

Spring 2013

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

<b><u>Instructor</u></b> R.G. Melton 229 Hammond Bldg. rgmelton@psu.edu 865-1185  Office Hours: 1:00-3:00 TR Or by appt.	<b><u>TA</u></b> Brad Sottile 234 Hammond Bldg. bsottile@psu.edu 863-3971  Office Hours: 3:00-5:00 TR Or by appt.
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**Prerequisites:** E MCH 212, AERSP 313

**Required Text:** 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:**

Homework	13%	weekly		
Quizzes	12%	weekly (ANGEL)		
Test #1	25%	20 Feb.	8:15-10:15 p.m.	26 Hosler
Test #2	25%	3 Apr.	8:15-10:15 p.m.	26 Hosler
Final Exam	25%			

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

**Academic Integrity:**

University Faculty Senate Policy No. 49-20 states “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.

(continued on next page)

“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.”

The official procedures regarding violations of this policy are described at [www.psu.edu/dept/oue/aappm/G-9.html](http://www.psu.edu/dept/oue/aappm/G-9.html). The first violation will result in a grade of zero for the particular homework assignment, quiz, test or exam, and more severe penalties for subsequent violations.

### **Homework Policy:**

Homework is due at the beginning of class. The penalty for late homework is 10% per day (after 5 days, I will not accept it for grading). I encourage you to study together and to discuss the homework, but the work you submit must be your own. You may not share your solutions or computer codes with others and you may not use others' solutions or computer codes.

### **Quiz Policy:**

All quizzes are online (on ANGEL). They are open-book, open-notes, but you may not give or receive assistance from anyone. I will announce each quiz in class. Make sure that you have set ANGEL to forward your mail to a working email address!

### **Makeup quizzes and tests**

Makeups will be given for legitimate excuses only (forgetting to take a quiz is not an acceptable excuse). If possible, let me know ahead of time if you will need to take a makeup quiz or test.

### **Reserved Reading List** (Engineering Library, 3<sup>rd</sup> floor Hammond):

Rao, S.S., *Mechanical Vibrations*, 4<sup>th</sup> 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*, 2<sup>nd</sup> ed., Prentice-Hall, Upper Saddle River, NJ, 1997.

### **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.

Week	AERSP 304 Lecture Topics	Reading
<b>1</b> 1/7-1/11	Introduction; system response, linearizing diff. eqs.; unit impulse and step functions, stability, brief review of Matlab and plotting	pp. 12-46
<b>2</b> 1/14-1/18	Moments of inertia, parallel-axis th'm, degrees of freedom, springs, damping, external forces and torques	pp.50-79
<b>3</b> 1/21-1/25	Free-body diagrams, Newton's laws, motion of particles and rigid bodies, D'Alembert's principle, single- and multiple-DOF sys.	pp. 80-104
<b>4</b> 1/28-2/1	Lagrange's formulation : conservative sys. and non-conservative* sys.	pp. 105-126 *handout material
<b>5</b> 2/4-2/8	Laplace transforms, inverse transforms, partial fraction decompositions	pp. 269-300
<b>6</b> 2/11-2/15	Solving diff. eqs. via Laplace xforms, transfer functions (single and multiple input/output sys.),	pp. 301-342
<b>7</b> 2/18-2/22	Transient response, stability, Routh criterion, root-locus analysis <b>TEST #1 (20-Feb)</b>	pp. 342-360
<b>8</b> 2/25-3/1	Response of 1 <sup>st</sup> -, 2 <sup>nd</sup> - and higher-order systems	pp. 361-398
<b>9</b> 3/4-3/8	<b>SPRING BREAK ☼</b>	Any novel, just read something!
<b>10</b> 3/11-3/15	Multiple-DOF sys., effects of time delay, numerical integration*	pp. 399-429 *handout material
<b>11</b> 3/18-3/22	Frequency response, Bode diagrams	pp. 435-466
<b>12</b> 3/25-3/29	Freq. response of 2 <sup>nd</sup> -order sys., resonance	pp. 472-512
<b>13</b> 4/1-4/5	Feedback control, block diagrams <b>TEST #2 (3-Apr)</b>	pp. 515-534
<b>14</b> 4/8-4/12	Simulink, controller types and steady-state errors, control of 1 <sup>st</sup> -order plants	pp. 535-573
<b>15</b> 4/15-4/19	Control of 2 <sup>nd</sup> -order plants, root-locus methods	pp. 601-630
<b>16</b> 4/22-4/26	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)