AA/ME/EE 597
Networked Dynamic Systems
Spring 2016; Syllabus[1]

Instructor: Mehran Mesbahi
Professor of Aeronautics & Astronautics
Gug 318E; Tel: (206) 543-7937
Email: *mesbahi@aa.washington.edu*
www.aa.washington.edu/faculty/mesbahi

Instructor's Office Hours: M: 2-4 pm; Thursdays: 1:30-2:30 pm
Class website: from *http://faculty.washington.edu/mesbahi/*
Class Room: Loew 202
Class Time: T/Th: 11:30 am-12:50 pm

Textbook: *Graph Theoretic Methods in Multiagent Networks*, by M. Mesbahi and M. Egerstedt, Princeton, 2010.
Some reference books related to this course include:
Distributed Control of Robotic Networks, by F. Bullo, J. Cortes, and S. Martinez, Princeton, 2009.
Distributed Consensus in Multi-vehicle Cooperative Control, by W. Ren and R. Beard, Springer, 2008.
Some other reference books related to this course include:
Graph Theory, by R. Diestel, Springer, 2000.
Algebraic Graph Theory, by C. Godsil and G. Royle, Springer, 2001.
Networked Embedded Sensing and Control, edited by P. J. Antsaklis and P. Tabuada, Springer 2006.
Matrix Analysis, by R. A. Horn and C. R. Johnson, Cambridge, 1990.
Sync: The Emerging Science of Spontaneous Order, by S. Strogatz, Hyperion, 2003.
Handouts/papers: I will provide hand-outs or post papers/notes on the class website on topics of interest during the quarter; please check the website regularly.
Synopsis: A networked dynamic system is a set of dynamical units that interact over a signal exchange network for its coordinated operation and behavior. Such systems have found many applications in diverse areas of science and engineering, including multiple space, air, land, and underwater vehicles, energy and power systems, physiology, and medicine. Currently, there is an active research effort underway in control and systems community to formalize these dynamical systems and lay out a foundation for their analysis and control synthesis. This course provides an overview of graph-theoretic techniques that have proven instrumental for studying networked dynamic systems. Specifically, we will look at the following topics: (1) network models (graphs, random graphs, random geometric graphs, state-dependent graphs, switching networks), (2) network properties (some useful combinatorial and algebraic properties of graphs), (3) dynamics over networks- theory and some applications, including agreement/consensus protocol and its various extensions, and (4) formation control. Other topics that will be covered- depending on the available time- include: advanced algebraic methods in graph theory, biological networks, network controllability and observability, and games over networks. Suggested prerequisite is Linear Systems (AA/EE/ME 547).

Homeworks: We will have weekly homework assignments, assigned every Tuesday; the homework is also due on Tuesdays. The contribution of homework toward the final grade is 60%. Some of homework assignments will be weighted more and should be done as if they were a take home midterm without consultation with others.

Project: The project will consists of presenting a poster and submitting a report relevant to networked dynamic systems, related to your own research or a published journal paper by another researcher. The project will contribute 40% to the final grade. Some representative journals that you might like to start consulting for selecting your project topic are: *IEEE Transactions on Automatic Control*, *IEEE Transactions on Control Systems Technology*, *IEEE Transactions on Control of Network Systems AIAA Journal of Guidance, Control, and Dynamics*, *Automatica*, *European Journal of Control*, *SIAM Journal on Applied Dynamical Systems*, and *SIAM Journal on Control and Optimization*.

[1] Rev. 0; March 29, 2016