UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria		
ACADEMIC YEAR	2016/2017		
BACHELOR'S DEGREE (BSC)	CIVIL AND BUIDING ENGINEERING		
INTEGRATED COURSE	CHEMISTRY/TECHNOLOGY OF MATERIALS - INTEGRATED COURSE		
CODE	10050		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	CHIM/07, ING-IND/22		
HEAD PROFESSOR(S)	FIORE VINCENZO	Professore Associato	Univ. di PALERMO
OTHER PROFESSOR(S)	FIORE VINCENZO	Professore Associato	Univ. di PALERMO
	BELLARDITA MARIANNA	Professore Associato	Univ. di PALERMO
CREDITS	12		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	2° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**BELLARDITA MARIANNA**		
	Monday 10:00 12:00 Tutti i giorni, previo appuntamento da concordare via mail: marianna.belardita@unipa.itPer il momento i ricevimenti si svolgeranno on-line		
	FIORE VINCENZO		
	Tuesday 09:00 11:00 Viale delle Scienze, Edificio 6, terzo piano, stanza 3012		
	Thursday 09:00 11:00 Team "Didattica telematica Prof. Fiore" codice: opuh3tj		

DOCENTE: Prof. VINCENZO FIORE

PREREQUISITES	Basic knowledge of mathematics and physics
LEARNING OUTCOMES	- Knowledge and understanding Objective of the course is to promote students maturation, thanks to a reasonable time devoted to individual study, skills and understanding that empower them to include in their knowledge of issues most recent development in the field of materials technology together with consolidated content in basic chemistry. In particular, the student at the end of the course will have knowledge of the issues involved in the structure of matter, the principles governing its chemical and physical transformations (phase transformations, chemical reactions etc.), including the variations of energy that always accompany them. Also, students will be able to understand the basic principles of atomic structure and chemical bonding. They will also be able to evaluate the influence of the operating parameters (such as temperature and pressure) on chemical reactions. The student will be able to correlate the properties of the main materials currently used in Civil Engineering to their structure and to apply such knowledge in design and construction of civil engineering works (roads, railways, airports, aqueducts, sewers, maritime works and hydraulic defense, elevated structures and foundation, retaining structures, etc.) and for the design, management and maintenance constructions of ordinary complexity. Assessment of the achievement of learning outcomes will be through oral and written exams. - Applying knowledge and understanding Students will be able to use tools related to knowledge of the structure of matter to correlate in a qualitative way its properties (melting and boiling temperature, vapor pressure etc.) with the structure and the possible applications in the Civil sector. Furthermore, they will be able to qualitatively indicate the optimum process conditions for conducting a chemical reaction according to the nature of the objectives to be pursued (synthesis of a product, production of energy, etc.). In this way the student will acquire appropriate skills demonstrated through devising and sustaining arguments and solving problems in the fields of application Civil Engineering / Building and, in particular, will be capable of expressing his knowledge in a working context, both public and private as concerns collaboration to integrated design and construction of buildings and civil infrastructure, civil works in industrial plants, road infrastructure and transport, hydraulic and structural. Assessment (written and oral exams) will be structured so that the student demonstrates mastery of tools, methodologies and content both within the basic chemistry and in the materials technology. -Making judgments; Students will be able to assess themselves: - The validity and limits of approximation of the interpretative models of the structure of matter; - The areas of use of the principles of thermodynamics and kinetics for the conduct of chemical reactions. - The validity and limits of approximation of the interpretative models of the chemical / physical properties and the behavior of materials in different conditions; - The effects of weathering, external actions, catastrophic events on the materials chosen in order to verify the design results in terms of safety, comfort, usability, etc .; Communication skills Students will acquire the ability to communicate and express issues concerning the subjects of the course. They will be able to hold conversations on topics related to fundamental aspects of the discipline (atomic structure, molecular thermodynamics, kinetics of chemical reactions, structure-property relationship) or through a rigorous knowledge of the technical language, general and sector, and to the tools of mathematical representation of the main factors described -Learning skills Students will have learned the basics of the structure of matter and conducting chemical reactions. They will understand the difference between a phenomenological approach and a microscopic approach / modeling to the study of the properties of matter, of its chemical transformations and related energy changes. This knowledge will contribute to the formation of his wealth of knowledge of phenomenological disciplines (physical and chemical) and this will allow them to continue their engineering studies with greater autonomy and discernment. To the achievement of learning skills will contribute, in varying degrees, all the academic activities, within which an important role is played both by hours of individual study with regard to the intrinsic acquisition of such capabilities, both from educational activities that involve a comparison (between student and

	teacher, the students among themselves, between students and outside experts) in relation to their correct manifestation. Learning skills will be achieved in particular through the self-study, and the work done for the preparation of the written and oral exams, evaluation of which will be verified through the achievement of learning skills.
ASSESSMENT METHODS	Written and oral test
TEACHING METHODS	Lectures and numerical exercises carried out in class.

MODULE
TECHNOLOGY OF MATERIALS

Prof. VINCENZO FIORE

SUGGESTED BIBLIOGRAPHY

- William F. Smith, Scienza e tecnologia dei materiali, McGraw-Hill. –
-W. Smith "Scienza e Tecnologia dei Materiali", MacGraw–Hill
M. Lucco Borlera, C. Brisi "Tecnologia dei materiali e chimica applicata" Ed. Levrotto e Bella,

AMBIT	10653-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54

EDUCATIONAL OBJECTIVES OF THE MODULE

The course aims to provide knowledge about the structure, properties and technological applications of the main types of materials currently used in the construction industry

SYLLABUS

Hrs	Frontal teaching
8	WATER (Introduction, properties, features and analysis of water. Sedimentation, coagulation, flocculation, filtration. Aeration and degassing. Hard water and softening treatments. Lime and soda softening. Cation-exchange softening. Demineralisation by ion-exchange. Other treatments.)
6	METALS STRUCTURE (Chemical bonds, crystallography and Bravais lattices. Defects and solutions. Number of coordination. Atomic packing factor. Crystallization. Phase diagrams. Phase transformations. Microstructures. Eutectic systems and other systems.)
4	STEEL AND CAST IRON (Iron-Carbon phase diagram. TTT diagrams. Thermal and thermochemical treatments: hardening, annealing, carburization of steel. Classification of steels and cast irons. Production of steel and cast iron.)
2	METALS AND THEIR ALLOYS (aluminum and copper)
4	MECHANICAL PROPERTIES (Tensile test, compression test, bending test, impact test, hardness, fatigue behavior.)
4	CERAMIC AND GLASSES (Structure, amorphous and crystalline phases, viscosity, processing methods.)
4	POLYMERS (Introduction and features. Solid state, glass transition and crystalline state. Processing methods, extrusion and injection molding. Industrial polymers and related applications.)
4	COMPOSITE MATERIALS (Introduction and features, manufacturing technologies, synthetic and natural fiber as reinforcement, mechanical properties evaluation, main applications.)
10	BINDERS (Air binders: lime and gypsum. Hydraulic binders. Portland cement: production, setting and hardening, properties' end. Other cements as alternative to Portland one: pozzolanic cement and concrete blast furnace. Mix design of concrete

Hrs	Practice
8	WATER (calculation of water hardness and of reactives for lime and soda softening; sedimentation); METALS (calculation of theoretical density, determination of the Miller indices, phase diagrams); MECHANICAL PROPERTIES (stress-strain curve, resilience calculation); COMPOSITE MATERIALS (micromechanics prediction of the elastic properties along the principal directions); BINDERS (Mix-design examples

MODULE
CHEMISTRY

Prof.ssa MARIANNA BELLARDITA

SUGGESTED BIBLIOGRAPHY	
P. Atkins – L. Jones Principi di Chimica, terza edizione Zanichelli, Bologna DW Oxtoby, H.P: Gillis, A. Camoion, Chimica Moderna, EdiSES Srl Napoli M. Schiavello L. Palmisano, Fondamenti di Chimica III EdiSES Srl Napoli.	
AMBIT	50280-Fisica e chimica
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
EDUCATIONAL OBJECTIVES OF THE MODULE	
The module aims to provide students with basic knowledge of chemistry necessary to address the study of all those courses that require basic concepts in this area	

SYLLABUS

Hrs	Frontal teaching
5	Introduction to the course. Elements. Compounds. Atom and molecule. Atomic number. mass number. Isotopes. Atomic mass. Scale of atomic masses. Molecular mass and mass formula. Avogadro constant. Mole. Molar mass. Number of oxidation. Formulas and nomenclature of the main classes of inorganic compounds (oxides, hydrides, hydroxides, acids, salts). Empirical formula and molecular formula. quantitative significance of the formulas. Chemical Reactions and balance of chemical reactions. Reactions in aqueous solution (acid-base reactions, precipitation, complexation, oxidation-reduction, dismutation). Reactions in ionic form. quantity of the chemical reactions meaning. stoichiometric calculations. Atomic structure. fundamental constituents of the atom. Historical succession of atomic models. Bohr model. Elements of wave theory. quantum numbers; atomic orbital s, p, d, f: methods for their representation; Pauli exclusion principle; Hund principle; Electronic configuration of the elements; periodic system: periods, groups, blocks. periodic law and periodic properties of elements (atomic radius, effective nuclear charge, ionization energy, electron affinity, metallic character).
5	Chemical bond. Ionic bond; lattice energy; ionic radii; typical ionic lattices; properties of ionic compounds; Nonpolar covalent bond. Bonds and polar covalent bond. Electronegativity: Pauling scale, electronegativity difference and percentage of ionicity. Dative bond: donors and acceptors. Molecular geometry: hybridization of atomic orbitals, VSEPR theory. polar and non-polar molecules; Hydrogen bonding, dipole interactions, Van der Waals forces. metallic bond, conductors, insulators, semiconductors. States of matter: solids: types of solids and their properties, polymorphism, isomorphism. ionic solids, molecular, covalent and metal. Liquids: general properties of the liquid state. Vapour pressure, boiling temperature. Gas: General and equations of state of ideal gas and real gas properties.
6	Thermodynamics. Thermodynamic aspects of chemical transformations: internal energy, enthalpy, entropy, free energy. Conditions of equilibrium, G, Criteria of spontaneity for a transformation, applications in chemical reactions. chemical balance; homogeneous and heterogeneous equilibria. G ° of the reaction and the equilibrium constant (Kc, Kp). shifting balance: Le Chatelier's principle, effects of temperature, pressure and the change in the equilibrium concentrations. Chemical kinetics. Reaction rate, reaction order, catalysts; effect of temperature on the reaction rate. thermodynamic and kinetic aspect of chemical reactions. State transitions and state diagrams The Clausius-Clapeyron. Phase rule and its applications. Diagrams of chemical species (H2O, CO2, S). Phase diagrams with two components.
6	Solutions. Types of solutions and mechanisms of solubilization of the solutes. Concentration of solutions (mass%, mole fraction, molarity,% by volume, molarity and normality). Raoult's Law. Dilute solutions of non-volatile solutes. Properties of solutions. electrolyte solutions; degree of dissociation. Equilibria in aqueous solution. Ionic product of water. pH, pOH. Acids and bases: theories of Arrhenius, Brönsted and Lowry, Lewis. Strength of acids and bases (Ka, Kb). Polybasic acids and bases. Amphoteric electrolytes. Calculation of pH of solutions of strong acids, strong bases, weak acids, weak bases. Hydrolysis, the pH calculation of aqueous solutions of salts. Buffer solutions. PH indicators. Acid-base titrations. Heterogeneous equilibria in aqueous solution: solubility product and its applications. Relationship between solubility and solubility product. Effect of temperature and common ion on solubility.

6	Electrochemistry. General information on electrode potentials and the reversible chemical cells. Electromotive force of the battery: Nernst equation. Standard reduction potentials and their applications: prediction of the possibility of reaction and calculation of the equilibrium constant for a reaction of oxide-reduction in aqueous solution. Corrosion processes. General information on the phenomenon Electrolysis and Faraday's laws.

Hrs	Practice
26	Applications and tutorials on the topics covered in the course