# Master's Department of Engineering Sciences

**Name of the unit:** Basics of Mechanics for Robotics

**Lecturer:** Viviane PASQUI and Fabien VERITE (pasqui@isir.upmc.fr fabien.verite@sorbonne-universite.fr)
**Course code:** UM4RBT15
**Student workload:** 16h of lectures, 14h of tutorial sessions, 0h of lab sessions@
**Credits:** 3 ECTS

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|---|---|---|---|---|
| **Specialization tracks:** | - **E3A** : | ☐ CIMES | ☐ Syscom | ☐ IPS |
| | - **AR** : | ☒ ROBOT | ☐ SI | ☒ MeDH |
| | - **MECA** : | ☐ MS2 | ☐ MF2A | ☐ CompMech |
| | | ☐ ACOU | ☐ EE | ☐ EE APP |

**Semester offered:** ☒ S1 ☐ S2 ☐ S3 ☐ S4
**Language of instruction:** ☒ French ☐ English
**Targeted audience:** ☒ Engineering Sciences students ☐ Other (specify):
**Localization :** ☒ PMC Campus ☐ Other (specify):

## Course Overview

This course aims to bring students coming from an electrical engineering degree up to academic level in mechanics.
*Keywords:* Mathematical tools, Rigid solid mechanics, kinematic torsor, kinetic torsor, dynamic torsor

## Prerequisites

Students should have previously acquired the following prerequisites to follow this course:

- Trigonometric functions, matrix calculus, differential calculus

## Intended Learning Outcomes

By the end of this course, students will be able to:

1. Know and know how to apply the following mathematical tools to a mechanical problem: trigonometric functions, vector calculus, differential calculus
2. Identify and characterize the elementary bonds between solids (embedded, pivot, slide, ball joint, etc.) and their effects on possible movements/transmissible forces between components.
3. Position a solid in space and determine its kinematic torsor to accurately describe its speed of translation and rotation.
4. Model a mechanical action and apply the Fundamental Principle of Statics to determine the equilibrium conditions of a system.
5. Calculate the momentum of a moving solid with respect to a Galilean frame and apply the Fundamental Principle of Dynamics to analyze its dynamical behavior.

## Indicative Teaching Sequence and Methods

| Week | C/TD/TP* | Content | Preparation | Learn. outc. |
|---|---|---|---|---|
| S1 | C1 | Trigonometric functions, vector calculus, linear applications, matrix calculus, differential calculus | | AAV1 |
| S1 | TD1 | Training on the mathematical tools seen in class | | AAV1 |
| S2 | C2 | Locating a solid in space and elementary connections. | | AAV2 |
| S2 | TD2 | Calculate the position and orientation of a solid in space in an orthonormal coordinate system. | | AAV2 |
| S3 | C3 | Kinematic torsor of a moving solid in a direct coordinate system and particular movements. Composition of movements. Case of the Plane on Plan movement. | | AAV2 |
| S3 | TD3 | Calculation of kinematic torsors for elementary bonds. Minimal kinematic scéma. Composition of movements. Movement shot by shot. | | AAV2 |
| S4 | C4 | Torseur of the forces. Efforst transmitted by elementary connections. Static balance. | | AAV3 |
| S4 | C5 | Modeling of forces in a mechanical system | | AAV3 |
| S5 | TD5 | Modeling of forces in a mechanical system | | AAV4 |
| S6 | C6 | static equilibrium. | | AAV4 |
| S6 | TD6 | static equilibrium. | | AAV4 |
| S7 | C7 | Momentum torsor and dynamic torsor of a solid or a set of solids in a Galilean frame of reference. Fundamental Principle of Dynamics. | | AAV5 |
| S7 | TD7 | Momentum torsor and dynamic torsor of a solid or a set of solids in a Galilean frame of reference. Fundamental Principle of Dynamics. | | AAV5 |
| S8 | C8 | PFD applied to a solid or set of solids. | | AAV5 |

* C/TD/TP respectively corresponds to lectures, tutorials and lab sessions.

**Sequence of the unit:**
Alternating courses and tutorials

## Indicative Assessment of Intended Learning Outcomes (1st session)

| Week | Individ./group | In-person/remote | Type of exam | Evaluated outcomes | Scale % |
|---|---|---|---|---|---|
| S5 | Individual | In-person | Written | AAV1, AAV2, AAV3 | 50 % |
| S8 | Individual | In-person | Written | AAV4, AAV5 | 50 % |

## 2nde session of exam

| Session | Individ./group | In-person/remote | Type of exam | Evaluated outcomes | Scale % |
|---|---|---|---|---|---|
| 2 | Individual | In-person | Written | All | 100 % |

**Date of generation of this unit description:** January 14, 2026