Master's Department of Engineering Sciences

Name of the unit: CAx and Fablab

Lecturer: Jean-Phiippe FERBEYRE, Véronique MAUDRU (jean-philippe.ferbeyre@sorbonne-universite.fr)
Course code: UM4RBM20
Student workload: 12h of lectures, h of tutorial sessions, 28h of lab sessions@
Credits: 6 ECTS

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 unit aims to provide students with both CAD knowledge to create digital models of mechanical parts and use components from libraries, and CAD knowledge focused on modeling and kinematic-static and/or dynamic calculation of robotic systems for part dimensioning, simulation, stress-induced deformation, fatigue, basic manufacturing processes, and prototyping, in collaboration with the FabLab.
Keywords: CAD, CAM, kinematic simulation, stress-strain behavior, fatigue, manufacturing processes, prototyping.

Prerequisites

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

- Kinetic diagram, topological graph, cyclomatic number
- General mobility and kinematic mobility of a mechanism
- Concept of hyperstatism
- Kinematics and statics of input-output relationships in a mechanism
- Serial and parallel manipulator structure

Intended Learning Outcomes

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

1. Read and interpret a 2D plan, taking into account its nomenclature
2. Create a simple mechanical part in 3D solid modeling and its 2D drawing with SolidWorks.
3. Assemble parts in SolidWorks to create a digital model of a mechanism.
4. Use SolidWorks motion study features to analyze the consistency of the mechanism's mobility and actuating elements.
5. Use SolidWorks analysis features to study stress-induced deformations in a part.
6. Use SolidWorks analysis features to study the fatigue of a part.
7. Create a mechanism from 2D drawings.

8. Identify the characteristics and constraints of digital manufacturing processes (additive and subtractive).
9. Design a model or assembly incorporating manufacturing requirements.
10. Implement one or more rapid prototyping processes to produce a functional object or demonstrator.

Indicative Teaching Sequence and Methods

Week	C/TD/TP*	Content	Preparation	Learn. outc.
S1	C1, TP1	CAD Basics 1	Lectures/practical classes in PDF format, educational videos	AAV1
S2	C2, TP2	CAD Basics 2	Lectures/practical classes in PDF format, educational videos	AAV1, AAV2
S3	TP3	CAD 3		AAV1,AAV2, AAV3
S4	C3, TP4	Guides, Roller Bearings, Plain Bearings, Library	Lectures/practical classes in PDF format, educational videos	AAV3,AAV4, AAV7
S5	TP5	Components, CAD 1		AAV1, AAV2
S6	C4, TP6	Transmissions: Gears, Screw-Nut System, CAD 2	Lectures/practical classes in PDF format, educational videos	AAV3,AAV4, AAV7
S7	C5, TP7	Transmissions (Cont.), CAD 3	Lectures/practical classes in PDF format, educational videos	AAV3,AAV4, AAV7
S8	TP8	Transmissions (Cont.), CAD 4		AAV3,AAV4, AAV7
S9	C6, TP9	Solidworks simulation—Deformations/Stresses/Fatigue	Lectures/practical classes in PDF format, educational videos	AAV5,AAV6
S10	TP10	Solidworks simulation—Deformations/Stresses/Fatigue		AAV5,AAV6
S11	TP Fablab 1	Introduction to additive manufacturing: principles of 3D printing, modeling adapted to manufacturing, and creation of a first object.		AAV2, AAV8, AAV9
S12	TP Fablab 2	Advanced 3D printing: analysis of completed prints, advanced slicing settings, discovery of materials and post-processing.		AAV2, AAV8, AAV9
S13	TP Fablab 3	Laser cutting: introduction to the process, machine demonstrations, and design of a cut assembly project.		AAV2, AAV8, AAV9
S14	TP Fablab 4	Subtractive manufacturing: introduction to waterjet cutting and CNC, debriefing of laser projects, and preparation of the final project.		AAV2, AAV8, AAV9, AAV10
S15	TP Fablab 5	Implementation of projects integrating several digital manufacturing technologies (3D printing, laser cutting, water jet cutting, CNC).		AAV2, AAV8, AAV9, AAV10

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

Indicative Assessment of Intended Learning Outcomes (1st session)

Week	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
S5	Individual	In-person	Labs	AAV 1 to 3	25 %
S8	Individual	In-person	Labs	AAV 3, 4 and 7	25 %
S14	Collective	In-person	Other	AAV 2 and AAV8, AAV9, AAV10	50 %

2nde session of exam

Session	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
2	Individual	In-person	Labs		50 %
1	Collective	In-person	Other	AAV 2 et AAV8, AAV9, AAV10	50 %

Bibliographic references

- Structure et cinématique des mécanismes (coll. Étude des mécanismes et des machines), ARAKELIAN Viguen, Ed. HERMES
- Cinématique des Mécanisme, Gilbert Bals, Ed. Eyrolles

- Jean-Louis Fanchon, Guide de mécanique, Ed. Nathan
- P. Agati et M. Rossetto, Liaisons et mécanismes, Ed. Dunod

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