Material Field		Macroscopic approach	Total of teaching hours : 92 hrs		
			Course	Supervised work	Lab work
MT I3.6	3 ECTS credits		36 hrs		24 hrs
			4 hrs evaluation - 28 hrs individual work		

Objectives

The goal is to take over the functions of materials from the tools acquired in the previous module. The different classes of materials are studied in order to be able to choose the appropriate materials for a given application and to know the constraints of the associated implementation.

- Make the link with the fields of application of the families of materials (metals, polymers, composites, ceramics) in the industrial field.
- Identify the strengths and limitations of the transformation and implementation processes as well as their impact on the finished products.
- Implementation, sustainability, and new approaches.

(taxonomic level : application and analysis)

Prerequisites and links to other modules

Module MT I3-5

Chapter 1 **Heat treatment of metals**	○ Fields of transformation of austenitic ○ Diffusive transformations ○ Displacive transformations ○ Soaked isotherms (principle) ○ Constitution and use of TTT abacus ○ Soaked with continuous cooling (principle) ○ Constitution and use of TRC abacus ○ Yields ○ Re-heated ○ Hardenability (Test Jominy curve, depth of hardening)
Chapter 2 **Polymers**	○ Observation and characterisation of materials techniques ○ Polymer properties (physical, optical, thermal) ○ Thermo mechanical properties ○ Specific characterisation methods (DSC, DMA) ○ Mechanisms of deformation? (Lille site: to be verified) ○ Rheology ○ Implementation techniques
Chapter 3 **Composite materials**	○ Definition ○ The different types of reinforcements ○ The fibre interface matrix ○ Stratification ○ Implementation techniques
Chapter 4 **Ceramics and glass**	○ Processing of ceramics (forming) ○ Influence of sintering parameters ○ Sintering techniques ○ Comparison of crystallised and amorphous ceramics ○ Modes of rupture (fragile, deferred) ○ Strengthening
Chapter 5 **Preparation of ferrous alloys (overview)**	○ Obtaining cast iron from the ore (operating principle for the blast furnace) ○ Converting the iron ○ Solidification of the steel (ingot and continuous casting, effervescence) ○ Morphologies of the products obtained
Chapter 6 **Corrosion**	○ General principles (reminders of oxidation-reduction) ○ Measurement techniques ○ The various forms of corrosion ○ Modes of prevention
Chapter 7 **Processing of polymers**	○ Structure (pellet statistics, tacticity, crystallisation by refolding of chains, spherules) ○ The big families of polymers (widespread dissemination, technical, speciality) ○ Polymerisation reactions ○ Typology of products obtained according to the synthesis method (ThD, ThP)
Chapter 8 **Ceramics**	○ Definition / Properties / Fields of use ○ Structural approach (including different forms of carbon) ○ Balance diagrams (ceramics)
Lab Work **6 sessions per site (Lille, Nantes or Toulouse)**	TP1 : Construction of diagram of Bi-Sn phases TP2 : Metallography (main structures of steels and irons) TP3 : Diffusion on Cu/Zn TP4 : Chemical analysis of an aluminium alloy TP5 : Measures by IRFT on polymers (with measures of thicknesses of thin films) TP6 : Synthesis of polyamide and characterisation **(N/T)** TP7 : Hardening of aluminium alloys and evolution of the sizes of grain during traction TP8 : Ceramics (study of a thermistor**)**

	TP9 : Corrosion TP10 : Colorimetry

Pedagogical approaches and assessment methods

Document of individual work on the preparation of ferrous alloys
Bibliographic research / technology monitoring work on a theme linked to the programme
Supervised coursework at the end of module - 4 hrs (including an assessment of the student's individual work)
Evaluation of the Lab work sessions (reports, QCM, Lab work assessment, etc.)

Bibliography

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