Course Title
Introduction to Mathematical Modeling

Course Number
MATH-UA.9251001

SAMPLE SYLLABUS

Lecturer Contact Information
Ralf Banisch
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Course Details
When: Spring 2017, Tuesdays 3:30pm - 6:15pm
Where: NYUB Academic Center, Room "Pankow" (tbc)

Prerequisites
MATH-UA 121 Calculus I, MATH-UA 122 Calculus II and MATH-UA 123 Calculus III or equivalents with a grade of C or better.

Units earned
4 points

Course Description
In this course, students will learn how to formulate and analyze mathematical models. The mathematical tools to be handled include dimensional analysis, optimization, numerical simulation, elementary probability and stochastic processes, as well as elementary differential equations. The fields of application include biology, economics, and other areas of science.

The necessary mathematical and scientific background will be developed as needed. Students will learn how to simulate models using MATLAB.

Course Objective
Students will learn how to formulate, analyze and simulate mathematical models.

Assessment Components
The results of homework assigned weekly or biweekly (30%), the midterm exam (30%, 120 minutes) and a final research project (40%, 5-10 pages report and a short presentation) will be combined.
Failure to submit or fulfill any required component may result in failure of the class, regardless of grades achieved in other assignments.

Assessment Expectations

Grade A: The student makes excellent use of empirical and theoretical material and offers well-structured arguments in his/her work. The student writes comprehensive essays / answers to exam questions and his/her work shows strong evidence of critical thought and extensive reading.

Grade B: The candidate shows a good understanding of the problem and has demonstrated the ability to formulate and execute a coherent research strategy.

Grade C: The work is acceptable and shows a basic grasp of the research problem. However, the work fails to organize findings coherently and is in need of improvement.

Grade D: The work passes because some relevant points are made. However, there may be a problem of poor definition, lack of critical awareness, poor research.

Grade F: The work shows that the research problem is not understood; there is little or no critical awareness and the research is clearly negligible.

Grade Conversion

Your lecturer may use one of the following scales of numerical equivalents to letter grades:

$$
\begin{align*}
B+ &= 87-89 \\
C+ &= 77-79 \\
D+ &= 67-69 \\
F &= \text{below 65}
\end{align*}
$$

$$
\begin{align*}
A &= 94-100 \\
B &= 84-86 \\
C &= 74-76 \\
D &= 65-66
\end{align*}
$$

$$
\begin{align*}
A- &= 90-93 \\
B- &= 80-83 \\
C- &= 70-73
\end{align*}
$$

Alternatively:

$$
\begin{align*}
A &= 4.0 \\
A- &= 3.7 \\
B+ &= 3.3 \\
B &= 3.0 \\
B- &= 2.7 \\
C+ &= 2.3 \\
C &= 2.0 \\
C- &= 1.7 \\
D+ &= 1.3 \\
D &= 1.0 \\
F &= 0.0
\end{align*}
$$

Attendance Policy

Participation in all classes is essential for your academic success, especially in courses that meet only once per week. Your attendance in both content and language courses is required and will be checked at each class meeting. As soon as it becomes clear that you cannot attend a class, you must inform your professor by e-mail immediately (i.e. before the start of your class). Absences are only excused if they are due to illness, religious observance or emergencies. Your professor or NYU Berlin's administration may ask you to present a doctor's note or an exceptional permission from NYU Berlin's Director or Wellness Counselor as proof. Emergencies or other exceptional circumstances must be presented to the Director. Doctor's notes need to be submitted to the Academics Office, who will inform your professors. Doctor's
notes need to be from a local doctor and carry a signature and a stamp. If you want the reasons for your absence to be treated confidentially, please approach NYU Berlin's Director or Wellness Counselor.

Unexcused absences affect students' grades: In content courses each unexcused absence (equaling one week's worth of classes) leads to a deduction of 2% of the overall grade and may negatively affect your class participation grade. In German Language classes two or three (consecutive or non-consecutive) unexcused absences (equaling one week's worth of classes) lead to a 2% deduction of the overall grade. Three unexcused absences in one content course and five unexcused absences in your German language course may lead to a Fail in that course. Furthermore, your professor is entitled to deduct points for frequent late arrival or late arrival back from in-class breaks. Being more than 15 minutes late counts as an unexcused absence. Please note that for classes involving a field trip, transportation difficulties are never grounds for an excused absence. It is the student's responsibility to arrive in time at the announced meeting point.

Exams, tests and quizzes, deadlines, and oral presentations that are missed due to illness always require a doctor's note as documentation. It is the student's responsibility to produce this doctor's note and submit it to the Academics Office; until this doctor's note is produced the missed assessment is graded with an F and no make-up assessment is scheduled. In content classes, an F in one assignment may lead to failure of the entire class.

**Attendance Rules on Religious Holidays**

Members of any religious group may, without penalty, excuse themselves from classes when required in compliance with their religious obligations. Students who anticipate being absent due to religious observance should notify their lecturer AND NYU Berlin's Academics Office in writing via e-mail one week in advance. If examinations or assignment deadlines are scheduled on the day the student will be absent, the Academics Office will schedule a make-up examination or extend the deadline for assignments. Please note that an absence is only excused for the holiday but not for any days of travel that may come before and/or after the holiday. See also [http://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/university-calendar-policy-on-religious-holidays.html](http://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/university-calendar-policy-on-religious-holidays.html)

**Late Submission of Work**

(1) Written work due in class must be submitted during the class time to the professor.

(2) Late work should be submitted in person to the lecturer or to the Academics Office, who will write on the essay or other work the date and time of submission, in the presence of the student. Another member of the administrative staff may also personally accept the work, and will write the date and time of submission on the work, as above.

(3) Work submitted late receives a penalty of 2 points on the 100 point scale for each day it is late (excluding weekends and public or religious holidays), unless an extension has been approved (with a doctor's note or by approval of NYU Berlin's administration), in which case the 2 points per day deductions start counting from the day the extended deadline has passed.

(4) Without an approved extension, written work submitted more than 5 days (excluding weekends and public or religious holidays) following the submission date receives an F.

(5) End of semester essays must be submitted on time.
(6) Students who are late for a written exam have no automatic right to take extra time or to write the exam on another day.

(7) Please remember that university computers do not keep your essays - you must save them elsewhere. Having lost parts of your essay on the university computer is no excuse for a late submission.

Provisions for Students with Disabilities
Academic accommodations are available for students with documented disabilities. Please contact the Moses Center for Students with Disabilities at 212-998-4980 or see their website (http://www.nyu.edu/life/safety-health-andwellness/students-with-disabilities.html) for further information.

Plagiarism Policy
The presentation of another person’s words, ideas, judgment, images or data as though they were your own, whether intentionally or unintentionally, constitutes an act of plagiarism. Proper referencing of your sources avoids plagiarism (see as one possible help the NYU library guide to referencing styles: http://nyu.libguides.com/citations).

NYU Berlin takes plagiarism very seriously; penalties follow and may exceed those set out by your home school. Your lecturer may ask you to sign a declaration of authorship form.

It is also an offense to submit work for assignments from two different courses that is substantially the same (be it oral presentations or written work). If there is an overlap of the subject of your assignment with one that you produced for another course (either in the current or any previous semester), you MUST inform your professor.

For a summary of NYU Global's academic policies please see: www.nyu.edu/global/academic-policies

Recommended Text
Electronic Resources (via NYU Classes / NYU Library)
All necessary materials will be provided in class. The following textbook is recommended for background reading:


NYU Berlin Library Catalogue: http://guides.nyu.edu/global/berlin or follow the link on NYU Berlin's website (Academics/Facilities & Services).

Supplemental Text(s) (not required to purchase)

**Internet Research Guidelines**
to be discussed in class

**Additional Required Equipment**
All students should have access to MATLAB2013a or higher.

**Session 1 - 31 Jan 2017**
The modeling process.
Arguments from scales: Dimensional analysis.

**Session 2 - 7 Feb 2017**
Arguments from data: Least squares, parameter estimation.

**Session 3 - 14 Feb 2017**
Linear models: Generalized least squares estimators. MATLAB tutorial (Census data).

**21 Feb 2017: No Class [Make-up Session on 3 Mar 2017]**

**Session 4 - 28 Feb 2017**
Mathematical models in biology: Population models, predator-prey systems.

**Session 5 - Make-Up Day: Friday, 3 Mar 2017 - at the earlier time of 10:00am - 12:45pm**
Stability analysis: Equilibria, oscillations, growth and decay.

**Session 6 - 7 Mar 2017**
Optimal control and application in fishery management.

**14 Mar 2017: Spring Break - No Class**

**Session 7 - 21 Mar 2017**
Markov processes: Modeling of chemical reactions.

**Session 8 - 28 Mar 2017**
Midterm exam (2 hours).
Session 9 - 4 Apr 2017
Modeling of chemical reactions, Stochastic differential equations. MATLAB tutorial: Gillespie’s algorithm.

Session 10 - 11 Apr 2017
Difference equations: Microscopic modeling of traffic flows.

Session 11 - 18 Apr 2017
Conservation laws: Macroscopic modeling of traffic flows. MATLAB tutorial: Euler method to integrate difference equations.

Session 12 - 25 Apr 2017
Conservation laws, traffic flow when the light turns green.

Session 13 - 2 May 2017
Poisson processes: waiting in line.

Session 14 - 9 May 2017
Turing patterns: modeling vegetation pattern formation.

Session 15 - 16 May 2017
Project presentations (10 minutes + 5 minutes discussion).

Classroom Etiquette
to be discussed in class

Required Co-Curricular Activities
None.

Suggested Co-Curricular Activities
To be defined.

Your Lecturer
Ralf Banisch is a researcher in applied mathematics at FU Berlin. His field of research is the analysis and simulation of complex dynamical systems, with a special interest in Molecular Dynamics.