Vibrations and Control MEC 532 Fall 2018

Course Description:
Essentials of Vibration; Spring-Pendulum Dynamic System Investigation with Newton-Euler and Lagrange Methods, and Simulink; Periodic Motion, Energy Methods; Forced Periodic Motion; Initial Conditions & Transient Vibration; Damping; Damped Forced Vibrations; Two Degrees of Freedom; Matrix Methods; Nonlinear Vibration; Distributed System Vibration; Fundamentals of Open-Loop and Closed-Loop Control; Root-Locus Control Analysis and Design; Frequency-Response Control Analysis and Design; State-Space Control Analysis and Design; Passive & Active Control of Vibration; Introduction to Optimal Control (3 credits)

Instructor:
Dr. Kevin Craig, Adjunct Professor of Mechanical Engineering
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Course Notes: Supplied electronically by the professor.

References:
Vibration Problems in Engineering, S. Timoshenko, D.H. Young, and W. Weaver, Jr. 1974.
Mechanical Vibrations, Den Hartog, 1956.
Theory of Vibrations with Applications, W.T. Thomson, 1988.
Shock and Vibration Handbook, C.M. Harris and C.E. Crede, 1961.
Mechanical Vibration, S.S. Rao, 2004.
Feedback Control of Dynamic Systems, Gene Franklin and David Powell, 2005.
Control System Design: An Introduction to State-Space Methods, Bernard Friedland, 2005.
Vibration with Control, Daniel Inman, 2006.

Topics:
1. Essentials of Vibration; Spring-Pendulum Dynamic System Investigation with Newton-Euler and Lagrange Methods, and Simulink (notes)
2. Periodic Motion (notes pages 1-19, problems pages 10 & 19), Energy Methods (notes pages 20-40, problems pages 29 & 40)
3. Forced Periodic Motion (notes pages 41-68, problems pages 55 & 68); Initial Conditions & Transient Vibration (notes pages 69-104, problems pages 83, 89, 103 & 104)
4. Damping; Damped Forced Vibrations (notes pages 105-191, problems pages 116, 129, 137, 167-171 & 191)
5. Two Degrees of Freedom; Matrix Methods (notes pages 211-237, problems pages 238-241)
6. Nonlinear Vibration (notes); Distributed Systems (notes)
7. Vibrations Review; Exam #1; Graded Assignment #1 Due
8. Fundamentals of Open-Loop and Closed-Loop Control (notes)
9. Root-Locus Control Analysis and Design (notes)
10. Frequency-Response Control Analysis and Design (notes)
11. State-Space Control Analysis and Design (notes)
12. Passive & Active Control of Vibration (notes)
13. Introduction to Optimal Control (notes)
14. Controls Review; Exam #2; Graded Assignment #2 Due

Assignments:

- Homework problems will be assigned for each class. They should be *individually* and *professionally* done. This cannot be emphasized strongly enough. While collaborative discussion on homework assignments is encouraged, it is only through individual problem solving that will you uncover what you do not understand and thus prepare yourself for exams and engineering practice. These problems are not to be handed in but should be completed by the beginning of the next class after the assignment is given and kept in the student's binder for study in preparation for exams. Problem solutions will be posted. Exam problems will be very similar to the homework problems. The problem solution format presented in the course is to be followed; each student should strive to adhere to this professional standard.
- Two individual-work graded exercises will be assigned, each worth 20% of the final grade. You will have approximately 3 weeks to complete each graded assignment.

Exams:

There will be two 90-minute in-class exams during the semester, each counting 20% of the final grade. Each exam will be a closed-book, closed-note exam.

Final Exam:

There will be a closed-book, closed-note final exam (20% of the final grade) given during the final exam period. The exam will cover the entire course.

Class Attendance, Preparation, and Participation:

Attendance at all classes is mandatory and participation in class is strongly encouraged. Each session will be conducted with an interactive, applied, mentoring approach. There will be a brief presentation of the new concepts and step-by-step interactive solution of problems. Questions will be answered and difficult concepts explained. Students are expected to participate interactively.

Student Accessibility Support Center Statement

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631)632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website: http://www.stonybrook.edu/ehs/fire/disabilities.

Academic Integrity Statement

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-

specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website athttp://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.