UCLouvain

lmapr2013

2020

Science and engineering of metals and ceramics

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

5 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Jacques Pascal ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	Three main themes will be considered : non metallic inorganic solids (ceramics and mineral glasses), physical metallurgy, main processing of the principal industrial metals and alloys (steel, aluminum, ...).
Aims	**Contribution of the course to the program objectives** With respect to the general objectives of the KIMA program, the present course contributes to the development of the following learning outcomes : AA1 Scientific and technical knowledge(AA1.1, A.A.1.3) AA2 Engineering competences (AA2.1, 2.2) AA3 R&D competences (AA3.1) **Specific learning outcomes of the course** 1 At the end of the course, the students should be able to AA1.1. describe the solid state phase transformations in binary metallic systems : AA1.1. to give the general characteristics of the most common engineering metallic materials. AA1.1. to describe the equilibria in ternary systems. AA1.1. to describe the structure of ceramics and inorganic glasses, as well as the point defects. AA1.1. to give the mechanisms of mass and charge transport in ceramics. AA1.3, AA2.1. to analyse the influence of the production processes used for inorganics materials. AA1.3, AA2.1 to choose the mostly adapted category of inorganic materials for a specific application based on requested performances and economical concerns. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The students are evaluated individually with a written and oral exam based on the objectives described above. The organisation of the exam could be modified depending on the sanitary situation related to covid-19. Online oral exam will be preferred if needed. Continuous evaluation during the semester is possible. From informative evaluation, it could become certifying evaluation depending on the sanitary situation. The written exam will concern the scientific and technical knowledge seen during the lectures as well as the resolution of an exercise related to the physical chemistry of metals and ceramics. A specific exam will deal with the practicals. It consists in the recognition of the microstructure of specific samples and solving specific problems. The specific evaluation of the practicals will count for 10% of the final grade. This grade will be kept for the entire academic year. The organisation of this exam as well as the importance of this part in the final grade could be modified.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The course is organised around 12/13 lectures, 4 exercise sessions and 6 laboratories. These labs consist in the observation and analysis of metallic specimens by light microscopy.
Content	1. Phase equilibria : reminder of binary systems ; ternary equilibria ; 2. Diffusion in solids. 3. Ceramics and glasses : crystal structure, amorphous state, mineral glasses, crystalline defects, transport of mass and electrical conductivity, phase equilibria in processes 4. Physical metallurgy ' types of transformations, kinetics of transformations, TTT diagrams, application to different metals and alloys (steels, aluminum, ...) 5. Steelmaking processes 6. Physical metallurgy of aluminum and its alloys.

Inline resources	https://moodleucl.uclouvain.be/course/view.php?id=8186
Bibliography	Slides and documents will be available on the dedicated Moodle page. For Chapters I and II, the reference book is : Phase transformations in metals and alloys (D.A. Porter & K.E. Easterling, Taylor & Francis, ISBN:0-7487-5741-4). For Chapters III to VI, the reference book is «Physical Ceramics : Principles for Ceramic Science and Engineering » (Y-M Chiang, D. Birnie, W.D. Kingery) Wiley (ISBN 0-471-59873-9).
Other infos	It is highly recommended to have knowledge in chemistry and physical chemistry at the bachelor level. Particularly, the course LMAPR 1805 : Introduction à la science des matériaux.
Faculty or entity in charge	FYKI

Force majeure

Teaching methods	Classes and practical work are given online via Teams. If the teacher is absent, the course is pre-recorded and made available. A question-and-answer session related to this course may be scheduled.
Evaluation methods	The exam is organized remotely via Teams. This is a closed book oral exam, with no prior preparation period. In addition, 2 assignments will have been organized during the quadrimester (one on the metals part, the other on the ceramic part). The content of this work is also discussed during the exam and graded accordingly.

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Chemical and Materials Engineering	KIMA2M	5		
Master [120] in Chemistry and Bioindustries	BIRC2M	5		
Master [120] in Biomedical Engineering	GBIO2M	5		