WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

Math 846: Algebraic Graph Theory
MWF 11:00–11:50 AM, Van Vleck B329
Syllabus for Semester II, 2021/2022 (term 1224)

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Text: Lecture notes will be posted on my Terwilliger/Teaching website.

Prerequisites: Good understanding of linear algebra.

Course Content: Introduction to Algebraic Graph Theory. We will discuss the adjacency matrix and its eigenvalues, the adjacency algebra, the dual adjacency algebra, and the subconstituent algebra. We will bring in ideas from Lie theory, representation theory, quantum groups, the double affine Hecke algebra (DAHA), and orthogonal polynomials.

The lectures will be self contained and no prior knowledge of the subject is assumed. The only assumption is a good understanding of undergraduate linear algebra, such as eigenvalues, eigenspaces, bilinear forms, and tensor products. The course is recommended for anyone interested in algebraic combinatorics, representation theory, Lie theory, quantum groups, and statistical mechanical models.

Course Credits: 3. Each week there will be three 50 minute lectures.

Evaluation: There are no exams. Near the end of the semester each non-dissertator student is expected to give one lecture, on a topic of your choice that is related to the course. As the time approaches I will suggest topics and organize the speaking schedule.

Course goals/Learning outcomes: Master the material presented in lecture. For this I recommend the following study strategy: (i) Get your hands dirty as you play with the examples. (ii) If I prove in lecture that something is true for all n, then on your own, verify the thing by brute force if necessary, for some small values of n. (iii) In lecture I will give careful proofs for the main results. For each result, try to write your own proof starting from first principles and without looking at your notes. It is not important if your proof matches mine or not. Done properly this strategy is easy to carry out, since every result in the course builds naturally on what came before. (iv) As you study your lecture notes, try to guess what comes next. Make conjectures and try to prove them.