination regulations for the Elite Master's degree programme in Advanced Optical Technologies complement the current version of the General Examination Regulations for the Bachelor's and Master's degree programmes at the Faculty of Engineering of FAU (**ABMPO/TechFak**) from 18 September 2007.

### **Section 35 ECTS Credits, Standard Duration of Study, Start of Degree Programme**

(1) <sup>1</sup>120 ECTS credits shall be required in order to pass the Elite Master's degree programme in Advanced Optical Technologies (MAOT). <sup>2</sup>The standard duration of study shall be four semesters.

(2) The degree programme may only be started in the winter semester.

### **Section 36 Degree Title for the Elite Master's Degree Programme**

The student is conferred the degree Master of Science (abbreviated MSc) after passing the Master's examination.

### **Section 37 Teaching and Examination Language**

<sup>1</sup>Notwithstanding Section 4 (5) **ABMPO/TechFak**, the teaching and examination language in the Elite Master's degree programme in Advanced Optical Technologies shall be English; individual teaching units and examinations may be held in German. <sup>2</sup>The Master's thesis shall usually be written in English. <sup>3</sup>Exceptions shall require the Examination Committee's approval.

### **Section 38 Admissions Committee, Degree Programme Committee**

(1) <sup>1</sup>An Admissions Committee shall be formed pursuant to Section 11 **ABMPO/TechFak** to review whether applicants meet the qualification and admission requirements for the Elite Master's degree programme pursuant to Section 39. <sup>2</sup>It shall consist of the degree programme coordinator and a representative from each of the seven major topics covered in the MAOT. <sup>3</sup>The representatives shall be university lecturers or full-time research associates; at least two of these shall be professors. <sup>4</sup>The coordinator shall be a university lecturer.

(2) <sup>1</sup>Together with a student representative and the degree programme manager acting as a study advisor, the Admissions Committee shall also assume the tasks of a Degree Programme Committee for the Elite Master's degree programme. <sup>2</sup>A deputy shall be appointed for the student representative.

### **Section 39 Qualification for the Elite Master's Degree Programme**

(1) <sup>1</sup>In order to qualify for the Master's degree programme, applicants must have completed a degree programme in a relevant engineering or scientific subject as set forth

in Section 29 (1)(1) **ABMPO/TechFak** with an above-average grade and have passed the qualification assessment process pursuant to **Appendix 2** in connection with the **Appendix to ABMPO/TechFak**. <sup>2</sup>Completed Bachelor's degrees in physics, optical technologies or electrical engineering shall generally be considered relevant. <sup>3</sup>The same applies for degrees obtained at a faculty of engineering or sciences for which at least 20 ECTS credits had to be achieved in the areas of optics or optical technologies. <sup>4</sup>The provisions in Section 30 (3)(2) **ABMPO/TechFak** does not apply to related degree programmes.

(2) <sup>1</sup>Applicants should have completed this degree with an overall grade of at least 2.00 (good). <sup>2</sup>Section 12 (3) sentences 1 to 3 **ABMPO/TechFak** shall apply accordingly.

#### **Section 40 Structure of the Elite Master's Degree Programme, Failure at the Final Attempt**

(1) <sup>1</sup>The Elite Master's degree programme shall comprise 16 modules as listed in **Appendix 2**. <sup>2</sup>The modules M4 – M12 shall be chosen from at least two of the major topics listed in **Appendix 1**. <sup>3</sup>Modules worth at least 20 ECTS credits must be taken for one of the chosen major topics and modules worth at least 15 ECTS credits for another. <sup>4</sup>Modules worth up to 10 ECTS credits can be replaced by modules offered by FAU's Faculty of Engineering, Faculty of Sciences or Faculty of Medicine on condition that a request is filed with the Degree Programme Committee and the Degree Programme Committee confirms that the subject of these modules sufficiently conforms with one of the student's chosen major topics. <sup>5</sup>In the case of sentence 3, clause 2, the type and scope of the examinations for the modules imported from the other degree programmes shall be determined by the respective **degree programme and examination regulations**. <sup>6</sup>Modules with a higher or lower number of ECTS credits can replace modules with 5 ECTS credits accordingly. <sup>7</sup>The number of examinations can either increase or decrease accordingly. <sup>8</sup>The two practical courses in the module M13 be completed in the major topics chosen according to sentence 3 clause 1.

(2) <sup>1</sup>The modules M1 and M2 be completed by the end of the second semester by all students; otherwise the Elite Master's degree programme shall be regarded as having been failed at the final attempt, unless the reasons for failing to complete the modules in due time are beyond the student's control. <sup>2</sup>Section 7 (3) **ABMPO/TechFak** shall apply accordingly.

#### **Section 41 Choice of Major Topics**

<sup>1</sup>Students shall inform the Degree Programme Committee about the major topics (modules M4 – M12) they intend to choose from the subjects offered in **Appendix 1** by the beginning of the lecture period of the second semester. <sup>2</sup>The Admissions Committee shall be notified in case of a change after this deadline. <sup>3</sup>The choice of major topics according to sentence 1 and the change of major topics according to sentence 2 shall be regarded as permitted unless the Admissions Committee objects within a four-week deadline.

#### **Section 42 Examination and Course Achievements**

[revoked]

### **Section 43 Research Project**

(1) <sup>1</sup>Students shall carry out a research project as part of the module group M14. <sup>2</sup>This is intended to teach students how to independently solve scientific problems such as those dealt with in a Master's thesis. <sup>3</sup>Students shall register their projects and deadline with the Examinations Office. <sup>4</sup>The research project shall have a workload of approximately 300 hours. <sup>5</sup>It shall be approximately 15-25 pages in length. <sup>6</sup>The research project period should generally not exceed six months.

(2) The research project shall preferably be carried out on one of the major topics chosen according to Section 40 (2) and (3) and supervisors shall preferably be university lecturers teaching the subject in question.

### **Section 44 Internship**

<sup>1</sup>The internship (M15) shall have a minimum duration of five weeks and shall preferably be completed in a research area at FAU's Faculty of Engineering, Faculty of Sciences or Faculty of Medicine that is relevant to the degree programme. <sup>2</sup>If the internship is completed outside FAU, the internship guidelines set forth by MAOT shall apply.

### **Section 45 Admission to the Master's Thesis**

Students shall successfully complete modules worth a minimum of 80 ECTS credits to gain admission to the Master's thesis.

### **Section 46 Master's Thesis**

(1) <sup>1</sup>The Master's thesis is intended to demonstrate students' ability to solve problems independently in one of their major topics. <sup>2</sup>The thesis shall have a workload of approximately 900 hours to be completed within six months. <sup>3</sup>As part of the Master's thesis module, students shall give an additional presentation on the results of the Master's thesis followed by a discussion. <sup>4</sup>The date of the presentation shall be determined by the supervising lecturer either after the student has submitted their Master's thesis or during the final stage of thesis work.

(2) <sup>1</sup>The Master's thesis shall preferably deal with a scientific subject at the intersection of two of the student's major topics. <sup>2</sup>The subject of the Master's thesis shall be allocated by a full-time university lecturer teaching the degree programme who represents one of the chosen major topics.

### **Section 47 Evaluation of Achievements in the Master's Degree Programme, Resit Examinations, Withdrawal from the Degree Programme**

(1) The Master's degree programme shall have been passed if all modules of the module groups M1 – M16 have been passed pursuant to **Appendix 2**.

(2) The overall grade for the Master's degree programme is calculated from the grades for modules M1 and M2, M4 to M12, M14 and M16. <sup>2</sup>The module grades shall be weighted according to the modules' ECTS credits.

(3) <sup>1</sup>Notwithstanding the respective provisions in **ABMPO/TechFak**, examinations in the Elite Master's Degree Programme Advanced Optical Technologies can be resat in accordance with the following provisions. <sup>2</sup>Examination achievements in modules M1, M2 and M14 can be repeated twice. <sup>3</sup>Examination achievements in modules M4 to M12 and M15 can be repeated once. <sup>4</sup>Examination achievements in modules M3 and M13 can be repeated without restriction.

(4) <sup>1</sup>Students who are obliged to withdraw from the Elite Master's degree programme as a result of the provision set forth in (3)(2) shall be offered the option of entering a Master's degree programme at the Faculty of Engineering, provided the relevant qualification assessment process is passed successfully. <sup>2</sup>Examination and course achievements from the Elite Master's degree programme shall be recognised in the subsequently studied degree programmes unless the relevant **degree programme and examination regulations** state otherwise. <sup>3</sup>The relevant Master's degree programme shall be proposed by the Admissions Committee with the approval of the degree programme representatives on the Admissions Committee

## Part 2: Final Provisions

### Section 48 Legal Validity and Transitory Provisions

(1) <sup>1</sup>These degree programme and examination regulations shall come into effect on the day after their publication. <sup>2</sup>They shall apply to all students who enter the Elite Master's degree programme in Advanced Optical Technologies in the winter semester 2007/2008 or later.

(2) <sup>1</sup>The amendment statute of 11 August 2010 shall come into effect on 1 October 2010. <sup>2</sup>It shall apply to students who enter the Elite Master's degree programme in the winter semester 2010/2011 onwards.

(3) <sup>1</sup>The seventh amendment statute shall come into effect on the day after its publication. <sup>2</sup>It shall apply to all students starting a degree programme from the winter semester 2018/2019 onwards.

(4) <sup>1</sup>The eighth amendment statute shall come into effect on 1 October 2019. <sup>2</sup>Notwithstanding sentence 1, the amendments in Section 39 (1)(4) shall apply to all students starting the Master's degree programme from the winter semester 2019/2020 onwards. <sup>3</sup>Notwithstanding sentences 1 and 2, the amendments in Section 37 (2) (old), Section 40, Section 43 (1)(3), **Appendix 1** (9) and the changes to the foundation subjects in **Appendix 2** only apply to examination procedures commenced as of winter semester 2019/2020 (first attempt).

## Appendix 1: Major Topics

(1) <sup>1</sup>The learning outcome of the major topics is to allow students to specialise in a specific subject area by choosing from the modules offered. <sup>2</sup>Whilst complying with the provisions stipulated in Section 40 (1) sentences 2 to 4 and Section 41, students can choose from the following major topics:

1. Optical metrology
2. Optical material processing
3. Optics in medicine
4. Optics in communication and IT
5. Optical materials and systems
6. Computational objects
7. Physics of light.

<sup>3</sup>Modules which can be chosen are listed in **Appendix 3**; further modules may be added in future.

(2) <sup>1</sup>The learning outcome of the major topic Optical metrology is for students to become familiar with optical measuring methods and acquire the ability to use them adequately in practice. <sup>2</sup>Students acquire specialised knowledge in the properties of light, light-matter interaction and common sensors and analysis methods.

(3) The learning outcome of the major topic Optical material processing is for students to learn how to process material using light, focusing in particular on the necessary properties of light and light-material interaction.

(4) The learning outcome of the major topic Optics in medicine is for students to explore how and where light is used in the field of medicine, both for diagnosis and therapy.

(5) The learning outcome of the major topic Optics in communication and IT is for students to obtain advanced knowledge of using optics in communication systems.

(6) The learning outcome of the major topic Optical materials and systems is for students to gain advanced knowledge about characteristics of material which determine the optical properties of the material.

(7) The learning outcome of the major topic Computational objects is for students to become familiar with mathematical methods for analysing data in the field of optical technologies and methods for simulating optical components and systems.

(8) The learning outcome of the major topic Physics of light is for students to acquire knowledge in the physics on which optical technologies are based going beyond the foundation modules (geometrical optics, wave optics, Fourier optics, quantum optics).

(9) <sup>1</sup>The type and scope of the examination are dependent on the competencies for the chosen module according to (1) to (8) and the module handbook. <sup>2</sup>Possible examination achievements are: written examination (60, 90 or 150 mins) or oral examination (approx. 30 mins). <sup>3</sup>The module handbook is published before the beginning of the seminar in accordance with local practice.

(10) <sup>1</sup>Modules generally consist of two teaching units (lecture and tutorial), each with a workload of 2 semester hours (SWS). <sup>2</sup>Further provisions shall be set forth in the module handbook.

## Appendix 2: Structure of the Degree Programme

| Module group  | Module number | Module title   | SWS (semester hours) |           |          |   | Total ECTS credits | Workload per semester in ECTS credits |             |           |           | Type and scope of the examination/course achievements                          |
|---|---------------|--|----------------------|-----------|----------|---|--------------------|---------------------------------------|-------------|-----------|-----------|--|
|   |               |  | L                    | T         | P        | S |                    | 1. sem.                               | 2. sem.     | 3. sem.   | 4. sem.   |  |
| <b>Basic subjects</b>                               | 1             | Fundamentals of optics                               | 8                    | 4         |          |   | 15                 | 15                                    |             |           |           | EA (written examination 150 min.)  |
|   | 2             | Basics of laser technology                           | 2                    | 1         | 1        |   | 5                  | 5                                     |             |           |           | EA (written examination 90 min.), 80 %<br>EA: LA (lab report, 5-7 pages), 20 % |
|   | 3             | Numerical methods and topics in optical technologies | 4                    |           |          |   | 5                  | 5                                     |             |           |           | CA (SA)  |
| <b>Major Topic 1 pursuant to Appendices 1 and 3</b> | 4             | Major topic 1 – Module 1                             | 2                    | 2         |          |   | 5                  |                                       | 5           |           |           | pursuant to Appendix 1 (9) or Section 40 (1) sentence 4                        |
|   | 5             | Major topic 1 – Module 2                             | 2                    | 2         |          |   | 5                  |                                       | 5           |           |           | pursuant to Appendix 1 (9) or Section 40 (1) sentence 4                        |
|   | 6             | Major topic 1 – Module 3                             | 2                    | 2         |          |   | 5                  |                                       |             | 5         |           | pursuant to Appendix 1 (9) or Section 40 (1) sentence 4                        |
|   | 7             | Major topic 1 – Module 4                             | 2                    | 2         |          |   | 5                  |                                       |             | 5         |           | pursuant to Appendix 1 (9) or Section 40 (1) sentence 4                        |
| <b>Major Topic 2 pursuant to Appendices 1 and 3</b> | 8             | Major topic 2 – Module 1                             | 2                    | 2         |          |   | 5                  |                                       | 5           |           |           | pursuant to Appendix 1 (9) or Section 40 (1) sentence 4                        |
|   | 9             | Major topic 2 – Module 2                             | 2                    | 2         |          |   | 5                  |                                       | 5           |           |           | pursuant to Appendix 1 (9) or Section 40 (1) sentence 4                        |
|   | 10            | Major topic 2 – Module 3                             | 2                    | 2         |          |   | 5                  |                                       |             | 5         |           | pursuant to Appendix 1 (9) or Section 40 (1) sentence 4                        |
| <b>Free Modules<sup>1)</sup></b>                    | 11            | Free module 1  | 2                    | 2         |          |   | 5                  |                                       | 5           |           |           | pursuant to Appendix 1 (9) or Section 40 (1) sentence 4                        |
|   | 12            | Free module 2  | 2                    | 2         |          |   | 5                  |                                       |             | 5         |           | pursuant to Appendix 1 (9) or Section 40 (1) sentence 4                        |
| <b>Lab courses</b>                                  | 13            | Lab courses Major topics                             |                      |           |          | 4 |                    | 2.5                                   | 2.5         |           |           | CA (Lab report log, approx. 20-30 pages)                                       |
| <b>Project report</b>                               | 14            | Project report                                       |                      |           |          |   | 10                 |                                       |             | 10        |           | EA (written assignment, approx. 15-25 pages)                                   |
| <b>Internship</b>                                   | 15            | Internship   | at least 5 weeks     |           |          |   | 5                  |                                       | 5           |           |           | CA (internship report)   |
| <b>Master's thesis</b>                              | 16            | Master's thesis                                      |                      |           |          |   | 30                 |                                       |             |           | 30        | Master's thesis (90 %) and presentation (approx. 30 min., 10 %)                |
|   |               | <b>Total semester hours and ECTS credits</b>         | <b>32</b>            | <b>23</b> | <b>5</b> |   | <b>120</b>         | <b>27.5</b>                           | <b>32.5</b> | <b>30</b> | <b>30</b> |  |
|   |               |  | <b>60</b>            |           |          |   |                    |                                       |             |           |           |  |

### Information sheets

CA = ungraded course achievement, see Section 6 (3) sentence 8 **ABMPO/TechFak.**

EA = graded examination achievement, see Section 6 (3) sentence 7 **ABMPO/TechFak.**

LA = laboratory achievement, see Section 6 (3) sentences 3 and 5 **AMBPO/TechFak.**

SA = seminar achievement, see Section 6 (3) sentences 4 and 5 **ABMPO/TechFak.**

1) Modules can be chosen from the range of major topics offered pursuant to **Appendix 1**; Section 40 (1) sentence 3 (2) shall apply accordingly. The modules chosen shall depend on the major topics chosen in modules M4 to M10. Due to the additional specific subject competencies that must be acquired as part of the qualification goals of the Elite Master's degree programme, modules which have already been chosen as part of the modules M4 to M10 and M11 or M12 may not be chosen a second time.

### Appendix 3: Catalogue of subjects covered in major topics

| Major topic                  | Module   | ECTS credits | Semester | Examination form                     |
|------------------------------|--|--------------|----------|--------------------------------------|
| Optical metrology            | Light scattering   | 5            | SS       | pursuant to <b>Appendix 1</b><br>(9) |
|                              | Dynamic light scattering   | 5            | WS       |                                      |
| Optical material and systems | Optical technologies in life sciences  | 5            | WS       |                                      |
|                              | Product analysis   | 5            | WS       |                                      |
|                              | Advanced laser technology  | 5            | SS       |                                      |
|                              | Optical lithography  | 5            | WS       |                                      |
| Computational optics         | Non-linear optics  | 5            | TBA      |                                      |
|                              | Computational optics   | 5            | SS       |                                      |
|                              | Medical image processing for interventional applications                             | 5            | SS       |                                      |
|                              | Medical image processing for diagnostic applications                                 | 5            | WS       |                                      |
| Optical material processing  | Laser technology   | 5            | WS       |                                      |
|                              | Laser-tissue-interaction   | 5            | SS       |                                      |
|                              | Optical lithography  | 5            | WS       |                                      |
|                              | Advanced laser technology  | 5            | SS       |                                      |
| Optics in communication      | Non-linear fibre optics  | 5            | SS       |                                      |
|                              | Advanced optical communication systems   | 5            | WS       |                                      |
|                              | Non-linear optics  | 5            | TBA      |                                      |
| Optics in medicine           | Laser-tissue-interaction   | 5            | SS       |                                      |
|                              | Photonics in medical engineering   | 5            | WS       |                                      |
|                              | Clinical applications of optical technologies and associated fundamentals of anatomy | 5            | SS       |                                      |
|                              | Optical technologies in life sciences  | 5            | WS       |                                      |
| Physics of light             | Advanced laser technology  | 5            | SS       |                                      |
|                              | Non-linear optics  | 5            | TBA      |                                      |
|                              | Quantum optics   | 5            | TBA      |                                      |



#### **Appendix 4: Qualification Assessment Process**

(1) <sup>1</sup>Applications for the qualification assessment process shall be transferred electronically to the office responsible for the degree programme. <sup>2</sup>The procedure is explained in detail on the degree programme website. <sup>3</sup>Applicants for admission to the Master's degree programme shall submit the following documents to the Committee:

1. Documents showing fulfilment of admission requirements according to Section 39.
2. An English-language CV with proof of any relevant professional activity or placements which are relevant with regard to the subject of the Master's degree programme.
3. A form completed in English giving personal details (available on the MAOT website or from the MAOT office).
4. If the applicant did not complete their university entrance qualifications or first degree in English: proof of English language skills equivalent at least to Level B2 of the Common European Framework of Reference (CEFR). Proof of language skills shall be provided either with school reports or certificates obtained for having completed a language course stating that the student has attended English lessons up to a level equivalent to B2; evidence of having successfully completed the Test of English as a Foreign Language (TOEFL) with at least 85 points in the iBT; or having passed the International English Language Testing System (IELTS) with a grade of 5.0 or above.

(2) Applications shall be submitted so as to arrive at the MAOT office by 15 April for foreign applicants and by 15 July for German applicants.

(3) <sup>1</sup>In accordance with Section 11 **ABMPO/TechFak** in conjunction with Section 38, qualification assessment shall be the responsibility of the Admissions Committee of the Master's degree programme. <sup>2</sup>The Admissions Committee may transfer the task of coordinating and carrying out the process to individual members unless otherwise stated.

(4) <sup>1</sup>Applicants with a degree within the meaning of (1)(1) or in the case of Section 29 (3) **ABMPO/TechFak** with an average grade of their achievements to date of 2.0 (= 'gut', good) or better or an average module grade in the areas of optics and optical technologies of 2.5 (= 'gut', good) or better shall be invited to a 20-minute interview, which may also be conducted as a video conference. <sup>2</sup>The interview shall be conducted by at least one member of the Admissions Committee and an observer. <sup>3</sup>In the interview, the applicant shall outline their qualifications and previous papers on subjects relevant to the degree programme and answer questions regarding their papers and topics relevant to the Elite degree programme at an appropriate level. <sup>4</sup>The applicant's qualification for the Elite Master's degree programme will be assessed based on:

1. Standard of previous knowledge in physics, in particular in the areas of electromagnetism and optics (50 %),
2. Standard of knowledge of the mathematical processes required for the previous knowledge in physics as stipulated in (1), such as matrix operations and complex numbers (20 %) and
3. Standard of knowledge of important technical applications, in particular lasers and optical fibres (30 %).

(5) It will not be possible to repeat the qualification assessment process on the basis of the documentation submitted with the first application.