



This biannual learning unit is not being organized in 2026-2027 !

Teacher(s)	Jacques Pascal ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Main themes	Advanced and complementary themes with respect to LMAPR 2013 "Physical-chemistry of metals and ceramics" and LMAPR 2481 "Deformation and fracture of materials".
Learning outcomes	<p>At the end of this learning unit, the student is able to : Contribution of the course to the program objectives</p> <p>With respect to the general objectives of the KIMA program, the present course contributes to the development of the following learning outcomes :</p> <ul style="list-style-type: none"> • AA1: Scientific and technical knowledge(AA1.1, A.A.1.2, AA1.3) • AA2: Engineering competences (AA2.1, AA2.3) • AA3: R&D competences (AA3.1,AA3.2,AA3.3) • AA4: Project management (AA4.1, AA4.2, AA4.3, AA4.4) • AA5: Effective communication efficace (AA5.1, AA5.2, AA5.3, AA5.4, AA5.5, AA5.6) • AA6: Ethics and professionalism (AA6.1, AA6.2, AA6.3, AA6.4, AA6.5) <p>Specific learning outcomes of the course</p> <p>At the end of the course, the students should be able to</p> <ul style="list-style-type: none"> • AA1.1 to describe intermetallic solutions and compounds thanks to the Hume-Rothery rules and to describe the order/disorder phase transitions; • AA1.1 to explain the magnetic properties of metallic materials and to link these properties with the use of such materials (ferromagnetism, permanent magnets, soft magnetic materials, superconductors); • AA1.1 to establish in the case of steels and aluminium alloys the link between processing parameters, microstructure evolution and properties. Other metals and alloys will be also considered such as titanium or nickel alloys; • AA1.1 & 1.2 to explain owing to simple physically-based models, the mechanisms responsible for work hardening, creep, wear resistance of advanced metallic alloys as well as coatings; • AA3.1, 3.2, 3.3to compare his/her knowledge with the reality of industrial cases ; • AA3.1, 3.2, 4.2to propose solutions as the output of a working group in order to solve industrial problems, strictly taking into account the limit of time and human resources; • AA4.2 to organise the different tasks to carry out amongst the members of the group; • AA5.3, 5.6 to present the chosen methodology and to defend the reached solutions.
Evaluation methods	<p>The students are evaluated individually with a written and oral exam based on the objectives described above. The written exam will concern the scientific and technical knowledge seen during the lectures as well as the projects carried out during the laboratories.</p> <p><u>Evaluation of the practicals</u></p> <p>An individual evaluation of the project will be carried out. This evaluation will take into account :</p> <ul style="list-style-type: none"> • the evaluation by the group supervisor of the work really carried out ; • the individual contribution during the presentation of the project (including the answers to the questions) ; • the part of the exam related to the project <p>In the event of a health situation requiring the switch to distancial mode, the projet presentation and oral exam will be held on microsoft teams</p>
Teaching methods	The course is organised around 12/13 lectures and projects in groups of 2 to 4 students.
Content	<p>After a general introduction, the different stages of the life cycle of metallic materials will be considered.</p> <p>1.General Introduction : Concepts of sustainable development largely influenced by the processing and use of metallic materials ; quantitative indicators ; direct and indirect effects ; eco-design ; involved emissions and energy sources in the processing of metallic materials ; concept de criticity ; circularity and recycling in the case of metallic materials ;</p>

	<p>2. Raw materials – extraction / supply chains ; geopolitical issues and geostrategy ; urban mining ;</p> <p>3. Processing and use of metallic materials – Problems and solutions ; consequences of sustainable alternative methods of use and recycling on physical metallurgy and properties; circularity, recycling, upcycling, etc.;</p> <p>4. Use – contribution of metallic materials to environmental transition and sustainable development ; structural properties (weight reduction, hydrogen transport, etc.) and functional properties (electrification, magnetic properties, etc.) ; direct and indirect effects; extended service life ; positive impact of high performance/multi-performance (possible links with LMAPR2483).</p> <p>Practical work is organised in the form of a group project. The aim of this project is to help develop the skills listed in point 1 above. In order to enable groups to apply their knowledge and expertise to real-world industrial problems, the project topics are proposed by companies.</p>
<p>Inline resources</p>	<p>https://moodleucl.uclouvain.be/course/view.php?id=9255</p>
<p>Bibliography</p>	<p>Un syllabus est disponible.</p>
<p>Other infos</p>	<p>Science of metallic materials at EPL is the topic of successive course of the FYKI and KIMA programs (LMAPR 1805 - Introduction to the Materials Science, LMAPR 2013 Science and Engineering of Metals and Ceramics, LMAPR 2481 Deformation and Fracture of Materials). The present course is thus the last one of the series. For non-UCL students, a minimum background of about 15 ECTS in the field of Materials Sciences (particularly the processing, thermodynamics, microstructures and properties of metallic materials) is needed.</p>
<p>Faculty or entity in charge</p>	<p>FYKI</p>

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Chemical and Materials Engineering	KIMA2M	5		