Space Vehicles and Orbital Dynamics

Academic Year: (2018 / 2019) **Review date: 04-06-2018**

Department assigned to the subject: Bioengineering and Aeroespace Engineering Department

Coordinating teacher: MERINO MARTINEZ, MARIO

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 2

OBJECTIVES

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).

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

BASIC BIBLIOGRAPHY

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

ADDITIONAL BIBLIOGRAPHY

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