# Algebraic Graph Theory I, II, and III

## MTH 661, 662, 663, Fall, Winter, Spring 2017 & 2018

---

**Professor:** J. J. P. Veerman
**Class meets:** TR 17:15 - 18:30 in NH 382.
**Office:** 311 Neuberger Hall (725-8187)
**Office Hours:** After class or by appointment.
**Email:** veerman@pdx.edu
**Web Page:** `http://web.pdx.edu/~veerman/`

---

**Text:** T. Biyikoglu, J. Leydold, P. F. Stadler, Laplacian Eigenvectors of Graphs, Springer, 2007.
Handbook of Graph Theory, 2nd edn, editors: J. L. Gross, J. Yellen, P. Zhang, CRC Press, 2013.
Other material may be provided by instructor.

**General Description:** This is an advanced course in graph theory and its applications. This year we will concentrate on the graph Laplacian and its eigenvectors and eigenvalues. These are of fundamental importance when studying phenomena related to flocking, consensus, distributed sensing and related problems. Among other things we will study the Perron-Frobenius theorem, the relation between invariant measures for random walks on directed graphs and their Laplacians, nodal domains, and the Fiedler number. We will discuss some applications of these ideas, in particular the convergence (or lack thereof) of the movement of a flock to coherent movement.

In the remainder of the course we will study other aspects of graph theory. Topological graph theory (embeddings of minimal separating graphs in surfaces using rotation systems), random graphs, and networks. We will also discuss applications of these topics in the sciences (biology, chemistry, and physics) and the social sciences (gossip networks, epidemics on graphs). Towards the end of the year, there will be the possibility of doing small projects counting towards a final grade.

**Background:** Prerequisites: MTH 462/562 or consent of the instructor. This is a sequence of three courses, and they must be taken in sequence.

**Grading:** In the first two terms, your course grade will be based on in-class performance, homeworks, and midterms. In the last term, the grade will be based on projects carried out during the term.

Homeworks will be assigned, and the exams/midterms will in large part be drawn from those assigned homeworks. In homeworks and projects, collaboration is allowed and encouraged. Plagiarism, however, is not tolerated. You must turn in original work.

All answers on any work you turn in (home works, quizzes, or exams) must be justified, even if that is not evident from the phrasing of the question. Answers without justification will receive partial credit at best. Before turning in exams or home works, write your first plus last name in the top right corner of each sheet you turn in (even if you staple them together)!

**Attendance:** You are expected to attend classes. Home works, changes to this syllabus or to the scheduling of exams will be announced in class. If you have to miss class, it is your responsibility to find out what happened in class *from your classmates.*

**Homework:** As material is covered in class, a list of accompanying homework will be assigned. Reading the text and completing the homework is essential to your success in this course, and it will likely require a substantial amount of time and effort on your part to complete it successfully. You may find it helpful to form a study group with 2-5 other students and work together outside of class on the assignments. However, each student must write up and submit his or her own work. Plagiarism from either the web, your colleagues, or any other source is unacceptable at Portland State, and cases may be referred to the Dean Students for action. Homework (if due) must be turned in on the due date *at the beginning* of the class. ***HW 10 minutes late or more will not be accepted, except in cases governed by university guidelines (illness, etc).***

**Exams:** If given, exams or quizzes are cumulative and will cover all assigned exercises and theory. Dates and times for finals are set by the University. Before taking the final, students must double-check the following information on the University web-site.

FINAL 661: Tues, Dec 05, 17:30-19:20.
FINAL 662: Tues, Mar 20, 17:30-19:20.
FINAL 663: Tues, Jun 12, 17:30-19:20.

---

**Access and Inclusion for Students with Disabilities:** PSU values diversity and inclusion; we are committed to fostering mutual respect and full participation for all students. My goal is to create a learning environment that is equitable, useable, inclusive, and welcoming. If any aspects of instruction or course design result in barriers to your inclusion or learning, please notify me. The Disability Resource Center (DRC) provides reasonable accommodations for students who encounter barriers in the learning environment.

If you have, or think you may have, a disability that may affect your work in this class and feel you need accommodations, contact the Disability Resource Center to schedule an appointment and initiate a conversation about reasonable accommodations. The DRC is located in 116 Smith Memorial Student Union, 503-725-4150, drc@pdx.edu, http://www.pdx.edu/drc.

If you already have accommodations, please contact me to make sure that I have received a faculty notification letter and discuss your accommodations.

Students who need accommodations for tests and quizzes are expected to schedule their tests to overlap with the time the class is taking the test.

Please be aware that the accessible tables or chairs in the room should remain available for students who find that standard classroom seating is not useable.

For information about emergency preparedness, please go to the Fire and Life Safety webpage
(http://www.pdx.edu/environmental-health-safety/fire-and-life-safety) for information.

**Title IX Reporting Obligations:**
As an instructor, one of my responsibilities is to help create a safe learning environment for my students and for the campus as a whole. Please be aware that as a faculty member, I have the responsibility to report any instances of sexual harassment, sexual violence and/or other forms of prohibited discrimination. If you would rather share information about sexual harassment, sexual violence or discrimination to a confidential employee who does not have this reporting responsibility, you can find a list of those individuals or contact a confidential advocate at 503-725-5672. For more information about Title IX please complete the required student module Creating a Safe Campus in your D2L.