MATH 3151 Analysis II, Spring 2017

Syllabus

Please read carefully!!

Lecture time and location: Tuesdays and Thursdays at 2:00–3:15 PM in MONT 314.

Course website: http://arthur-parzygnat.uconn.edu/teaching/s2017math3151/ and HuskyCT

Instructor: Arthur J. Parzygnat

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- Office phone number: (860) 486-1282
- Office hours: Thursdays 11:00 AM – 12:00 PM and 12:45 PM – 1:45 PM or by appointment

Course Description: This is a continuation of 3150 Analysis I, where we studied a mathematically rigorous approach to calculus of a single variable. Analysis II will provide an introduction to the following three broad topics with *possible* subtopics indicated in parentheses.

1. Multivariable calculus (gradient operator, multivariable chain rule, vector fields, dynamical systems, inverse function theorem, implicit function theorem, integration, Fubini's theorem, change of variables, Sard's theorem, smooth manifolds).
2. Metric spaces (sequences, convergence, compactness, completion, contraction mappings, fixed point theorems, and applications to fractals, differential equations, and Markov chains).
3. Functional analysis (convex sets and convex functions, applications to probability theory and entropy, normed vector spaces, bounded operators, non-commutative analysis, quantum mechanics).

The student will be expected to write a lot of proofs throughout the entire course and will learn to hone these skills. Be prepared to spend a lot of time formulating precise statements, questioning foundations, proving theorems, and learning topics beyond what's covered in class!

Textbooks: There are two required textbooks for this course.

1. Michael Spivak, *Calculus on Manifolds*, 1967. W. A. Benjamin Inc.
2. A. N. Kolmogorov and S. V. Fomin *Introductory Real Analysis*, translated by Richard A. Silverman, Dover Books on Mathematics

In the present document, these books will be referred to as [Sp] and [KF], respectively. You are expected to read the relevant sections before coming to class.

Prerequisites: MATH 3150.

Attendance/Notes: There are occasionally new topics introduced in lecture that are not presented in [Sp] and [KF]. In addition, some concepts may be introduced slightly differently. It is therefore important that you attend all lectures. I hope to provide full notes for the course a few lectures in advance. In addition, I will upload some videos explaining certain topics.

Homework and Participation: Homework will be assigned on a *daily* basis but will be due in weekly segments. Class-time will be spent going over problems that were assigned during the last class, questions about the material for the present section, occasional quizzes, and presentations. Students will be asked to present solutions and may volunteer to present solutions. Homework throughout the semester will be worth 40 points and these points can be achieved in the following manners with their corresponding point value.

Task	Point value
Typing up a correct solution to a Level I problem on the database	0.5
Typing up a correct solution to a Level II problem on the database	1
Typing up a correct solution to a Level III problem on the database	1.5
Voluntarily presenting a solution in class	0.5
Voluntarily presenting a correct solution in class	1
Involuntarily presenting a correct solution in class	1.5
Answering a question voluntarily and correctly in class	0.5
Answering a question involuntarily and correctly in class	1
Correcting someone else's mistake (a.k.a. assisting)	0.5
Successfully completing a mini-project	Varies
Scoring a 95% or higher on a quiz	2
Scoring a 85% or higher on a quiz	1.5
Scoring a 75% or higher on a quiz	1.0
Scoring a 65% or higher on a quiz	0.5

However, there are a few rules. Note that there are a total of 14 weeks in the semester but if we include days for the introduction, exams, and reviews, this leaves us with only **12 weeks** (please see the calendar).

1. You cannot obtain more than 3.5 points in any given week. Thus, for instance, if one obtains 3.5 points every week for the first 10 weeks, then they must obtain at least 2.5 points each for the following 2 weeks. In essence, you should aim to achieve ~~the full 3 points~~ between 3.0 and 3.5 points every week. Similarly, if you obtain only 1 point every week for the first 6 weeks, then the most number of points you can get by the end of the semester is $1 \times 6 + 3.5 \times 6 = 27$. The only exception to the limit on points per week are the mini-projects which provide a certain number of points spread out over 2 weeks ~~(2 points per week)~~. Mini-projects are discussed below.

2. ~~To receive *any* points for the week, you must type up *at least one* problem for that week.~~ No one can receive points for more than 3 problems per week unless otherwise stated on the assignment for that week (but you are welcome to do more than 3 problems if they are available). To request problems, you will select them from an online bank (or a "sign up sheet" that will be available in class and during office hours) on a first come first serve basis.[1]

3. Homework is assigned every two lecture period and any typed solutions are due on the second day in said period. For the first assignment, this period begins on Thursday January 19th. Although typed solutions are not due until Tuesday January 24th, it is very helpful to have at least one problem done by Thursday. It is to your benefit to tell me which problems you are doing as you figure out so that you may receive credit.

4. You can only receive points for a maximum of three mini-projects, but if you have already done two and someone who has done less than two wants to do that project, they will be given preference over you. No one is required to do a mini-project.

5. For voluntarily answering questions, slight preference will be given to those who participate in class less frequently and/or have fewer points for that week.

6. You may use your notes to present solutions in class, even if you are called on involuntarily. Students will only be called on for involuntarily presentations if they requested the problem. For voluntary presentations, you can present solutions to any problem, even ones you did not request to do.

7. I will moderate who is allowed to give presentations. It is also important to be efficient with time to allow many people to present to optimize the amount of points that can be earned. Therefore, if your solution is taking too long, I may request that you return to your seat unless the audience assists.

Note: if you type a solution, which is incorrect on the first attempt, you will be given the opportunity to correct any mistakes for another week and the points you earn will be for the week in which the problem was assigned. Therefore, it is *strongly* advised that you do not look for solutions online and instead you try to attempt the problem on your own or with your classmates.

If, however, you do end up using an any outside reference whatsoever, you must **cite your references in full** (yes, this includes wikipedia, stackexchange, wolframalpha, etc.). In particular, if it is one of these websites, use the full link and provide author information if available. Avoid plagiarism and read (and abide by) the student code, including the section on Academic Integrity available at http://community.uconn.edu/the-student-code-appendix-a/. Please write clearly, legibly, with correct English grammar, and in an organized manner.

Quizzes: ~~There will be about four to five short 20 minute quizzes at the beginning of class once in a while.~~ There will be a quiz at the beginning of class after every two week period, i.e. every

[1] If you find a substantially different solution to a particular problem that was already done by somebody, you may request to write your other solution as well and have it count as completing a problem. This must be based on my approval.

$(4n+1)$-st day (excluding midterms), where $n \in \mathbb{N}$, until the end of the semester. Quizzes are given points based on your grade according to the distribution above. The points you receive will be spread in whatever way benefits you most over the two week period that is covered on the quiz.

Exams: There will be two midterms in class and one final, each worth 20 points. The first midterm will be on **February 21st** (Tuesday) and the second midterm will be on **March 30th** (Thursday). The date of the final will be provided as soon as it becomes available to the instructor.

Mini-projects: Every lecture, there may be a short list of mini-projects that you can request and must complete within a certain specified number of weeks. The total number of points and weeks you can work on the problems will be specified. These involve delving further into topics that are tangential to our study, particularly within a week or two of when the projects are presented. If one person completes a mini-project successfully, they will be awarded a certain number of points equally distributed over the two week period for the week in which the announcement of the mini-project was made and for the week that follows it. The project need not be perfect upon a first attempt, but corrections may be done provided they are complete within an additional two week window. At most two people may work on a mini-project. In this event, if N is the number of points for the mini-project, then each individual will receive $\lfloor \frac{2}{3}N \rfloor$ points (here $\lfloor \cdot \rfloor$ is the floor function and gives the greatest integer less than or equal to its input). If after one week you have not made any progress on the project, you will forfeit the project and it will once again become available to others.
Note: Any extra points earned from a mini-project might be partially added to exam grades.
Another note: You may plan out your own mini-projects, but you must discuss them with me in advance for approval.
Yet one more note: I have made a color-coded calendar of our homework assignments, midterm exams, and quizzes. This includes when assignments are due, when corrections are due, when quizzes are administered, and so on.

Grading: Attendance is mandatory because participation in class is especially important as this is a proof-based course. Habitual tardiness (which disrupts the class) and skipping of class will negatively affect your grade. The approximate distribution of grades is given in this table:

Homework, quizzes, mini-projects, and participation	40%
Midterm I	20%
Midterm II	20%
Final	20%

Grade conversion chart:

%	93-100	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	< 60
Letter	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

More information about grades can be found at
http://catalog.uconn.edu/academic-regulations/grade-information.

Secondary references: We will occasionally use several additional references.

1. Walter Rudin *Principles of Mathematical Analysis* 3rd Edition, 1976, McGraw-Hill Education.
2. James R. Munkres *Analysis on Manifolds* 1991, Addison-Wesley Publishing Company.
3. John W. Milnor *Topology from the Differentiable Viewpoint* Revised Edition 1997, Princeton University Press.
4. Victor Bryant *Metric Spaces: Iteration and Application* 1985, Cambridge University Press.

Important dates: Please refer to the academic calendar http://registrar.uconn.edu/academic-calendar/spring-2017/ for important dates (last day to drop a course, etc.).

Special accommodations: The Center for Students with Disabilities (CSD) at UConn provides accommodations and services for qualified students with disabilities. If you have a documented disability for which you wish to request academic accommodations and have not contacted the CSD, please do so as soon as possible. The CSD is located in Wilbur Cross, Room 204 and can be reached at (860) 486-2020 or at csd@uconn.edu. Detailed information regarding the accommodations process is also available on their website at www.csd.uconn.edu.

LaTeX: You are required to type **all** solutions using LaTeX(LaTeX). What is LaTeX? See https://en.wikipedia.org/wiki/LaTeX and https://www.latex-project.org/ for more details. I have uploaded (and will continue to upload) short tutorials on certain aspects of LaTeX so that you have a better idea of how to use it.

Policy Against Discrimination, Harassment and Related Interpersonal Violence: The following is directly from UConn (http://cetl.uconn.edu/syllabus-design/): "The University is committed to maintaining an environment free of discrimination or discriminatory harassment directed toward any person or group within its community students, employees, or visitors. Academic and professional excellence can flourish only when each member of our community is assured an atmosphere of mutual respect. All members of the University community are responsible for the maintenance of an academic and work environment in which people are free to learn and work without fear of discrimination or discriminatory harassment. In addition, inappropriate amorous relationships can undermine the Universitys mission when those in positions of authority abuse or appear to abuse their authority. To that end, and in accordance with federal and state law, the University prohibits discrimination and discriminatory harassment, as well as inappropriate amorous relationships, and such behavior will be met with appropriate disciplinary action, up to and including dismissal from the University. Additionally, to protect the campus community, all non-confidential University employees (including faculty) are required to report sexual assaults, intimate partner violence, and/or stalking involving a student that they witness or are told about to the Office of Institutional Equity. The University takes all reports with the utmost seriousness. Please be aware that while the information you provide will remain private, it will not be confidential and will be shared with University officials who can help." More information can be found at http://equity.uconn.edu/ and http://titleix.uconn.edu/.

Other: Calculators are unnecessary in this course. Only writing utensils are allowed on quizzes and exams. There will be no make-up exams or quizzes unless under extreme circumstances (serious

illness, family emergency, religious holidays, etc.). In this event, please notify well in advance. If you are unable to make it to an exam for extreme circumstances, please obtain a proper validation for your absence.

Disclaimer: This syllabus is not set in stone and I may adjust it as I deem necessary throughout the semester. By taking this course, you acknowledge that you have read this syllabus and abide to it and any such changes.