UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2020/2021
BACHELOR'S DEGREE (BSC)	ENERGY ENGINEERING AND RENEWABLE ENERGIES
INTEGRATED COURSE	PRINCIPLES OF CHEMISTRY FOR TECHNOLOGIES - INTEGRATED COURSE
CODE	20465
MODULES	Yes
NUMBER OF MODULES	2
SCIENTIFIC SECTOR(S)	CHIM/07, ING-IND/22
HEAD PROFESSOR(S)	GARCIA LOPEZ ELISA ISABEL Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	GARCIA LOPEZ ELISA ISABEL Professore Associato Univ. di PALERMO BOTTA LUIGI Professore Associato Univ. di PALERMO
CREDITS	12
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**BOTTA LUIGI** Monday 15:00 17:00 Ufficio (Ed. 6, terzo piano) Thursday 15:00 17:00 Ufficio (Ed. 6, terzo piano) **GARCIA LOPEZ ELISA ISABEL** Friday 10:00 13:00 Stanza S06P1004. Primo piano. Edificio 6.

DOCENTE: Prof.ssa ELISA ISABEL GARCIA LOPEZ

PREREQUISITES	Basic concepts on calculus and trigonometry
LEARNING OUTCOMES	Knowledge of issues concerning the structure of matter and the principles that regulate its chemical-physical transformations (phase transformations,chemical reactions, etc ..). In particular, the student will be able to understand the basic principles of atomic structure and chemical bonding. The student will also able to evaluate the influence of the operating parameters (such as temperature and pressure) on chemical reactions. These abilities will be verified by the written and oral examinations. -Applying knowledge and understanding: Ability to independently evaluate both the validity and the accuracy limits of of the structure of matter models and the principles of thermodynamics and kinetics of chemical reactions. These abilities will be verified by the written and oral examinations. Making judgments The student will have acquired the capacity to independently assess both the validity and the approximate models limits of the matter structure, as well as the use of the thermodynamics principles and the kinetics of chemical reactions. This ability will be verified by the written and oral examinations. -Communication skills: Ability to communicate and express issues concerning the fundamental aspects of the discipline (atomic structure, thermodynamics and kinetics chemical reactions). This ability will be verified by the written and oral examinations. -Learning ability: The student will learn the basic aspects of the structure of matter and of the chemical reactions. This knowledge will contribute to the student formation in the phenomenological disciplines (physical and chemical) and it will allow him to continue his engineering studies with greater autonomy and discernment. This ability will be verified by the written and oral examinations.
ASSESSMENT METHODS	Two exams: a first written test lasting two hours consisting in at least 10 theoretical and numerical questions which require a short answer. This text will been evaluated on the basis of thirtieths. Students who get a vote in the writing test not lower than eighteen/thirtieths will be admitted to the oral exam. The exam will be not passed if the student will show a not acceptable knowledge of the topics. The oral exam will consist of an interview, based on the written test, in order to check that the student possess the skills and disciplinary knowledge in all of the main topics described in the program. The oral questions could have also an open nature and hence the answers could be discursive. The final assessment will be formulated taking into account both the written exam and the interview. The final assessment is on a 30 basis according to the following criteria: 30-30+: excellent knowledge of the topics, excellent language and vocabulary, good analytical capability, the student is able to apply knowledge to solve the proposed problems 26-29: Good management of the topics, nice language and vocabulary, the student is able to apply knowledge to solve the proposed problems 24-25: basic knowledge of the topics, fair language and vocabulary, limited capability to apply autonomously knowledge to solve the proposed problems 21-23: the student does not show full management of the main topics while possessing the knowledge, satisfactorily language and vocabulary, poor capability to apply autonomously the acquired knowledge 18-20: minimal basic knowledge of the main topics and of the technical language and vocabulary, poor or no capability to apply autonomously the acquired knowledge.
TEACHING METHODS	Lectures and classroom exercises

MODULE TECHNOLOGY OF MATERIALS *Prof. LUIGI BOTTA*	
SUGGESTED BIBLIOGRAPHY	
W. F. Smith, J. Hashemi. SCIENZA E TECNOLOGIA DEI MATERIALI, McGraw-Hill	
AMBIT	10657-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	48
COURSE ACTIVITY (Hrs)	27
EDUCATIONAL OBJECTIVES OF THE MODULE	
The aim of this part of course is to provide students with the main skills to operate design and management choices regarding the selection of materials according to their properties and applications.	

SYLLABUS

Hrs	Frontal teaching
1	INTRODUCTION TO MATERIALS SCIENCE AND TECHNOLOGY (Introduction to materials: metals, polymers and ceramics. Comparing the properties. Criteria for the selection.)
3	METALS (Crystalline systems and Bravais lattices. Main metallic crystal structures. Number of coordination. Atomic packing factor. Positions of atoms, directions and planes in cubic elementary cells. Polymorphism.)
2	SOLIDIFICATION AND CRYSTAL DEFECTS (solidification of metals. Metal solid solutions. Crystalline defects)
3	PHASE DIAGRAMS (Phase diagrams. Phase transformations. Microstructures. Isomorphic binary systems. Eutectic systems and other systems. Examples of metal alloys.)
4	STEEL AND CAST IRON (Iron-Carbon phase diagram. TTT and CCT diagrams. Thermal and thermochemical treatments: hardening, annealing, carburization of steel. Classification of steels and cast irons. Production of steel and cast iron.)
4	MECHANICAL PROPERTIES (Tensile test, compression test, bending test, impact test, hardness, fatigue behavior.)
6	POLYMERS (Introduction and features. Solid state, glass transition and crystalline state. Processing methods, extrusion and injection molding. Industrial polymers and related applications.)

Hrs	Practice
4	METALS (calculation of theoretical density, determination of the Miller indices , phase diagrams) - MECHANICAL PROPERTIES (stress-strain curve, resilience calculation).

MODULE
CHEMISTRY FOR ENGINEERING

Prof.ssa ELISA ISABEL GARCIA LOPEZ

SUGGESTED BIBLIOGRAPHY

Testo principale: L. Palmisano, M. Schiavello “Elementi di Chimica” Ed. Edises
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Testi di approfondimento:
P. Atkins, L. Jones, “Principi di Chimica” Ed. Zanichelli
J. C. Kotz, P. Treichel, “Chimica” Ed. Edises
D. W. Oxtoby, N. H. Nachtrieb “Chimica Moderna” Ed. Edises
M. Silbelberg “Chimica: La natura molecolare della materia e le sue

AMBIT	50293-Fisica e chimica
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81

EDUCATIONAL OBJECTIVES OF THE MODULE

The aim is the learning of the fundamental principles of Chemistry,
highlighting the importance of the methodological criteria that may be useful for
the continuation of engineering studies.

SYLLABUS

Hrs	Frontal teaching
4	Elements, compounds, mixtures, molecules, ions. The concept of mole. Chemical reactions and stoichiometry
1	Thermodynamic system, state functions and equations of state; definition of phase, homogeneous and heterogeneous systems
5	Atomic models for the hydrogen atom. Introduction to wave mechanics. Schroedinger equation. Atomic orbitals for the hydrogen atom and for polyelectronic systems. Quantic numbers. Configuration of the elements and the periodic table. Periodic properties: ionization energy, electron affinity
5	Chemical bond. Ionic bond. Covalent bond (homopolar and heteropolar). Sigma and greek pi bonds . Electronegativity. Molecular geometry and hybrid orbitals. Dative bond. Intermolecular bonds. Hydrogen bonding. Metallic bonding. Metals, insulators and semiconductors.
2	Oxidation number. Oxidation-reduction reactions. Combustion
3	Gaseous systems. Ideal gas: equation of state. Elements of kinetic theory of gases, distribution of the molecular rate. Real gases: equation of Van der Waals. Andrews diagrams
2	Solid state – Amorphous solids and crystalline solids. Solid structure. Unit cell. Packaging. Bravais cells. Types of crystalline solids: ionic, molecular, metallic, macromolecular
2	Vapour-liquid equilibrium: the vapor pressure of a liquid. Boiling of a liquid. Phase diagrams for systems of one component.
3	Types of solutions: solubility and saturated solutions. Solubility of gases in liquids: Henry's law. Properties of solutions: Raoult's law. boiling point increase, cryoscopic decreasing and osmotic pressure. Phase diagrams for two-component systems.
4	Thermodynamics: System, state and state function. Forms of energy and their equivalence. 1st Principle. Enthalpy. Hess's Law. 2nd Principle. Entropy. Free energy. Spontaneity criteria. Gibbs law. Application of thermodynamic functions. 3rd Law of Thermodynamics.
4	Two-component systems. Colligative properties. Raoult's Law. Cryoscopy and ebullioscopy. Osmosis and osmotic pressure. Phase changes in two-component systems. Vapor-liquid equilibria. Azeotropes. solid-liquid equilibria. Eutectic.
2	Chemical equilibrium. Equilibrium constant for reactions in ideal homogeneous systems. The principle of Chatelier. Equilibrium constant for heterogeneous reactions
3	Chemical equilibrium: Features of a chemical reaction equilibrium. Mass law. Equilibrium constants. Shifting of the equilibrium. Dependence of the equilibrium constant on temperature. van't Hoff law. heterogeneous equilibria. Mobile balance principle or the Chatelier.
4	Aqueous solution equilibrium: acids and bases. Definition of acid and basic by Arrhenius, Bronsted-Lowry and Lewis. Calculation of pH for solutions of strong and weak acids and bases . Hydrolysis of salts. Buffer solutions. Product solubility.
3	Electrochemistry. Batteries, galvanic half cells, standard reduction potentials and policies to determine the force oxidation or reduction of a redox couple. Nernst law. Electrolysis and Faraday's laws.
3	Periodic table of elements, description of groups. Hydrides. basic oxides, acid and amphoteric surfactants. inorganic acids Most common. Salts. Introduction to organic chemistry. Nomenclature of: the hydrocarbons (alkanes, alkenes, alkynes and aromatic), alcohols, aldehydes and ketones, carboxylic acids, amines.

Hrs	Practice

5	The concept of mole. Chemical reactions and stoichiometry
3	Numerical applications: Concentration units in homogeneous systems: molarity, normality, molality, mole fraction, percentage by weight and by volume.
3	Numerical applications: Redox reactions and combustion
3	Chemical bond. Lewis Molecular structures
3	Thermochemistry: numerical applications
2	Numeric applications of colligative properties
3	Chemical equilibrium: Features of a chemical reaction equilibrium. Mass law. Equilibrium constants. Shifting of the equilibrium. Dependence of the equilibrium constant on temperature. van't Hoff law. heterogeneous equilibria. Mobile balance principle or the Chatelier.
5	Ionic equilibrium: weak and strong electrolytes, degree of dissociation. Effect of dissociation on the colligative properties: the van't Hoff law. Ionization of water. pH and pOH of solutions of acids, bases and buffer solutions monoprotic weak solutions of acids and bases. Polybasic acids. Buffer solutions. Acid-base balance in the saline solutions. Solubility equilibria: solubility equilibrium constant
4	Electrochemistry. Redox reactions, half-elements and their representation, batteries. Normal Potential reduction table. Nernst equation. Galvanic concentration cells. Electrolysis. Faraday's laws. overvoltage