MATH 2910 SECTION 702 -SPRING 2016

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Textbook: Calculus (Early Transcendentals, Third Edition), by Jon Rogawski

Course Content: This is a Honor section of Calculus II. Our goals for this semester are to understand in depth concepts from Calculus II and to study some of their applications. An important component in our work will be the enhancement of skills of finding, constructing and writing solutions to concrete problems.

Attenance: Attendance is required.

Grading: Three to four long assignments will be graded. Each assignment will cover a main topic of calculus and its applications. The assignments will be worked out in groups. Each group will submit a typed solution. Each assignment will consists of a theoretical and a practical part. The written assignments will help you learn to communicate mathematical ideas in a clear, rigorous manner and get feedback on your techniques. I do not generally accept late homework. Missing even one homework can drastically lower your course grade, so please keep up with your work. You should expect to have to work hard to get some of the problems; you do not learn anything by doing problems identical to what I do in class. Please attend office hours at the first sign of trouble.

Each assignment will be worth 50 points. Letter grades will be assigned as follows: 90 % will guarantee and A, 80$ will guarantee a B, 70 $ will guarantee a C, 60$ will guarantee a D.

Missed work: Students shall be offered reasonable accommodation in the even he/she is unable to turn in a homework assignment on time for a valid and documented reason. Valid reasons include official University activities, activities associated to military service, illness and family emergencies. Appropriate documentation shall be provided by the student in a timely fashion, preferable in advance, to support his or her request for accommodation.

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Project 1: The concept of limits.

This is a group assignment. Each group will submit (a) a typed solution, (b) a list of references, and (c) a description of each team member contribution to the project. Please use full sentences to explain your arguments. Be sure that your answers are fully justified.

Part 1 Briefly describe how the concept of *limits* was developed. Your short account on the history of limits should include when the concept of limits was introduced and an explanation of some of the motivations that lead to the notion of limits. This should not be more than a page in length.

Part 2 Give the precise definition of limit of a sequence. This is the ( ) definition. Include examples of sequences, their limits and use the definition to prove your claim. Include no less than five examples. (Your examples should be interesting..)

Part 3 Use decimal expansion to write $0.44444\ldots$ ($0.987987987\ldots$ resp.) as the limit of a sequence. Which fraction does the decimal $0.44444\ldots$ approximate? us tify your answer.

Part 4 Use Newton's method to approximate $\sqrt{7}$. What is the relevant sequence?

Part 5 Use the fact that

$$\ln(n) = \int_1^n \frac{dx}{x}$$

to show that

$$\ln(n) < 1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n} < 1 + \ln(n) \tag{0.1}$$

Do you expect $\lim_{N\to\infty} \sum_1^N \frac{1}{n}$ to be a finite number? Why?

Part 6 Show that

$$\int_4^N \frac{dx}{x^2} < \sum_4^N \frac{1}{n^2} < \int_3^N \frac{dx}{x^2}. \tag{0.2}$$

Conclude that $\lim_{N\to\infty} \sum_1^N \frac{1}{n^2} \simeq 1.653$.

Due Feb 12, 2016