



# UCSB “Network Systems”

## ME/ECE 269, Winter 2024

### Instructor: Francesco Bullo

This is the website for the UCSB course ME/ECE 269 “Network Systems”, Winter 2024. This website’s URL is <http://motion.me.ucsb.edu/ME269-Winter2024>.

A pdf version of this documentation is available on [here](#).

## Official Description

Motivating socio/economic networks, power grids, multi-agent robotics. Perron-Frobenius matrix theory and algebraic graph theory. Fundamental dynamics in networks: averaging dynamics in discrete and continuous time; positive and compartmental systems; coupled oscillator systems; virus propagation models; population dynamic models; robotic coordination problems.

*The course is intended primarily for graduate students interested in network science, dynamics over networks, cooperative and distributed control, distributed systems, and distributed algorithms. Topics will include: (1) Perron Frobenius theory, (2) graph theory and algebraic graph theory, (3) basic network models such as averaging dynamics in discrete and continuous time, compartmental flow and positive systems, (4) stability theory for nonlinear systems, (5) Lotka-Volterra population dynamics, virus propagation dynamics, and coupled-oscillators dynamics, (6) examples are drawn from socio-economic networks, power grids, robotics.*

## Prerequisites

Competency in linear algebra, nonlinear dynamical systems and linear control systems.

## Textbook

- The main source is:  
Lectures on Network Systems version 1.6, Sep 1, 2022, by Francesco Bullo.  
The textbook is available at <https://fbullo.github.io/lns/>  
You are welcome to download the textbook in standard format as well as in slide format.
- Youtube vides for the first seven chapters of the text are available in this [youtube playlist](#).

## Lecture Time and Place

The official course lecture time and place are:

- Mon and Wed 11:00-12:15, Phelps Hall 3505

Nomilally, we have 2 lectures per week for 10 weeks. However:

- per campus calendar, lecture is canceled on Monday January 15th (MLK Jr. Day) and Monday February 19th (Presidents’ Day)
- I decided to cancel class on Monday January 8th, and
- unfortunately, I have a business trip on Mon-Wed Jan 29-31; my apologies.

To make up for the lost contact time, there will be makeup lectures on

- Fridays, 3pm-4:15pm in the same room Phelps Hall 3505.

Specifically, we will meet on:

- Friday January 19th
- Friday January 26th
- Friday February 2nd
- Friday February 9th (to be confirmed)
- Friday March 15th (presentations)

## Course Credit

Units: 4 for graduate students taking ME/ECE269

## Instructor

Professor Francesco Bullo  
Department of Mechanical Engineering  
Email: bullo-at-ucsb.edu  
Website: <https://fbullo.github.io>

## Office Hours

Place: Professor Bullo's Zoom room (see your email)

Time: Tuesdays 4pm-6pm

If you have any questions about the course, please send me email. I will try to respond as quickly as possible. Additionally, I will share questions that are particularly good (and their answers) with the rest of the class by broadcasting my answer to the entire class.

If you come to office hours with questions about homework, please be prepared to show attempts at solving the problem prepared before coming.

## Grading

Class grade will be determined by:

- 40% weekly homework assignments
- 30% final report
- 30% final presentation

In exceptional cases, I reserve the right to give extra points for excellent performance on the final report and presentation. Please, do not count on it as a way to avoid doing homework assignments.

## Homework Self-Grading Scheme

- Homework is due one week after the corresponding chapter is fully covered in class; precise deadlines will be announced in class.
- Please write one exercise per page and write clearly for partial credit.
- To turn in the homework, please scan solutions in a single PDF file and email me the file by the deadline.
- After the homework deadline, I will email you the solutions (after which no late homework will be accepted).

- I will ask you to please self-grade your homework and email the marked homework to me. Please self-grade within a week of receiving the solutions.
- Each exercise in each homework assignment is worth 10 points, unless otherwise marked.

## Final Report and Final Presentations

Instructions on the report and presentation will be discussed in class.

Here are some [draft instructions](#).