

**AERSP 304 Dynamics and Control of Aerospace Systems**

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Office Hours	
TR 1:00-3:00 or by appointment	TR 3:00-5:00 (129 Hammond) or by appointment

**Prerequisites:** EMCH 212, AERSP 313.

**Required textbook:** Kelly, S.G., *System Dynamics and Response*, Cengage Learning, Toronto, 2007.

**Student Outcomes:** Students who complete this course will be able to:

1. Develop equations of motion for single- and multiple-degree-of-freedom mechanical systems,
2. Analyze their time-domain response,
3. Analyze their frequency-domain response, and
4. Analyze the stability and response of simple linear feedback control systems

**Grading:**

			time	location
projects	12%			
quizzes	22%	weekly		
Test #1	22%	Wed. Feb. 19	8:15-10:15pm	112 Kern
Test #2	22%	Wed. Apr. 2	8:15-10:15pm	26 Hosler
Final exam	22%			

Course Grade	Minimum Score
A	93
A-	90
B+	87
B	83
B-	80
C+	77
C	70
D	60
F	0

**Practice Problems:** Practice problems will be assigned each week, but not collected or graded. It is critical that you work all of the practice problems; this is the only way that you can really learn the material in the course.

**Quizzes:** Weekly 10-minute quizzes (usually on Fridays), closed-book, no calculators. These will be based mostly upon the practice problems, but may include some conceptual questions from lecture. The lowest quiz score from the semester will be dropped.

**Projects:** These will make use of some results from earlier practice problems, as well as new material from lecture, and will include some computer-coding.

**Makeup quizzes and tests :** Makeups will be given for legitimate reasons only: illness or personal or family emergency (sleeping late or forgetting to take the quiz are not acceptable reasons). If possible, let me know ahead of time if you will need to take a makeup quiz or test, but in any event, contact me as soon as possible to make the arrangements.

## **What is Academic & Professional Integrity?**

Integrity, to a great degree, is a matter of intent. A person of integrity intends to act consistently according to his/her beliefs and values, and such actions constitute ethical behavior. We recognize common values<sup>1</sup> that are critical to the success of our academic community: honesty, trust, fairness, respect, and responsibility. At various times during the semester, we will discuss these values as they pertain both to you and me. We'll also talk about how they are related to professional codes of ethics. It is important that you positively assert your commitment to integrity and ethical behavior both within and outside the classroom. On each quiz, test and exam in this course, you will be required to write out and sign the following statement: "I have completed this work with integrity."

## **What are Penn State's Standards for Academic Integrity?**

"Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts. "Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others." (Penn State University Faculty Senate Policy No. 49-20: [www.psu.edu/ufs/policies/separate\\_policy/49-20.htm](http://www.psu.edu/ufs/policies/separate_policy/49-20.htm))

## **What is Penn State's Policy for Handling Violations of Academic Integrity Standards?**

Our professional integrity compels us not only to monitor our own behaviors but to protect the integrity of the course by not standing by and letting others cheat and get away with it. So, I encourage you to intervene with a student you know to be cheating (you can talk to them or talk to me, anonymously or otherwise) and I will always intervene when I become aware of integrity violations. I will do this by reducing the student's grade for the quiz, test or exam, as well as following Penn State's procedures for reporting violations, Penn State Academic and Administrative Policy G-9 ([www.psu.edu/dept/oue/aappm/G-9.html](http://www.psu.edu/dept/oue/aappm/G-9.html)).

## **Accessibility:**

Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at <http://equity.psu.edu/ods/>.

In order to receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at <http://equity.psu.edu/ods/guidelines/documentation-guidelines>). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.

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<sup>1</sup>An excellent collection of writings on these values is available from the International Center for Academic Integrity ([www.academicintegrity.org](http://www.academicintegrity.org)).

Week	AERSP 304 Lecture Topics	Reading
1: 1/13 – 1/17	Introduction; system response, linearizing diff. eqs.; unit impulse and step functions, stability, brief review of Matlab and plotting	pp. 12-46
2: 1/20 – 1/24	Moments of inertia, parallel-axis th'm, degrees of freedom, springs, damping, external forces and torques	pp.50-79
3: 1/27 – 1/31	Free-body diagrams, Newton's laws, motion of particles and rigid bodies, D'Alembert's principle, single- and multiple-DOF sys.	pp. 80-104
4: 2/3 – 2/7	Lagrange's formulation : conservative and non-conservative sys.	pp. 105-126
5: 2/10 – 2/14	Laplace transforms, inverse transforms, partial fraction decompositions	pp. 269-300
6: 2/17 – 2/21	Solving diff. eqs. via Laplace xforms, transfer functions (single and multiple input/output sys.)	pp. 301-342
7: 2/24 – 2/28	Transient response, stability, Routh criterion, root-locus analysis	pp. 342-360
8: 3/3 – 3/7	Response of 1st-, 2nd- and higher-order systems	pp. 361-398
9: 3/10 – 3/14	SPRING BREAK	Any novel, just read something!
10: 3/17 – 3/21	Multiple-DOF sys., effects of time delay, numerical integration	pp. 399-429
11: 3/24 – 3/28	Frequency response, Bode diagrams	pp. 435-466
12: 3/31 – 4/4	Freq. response of 2nd-order sys., resonance	pp. 472-512
13: 4/7 – 4/11	Feedback control, block diagrams	pp. 515-534
14: 4/14 – 4/18	Simulink, controller types and steady-state errors, control of 1st-order plants	pp. 535-573
15: 4/21 – 4/25	Control of 2nd-order plants, root-locus methods	pp. 601-630
16: 4/28 – 5/2	State-space methods, multiple-input, multiple-output sys.	pp. 631-652

**Lecture notes and videos:**

Lecture notes (pdf's) will be posted on ANGEL.

Video capture of the lectures will be posted at [www.aero.psu.edu/aersp304](http://www.aero.psu.edu/aersp304)

**Reserved Reading List** (Engineering Library, 3rd floor Hammond):

Rao, S.S., *Mechanical Vibrations*, 4th ed., Prentice-Hall, Upper Saddle River, NJ, 2004.

Shearer, J.L., Kulakowski, B.T., and Gardner, J.F., *Dynamic Modeling and Control of Engineering Systems*, 2nd ed., Prentice-Hall, Upper Saddle River, NJ, 1997.