MAE 3134: Linear System Dynamics (3 credits)

The George Washington University
Mechanical and Aerospace Engineering
Spring 2016

INSTRUCTOR

Santiago Solares
Office: Science and Engineering Hall (SEH), Room 3560
Office Hours: Tuesdays, 12:00-2:00 pm, and by appointment
Phone: (202) 994-0372
Email: ssolares@gwu.edu

TEACHING ASSISTANT

Louis Camacho
Office: TBD
Office Hours: Wednesday, 9:30-11:30 in SEH3990 and by appointment
Email: carlosej@gwu.edu

MEETING TIMES

Lecture: Tuesdays and Thursdays, 9:35 – 10:50 am, ROME 204
Recitation: Fridays, 2:20 – 3:10 pm, DUCQUES 359

PREREQUISITES

- APSC 2113 (prerequisite) and APSC 2058 (co-requisite)
- Knowledge of ordinary differential equations, complex numbers, basic linear algebra, mechanics, basic programming in any language (e.g., Matlab)

EDUCATIONAL OBJECTIVES

- To introduce the fundamentals of linear dynamical systems in the time and frequency domain
- To present design and analysis procedures for various typical systems

By the end of the course, students will be able to:

1. Apply force/moment/energy balances to derive equations of motion (EOMs) for single- and multiple-degree-of-freedom (SDOF/MDOF) systems
2. Describe the important properties of transient, steady-state, free, and forced responses
3. Convert between frequency and time domains and determine which is most appropriate for a given problem
4. Develop analytical and computational solution procedures for linear systems
5. Compute the transient and steady-state response of a system to specific inputs
6. Compute the frequency response of a system

COURSE TOPICS

1. Complex numbers, Laplace transform, solutions to linear ordinary differential equations (ODEs)
2. Free body diagrams, mathematical modeling of mechanical, electrical, fluid, and thermal systems; linearization
3. Modeling of systems as transfer functions and in state space
4. Transient response, characteristic equation, stability, general forcing
5. Frequency response, resonance, Bode plots, Fourier series
6. Vibration isolation, dynamic absorbers
7. MDOF systems: modal analysis, normal modes, forced response

GRADING

Homework:	40% (approximately 12 assignments)
Recitation session ***in-class*** work	10%
Mid-term exam:	25%
Final exam:	25%

- Homework is collected at the beginning of lecture on the due date (with some exceptions, as indicated on the assignments). *Homework can be turned in late at the instructor's office until 5 pm the weekday following the due date, with a 25% penalty. No homework is accepted after that.* With extenuating circumstances, homework extensions can be provided and exams can be made up or rescheduled if approved *beforehand* by the instructor.

- A missed exam with no approved excuse can be made up within one week, with a 20% penalty.

- Re-grade requests must be submitted within a week of the day when the assignments or exams were returned. Grades are final after this 1-week period. Note that is possible for a grade to be lowered after a re-grade.

- Extra credit is *not* given on an individual basis, and all grades are final.

- Recitation session work will be collected at the end of each session. *These assignments cannot be rescheduled.* The two recitation assignments with the lowest grade will be dropped.

TEXTBOOK

Ogata, System Dynamics, 4th Edition, Prentice Hall (required)

ATTENDANCE

Students are expected to attend every lecture and recitation session, and they are responsible for all course material and announcements discussed in class. ***Note that recitation sessions include in-class graded work which accounts for 10% of the final grade.*** However, students are encouraged to avoid attending lecture if they are ill and/or contagious. Please inform the instructor as soon as possible if you must miss class due to illness. Other reasons for absence must be communicated to the instructor ahead of time and approved. Notes written on the board, either in lecture or in recitation, will *not* be posted.

UNIVERSITY POLICY ON RELIGIOUS HOLIDAYS

1. Students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance.

2. Faculty should extend to these students the courtesy of absence without penalty on such occasions, including permission to make up examinations.

3. Faculty who intend to observe a religious holiday should arrange at the beginning of the semester to reschedule missed classes or to make other provisions for their course-related activities

SUPPORT FOR STUDENTS OUTSIDE THE CLASSROOM

Disability Support Services (DSS)
Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in the Rome Hall, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information please refer to: gwired.gwu.edu/dss/

Mental Health Services 202-994-5300
The University's Mental Health Services offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include: crisis and emergency mental health consultations confidential assessment, counseling services (individual and small group), and referrals. counselingcenter.gwu.edu/

ACADEMIC INTEGRITY

Students may work collaboratively on assignments in order to learn together but homework submissions should reflect individual effort. Strict copying is not permitted and will be penalized. Exams must reflect only individual effort. Only materials permitted by the instructor are allowed to be used during the exams.

Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information. For the remainder of the code, see: studentconduct.gwu.edu/code-academic-integrity