Control of aerospace systems

Academic Year: (2021 / 2022) **Review date: 21/06/2021 17:09:16**

Department assigned to the subject: Systems Engineering and Automation Department

Coordinating teacher: MONJE MICHARET, CONCEPCION ALICIA

Type: Electives ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I
Calculus II
Linear Algebra
Programming

OBJECTIVES

With this subject the students are aimed to acquire basic knowledge on analysis and control of dynamic systems in continuous time, with application to aerospace systems. The study of the behavior of the systems will be carried out by means of the classic control theory.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Laplace transform

   1.1. Definition
   1.2. Properties
   1.3. Inverse transform

2. System modeling: transfer function

   2.1. Definition of the transfer function
   2.2. Solution of the dynamics of a system through the transfer function
   2.3. Limitations of the transfer function

3. System modeling: state space

   3.1. Definition of the state space
   3.2. Solution of the state equation
   3.3. Cannonical forms of the state space
   3.4. Transformation between state space and transfer function

4. Stability and feedback: systems characterization

   4.1. Definition of stability for a dynamic system
   4.2. Variables for the stability analysis of a dynamic system

5. Stability and feedback analysis in time domain

   5.1. Definition of stability in the time domain
   5.2. Methods for stability analysis in the time domain

6. Stability and feedback analysis in frequency domain

   6.1. Definition of stability in the frequency domain

6.2. Methods for stability analysis in the frequency domain

7. Aircraft systems fundamentals

7.1. Control system for an aircraft
7.2. Sensors and actuators in an aircraft
7.3. Quality factors characterizing the aircraft dynamics
7.4. Properties of a control loop for the aircraft

8. Aircraft dynamics (I)

8.1. Longitudinal model of an aircraft
8.2. Longitudinal modes of an aircraft

9. Aircraft dynamics (II)

9.1. Lateral model of an aircraft
9.2. Lateral modes of an aircraft

10. PID controllers: design methods

10.1. Definition of a PID controller
10.2. Effects of the PID control actions
10.3. Desing of PID controllers: empirical and analytical methods

11. Nonlinear systems: describing function

11.1. Definition of the describing function
11.2. Characteristics of the describing function

12. Nonlinear systems: stability analysis (I)

12.1. Analysis of the stability of the nonlinear system by the describing function in the frequency domain

13. Nonlinear systems: stability analysis (II)

13.1. Analysis of the stability of the nonlinear system by the phase plane in the time domain

LEARNING ACTIVITIES AND METHODOLOGY

- Master classes and reduced group sessions for resolution of problems.
- 4 Laboratory sessions using software Matlab with personal work of the student; oriented to the acquisition of practical abilities related to the program of the subject.
- Personal tutorial sessions in the times published in Aula Global.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

The continuous evaluation is done through two partial exams:

* If the student passes both exams (minimum mark of 5 in each exam), it is not necessary to do the recovery exam of the continuous evaluation. If the student still wants to do to the recovery exam to improve his/her marks, the previous note will be erased, only the recovery exam counts.

* If the student fails one of the partial exams, this part must be done in the recovery exam. The average between the recovery exam, if it is passed, and the passed partial exam will be the mark for the passed theory part. If the partial exam is failed again, then the theory exam will be failed.

* If the student fails both partial exams, the whole recovery exam must be done. The theory mark will be the score of the final exam.

% end-of-term-examination/test:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

Regarding the practical part, it is also necessary to pass it (5 or greater). A report for every practice must be done by the student (evaluated as passed or failed) together with a test for every practical session (minimum mark of 5 to pass every test). If any practical report or test is failed, the student will be able to recover it in the recovery exam of the continuous evaluation, following the same evaluation criteria as for the theoretical part.

The final score of the continuous evaluation is composed of the theory part (70% of the final score) and the practical part (30% of the final score). But it is important to remark that this subject will be passed only if both theoretical and practical parts are passed separately.

The recovery exam of the continuous evaluation will be the same date and place as for the final exam (according to the official exams schedule).

The extraordinary exam will have a theorical part and a practical part, which will be evaluated in the same way as in the ordinary call (70% theory and 30% practices). The theory exam will be on all the contents of the subject. If the student has passed the practical part in the ordinary call, his/her mark will be saved and taken into account for the extraordinay exam.

BASIC BIBLIOGRAPHY

- Concepción A. Monje Lecture Notes, NA.
- Cook, M. V. Flight Dynamics Principles, Elsevier, 2007
- DiStefano et al. Feedback and Control Systems, McGrawHill, 1990
- Kuo, B. C. Automatic Control Systems, Prentice-Hall, 1991
- MOHLER, R.R. Nonlinear systems. Dynamics and Control., Prentice-Hall, 1991..
- McLean, D. Automatic Flight Control Systems, Prentice-Hall, 1990
- OGATA, K. Modern Control Theory, Prentice-Hall, 1987..