Objectives: Students passing this course will

1. know basic results in one-dimensional real analysis including, but not limited to, results about completeness of the real numbers, the basic topology of the real numbers and continuity of real valued functions. This knowledge must be demonstrated at both an intuitive and a formal level.
2. clearly communicate their knowledge of these fundamental results orally and through written mathematical proofs.
3. be aware of the fundamental problems in mathematics that led to the discovery/invention of the above basic results. To promote this awareness, during the course we will consider these fundamental problems via a discovery approach.

Assignments: The purpose of this course is to explore the real numbers as an axiomatic structure. We will therefore be proving many theorems in this class.

Learning Goals

This course most directly addresses Siena learning goals 1, 2 and 3. We see goal 1 because mathematics in general is concerned with clear and logical reasoning, which is the cornerstone of measured judgement. We observe goal 2 because of the necessity of students clearly presenting their findings in language, although rhetoric here isn’t quite the point but clarity and economy of language which is separate from logic. We treat goal 3 because of the architecture of our course requires the humane help of each other through the difficulties of learning a hard subject; mathematics brings many students to the edge of their learning ability, leading to careful reflection on how we learn about and understand our world.

Regarding the learning goals of the School of Science, this course most directly deals with goals A and C found here. We include goal A, since application of method and problem solving are essential to the course, and goal C because of our emphasis on presentation of solutions.

Regarding the learning objectives of the Mathematics Department, this course most directly speaks to objectives 3 and 5 found here. These are the ability to communicate mathematical ideas with clarity and
coherence through writing and speaking; 
and the ability to make conjectures and prove propositions within the axiomatic structures of mathematics.

Course Goals: After successfully completing this course, a student will be able to:

1) Deduce basic facts about the real numbers from the algebraic and order properties.
2) Prove theorems that follow from the completeness axiom.
3) Prove theorems about convergence of sequences and series.
4) Deduce certain basic theorems in Calculus rigorously.
5) Employ the basic strategy of analysis in solving problems, which is: First, prove your result for simple, well-understood approximating objects and second, show that your proof survives taking limits.

Assessment
In this course students embark on a mathematical journey through a craggy landscape with many pitfalls. To avoid missteps it is essential to monitor student work more closely than in a typical course. For this reason, the sole assessment for the course is my personally checking each student’s understanding of every one of their completed problems. Please read the following carefully, as it describes precisely the process by which students will be awarded credit in the course.

Every problem must be written up carefully, sensitive to criteria in my (available) writing rubric. When a student is ready for me to check a completed problem I will sit with the student and read his or her proof line by line either in class or during scheduled office hours. I will continue to read until I find an error in reasoning or calculation, or the writing is too unclear, at which point I will stop and indicate where I stopped. I will give the student a hint and then move on to check another student’s work. After reading a proof I will ask the student to verbally describe his or her solution informally, without looking at what he or she has written, to ensure there has been no plagiarism. In the event that a write-up is perfect but the explanation does not indicate that the student has understood what he or she has written (e.g. has copied a solution from the internet) I reserve the right to award a zero for that problem. If I decide that many students have used overly similar language in their respective written solutions to a problem, I reserve the right to award the grade of zero for that problem for all students who have used the offending language. Once a zero is awarded in either of the above circumstances, it means that a student will not have the opportunity to make up the work for that problem. (The best way to guard against zeros is to talk with one another about the mathematics but not to directly borrow language from one another or look at what each other has written.) No further disciplinary action will be taken for plagiarism than the above, since mathematical writing is very precise and learning about what constitutes mathematical plagiarism is challenging because of the need for solutions to be very precise. One should regard learning not to plagiarize mathematics as a minor additional subgoal for the course. In the event that a student successfully completes a problem, I will award that student credit for that problem. When this happens, the student will have an opportunity to present another problem. Of course, unless you are awarded a zero for a problem you will have opportunities to present the problem only limited by time constraints.
Let me be absolutely clear about this: I do not promise to spend equal time with every student during class. More time will be spent with students who have worked very hard to write clear solutions to their problems. Such students will have the opportunity to present “runs” of problems to me and thereby may earn a better grade in the course. It is in your best interest to work hard to clarify your ideas before trying to present them!

There are no exams in this class. Your grade for the course is determined as follows: You must be awarded credit for at least 30 problems to guarantee a course grade of C, at least 60 problems to guarantee a grade of B and 90 problems to guarantee a grade of A. Plus or minus grades will be given at my discretion, understanding however that the above “lower bounds” will not be violated by the award of a minus grade, e.g. I cannot not give a “C-” to any student who has completed at least 30 problems and attends the class each day throughout the semester. In order to be awarded any of the above grades you must continue to attend class every day and work on problems, it is not acceptable to get the grade you want and then stop coming to class. If a student is habitually and regularly absent from class, then the above agreement for a minimum grade is null and void. In the event that I do not take formal attendance for the class, “habitual and regular” absence will be determined at my discretion, and will be gauged by how long it has been since I have seen a student in class or how long it has been since that student has presented a problem for credit.

Let me note that an ‘A’ grade in the class is just the beginning for anyone seriously interested in graduate study in mathematics. Such students should have the self-motivation to complete ALL problems in the IBL notes. I’m happy to check the work of any such student as part of the course period.

I will not consider your solutions to problems after the last scheduled day of classes.

Pandemic/Emergency Preparedness:

(a) You are instructed to bring all texts and a copy of the syllabus/course schedule home with you in the event of a College Closure. The Academic Calendar will be adjusted upon Reopening; so be prepared for the possibility of a short mini-semester; rescheduled class/exam period; and/or rescheduling of the semester, depending on the length of the Closure.

(b) If your situation permits, you should continue with readings and assignments to the best of your ability, per the course schedule.

(c) You will be given instructions regarding how to deal with paper assignments requiring library or other required research by me, as needed.

(d) Online office hours will be used by me in order to maintain contact with my students. You will be able to "check-in" with questions that you have. If you do not have internet access available, I will also provide my home phone number and home address, as needed. Remember, internet, mail delivery, and telephone services may also be impacted by a Pandemic or other
emergency event.

(e) Finally, stay connected with information regarding the status of the College's status and Reopening schedule by monitoring the Siena