uc3m Universidad Carlos III de Madrid

Control Engineering III

Academic Year: (2020 / 2021) Review date: 17-11-2020

Department assigned to the subject: Systems Engineering and Automation Department

Coordinating teacher: GARRIDO BULLON, LUIS SANTIAGO

Type: Electives ECTS Credits: 6.0

Year: 4 Semester: 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Control Engineering I, Control Engineering II

OBJECTIVES

Upon successful completion of this subject, students will be able to:

- 1. Have a systematic understanding of the key concepts and aspects of system identification, nonlinearity analysis and controller design through the different control methods: Smith predictor, optimal control in both the continuous and discrete domain.
- 2. Have adequate knowledge of your engineering branch that includes some knowledge at the forefront of your field in control engineering.
- 3. Apply their knowledge and understanding of control engineering to identify, formulate and solve engineering problems using established methods for the identification of systems and their optimal control.
- 4. Apply their knowledge to develop and carry out optimal controller designs that meet specific requirements.
- 5. Have an understanding of the different driver design methods and the ability to use them.
- 6. Have technical and laboratory skills to implement discrete control systems on real platforms.
- 7. Select and use appropriate equipment, tools and methods for the design and implementation of discrete controllers.
- 8. Combine theory and practice to solve driver design and implementation problems.
- 9. Have an understanding of methods and techniques applicable in the field of control engineering and their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

- Unit 1. Identification of systems.
 - 1.1. Parametric and nonparametric models.
 - 1.2. Identification methods: transfer function, state space, impulse response, frequency response.
 - 1.3. Least squares method.
- Unit 2. Modeling of non-linear systems.
 - 2.1. Types and effects.
 - 2.2. Describing Function analysis. Limit cycle.
 - 2.3. Phase plane analysis.
- Unit 3. Stability.
 - 3.1. Lyapunov Criterion.
- Unit 4. Non-linear Systems Control:

- 4.1. Systems with delay. Smith Predictor.
- 4.2. Linearization by state feedback.
- 4.3. Application of Lie Algebra.

Unit 5. Optimal Control. Hamiltonian Formulation.

- 5.1. General problem (discrete-time)
- 5.2. Linear Quadratic Regulator (LQR) in discrete-time.
- 5.3. General problem (continuous-time)
- 5.4. Linear Quadratic Regulator (LQR) in continuous-time.

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures, classes to resolve doubts in small groups, tutorials and personal work, oriented to the acquisition of knowledge.
- Laboratory practices and kinds of problems in small groups, individual tutorials and personal work, oriented to the acquisition of practical skills related to the program of the course.

ASSESSMENT SYSTEM

% end-of-term-examination: 60 % of continuous assessment (assignments, laboratory, practicals...): 40

There will be five partial exams. The average score of the partial exams will be the 90% of the final score. The student has to pass the partial exams in order to pass the subject. If the student fails a partial exam, the corresponding part can be repeated in a recovery exam.

There will be three mandatory lab sessions of two hours each one. The average score of the lab sessions will be the 10% of the final score.

If the student does not go through the continuous evaluation process, the mark of the final exam will be the 60% of the final score.

BASIC BIBLIOGRAPHY

- L. Ljung System Identification, Prentice-Hall.
- Slotine Applied NonLinear Control, Prentice-Hall.