

CURRICULUM REVIEW – 2018
Part IV – Course Outline

Asian Institute of Technology
School of Engineering and Technology

AT-~~xxx~~74.12 Nonlinear Dynamics and Control 3(3-0)

Semester: January

Formatiert: Schriftart: Fett

Course Objective:

This objective of this course is to provide students fundamental knowledge on Nonlinear Dynamics and Nonlinear Control System Design, and its applications in the field of mechanical engineering.

Learning Outcomes:

Upon completion of this course, the students should be able to:

- Establish a nonlinear model to define a controlled system mathematically for real application.
- Analyze the response of nonlinear dynamical systems for the practical application of control theory.
- Synthesize control methods to achieve the desired performance of nonlinear dynamical systems.

Prerequisites: None

Course Outline:

I. Nonlinear Dynamics

1. Physical meaning of oscillation, velocity and acceleration.
2. Classical, Lagrangian and Hamilton's mechanics.
3. Linear vs. nonlinear dynamics.
4. Establishment of nonlinear differential equations of motion for simple mechanical systems.
5. Numerical approaches to solve a set of nonlinear differential equations.
6. Phase portrait analysis of linear and nonlinear dynamical systems.

II. Nonlinear Control

1. Brief review of linear control theory and its mathematical background.
2. Lyapunov stability theorems for autonomous systems.
3. Lyapunov stability theorems for non-autonomous systems.
4. Construction of Lyapunov functions.
5. Adaptive control theory.
6. Phase plane analysis for a nonlinear control system.

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7. Lyapunov based nonlinear control.
8. Nonlinear adaptive control based on Lyapunov approach.

Learning Resources

Textbooks: Lecture Notes

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2011.
2. C. Gignoux and B. Silvestre-Brac: Solved Problems in Lagrangian and Hamiltonian Mechanics, Springer Netherlands, 2009.
3. A. H. Nayfeh and P. F. Pai: Linear and Nonlinear Structural Mechanics, John Wiley & Sons, Inc., 2007.
4. S. H. Strogatz: Nonlinear Dynamics and Chaos, Westview Press, 2nd Edition, 2015.
5. M. Vidyasagar: Nonlinear Systems Analysis, Prentice-Hall, 2nd Edition, 1993.
6. H.K. Khalil: Nonlinear Systems, Prentice-Hall, 2nd Edition, 1996.
7. K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems, Prentice-Hall, Inc., 1989.
8. M. Krstic, I. Kanellakopoulos and P. V. Kotovic: Nonlinear and Adaptive Control Design, John Wiley & Sons, Inc., 1995.
9. J.-J. E. Slotine and W. Li: Applied Nonlinear Control, Prentice Hall New Jersey, 1991.

Journals and Magazines:

1. Journal of Sound and Vibration, Elsevier.
2. International Journal of Non-Linear Mechanics, Elsevier.
3. Nonlinear Dynamics, Springer.
4. Applied Physics Research, Canadian Center of Science and Education.
5. IEEE Transactions on Automatic Control, The IEEE Control Systems Society.
6. Mechatronics, Elsevier.

Teaching and Learning Methods:

This is a lecture-based course ~~using—including~~ lecture notes, projects and presentations, home assignments and quizzes. At the end of several lectures, there will be home assignments or pop quizzes for the students to increase understanding on the subject and become active learners. ~~The students are required to do literature reviews, individual project and presentation. The project is for the students to develop and practice several skills including, but not limited to, decision making,~~

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problem solving and critical thinking. The presentation is a part of the project and the assignment for personal development and knowledge sharing.

Kommentar [p1]: Agree to revises

Time Distribution and Study Load:

Lectures: 42 hours.

Project preparation: 30 hours

Presentation: 3 hours.

Self-study: 95 hours

Evaluation Scheme:

The final grade will be computed according to the following weight distribution: Midterm examination 43%, term project 40%, ~~attendance 10%~~ home assignments 10% and pop quizzes 10%. A closed-book examination and quizzes are usually given.

Kommentar [M2]: Pls. Delete. No marks should be allocated for attendance.

Kommentar [p3]: Deleted

An "A" would be awarded if a student can demonstrate clear understanding of the knowledge learned in class as well as from the project and assignments.

A "B" would be awarded if a student can understand the basic principles of the knowledge learned in class as well as from the project and from the assignments.

A "C" would be given if a student can understand partially the basic principles of the knowledge learned in class as well as from the project and from the assignments.

A "D" would be given if a student shows lack of understanding of the knowledge learned in class as well as from the project and from the assignments.

Instructor(s): Dr. Weon Keun Song

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ADRC Approval: _____

Academic Senate Approval: _____