

Academic Year: ( 2018 / 2019 )

Review date: 04-06-2018

Department assigned to the subject: Department of Bioengineering and Aerospace Engineering

Coordinating teacher: MERINO MARTINEZ, MARIO

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 2

**COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.**

Formulate and solve orbital mechanics problems, use that knowledge to perform preliminary designs of space missions, and evaluate the capabilities of different spacecraft and space systems.

Competences: CG9, CG10, CB2, CB5, CECRA13.

**DESCRIPTION OF CONTENTS: PROGRAMME**

1. Two body problem
  - Conservation laws
  - Conics and orbital elements
2. Kepler's equation
  - Formulation for the elliptic, parabolic, hyperbolic cases
  - Numerical solution
3. Orbital maneuvers
  - Fundamentals of spherical trigonometry
  - Hohmann, bielliptic transfers; plane change; phasing maneuvers, electric orbit raising
4. Preliminary orbit determination
  - Gibbs problem, Gauss problem
  - Lambert's problem
  - Porkchop diagrams
5. Perturbations
  - Special perturbation methods
  - General perturbation methods
  - Drag, solar radiation, third body
  - Geopotential and spherical harmonics
6. Interplanetary trajectories
  - Patched-conics method
  - B-Plane targeting
7. Relative motion and rendezvous
  - Clohessy-Wiltshire equations
8. Restricted three body problem
  - Derivation and normalization. Jacobi's energy integral
  - Lagrange libration points
  - Stability and trajectories near Lagrange points
9. Space vehicles: attitude dynamics
  - Quaternions. Free body attitude dynamics
  - Gravity gradient
10. Introduction to space missions and space systems
  - Application orbits, types of missions
  - Spacecraft subsystems

**LEARNING ACTIVITIES AND METHODOLOGY**

Theory sessions in master classes  
 Problem sessions in reduced groups  
 Computer sessions with mathematical software  
 Personal and group work

**ASSESSMENT SYSTEM**

End-of-term exam (60%)  
 Continuous evaluation (40%)

In order to pass the subject, two requirements need to be met:

- 1) to have a MINIMUM mark of 4.0/10 in the end-of-term exam;
- 2) to have a minimum overall mark of 5.0/10 (weighing 60% the end-of-term exam mark and 40% the mark of the continuous evaluation).

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

#### BASIC BIBLIOGRAPHY

- Hanspeter Schaub and John L. Junkins Analytical mechanics of space systems, AIAA, 2003

#### ADDITIONAL BIBLIOGRAPHY

- Howard D. Curtis Howard D. Curtis Orbital mechanics for engineering students, Butterworth-Heinemann Butterworth-Heinemann, 2013
- Peter Fortescue, Graham Swinerd, John Stark Spacecraft systems engineering, John Wiley and Sons, 2011