AMTLICHE BEKANNTMACHUNG

NUMMER 2015/069 **SEITEN** 1 - 5 **DATUM** 22.05.2015 **REDAKTION** Sylvia Glaser

3. Ordnung zur Änderung der Prüfungsordnung

für den Master-Studiengang

Applied Geophysics

der Delft University of Technology

der Eidgenössischen Technischen Hochschule Zürich

und

der Rheinisch-Westfälischen Technischen Hochschule Aachen

vom 21.05.2015

Aufgrund der §§ 2 Abs. 4, 64 des Gesetzes über die Hochschulen des Landes Nordrhein-Westfalen (Hochschulgesetz – HG) in der Fassung des Artikel 1 des Hochschulzukunftsgesetzes Nordrhein-Westfalen vom 16.09.2014 (GV. NRW S. 547) hat die Rheinisch-Westfälische Technische Hochschule Aachen (RWTH) folgende Prüfungsordnung erlassen:

HERAUSGEGEBEN IM AUFTRAGE DES REKTORS VON DER ABTEILUNG 1.1 DES DEZERNATES 1.0 DER RWTH AACHEN
Templergraben 55, 52056 Aachen | Tel. +49 241 80-99087 | Fax. +49 241 80-92664 | akad@zhv.rwth-aachen.de

Artikel I

Die Prüfungsordnung für den Master-Studiengang Applied Geophysics der Rheinisch-Westfälischen Technischen Hochschule Aachen (RWTH) vom 20.08.2012 in der Fassung der zweiten Ordnung zur Änderung der Prüfungsordnung vom 27.11.2013 (Amtliche Bekanntmachungen der RWTH Aachen, Nr. 2013/113) wird wie folgt geändert:

1. **Ab dem Wintersemester 2014/2015 wird der Modulkatalog um folgende Module im Wahlpflichtbereich erweitert:**

   - Numerical Methods for Geosciences
   - Numerical Reservoir Engineering

   Die Modulbeschreibungen befinden sich in Anlage 1 dieser Änderungsordnung.

2. **Ab dem Wintersemester 2014/2015 wird der Studienverlaufsplan durch die Fassung in Anlage 2 dieser Änderungsordnung ersetzt.**

Artikel II

Diese Änderungsordnung wird in den Amtlichen Bekanntmachungen der RWTH veröffentlicht, tritt am Tage nach ihrer Bekanntmachung in Kraft und findet auf alle in den Master-Studiengang Applied Geophysics eingeschriebenen Studierenden Anwendung.

Ausgefertigt aufgrund des Beschlusses des Fakultätsrates der Fakultät für Georessourcen und Materialtechnik vom 02.07.2014.

Der Rektor
der Rheinisch-Westfälischen
Technischen Hochschule Aachen

Aachen, den 21.05.2015

gez. Schmachtenberg
Univ.-Prof. Dr.-Ing. E. Schmachtenberg

Anlage 1: Neue Module

Modul: Numerical Methods for Geosciences [MSAGP-315/12]

MODUL TITEL: Numerical Methods for Geosciences						
ALLGEMEINE ANGABEN						
Fachsemester	**Dauer**	**Kreditpunkte**	**SWS**	**Häufigkeit**	**Turnus Start**	**Sprache**
3	1	6	4	jedes 2. Semester	WS 2014/2015	English

INHALTLICHE ANGABEN	
Inhalt	**Lernziele**
We will derive the equations of motion for a variety of geophysical flows, discuss their mathematical properties and introduce consistent and stable discretizations. We will start from simple scalar transport and proceed to compressible and incompressible Euler and Navier-Stokes equations, including Coriolis forces, bottom topography, and a free surface. From these, we will derive simpler shallow-water type models. A particular challenge are small scales, which require asymptotic preserving algorithms. Imbedded into the course are tutored online computer experiments.	The study goals are that students a.) understand how to derive fundamental equations related to geophysical flows, and they understand the influence of certain parameters. b.) understand the concept of stable and consistent discretizations, including important concepts such as well-balancing. c.) are able to program small one-dimensional example codes, and are at least in principle able to extend those codes to multiple dimensions. d.) understand the concepts of asymptotic expansions.
Voraussetzungen	**Benotung**
Students should have a sound background in calculus and linear algebra. Knowledge on numerical analysis and ordinary differential equations is advisable, but not necessary. In case of doubt, please contact responsible instructors.	The module grade is computed mostly from an oral exam. Additional assignments provided and graded during the semester can contribute up to 10% to the final course mark. At the beginning of a semester, but not later than the first date of the course, the exact criteria for the achievement of bonus credits is announced by the lecturer of the course.

LEHRFORMEN / VERANSTALTUNGEN & ZUGEHÖRIGE PRÜFUNGEN			
Titel	**Prüfungsdauer (Minuten)**	**CP**	**SWS**
Lecture "Numerical Methods for Geosciences" [MSAGP-315.a/12]		0	2
Exercise "Numerical Methods for Geosciences" [MSAGP-315.b/12]		0	2
Oral Examination "Numerical Methods for Geosciences" [MSAGP-315.c/12]	15 - 45	6	0

Modul: Numerical Reservoir Engineering [MSAGP-316/12]

MODUL TITEL: Numerical Reservoir Engineering

ALLGEMEINE ANGABEN

Fachsemester	Dauer	Kreditpunkte	SWS	Häufigkeit	Turnus Start	Sprache
3	1	6	4	jedes 2. Semester	WS 2014/2015	English

INHALTLICHE ANGABEN

Inhalt	Lernziele
a) Geophysical process simulations, uncertainties, and optimal experimental design Numerical reservoir engineering combines geological and geophysical data and knowledge with geophysical process simulations to address challenges related to an effective and sustainable use of the subsurface. Typical examples include geothermal reservoirs and groundwater studies, conventional and unconventional hydrocarbon reservoirs, but also reservoirs for gas storage and CO2 sequestration. In this course, several of these reservoir types will be studied from the perspective of numerical analysis and simulations. This includes considerations of multi-phase and multi-physics simulations, different numerical implementation schemes and relevant parameters and boundary conditions. In addition, methods for parameter sensitivities and uncertainty estimation will be discussed to obtain an insight into the potentials and limitations of subsurface reservoir studies. Based on these considerations, the final part of this module will deal with evaluations of how uncertainties can be reduced, for example with methods from optimal experimental design. b) Numerical Methods and Programming for Reservoir Engineering Practical numerical exercises will accompany the lectures to provide an additional insight into implementation techniques and uncertainty estimation. The exercises will be based on simple scripting and programming methods. Students will develop elementary code examples and apply them to the analysis of a realistic case study.	After attending this module, students will have a solid understanding of the interesting challenges and the multiple facets of subsurface usage, both from a theoretical as well as a practical perspective. They will be able to determine relevant physical processes in different reservoir scenarios and understand the underlying approaches to address practical problems such as geothermal energy extraction or CO2 sequestration. The students will be able to solve simple reservoir engineering problems numerically, and this is a valuable and important basis for a possible future use of highly complex reservoir simulation tools that are commonly applied in industry. An additional aim of the course is to equip students with an understanding of the uncertainties involved in numerical reservoir studies and the various methods to reduce these uncertainties with additional information. This is also revenant for geophysicists who are not directly involved in the reservoir simulations, but might provide important input data, for example from seismic studies. In this sense, the course provides an understanding of the interesting multidisciplinary aspects of numerical reservoir simulations.
Voraussetzungen	**Benotung**
Basic understanding of subsurface processes and geological structures, basic calculus and linear algebra, as well as knowledge of inverse theory and modelling (i.e. course ETH-C2). For exercises: previous knowledge of scripting concepts, especially with Python and/or Matlab, but a short introduction will be covered in the course. Additional knowledge of other programming languages (C, Fortran) and revision control systems (git) will be helpful but is not essential.	The module grade is calculated from partial performances by weighting individual scores according to ECTS credits. Additional assignments provided and graded during the semester can contribute up to 10% to the final course mark. At the beginning of a semester, but not later than the first date of the course, the exact criteria for the achievement of bonus credits is announced by the lecturer of the course via RWTH's electronic information system.

LEHRFORMEN / VERANSTALTUNGEN & ZUGEHÖRIGE PRÜFUNGEN

Titel	Prüfungsdauer (Minuten)	CP	SWS
Lecture "Geophysical process simulations, uncertainties, and optimal experimental design" [MSAGP-316.a/12]		0	2
Exercise "Numerical Methods and Programming for Reservoir Engineering" [MSAGP-316.b/12]		0	2
Written Examination "Geophysical process simulations, uncertainties, and optimal experimental design " [MSAGP-316.c/12]	45-90	3	0
Assignment "Numerical Methods and Programming for Reservoir Engineering" [MSAGP-316.d/12]		3	0

Anlage 2: Studienverlaufsplan

Third Term at RWTH Aachen University (RWTH)							
Core Modules: At least a minimum of 3 out of the 4 following Modules must be passed							
Status	**Semeste**	**Name**	Typ	Hours / Week	Self-Studies	**CP**	[1]**Exam**
		Module: Geophysical Special Methods					
CORE	3	Geophysics Special Methods: NMR	L/E	2	60 h	3	W
CORE	3	Geophysics Special Methods: Spectral IP	L/E	2	60 h	3	P
		Module: Geophysical Logging and Log Interpretation					
CORE	3	Geophysical Logging and Log Interpretation	L/E	4	90 h	5	W
		Module: Geothermics					
CORE	3	Geothermics	L/E	4	90 h	5	W
		Module: Hydrogeophysics and Data Analysis in Geoscience					
CORE	3	Hydrogeophysics	L	2	60 h	3	W+P
CORE	3	Data Analysis in Geoscience	L/E	2	60 h	3	W+R
Elective Modules							
Status	Semeste	**Name**	Typ	Hours / Week	Self-Studie	**CP**	[1]**Exam**
		Module: Sedimentary Basin Dynamics and Modeling					
ELEC	3	Sedimentary Basin Dynamics	L/E	2	60 h	3	W+P
ELEC	3	Petroleum System Modeling	E	2	60 h	3	
		Module: Engineering Geophysics and Remote Sensing					
ELEC	3	Remote Sensing of Sedimentary Basins	E	2	60 h	3	W
ELEC	3	Engineering Geophysics	L/E	2	60 h	3	P
		Module: Mineral Exploration and Project Management					
ELEC	3	Planning - Realization - Optimization in Georesource	L/E	2	60 h	3	W
		One out of two subjects have to be taken to complete the Module					
ELEC	3	Option 1: Mineral Exploration	L/E	2	60 h	3	P+R
ELEC	3	Option 2: Energy Resource Management	L/E	2	60 h	3	W+P
		Module: Geological Planning and Development					
ELEC	3	Portfolio Management	L/E	2	60 h	3	W
ELEC	3	Prospect Evaluation and Risk Analysis	L/E	2	60 h	3	
		Module: Numerical Methods for Geosciences					
ELEC	3	Numerical Methods for Geosciences	L/E	4	120 h	6	**O**
		Module: Numerical Reservoir Engineering					
ELEC	3	Geophysical process simulations, uncertainties, and optimal experimental design	L/E	2	60 h	3	**W**
ELEC	3	Numerical Methods and Programming for Reservoir Engineering	E	2	60 h	3	**A**