

MA 50400 REAL ANALYSIS (FALL 2024)

INSTRUCTOR: DI QI (EMAIL: QIDI@PURDUE.EDU, OFFICE: MATH 644)

Time: Mon. Wed. Fri. 12:30 PM - 01:20 PM, SCHM 103

Office Hours: Wednesday, Friday, 11:00 AM -12:00 PM

First Class: Mon., August 19, 2024

Last Class: Fri., December 6, 2024

For other important dates, see Purdue 2024-2025 Academic Calendar.

(see also *Course Webpage* for supplementary course materials)

COURSE DESCRIPTION:

This course gives an introduction to mathematical analysis: the real number system, basic topological properties, compactness, sequences and series, absolute convergence of series, rearrangement of series, properties of continuous functions, the Riemann-Stieltjes integral, sequences and series of functions, uniform convergence, the Stone-Weierstrass theorem, equicontinuity, the Arzela-Ascoli theorem, and other selected topics.

Course Goals: (1) Ability to read and understand proofs of basic analytical facts: (2) Ability to write coherent proofs, both with time pressure (i.e. during exams) and without time pressure (i.e. on homeworks).

Audience: The course should be suitable to any Ph.D. and master student in applied and computational mathematics, physics, engineering, as well as related fields.

MAJOR LEARNING OUTCOMES:

- (1) Completeness of the real number system;
- (2) Basic topological properties, compactness;
- (3) Sequences and series, absolute convergence of series, rearrangement of series;
- (4) Properties of continuous functions;
- (5) The Riemann-Stieltjes integral;
- (6) Sequences and series of functions, uniform convergence, the Stone-Weierstrass theorem;
- (7) Equicontinuity, the Arzela-Ascoli theorem, inverse and implicit function theorems.

TEST BOOK & LEARNING RESOURCES

Textbook: Walter Rudin, *Principles of Mathematical Analysis* (3rd ed). We will cover Chapter 1-4, 6, 7, and most parts of Chapter 5, 9 of the textbook. I may also present material not contained in the text.

Reference: Maxwell Rosenlicht, *Introduction to Analysis*.

Course Resources: The main learning management system will be *Brightspace*. Lecture notes and homework will be posted on *Brightspace*. The following platforms (accessible through *Brightspace*) will also be used for assignments and other activities:

- *Gradescope* for homework/project submission.

- *Piazza* for class discussions.
- *Zoom* for potential online discussions and virtual meetings.

Course Schedule:

Week	Start Date	Topics	Homework Due	Comments
1	Aug. 19	1.1-19, 1.19-20 2.1-12		
2	Aug. 26	2.12-14, 2.15-22, 2.23-28	HW 1 due	
3	Sep. 2	2.28-36, 2.37-41	HW 2 due	No class on Sep. 2 (Labor day)
4	Sep. 9	2.41-47, 2.47-3.3, 2.4-10	HW 3 due	
5	Sep. 16	3.10-16, 3.17-20, 3.21-28	HW 4 due	
6	Sep. 23	3.33-41, 3.42-52, 3.52-4.2	HW 5 due	
7	Sep. 30	4.3-10, 4.11-19, 4.21-30		
8	Oct. 7	Review and Midterm I	HW 6 due	No class on Oct. 7 (Fall break)
9	Oct. 14	4.32-34, 6.1-8, 6.9-11	HW 7 due	
10	Oct. 21	6.11-13, 5.7-11, 6.17-22	HW 8 due	
11	Oct. 28	7.1-13, 7.17-25, 7.26-32	HW 9 due	
12	Nov. 4	9.1-9, 9.10-15, 9.16-21		
13	Nov. 11	Review and Midterm II	HW 10 due	
14	Nov. 18	9.22-24	HW 11 due	
15	Nov. 25	9.24		No class on Nov. 27, 29 (Thanksgiving vacation)
16	Dec. 2	Review for Final		Quiet period
	Dec. 9	Final exam week		

(Schedule is subject to change. Any changes will be posted on *Brightspace*.)

Lecture Notes: Typically, there will be three lectures per week, each corresponding to a section in the textbook and about 50 mins long. Lecture notes will be posted in *Brightspace* after each lecture. Please be aware that they may contain extra material which I may choose to omit during in-class lectures due to time constraints, or they may not contain material that I choose to emphasize during class, based on my assessment of student needs. You are responsible for any material that I discuss in class.

Attendance Policy: I will not take attendance. However, you are expected to attend lecture and are responsible for whatever is presented, discussed, or announced during lecture.

Office Hours: WF, 11:00am-12:00pm (Eastern Time) or through appointment. The time is subject to change. The information will be posted on *Brightspace*.

Homework: There will be homework assigned every week. They will be gradually posted as the course progresses.

Note that you should always show your work of full solutions in the homework to receive credits. Feel free to discuss the homework problems with your classmates and form study groups. But you have to write your own homework. The homework problems are graded mainly on your reasoning. No points will be given if

you only write the final answer. Furthermore, successful proof-writing during exams requires practice, which copying answers for homework will not provide

Normally, homework will be due on Sunday at 11:59pm. Late homework will not be accepted, but one lowest scores will be dropped in the final grading.

Exams: There will be two Midterm Exams (in class), tentatively in Week 8 and Week 13 and a Final Exam in the Finals Week (covering all material). We will have Review sessions for each exam.

An excused absence for a midterm exam requires notification to the instructor before the exam starts, followed by valid documentation. Excused absences will be approved in the following cases:

- A documented medical excuse
- A University sponsored event such as an athletic tournament, a play, or a musical performance. Athletic practices and rehearsals do not fall into this category. Please have your coach, conductor, or other faculty advisor contact your instructor.
- A religious holiday.
- Extreme hardship such as a family emergency.

Grading: Your grade will be determined from the total score, whose components have the following maximum values:

Category	Weight
Homework	25%
Midterm Exam I	20%
Midterm Exam II	20%
Final Exam	35%
Total	100%

This semester, we will apply the following rule: students who get at least 97% of the total points are guaranteed an A+, 93% guarantees an A, 90% an A-, 87% a B+, 83% a B, 80% a B-, 77% a C+, 73% a C, 70% a C-, 67% a D+, 63% a D, and 60% a D-. Please note, these are not the actual cutoffs, but rather upper bounds on those. The actual cutoffs of these grades will be determined after the final exam and can be lower but not higher than the ones above. Thus, the actual cutoff for A can be, say 85%, but not 95%.

COURSE AND UNIVERSITY POLICIES:

Attendance and course engagement: This is an in-person course. The students are expected to attend the lectures and read the corresponding lecture notes. Students are responsible for completing and submitting all assignments on time. Students are encouraged to participate actively during the lectures and after-class discussions. Students must also check periodically for possible changes in the course schedule (on *Brightspace*) including due dates for assignments and exams.

Drop/Add deadlines: In accordance with the updated university policy, since last year, the course drop deadlines have been set at the end of week 13 (November 19 for Fall 2024). You can access the Drop/Add calendars by visiting: <https://purdue.edu/registrar/calendars>, and scrolling down to locate the Drop/Add Refund & Deadline Calendars, or by following this direct link.

Late homework: Late homework will not be accepted. In the event that an assignment is missed for reasons that are serious, unavoidable, and beyond the student's control, the situation will be handled on an individual basis. Documentation may be required in such cases.

Makeup policy: Student needs to inform the instructor of any conflict that can be anticipated and will affect the submission of an assignment or the ability to give the presentation. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency conflict, when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, through *Brightspace*, or by phone. When the student is unable to make direct contact with the instructor and is unable

to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. Our course *Brightspace* includes a link on Attendance and Grief Absence policies under the University Policies menu.

Academic integrity: Academic integrity is expected for all students at all times in this course. You are free (even encouraged) to work with other students to solve the homework problems. However, you are required to complete and write up solutions for the homework using your own words and on your own. If you worked with any humans, book, the internet, you should be explicit about it and list all sources and the extent of help you got from each resource (no points will be taken for such disclosures). But if you present as your own work what was not, then you will get zero points on the assignment and an academic misconduct filing after the first instance.

Nondiscrimination statement: Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. More details are available on our course *Brightspace* table of contents, under University Policies.

Students with disabilities: Purdue University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, you are encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247, as soon as possible. If the Disability Resource Center (DRC) has determined reasonable accommodations that you would like to utilize in this class, you must send your Course Accommodation Letter to the instructor. Instructions on sharing your Course Accommodation Letter can be found by visiting: <https://www.purdue.edu/drc/students/course-accommodation-letter.php>. Additionally, you are strongly encouraged to contact the instructor as soon as possible to discuss implementation of your accommodations.

Emergency preparation: In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your *@purdue.edu* email on a frequent basis.

COVID-19 statement: If you become quarantined or isolated at any point in time during the semester, in addition to support from the Protect Purdue Health Center, you will also have access to an Academic Case Manager who can provide you academic support during this time. Your Academic Case Manager can be reached at acmq@purdue.edu and will provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via email or *Brightspace*. We will make arrangements based on your particular situation. The Office of the Dean of Students (odos@purdue.edu) is also available to support you should this situation occur. Other important policies can be found in *Brightspace*.

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