1. Introduction
Welcome at the Institute of Fluid Dynamics (IFD). You have decided to perform a Bachelor, Semester, CSE Seminar or Master thesis in one of the research groups at our Institute (Profs. Jenny and Rösgen). This document will offer you some general guidelines and introduce a few rules and regulations so as to simplify your upcoming thesis work.

2. Schedule
There are two time constraints applicable to your thesis project.

First, the overall duration is limited to 14 weeks (one semester) for Bachelor, Semester and CSE Seminar theses, while a Master thesis must not take longer than 6 months.

Second, the specific effort differs between the different types of thesis. Bachelor theses should require an effort of approximately 30 hours/week, Semester theses 17 hours/week, CSE Seminar 120 hours in total, while Master theses are considered full-time work (40 hours/week).

The start and finish dates of a thesis usually coincide with the semester dates, but can be adjusted if necessary. Remember to register electronically for your thesis at the beginning of your work (myStudies).

There are several milestone events throughout the course of a thesis such as

- the official start event of all thesis projects at IFD (on the first Friday of a new semester),
- individual progress meetings with the supervising assistant or the responsible professor,
- the oral presentation of the thesis results, and
- the final submission, review and revision of the written thesis.

Except for Master theses, oral presentations are usually grouped on dates in the last week of the semester. Presentations of Master projects are mostly scheduled on an individual basis.

The final grade will be assigned and submitted to the administration once all of the following steps have been completed.

- Oral Presentation
- Submission of the following content:
  - Report with corrections as requested by the supervisor and the signed declaration of originality appended
  - Presentation material
  - Mini-Poster
3. Task Description
At the beginning of your work, you will receive a project sheet clearly stating the required work and objectives, indicating the responsible supervisor, and providing the official starting and end dates of the thesis.

4. Final Report
The final report is the centerpiece of your thesis work and should be compiled with great care. Sufficient time should be allocated for this task, and it is advisable to start early with the writing. The report should describe your work in a self-contained manner such that all project results can be reproduced based on the report and possibly additional computer codes.

Except for the title page, there are no strict requirements regarding style, content or length, but certain “good practice” rules should be adhered to. In general, content and clear structure are more important than length. As a guideline, the manuscript should not exceed 80 A4 pages for a Master thesis – Bachelor, Semester and CSE Seminar projects will most likely lead to shorter reports.

Detailed formatting templates are available for the layout of your report. Text files based on LaTeX, Open Office, Pages or Microsoft Office (Word) are acceptable. The thesis text should be submitted both in source format (e.g. doc or tex file) and in a printable version (pdf file). The title page of the thesis must follow the layout format given in section 13 and contain a fixed set of bibliographic information (title, author, semester i.e. FS or HS, year, supervisor, etc.). The last page of the report should contain a scan of the signed declaration of originality.

The language of the thesis can be either German or English. It is recommended to pick a language in which you are truly fluent because this will facilitate the editorial process.

The thesis manuscript will be proof-read by at least one person familiar with your work (usually the direct thesis supervisor). Any requests for corrections resulting from this review must be worked into the final version before it is re-submitted at the end of the project.

5. Presentation
The presentation should provide an overview of the thesis topic, explain the methods employed (numerical or experimental) to address the assigned tasks and present the achieved results.

Since the presentations are usually held as part of a series of talks, a strict time limit of 30 minutes (=20 minutes talk + 10 minutes discussion) is enforced.
It is recommended to use your own computer for the presentation in order to minimize compatibility problems. A beamer will be available in the lecture room and speakers should try out the hardware before their talk.

The presentation can be held in English or German.

The audience of the presentations is usually composed of IFD researchers (professors, assistants) but fellow students and external guests are welcome as well.

6. Miniposter
Results of selected student projects are presented to a broader audience. Corresponding “mini posters” are displayed in a prominent location (ML building hall way, H level).

Every student is required to compose a one page (A4) mini poster based on his thesis work. Since the target audience is not necessarily familiar with the detailed study subject, the content of these posters should be kept comparatively general and self-explanatory. Preference should be given to graphical and pictorial content.

Templates (LaTeX or PowerPoint format) are available in order to assure a uniform appearance of the posters. The content and layout of the poster should be discussed with and approved by the thesis supervisor.

7. Declaration of Originality
The ETH study office requires a signed statement from every student regarding the familiarity with ETH rules on plagiarism and the independence of the work performed. These rules are documented at www.ethz.ch → student portal → studies → performance assessments → plagiarism and must be adhered to when citing foreign work.

The declaration of originality is available from the previously indicated weblink and a scan of the signed declaration should be appended to the electronic version of the final report.

8. Archival and Electronic Storage, Publishing
The finalized thesis documents (including computer codes, the miniposter and presentation) will be archived in the electronic IFD data archive.

ETH allows for the storage of Master theses also in the “Research Collection” which is accessible to the general public. Such a publication requires a declaration of consent from the supervising professor or research director. A corresponding template form is available (see section 13).

In exceptional cases, the results of a thesis may lead to a conference publication or a journal paper. In that case, the student’s contribution shall be recognized through an explicit acknowledgment, or in case of an essential contribution, with a (co-)authorship.
9. Intellectual Property and Confidentiality Issues

Generally, the final thesis is a document in the public domain which is freely accessible to any interested person. This may sometimes create potential conflicts of interest when the intellectual property rights of third parties are affected.

ETH Zurich does not claim inventions made by its students within the scope of their thesis work. If there is a contribution by an employed co-inventor (e.g. a supervisor), both parties are joint owners. However, the students may transfer their rights to ETH Zurich and will then be supported administratively and participate in any income on the same basis as ETH employees.

In case of an “external” thesis, that is work performed with an external collaborator (e.g. a company), the student’s position regarding confidentiality and ownership of intellectual property must be clarified in advance. Occasionally, non-disclosure agreements will have to be signed. The thesis must, however, still be available for unrestricted public access. IFD has introduced a set of separate, additional rules in order to better recognize the status and claims of the different parties involved.

10. Evaluation Criteria

The quality of the thesis work is evaluated according to a fixed set of evaluation criteria. These criteria and the associated relative weight factors are laid out in an evaluation sheet.

Note that these criteria are the same for all types of thesis work. For a successful CSE Seminar thesis, a grade greater than or equal to four is necessary. The relative “difficulty” of projects is captured in the individual evaluation criteria given in section 13.

Usually, external theses are evaluated by an IFD professor, taking into account the recommendations by the external collaborator(s).

11. Logistics

11.1. Computer Use

The Institute operates a limited number of desktop computers for student projects located in our student project room (see section 11.9) or in the lab.

Thesis work with a predominantly numerical focus is usually performed on one of our Linux desktops in the student project room.

Experimental work is in most cases also dependent on computer access. The laboratory machines operate on the Windows operating system. Except for the Windows desktops in the student project room, machines are not operated with individual accounts, but shared accounts for all students are used. While this limits the amount of user “privacy” on these computers, it facilitates access to all machines in the laboratory domain.
In order to store project-related data and to facilitate data exchange with the supervisor, a shared project folder, accessible by both student and supervisor, is made available on machines in the student project room. The student is granted access to this folder during the time of his project.

It is very important that a certain professional standard is maintained among computer users.

This means that computers are NOT to be used for private purposes, especially not for storage of private data and/or the installation of programs. Similarly, the printers, scanners and other IT hardware may only be used for project-related purposes.

If there is a need for installation of additional software, the supervisor should be contacted.

Except for the data contained in the mentioned shared project folders, user data is NOT backed up.

11.2. Laboratory Use
Experimental work in the laboratories takes place in a highly collaborative environment. Computers and scientific instruments are readily available, but certain rules have to be followed in order to maintain visibility of the hardware status at all times.

11.3. Equipment Loans
There is a pool of instruments available to all experimenters. If you need to sign out one of the instruments, contact the supervisor or one of the laboratory technicians. Please do NOT borrow instruments without informing Institute personnel – this avoids “loosing” hardware which is not accounted for.

11.4. Tools
Normally, a fully furnished toolbox is available at every experiment station. If you need additional tools, contact one of the assistants, technicians or your supervisor. Again, borrowing tools without returning them leads to their effective loss and must be avoided.

11.5. Access to Restricted Facilities and Resources
There are a number of facilities in the IFD laboratories which may not be accessed / used without prior explicit instruction and permission by the supervisor. Among those are

- The large IFD wind tunnel
- Laser-based illumination systems
- Machine tools (drill presses, lathes, milling machines, etc.)
- Chemicals (laser dyes, flammable substances etc.)

If you need access to such facilities, contact your supervisor and make sure that you have received proper safety and operations training, as well as the required protective equipment (laser safety goggles, gas masks, working gloves, etc.)
11.6. **Consumables**

Consumables such as gases, chemicals, printer paper are often available in-house. Please contact the supervisor if you need replenishment and/or exchange of such materials – this helps to maintain the inventory and facilitates advance orders.

11.7. **Purchase Orders**

If you need to order external goods, please contact the supervisor. Do not order any items without permission by the supervisor. In exceptional cases and with proper authorization, you can be reimbursed for small purchase items by the Institute secretary.

11.8. **Workshops**

The Institute maintains an electronic and a mechanical workshop. These are professional facilities and not accessible for your thesis work. In particular, NO equipment in these workshops may be borrowed or operated by students (safety regulations).

You can, however, discuss any technical issues with the professional technicians in order to find professional solutions.

11.9. **Workplace Access, Keys, Locks**

After-hours access to the ML building is via the electronic access system of ETH.

If you are working in the student project room (ML H51.2), you will need a separate key, which can be issued by the Institute’s secretary against a refundable deposit of CHF 50.

In the student project room there are workplaces with lockers that are partially equipped with desktop computers. These workplaces can be booked on a “first come” basis for the duration of your project. Please contact the secretary to initiate the booking process.

The laboratory facilities are normally locked and not accessible to the public. During normal working hours, Institute personnel can open the laboratories for you.

If you require individual access to the laboratories, you can request a key against a refundable deposit of CHF 50.

Especially when in possession of a key, please take care that the doors to the laboratory are locked when you leave.

There is video surveillance in most laboratories of the Institute to prevent theft and to monitor the access to the laboratory facilities.

12. **General Recommendations**

12.1. **Consultations with the supervisor(s)**

As you have seen from the previous documentation, there are many situations where your supervisor will act as the interface between you and the Institute’s personnel and facilities.
In order to establish an efficient collaboration, it is good practice to seek regular contact with your supervisor, say, once a week.

12.2. **Collaborations with other students**

You are encouraged to discuss your work with your fellow students. This will help you to articulate problems and generate insights by looking beyond the constraints of your specific thesis topic.

While such an exchange is useful – and is, as a matter of fact, an integral part of research work – you must not integrate other people’s inputs into your work without due recognition. Make sure that any significant contribution from the outside is properly documented and acknowledged.

12.3. **Research seminar and colloquium**

Students conducting thesis work at our Institute are invited to attend our Research Seminar in Fluid Dynamics, which takes place during the semester on a weekly basis. Details about the seminar can be found on the ETH course catalogue. Moreover, students are encouraged to attend the Kolloquium Thermo- und Fluidodynamik (KTF), which is co-organized by IFD. KTF talks are announced on the IFD website and the ETH event calendar.
13. List of Forms and Templates

- Task Description („Begleitblatt or Project Sheet“)

Project Sheet

for a: ( ) Bachelor’s Thesis (X) Semester Project ( ) Master’s Thesis ( ) CSE-Seminar

carried out in the semester: FS 2018

by: Greggory Papageorgiou

Topic
Lagrangian Numerical Scheme for Advection/Diffusive Transport

Project Description
For the simulation of mass transport in a continuous flow field including molecular diffusion, Lagrangian schemes based on particles are attractive as they don’t suffer from numerical diffusion. These schemes are applied for example to simulate transport in the complex pore space of a natural porous medium (see figure). In this work, we focus on flow fields that are specified on equally-spaced Cartesian grids. Popular Lagrangian schemes apply a sequential stepping comprised of an advection and a diffusion step, both with the same time-step size \( \Delta t \) [e.g., eq.(4) in Mostaghimi et al., SPE Journal, 2012]. Moreover, constant-length diffusion increments are used in order to avoid numerical issues resulting from exact but unbounded Maxwellian increments (Gaussian spatial components). In order to balance numerical accuracy (resolution of velocity gradients) with computational costs (few time steps), \( \Delta t \) should be selected such that an advective/diffusive step covers of the order of one grid cell. Depending on the variability in the flow field, this can lead to a wide range of suitable grid time-steps \( \Delta t \).

In this project, the coupled advective/diffusive motion shall be computed by hopping from one point on a grid-cell boundary to the next within varying \( \Delta t \) resulting from a first passage or exit time distribution. The velocity components of the flow field in one grid cell are linearly varying in the direction of the component and constant in the perpendicular directions. In this way, given a set of mass conservative surface fluxes at the cell interfaces, a divergence-free flow field is resulting. This implies a particle position evolution equation with a linear drift and a constant diffusion term. For this process and a rectangular boundary, the first exit time and location distributions shall be formulated and numerically implemented.

The project is comprised of the following steps:
2. one-dimensional prototype
3. validation of particle transport against analytical result
4. two- and three-dimensional extensions
5. validation against previously developed coupled advection/diffusion transport scheme
6. documentation and presentation of project results

Supervisor: Vitaly Heinemann
Responsible Professor: Prof. Dr. Thomas Rösgen
Handed out on: 18.02.2019
Report is due on: 24.05.2019
Signature Professor: _______________________________

Figure: Pore-space geometry of Portland carbonate rock. [Bijeljic et al., PRE, 2019]
## IFD Thesis Checklist

<table>
<thead>
<tr>
<th>Task</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final thesis manuscript submitted (to supervisor *)</td>
<td></td>
</tr>
<tr>
<td>Signed plagiarism form submitted (to supervisor *)</td>
<td></td>
</tr>
<tr>
<td>Mini poster submitted (to supervisor *)</td>
<td></td>
</tr>
<tr>
<td>Thesis presentation submitted (to supervisor *)</td>
<td></td>
</tr>
<tr>
<td>Codes and data submitted (to supervisor)</td>
<td></td>
</tr>
<tr>
<td>Computer account cleanup</td>
<td></td>
</tr>
<tr>
<td>Laboratory and/or computer desk cleanup</td>
<td></td>
</tr>
<tr>
<td>Books returned (to IFD library)</td>
<td></td>
</tr>
<tr>
<td>Keys returned (to IFD secretary)</td>
<td></td>
</tr>
<tr>
<td>Coffee bill paid</td>
<td></td>
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</tbody>
</table>

*) or responsible IFD professor in case of an external project
Declaration of originality

The signed declaration of originality is a component of every semester paper, Bachelor’s thesis, Master’s thesis and any other degree paper undertaken during the course of studies, including the respective electronic versions.

Lecturers may also require a declaration of originality for other written papers compiled for their courses.

I hereby confirm that I am the sole author of the written work here enclosed and that I have compiled it in my own words. Parts excepted are corrections of form and content by the supervisor.

Title of work (in block letters):

Author(s) (in block letters):
For papers written by groups the names of all authors are required.

Name(s): First name(s):

With my signature I confirm that
- I have committed none of the forms of plagiarism described in the ‘Citation etiquette’ information sheet.
- I have documented all methods, data and processes truthfully.
- I have not manipulated any data.
- I have mentioned all persons who were significant facilitators of the work.

I am aware that the work may be screened electronically for plagiarism.

Place, date Signature(s)

For papers written by groups the names of all authors are required. Their signatures collectively guarantee the entire content of the written paper.
Simulating Turbulence Modulation with RANS and PDF Methods

Billy G. Taylor

Studiengang Rechnergestützte Wissenschaften

Seminararbeit HS 11

Institut für Fluidodynamik
ETH Zürich

ausgeführt bei

University of Massachusetts
Institute of Aerodynamics

Betreuer: Dr. Oscar B. Peterson
Professor: Ahmad P. Jamal
## Evaluation Criteria

**Criteria for the Evaluation of Bachelor, Semester- und Master Theses at the Institute of Fluid Dynamics (IFD)**

Name: 
Title: 
Supervisor: 
Responsible Professor: 

No explicit distinction is made in the evaluation of the different types of thesis. Differences in complexity and scope of the work will be reflected in the point scores.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Grade</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Technical and scientific work - knowledge, understanding, results, conclusions</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>2: Ancillary work - preparation, resource utilization, literature survey</td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>3: Individual commitment – interest, independence, creativity</td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td>4: Professionalism – care, efficiency, methodology, time management</td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td>5: Final Report – structure, clarity, correctness, layout</td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>6: Oral Presentation – structure, clarity, layout</td>
<td></td>
<td>0.15</td>
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</tbody>
</table>

### Total (rounded) ( )

US grade conversion (approx.): 6.0=A+, 5.75=A, 5.5=A-, 5.25=B+, 5.0=B, 4.75=B-/C+, 4.5=C, 4.25=C-, 4.0=D

Remarks:

07/12/2018
– Presentation Template

– Thesis Template
Title of the student project
Master thesis by <yourself>
Supervised by <your supervisor>

Title
Use a two-column layout if possible. Pictures may span both columns. Try to stay with the given layout as closely as possible. Use the "ETH light" font (downloadable for free from ides.ethz.ch). The template uses a DIN-A0 poster format. For printing out on A4 you must select the option "An-Papiergrösse anpassen".

Text body
A list:
i. One
ii. Two
iii. Three

Formulas
Formulas look nice if you cut-and-paste from a PDF file ("snapshot tool").

\[ \frac{\partial x}{\partial \xi} = 2 \pi \sum_{n=-N/2}^{N/2} (2n) \Theta_n \exp \left( \frac{2\pi in}{N} \right) \]

\[ \theta_{n+2} + \theta_{n-2} + 2 \theta_n \]

A picture
Use pictures which do not need a lot of explanation. A figure caption is not necessary for posters.

Concluding remarks
In conclusion, ...

Inset
Use a text inset to highlight a text block, e.g. for definitions, for describing a special application, or to give some background information.
Research Collection Consent Form (for Master thesis only)

Declaration of consent

for the publication of a master thesis, bachelor thesis or student paper on the Research Collection, ETH Zurich's publication platform.

ETH Zurich's publication platform allows users to access master theses, bachelor theses and student papers written at ETH Zurich. This offers students and graduate students the opportunity to present their work worldwide. The published theses fulfill the specified formal quality criteria.

Declaration of the author

I hereby declare that I consent to the ETH-Bibliothek making my master thesis, bachelor thesis or student paper which I shall submit to the ETH-Bibliothek as a pdf file, available to the public on the Research Collection publication platform. The rights of third parties are not infringed by this publication. I consent to any subsequent necessary conversions into other data formats being made.

Author:
Title of the publication:

Department:
Publication year:
Email/Phone:
Private address:

Zurich, on

Signature __________________________

Recommendation of the responsible ETH professor or research supervisor

I have supervised this master thesis, bachelor thesis or student paper at ETH Zurich and recommend its publication. In particular, I hereby declare that the publication of this thesis does not infringe the rights of third parties and that any rights to confidentiality are protected.

Zurich, on

Signature __________________________

Declaration of the ETH-Bibliothek

The ETH-Bibliothek guarantees the long-term availability of the thesis as well as the integrity of its content and its authenticity and will make the document accessible via the Internet. The intellectual property rights remain with the author.

Version: 01.06.2017