Syllabus, MAA 4211 Advanced Calculus, Class Number 11408, Spring'26

Book: "Advanced Calculus: Theory and Practice" by John S. Petrovic, Second edition

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;
(6) Infinite series of numbers;
(7) Sequences and series of functions.

The listed topics form the "must cover" 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.

(8) 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 8 in the book by Petrovic. to be used in the course. The book is organized in the classical fashion of developing theory and then illustrating it with examples and garnered with excellent, but challenging Exercises. It is unique in its presentation of the material as well: every chapter starts with worked out examples done using the recollections of the readers from Calculus 1 and Calculus 2, then it rigorously develops the theory underlining the examples , and then illustrates the theory with more interesting and deeper examples. Plenty of exercises, of different difficulty, can be found in the end of the chapters. They provide the students material to enforce their knowledge and learn even more on the topics discussed in the respective chapter.

The students are encouraged to do in a timely manner the preliminary examples in the beginning of the chapters as a warm up for the theory to be discussed in class.

Assessment of the progress of the students in class. There will be four Turn-in Hw assignments and a final exam. 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 the five assignments above. All they will be equally weighted (20% each).

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	$0.58 < S < 0.62$: D	$S < 0.58$: 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.