

Syllabus for Advanced Calculus I and II

(JTME-120203 and JTME-120204)

Fall Semester 2018

Up-to-date course information can be found on the course website
http://math.jacobs-university.de/petrat/teaching/2018_fall_advanced_calculus/

1 Official Course Description

This is an introductory course to calculus. It covers standard calculus topics on a high level. The course is mandatory for students in the Mathematics major, and recommended for students in other majors with a mandatory Calculus class who had some mathematics specialization at high school, in particular concerning differentiation and integration techniques. The course is highly recommended for everybody who takes the “Fundamental Mathematics” module. Advanced Calculus I and II cover many calculus techniques as well as some proofs and foundational material. Advanced Calculus I covers topics like induction, polynomials, sequences and limits, continuity, series, power series, complex numbers, differentiation, Taylor expansion, Newton’s method, and Riemann integration. Advanced Calculus II covers topics like the Riemann integral, integration techniques, uniform convergence, ordinary differential equations (ODEs), Fourier series, and some topics in higher dimensions, e.g., basic introduction to PDEs, vectors, curves, surfaces, or differentiation and integration in \mathbb{R}^n .

2 Contact Information

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3 Time and Place

Mon 11:15 – 12:30, Lecture Hall Research I

Wed 11:15 – 12:30, Lecture Hall Research I

First class: September 3, 2018; last class: December 5, 2018

No classes on October 3 (German Unity Day), October 22 (reading day), and October 31 (Day of Reformation)

4 Textbooks

This class does not follow one particular textbook, but the material is similar to the following ones:

- E. Hairer, G. Wanner - Analysis by its History (Springer). This course covers most of chapter I and parts of chapter II. In general, this book might be a bit harder and more detailed than this course.
- K. F. Riley, M. P. Hobson and S. J. Bence - Mathematical Methods for Physics and Engineering (Cambridge University Press). This course covers roughly the contents of Chapters 1, 2, 3, 4, 12, 14, 15.
- R. Courant - Differential and Integral Calculus Volume I (Blackie and Son). This course covers most of the material from this book, with a few exceptions, and sometimes in less detail.

5 Exercises

Each week on Monday (with exceptions) there will be an exercise sheet/homework assignment. These are an integral part of the coursework and working on the exercise sheets consistently is the best preparation for the exams!

- The solutions have to be handed in at the beginning of class.
- No late submissions are accepted.
- The two worst exercise sheets are not considered for grading, in order to compensate for sickness, late adding etc.; In case you only take part I of this course only the one worst homework sheet is not considered.
- It is encouraged to discuss the exercise sheets with your classmates (e.g., discuss how to come up with the solution or what the right way of approaching the problem is). On the other hand, the solutions must be written down and handed in individually! Copying the solutions from somebody else is a violation of Academic Integrity.

6 Exams

There will be two exams, one at the end of part I (“midterm”) and one at the end of part II (“final”). The midterm will cover all material from part I and the final will cover material from both parts with emphasis on material from part II. More details will be announced. Note that this class uses gradescope for grading exams, see <https://gradescope.com> for more information.

7 Parts I and II

This course is officially split into two parts, part I from September 3 until October 17, and part II from October 24 until December 5. It is recommended to take both parts.

8 Grading

The final grade is weighted as follows:

Homework:	20%
Midterm:	30%
Final:	50%

Note: If the midterm grade is worse than the grade of the final, then only the grade of the final counts for both midterm and final.

Students who take both part I and II receive the same grade for part I and II according to the above scheme. For students who take only part I the final grade for part I is weighted 20% homework and 80% midterm.

9 Tentative Class Schedule

Advanced Calculus I

Session	Date	Topic
1	Sep 3	Polynomials, roots, factorization
2	Sep 5	Binomial expansion, binomial coefficients
3	Sep 10	Limits and continuity
4	Sep 12	More on continuity
5	Sep 17	Infinite series and convergence
6	Sep 19	Power Series
7	Sep 24	Power Series and Inverse Functions
8	Sep 26	Complex Numbers
9	Oct 1	Differentiation I
	Oct 3	German Unity Day, no class
10	Oct 8	Differentiation II
11	Oct 10	Differentiation III
12	Oct 15	Differentiation IV
13	Oct 17	Integration I

Advanced Calculus II

Session	Date	Topic
	Oct 22	Reading Day, no class
1	Oct 24	Midterm Exam
2	Oct 29	Integration II
	Oct 31	Day of Reformation, no class
3	Nov 5	Integration III
4	Nov 7	Sequences of functions and uniform convergence
5	Nov 12	ODEs I
6	Nov 14	ODEs II
7	Nov 19	ODEs III
8	Nov 21	Fourier series I
9	Nov 26	Fourier series II
10	Nov 28	Fourier series III
11	Dec 3	Differentiation and Integration in several variables I
12	Dec 5	Differentiation and Integration in several variables II
	TBA	Final Exam