

COURSE ID SHEET



Course No.	5295	NTUA				
Semester:	9	Core		Elective		Specialization X

Title:	CONSTRUCTION AND CERAMIC MATERIALS
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Aim:	The course focuses on the concepts and methods relating to the science and engineering of building materials, that allow their characterization, their design, their quality control, their selection as load-bearing elements of structures, their maintenance and protection, their management throughout the life-cycle of the building/construction. These are studied and applied at the scale of real construction systems, as subjected to their operational environment and within the requirements set for enhance sustainability of the materials and the building/construction.
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Content:	I. BUILDING MATERIALS CATEGORIES. CLASSIFICATION AND USAGE CRITERIA, BASED ON THE INTERRELATIONSHIP BETWEEN MICROSTRUCTURE/PROPERTIES/TECHNICAL PROCESSING, FOR EACH MATERIAL CATEGORY • Building stones: Natural building stones, artificial building stones. • Bricks – Ceramics: Composition / microstructure and structure / manufacturing technology, characterization / classification/assessment of historic ceramics. • Binders and mortars: Binders, aggregates, additives, building mortars, plasters. • Cement: General description – manufacturing, cement chemistry, basic cement types, special cements, cement properties. • Concrete: Raw materials, concrete types. • Structural steels: Steel production, thermal and chemical treatments of steels, steel properties, steel building products, eurocode – standards, steel protection. • Rebars: rebar categories, properties. • Aluminum alloys – Aluminum profiles: Aluminium, alloys and surface protection of aluminum profiles. • Wood as building material: Wood material, wood products. • Drywall systems: Building plates, drywall and insulation boards systems, ceiling systems. • Composite building materials. • Colors. II. QUALITY CONTROL • The concept of quality in the construction sector: Definition of the concept of quality, historical development of quality management, the role of quality assurance for construction companies. • Accreditation systems in the construction sector: Accreditation organizations-companies, operation of an accreditation organization, quality management systems, application of a quality management system.
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- Quality management systems in the construction sector: ISO 9000, ISO 14001, OHSAS 18001, Eco-management and audit scheme of the European Union (EMAS)), Tables – codes, archives-management systems in the construction sector.
- Special Consultant of Quality Control (ESPEL): Quality surveys by ESPEL, works that are subjected to ESPEL quality assessment, quality assessment process.
- Scientific methodology to support a total quality system.
- Integrated quality control framework with non-destructive techniques: Use of non-destructive techniques in the framework of total quality control of buildings and infrastructures.
- Codes, Standards, Normals.

III. SELECTION AND DESIGN OF BUILDING MATERIALS

- Performativity.
- Life-cycle of materials.
- Susceptibility criteria to environmental factors – environmental “performance” of building materials.
- Energy efficiency criteria.

IV. METHODOLOGY, TECHNIQUES AND METHODS FOR CHARACTERIZATION AND CONTROL OF BUILDING MATERIALS

- Instrumental techniques and methods in the laboratory and in-situ: Density measurements, grainsize distribution measurements, statistical theory of materials’ strength, Weibull analysis, mechanical tests, fatigue test, impact test, hardness test, X-ray diffraction (X-RD), flame spectroscopy (FS), atomic absorption spectroscopy (AAS), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, UV-Visual spectroscopy, nuclear magnetic resonance (NMR), liquid chromatography (TLC, HPLC), differential thermal analysis (DTA), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), thermomechanical analysis (TMA), dilatometry, dynamic mechanical analysis (DMA), optical and polarized microscopy, scanning electron microscopy (SEM), energy-dispersive x-ray spectroscopy (EDX), electron energy loss spectroscopy (EELS), transmission electron microscopy (TEM), scanning tunneling microscopy (STM), atomic force microscopy (AFM), permeability – specific surface – water absorption coefficient, mercury porosimetry, BET surface area measurement.
- Non-destructive methods at the scale of the building:
 - Assessment of intensive quantities of the masonry and its elements with non-destructive methods: Extension-meters, flat jack test, ground penetrating radar (GPR), Schmidt Hammer test, penetration resistance test, nail pull out test, scratch test, and fragment test.
 - Determination of elastic constants: Dynamic elastic modulus, Poisson ratio, shear modulus, ultrasonic pulse velocity test, reflection seismology.
 - Assessment (energy and environmental) of the building materials behavior in mass/heat transfer phenomena: Guarded hot plate test, hotbox, test chambers, infrared thermography (IRT).
 - Structural layers assessment: Electromagnetic prospection of materials and structures (Ground penetrating radar – GPR with high-frequency pulses, microwave method).

- Mapping of building materials / texture / structure / physicochemical characteristics: portable video-microscopy, endoscopy, chromatography, laser induced breakdown spectroscopy (LIBS), digital image processing (DIP).

Hours per semester:

LECTURE	39	EXERCISES	-	LABORATORY	68	HOME-WORK	68	TOTAL HOURS: 175
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Student performance/evaluation:

The evaluation will be done:

- Through written examination regarding the contents mentioned in the contents field above (B1).
- Through the evaluation of the laboratory reports and the attendance and participation of the students in the laboratory exercises (B2).
- Through the evaluation of the team-work with discrete roles (B3).

The final grade results as follows: Final Grade = 0.5 x B1 + 0.3 x B2 + 0.2 x B3