What is this course *really* about?
aka My aim for this course

According to Underwood Dudley, there are at least eight levels of mathematical understanding:

1. Being able to do arithmetic
2. Being able to substitute numbers in 'formulas'/ being able to state or use elementary properties of concepts
3. Given 'formulas'/ elementary properties of a concept, being able to get other 'formulas'/ elementary properties
4. Being able to understand hypotheses and conclusions of theorems
5. Being able to understand the proofs of theorems, step by step
6. Being able to *really* understand proofs of theorems: that is, seeing why the proof is as it is, and comprehending the underlying ideas of the proof and its relation to other proofs and theorems
7. Being able to generalize and extend theorems, and apply them to seemingly unrelated problems
8. Being able to see new relationships, and discover and prove entirely new theorems.

The word 'theorem' is used above in a very general sense - it can also represent algorithms and methods with a mathematical basis.

Levels 5 and 6 would be considered basic mathematical ability for Math majors. Non-trivial applications of Mathematics would lie in-between levels 6 and 7. While levels 7 and 8 constitute research in Mathematics. A lot of computer science, physics, and engineering, is deep applied mathematics and requires understanding at or beyond levels 6 and 7.

Calculus courses focus on a mixture of 1 and 2. Math 230 (Introduction to Discrete Mathematics) focuses on 3 and 4. Math 332 (Elementary Linear Algebra) focuses on 3 and 4 with a bit of 5.

In this course (Math 454), the focus is more on the upper part of levels 3, 4, 5, and 6. The aim is give you a firm foundation in levels up to 6, so that you can go onto levels 7 and 8, both as mathematicians and scientists/engineers, through graph theory as a versatile mathematical language for modeling real-world phenomenon and as a repository of structural and algorithmic techniques. The usage of graphs and networks is ubiquitous in modern applied mathematics, hence its important that we build a strong foundation in the basic subject matter through this first course in modern graph theory. From basic concepts leading onto fundamental existential and algorithmic problems arising from structures and optimization in graphs, using proof techniques based on induction, extremal choices, and algorithms.

I hope this course will help you make progress through these levels of mathematical understanding, and mathematical maturity. I would consider this a successful course if you gain confidence in your ability to read, understand, and write mathematical arguments (including proofs), especially as compared to the beginning of the semester. And, you feel that you can independently read, understand, and apply any other topic/ technique in Graph Theory that you might need later on in your career.

with best wishes,
Hemanshu Kaul