Syllabus, MAA 4211 Advanced Calculus, Class Number 11584, Spring'23

Books: "Mathematical Analysis: an introduction" by Andrew Browder, ISBN 0-387-94614-4,
(out of print, but still available through Internet)
"Advanced Calculus: Theory and Practice" by John S. Petrovic, Second edition
(available in Kindle version now, the book version will be available in mid January'23)

Description of the course

The course on Advanced Calculus is devoted to rigorous presentation of the basics of Mathematical Analysis of real valued functions of one (real) variable from the standpoint of contemporary/modern Mathematics. It comes as a natural continuation of the MAA 3200 Introduction to Advanced Mathematics, and relies on the previous experience of the students from Calculus I and II (in the form accepted at FIU). The Advanced Calculus students are expected to be skillful in the computational aspects of Calculus I and II, and to be aware of the basic theorems in those courses. The purpose of Advanced Calculus will be to give proofs of those (and even more) theorems, and to put them in a right perspective (the theorems in question form a body of a scientific knowledge rather than a list of recipes for doing exercises and passing exams...)

The topics to be covered are:

(1) Construction of the real numbers starting from scratch (that is from the set of counting numbers);
(2) Sequences and series of real numbers;
(3) Continuity of real valued functions of one real variable;
(4) Differentiability of real valued functions of one real variable;
(5) The Riemann integral of real valued functions of one real variable;

The listed topics form the "must have" list of topics. They look familiar from the Calculus I and II books. But in each of them, there will be some extra intriguing sub-topics such as algebraic numbers, unordered series (nets), deeper study of the points of discontinuity of monotone functions, as well as the points where a convex function might not be differentiable, examples of continuous and nowhere differentiable functions to mention just a few.

(6) If time permits, the concept of Riemann-Stieltjes integral and its applications to Probability Theory will be discussed as well as some basics of (general) topology will be covered (such as definition and first properties of topological spaces, metric spaces as most important for our purposes examples of topological spaces, compactness etc.). The Riemann-Stieltjes Integral will be presented by an ad-hoc lecture by the Instructor.

The topics above, with the exception of the Riemann-Stieltjes integral, occupy chapters 1 through 6 in the book by Browder and Chapters 1 through 9 in the book by Petrovic. to be used in the course. The former book is quite concise, and therefore dense to read, compared to the latter, and is organized in the classical fashion of developing theory and then illustrating it with examples and garnered with excellent, but challenging Exercises. The book by Petrovic is unique in its presenting of the material: every chapter starts with worked out examples done using the recollections of the readers from Calculus 1 and Calculus 2, then it develops the theory used in the examples (rigorously showing that the methods used are in fact correct), and then illustrates the theory with more interesting and deeper examples. There are in the end plenty of exercises, of different difficulty, which offer the students material to enforce their knowledge and learn even more on the topics discussed in the chapter.

In this course, we will follow the classical approach as in Browder, but will heavily use the examples and the exercises from Petrovic's book. **The students are encouraged to do in a timely manner the preliminary examples from the latter book as a worm up for the theory to be discussed**.

Assessment of the progress of the students in class. There will be two Midterms and a Final Exam performed during the course. There will also be turn-in homeworks assigned.
All the problems for Exams will be taken from those suggested by the Instructor for work at home. The overall grade will be based on 30% of the Turn-in homework's total score, 30% of the total of the Midterms' scores, and 40% of the Final Exam score.

The overall grade of the student above is determined now by the scale:

$0.92 < S$: A	$0.89 < S < 0.92$: A-	$0.86 < S < 0.89$: B+
$0.78 < S < 0.86$: B	$0.75 < S < 0.78$: B-	$0.71 < S < 0.75$: C+
$0.62 < S < 0.71$: C	$0.58 < S < 0.62$: C-	$0.55 < S < 0.58$: D+
$0.49 < S < 0.55$: D	$0.46 < S < 0.49$: D-	$S < 0.46$: F

No make-over exams will be scheduled.

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Remark: The Instructor reserves the right to make any changes he considers academically advisable. Any such changes will be announced in advanced in class or by posting them to the e-mail accounts of the students. The students are responsible to be aware of the changes announced this way.