



UNIVERSITÀ DI PISA

SPACECRAFT STRUCTURES AND MECHANISMS

MARIO ROSARIO CHIARELLI

Anno accademico 2016/17
CdS AEROSPACE ENGINEERING
Codice 666II
CFU 12

Moduli SPACECRAFT STRUCTURES AND MECHANISMS	Settore/i ING-IND/04	Tipo LEZIONI	Ore 120	Docente/i MARIO ROSARIO CHIARELLI
--	-------------------------	-----------------	------------	---

Learning outcomes

Knowledge

The student who successfully completes the course will be able to demonstrate a good knowledge of both mechanical and technological aspects that refer to the space structures and to the mechanisms;
will be aware of fatigue and fracture mechanics of metallic materials;
will be able to solve problems of mechanics and will be able to prepare a technical report at the end of a project exercise.
The evaluation is based for a 50% on the verification executed during the examination (written and oral).
The other 50% is based on the evaluation of the project report that a single student or a group of students will produce at the end of the course before the examination phase.

Syllabus

Course Contents

(I) – October-December

Notes about the design process of a spacecraft.

The launch phase: preliminary examination of acoustic and vibration loading conditions

Random vibrations analysis.

Vibroacoustic Response Analysis.

Reliability of components and structures: basic definitions and applications.

Strength analysis: definition of the limit loading condition and ultimate loading condition (yielding and collapse of structures).

(II) – February-April

Welded joints.

Fastened joints.

Fatigue.

S-N curves.

The Goodman diagram for ductile materials.

Effect of the stress concentration.

Fatigue crack growth: basic notes on fracture mechanics.

(III) – May

Contact stresses: discussion of results of the Hertz theory.

Springs.

Bearings.

Spur gears.

Gear trains.

Rotating shaft dynamics: critical speeds computation.

Bibliography

Recommended reading includes the following books:

T.P. Sarafin "Spacecraft Structures and Mechanisms - From Concept to Launch"
R.C. Juvinall & K.M. Marshek "Fundamentals of Machine Component Design"



UNIVERSITÀ DI PISA

ECSS Secretariat - ESA-ESTEC "Space engineering - Spacecraft mechanical loads analysis handbook", Noordwijk, The Netherlands,
February 2013
ESA - Buckling - ECSS-HB-32-24A_24_March2010

Assessment methods

Assessment Criteria

The evaluation is based primarily on the verification of the basic knowledge necessary for the design of aerospace structures and mechanisms (strength analysis, fatigue, fracture mechanics, joints, bearings, gears). The uncertainty of these skills is not allowed.

The student must demonstrate the ability to put into practice and to execute, with critical awareness, the design methods and the verification procedures illustrated during the course. For this reason the discussion of the project report will take an important part of the examination phase. The examination is based on the solution of written exercises and on a subsequent discussion of the results.

Updated: 24/05/2016 12:27