

**SYLLABUS**

# **Space Materials and Structures 7.5 credits R7024R**

**Rymdmaterial och strukturer**

**Course syllabus admitted: Autumn 2023 Sp 1 - Present**

**DECISION DATE  
2022-02-11**

# Space Materials and Structures 7.5 credits R7024R

## Rymdmaterial och strukturer

### Second cycle, R7024R

**Education level**  
Second cycle

**Grade scale**  
G U 3 4 5

**Subject**  
Rymdteknik

**Subject group (SCB)**  
Space Technology

### Main field of study

Space Technology

## Entry requirements

M0047M Differential calculus, M0048M Linear algebra and integral calculus, M0049M Linear algebra and differential equations, M0055M Multivariate analysis or other mathematics courses that include multi-dimensional analysis and vector analysis.

M0046M Mathematics Ry or courses in mathematics with transform theory and partial differential equations.

Mechanics in F0004T Physics 1 and F0006T Physics 3 or equivalent.

F0059T Engineering Mechanics.

Good knowledge in English equivalent to English 6.

## Selection

The selection is based on 30-285 credits

## Course Aim

The aim of the course is for the student to:

- have acquired the basics of the space environment's challenges in terms of material technology.
- have acquired basic knowledge for the construction and behavior of high-performance materials used in the aerospace industry.
- have acquired basic knowledge of how to estimate properties of composites, ceramics and alloys.
- know the most important degradation mechanisms that arise in the results of thermal and mechanical loads and lead to fatigue and lifetime reduction of materials.
- know typical solutions to structural problems in space and estimate effects of the space environments on the spacecraft structure.
- be able to carry out numerical simulations using commercial codes to analyze and optimize structures.
- be able to use simple structural models of thin flat and shell-shaped linear elastic bodies,
- be able to calculate stresses and deformations in such structural models,
- be able to carry out and evaluate practical experiments with such structural models,
- be able to methodically attack and solve strength-technical problems for the current class of structural models.

## Contents

### SPACE MATERIALS

- Basic knowledge in material science and engineering, such as crystal- and microstructure, mechanical properties.
- Relationship between material microstructure and properties. Hardening mechanisms.
- Light alloys, super alloys, ceramic materials and different types of composites.
- Material degradation and fatigue depending on effects of extreme environments.
- Oxidation, radiation resistance, out-gassing.

### STRUCTURES

- Energy methods: Minimum potential energy theorem. Virtual work. The Rayleigh-Ritz' method.
- Thin plates: The Kirchhoff plate equation. Solution methods.
- Shells structures: Basic equations. The membrane state of shells. Shells of circular symmetry and circular symmetric loading.
- Structural instability.
- Honeycomb panels. Whipple shield.
- Fundamental frequency of deployable systems as solar panels.

## Realization

Each course occasion's language and form is stated and appear on the course page on Luleå University of Technology's website.

The course is conducted in the form of lectures and laboratory work.

## Examination

If there is a decision on special educational support, in accordance with the Guideline Student's rights and obligations at Luleå University of Technology, an adapted or alternative form of examination can be provided. Written examination and laboratory work that are examined with written report.

## Unauthorized aids during exams and assessments

If a student, by using unauthorized aids, tries to mislead during an exam or when a study performance is to be assessed, disciplinary measures may be taken. The term "unauthorized aids" refers to aids that the teacher has not previously specified as permissible aids and that may assist in solving the examination task. This means that all aids not specified as permissible are prohibited. The Swedish version has interpretative precedence in the event of a conflict.

## Course offered by

Department of Computer Science, Electrical and Space Engineering

## Modules

Code	Description	Grade scale	Cr	Status	From period	Title
0002	Written exam	G U 3 4 5	4.5	Mandatory	A19	
0003	Laboratory work	U G#	3	Mandatory	S21	

## Study guidance

Study guidance for the course is to be found in our learning platform Canvas before the course starts. Students applying for single subject courses get more information in the Welcome letter. You will find the learning platform via My LTU.

## Last revised

by Jonny Johansson, HUL SRT 2022-02-11

## Syllabus established

by Jonny Johansson, HUL SRT 2019-02-15