

Materials technology for sustainable construction - CFU 6 – 2023/2024

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OVERVIEW

The course is characterized by an interdisciplinary approach and aims to provide students with an in-depth knowledge of some classes of traditional materials (metals, ceramics, binders, concrete, polymers, composites) and an introduction to the general concepts of sustainability and the discussion of sustainable building materials (wood).

LEARNING OBJECTIVES

Upon completion of the course, the students will be able to

- Describe the main properties of the studied materials
- Understand the correlation of material properties with composition and microstructure
- Analyze and compare the characteristics and performances between the different classes of materials
- Predict the behavior of materials in use
- Apply the acquired notions to solve numerical problems on topics of engineering interest

Furthermore, it will acquire independent judgment in the selection of the material in order to increase sustainability

COURSE DESIGN

The course consists of 60 lessons. Each lesson lasts 1 hour, made of 45 minutes of lecture and 15 minutes of break. The lectures will take place on Wednesday, in groups of 5 lessons between 10.30 and 16.00 (12 classes in total). Attendance is not mandatory but advisable.

The course material will be shared via Google Classroom and therefore students are expected to possess a Gmail account, preferably bearing at least their surname. For the access is required to send an email to irene.bavasso@uniroma1.it.

PROGRAM

- MATERIALS Classification, life cycle. The structure of crystalline solids. Crystals Defects. Diffusion. Relationship between structure and properties. Mechanical Properties. Mechanisms of strengthening in metals. Fatigue. Failure.
- METALS Ferrous and non-ferrous alloys. The iron-carbon phase diagram. Microstructure in Iron Carbon Alloys. Thermal treatments.
- CERAMICS and GLASSES Structure, properties, production and use.
- BINDERS Lime, plaster (production and hardening). Cement: production, cooking, hydration, setting and hardening, heat of hydration, porosity, false setting. Chemical and mechanical tests. Types of cement.
- CONCRETE Mixing water, aggregates, admixtures. The properties and critical issues of fresh and hardened concrete. Mix design. Durability. Green concrete.

- POLYMERS Characteristics, applications and processing of polymers.
- COMPOSITES characteristics and applications of composites.
- SUSTAINABILITY and SUSTAINABLE MATERIALS Sustainability and construction. Traditional (wood) and novel sustainable materials.

TEXTBOOKS AND MATERIALS

- W.D. Callister - Materials science and engineering
- W.F. Smith, J. Hashemi – Foundations of
- Lecture notes

TOPICS AND CALENDAR

(If necessary for educational and/or organizational purposes, the calendar might get modified accordingly).

CLASS 1	27/09/2023	PRESENTATION OF THE COURSE (PROGRAM, TEXTS, CALENDAR AND METHODS OF EVALUATION) INTRODUCTION TO MATERIALS SCIENCE THE EVOLUTION OF THE ATOMIC MODEL AND CHEMICAL BONDING
CLASS 2	4/10/2023	THE STRUCTURE OF CRYSTALLINE SOLIDS: - CRYSTAL STRUCTURES - CRYSTALLOGRAPHIC POINTS, DIRECTIONS AND PLANES
CLASS 3	11/10/2023	IMPERFECTION IN SOLIDS: - POINT DEFECTS - LINEAR DEFECTS - BULK OR VOLUME DEFECTS DIFFUSION MECHANISMS
CLASS 4	18/10/2023	MECHANICAL PROPERTIES OF METALS: - ELASTIC DEFORMATION - PLASTIC DEFORMATION
CLASS 5	25/10/2023	DISLOCATIONS AND PLASTIC DEFORMATION MECHANISMS OF STRENGTHENING IN METALS
CLASS 6	8/11/2023	FUNDAMENTALS OF FRACTURE FATIGUE CREEP
CLASS 7	15/11/2023	PHASE DIAGRAMS: - BINARY PHASE DIAGRAMS - THE IRON-CARBON SYSTEM
CLASS 8	22/11/2023	PHASE TRANSFORMATIONS: - MICROSTRUCTURAL AND PROPERTIES CHANGES IN IRON-CARBON ALLOYS TYPE OF METAL ALLOYS AND FABRICATION OF METALS
CLASS 9	29/11/2023	CERAMICS: - STRUCTURE AND PROPERTIES - APPLICATION AND PROCESSING
CLASS 10	6/12/2023	BINDERS: - LIME AND PLASTER (PRODUCTION AND HARDENING) - CEMENT (PRODUCTION, HYDRATION, SETTING AND HARDENING)

		- CONCRETE (MIXING WATER, AGGREGATES, ADMIXTURES)
CLASS 11	13/12/2023	POLYMERS (CHARACTERISTICS, APPLICATIONS AND PROCESSING) COMPOSITES: - PARTICLE/FIBER REINFORCED COMPOSITES - STRUCTURAL COMPOSITES
CLASS 12	20/12/2023	SUSTAINABILITY AND CONSTRUCTION. WOOD (STRUCTURE, COMPOSITION, MECHANICAL PROPERTIES, PRODUCTION, USE, REQUIREMENTS AND DURABILITY)

EXAMINATION DATES (academic year 2023/24): January 15th, February 19th, June 24th, July 23rd, September 9th