UCLouvain

lmapr2013

2021

Science and engineering of metals and ceramics

5.00 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, ...).
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 **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** 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.
Evaluation methods	The students are evaluated individually with an 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 could be possible based on homeworks to provide. The 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. The grade for the homeworks could count for 10% of the final grade, if needed.
Teaching methods	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, solidification , 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

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