

## Engineering Design of Space Missions and Spacecraft Components (C003662)

Course size (nominal values; actual values may depend on programme)

Credits 5.0      Study time 130 h      Contact hrs 20.0 h

Course offerings in academic year 2018-2019

A (semester 1)      English

Lecturers in academic year 2018-2019

Vandepitte, Dirk

KUL lecturer-in-charge

Rochus, pierre

ULG522 co-lecturer

Offered in the following programmes in 2018-2019

crdts      offering

[Master of Science in Space Studies](#)

5      A

Teaching languages

English

Keywords

Position of the course

Contents

### **Orbital Mechanics and Mission Design**

Part 1 : Orbital mechanics

- Fundamental laws of mechanics in Keplerian orbits : gravitational and centrifugal forces
- Types of orbits : circular, elliptical, hyperbolic, parabolic orbits
- Orbital parameters
- Perturbation of Keplerian orbits : regression of nodes, rotation of apsides
- Maneuvers : change of eccentricity, change of inclination \* Earth orbits : low orbit, sun-synchronous, medium orbit geosynchronous, geostationary
- Planetary orbits : Earth escape, gravitational velocity changes at planets, planetary orbit insertion, launch window
- Specifications for mission design

Part 2 : Spacecraft design

- General description of mission infrastructure : ground segment, spacecraft bus, payload
- Propulsion systems : spacecraft propulsion, launcher propulsion
- Spacecraft systems : structure, thermal control, attitude and orbital control, power supply, telecommunication
- Launcher performance
- Systems integration

### **Spacecraft Design and Instrumentation**

Spacecraft definition and characteristics

Space environment and constraints

Observation and science mission payloads

Optical and optoelectronic techniques

Mechanical and thermal engineering

#### **Detailed contents**

Space messengers (static fields (gravity, geoids, magnetic field), photons, particles, neutrinos, dust, samples, gravitons and gravitational waves, exoplanets, ...)

Why space activities and orbit selection

Information transported by photons.  
Aerospace and space systems designs compared  
Reliability and life time  
On ground environment  
Launch environment  
Space environment and impacts on the design of Spacecraft and Instrumentation

Vacuum and its effects  
Microgravity and its effects  
Temperature cycling and its effects  
Outgassing and its effects  
Contamination in space  
Materials selection  
Residual atmosphere  
Atomic oxygen  
Radiations  
Energetic particles, electrons, protons and ions  
Induced radiation  
Meteorites and orbital debris  
Electrical environment (solar wind, magnetosphere, radiation belts, plasma environment) and effects on spacecraft (electrical charging, mission definition, orbit selection, ...)

Effects on the optical, mechanical and thermal design  
Mechanical and dynamical design of instruments  
Thermal design of instruments  
Thermal control  
Scientific missions at ESA and at CSL.  
Different steps in the design of space instruments

Dimensioning criteria  
Integrity-Resistance  
Rigidity-Dynamical behavior  
Dimensional stability  
Specifications for instruments  
Electromagnetic compatibility (EMC-EMI)  
Contamination and cleanliness  
Qualification of instruments

Initial competences

none

Final competences

<http://www.ulg.ac.be>

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Learning materials and price

cursusmateriaal

References

Course content-related study coaching

Evaluation methods

Examination methods in case of periodic evaluation during the first examination period

Examination methods in case of periodic evaluation during the second examination period

Examination methods in case of permanent evaluation

Written examination, oral examination, assignment

Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible

Calculation of the examination mark