UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2017/2018
BACHELOR'S DEGREE (BSC)	CHEMICAL ENGINEERING
SUBJECT	APPLIED CHEMISTRY
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50297-Ingegneria chimica
CODE	01814
SCIENTIFIC SECTOR(S)	ING-IND/22
HEAD PROFESSOR(S)	LA CARRUBBA VINCENZO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	3
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**LA CARRUBBA VINCENZO** Tuesday 11:00 12:00 Studio docente, edificio 6 secondo piano Thursday 11:00 12:00 Studio docente, edificio 6 secondo piano

DOCENTE: Prof. VINCENZO LA CARRUBBA

PREREQUISITES	- Knowledge of General Chemistry: chemical bond, chemical equilibria, redox reactions, measure of concentrations, stoichometry - Knowledge of Thermodynamics: Gibbs' rule, free energy, phase diagrams - Knowledge of Organic Chemistry: hydrocarbons, isomery
LEARNING OUTCOMES	Knowledge and understanding knowledge of the main categories of materials for engineering and understanding of the correlations among chemical composition, structure and properties. Knowledge of the main parameters characterizing water for civil and industrial use, and the related treatment processes. Knowledge of the chemical nature and chemico-physical properties of fuels. Knowledge of theoretical principles and of practical aspects of combustion processes. Applying knowledge and understanding Choice of the materials suitable for specific applications/manufacts in relation to their characteristics. Methods for characterizing and qualifying materials based on their properties. Correlations properties/structure for materials, water and fuels. Ability to apply theories to case studies. Making judgments Ability to identify characteristics, properties and processing methods for the most relevant engineering materials. Ability to evaluate the quality of water selecting the most appropriate treatment methods in relation to the final application. Ability to design an industrial combustion process. Communication skills The student will be able to communicate with competence and correct use of language complex tasks related to the chemico-physical properties of water, fuels and the correlations structure-properties of materials in various contexts.
ASSESSMENT METHODS	The final examination consists of a written test followed by an oral examination. The written test, of the duration of about 4 hours, is divided in two parts. The first part consists of 9 questions concerning all the subjects treated during the course. The second part concerns the resolution of 5 numerical exercises on the following subjects: modules of cements, softening of water, computations on combustion, sedimentation, use of phase diagrams, TTT curves of steel, calculation of average molecular weight of polymers, master curves of polymers. The oral examination will focus on aspects not sufficiently clarified by the student in the written test and/or on additional subjects not included in the written test. The final assessment, properly graded, will be made on the basis of the following conditions: a) sufficient knowledge of subjects and theories addressed in the course; sufficient degree of awareness and autonomy in the application of theories to solve chemical problems (rating 18-21); b) Good knowledge of subjects and theories addressed in the course; fair degree of awareness and autonomy in the application of theories to solve chemical problems (rating 22-25); c) Good knowledge of subjects and theories addressed in the course; good degree of awareness and autonomy in the application of theories to solve chemical problems (rating 26-28); d) Excellent knowledge of subjects and theories addressed in the course; excellent level of awareness and autonomy in the application of theories to solve problems (rating 29-30L). The assessment, according to the point a, b, c and d will be carried out for both the written and the oral part, and an arithmetic averaging will be operated with a final round up.
EDUCATIONAL OBJECTIVES	Provide engineering students the cultural tools to guide design strategies for material and process selection, such as: - evaluation of the quality of water and definition of processes and equipment for treatment, depending on the final use - understanding of the production processes of the various categories of engineering (metals, ceramics, polymers) - selection of a material as a function of their properties and their final applications - evaluation of a fuel, ability to face stoichometric and themodynamic calculations on combustion processes
TEACHING METHODS	Lectures and classroom tutorials and exercises
SUGGESTED BIBLIOGRAPHY	William F. Smith, SCIENZA E TECNOLOGIA DEI MATERIALI, McGraw-Hill Cesare Brisi, CHIMICA APPLICATA, Ed. Levrotto-Bella G. Polizzotti, “L’Acqua”, Ed. Ambrosiana Slides fornite dal docente in formato elettronico

SYLLABUS

Hrs	Frontal teaching
2	Introduction to materials: metals, polymers and ceramics. Comparison of properties. Criteria for selection
8	Metals Chemical bonds, crystallography, Bravais lattices. Defects and solutions. Coordination number. Atomic packing and density. Solidification. Phase diagrams. Phase transformations. Microstructures. Binary isomorph systems. Eutectic systems and other systems. Examples of metal alloys.
6	Steel and cast iron. Fe/C diagram. TTT and CCT diagrams. Thermal and Themo-chemical treatments: quench, annealing, carburation, nitruration. Classification of steels and cast irons. Production of steel and cast iron. Bast furnace. Non-ferrous alloys (short notes). Strenghtening methods.
2	Mechanical properties (short notes). Tensile test, Young's Modulus, stiffness/toughness, Hardness
3	Ceramics and glasses (short notes) Structure, amorphous and crystalline state, viscosity, processing methods, tempering of glass.
8	Binders Aerial and hydraulic binders, lime, gypsum, hydraulic lime, portland cement, other cements. Moduls. Production of cement, use and applications, causes of degradation. Concrete (short notes).
8	Polymers Introduction and characteristics. Molecular weight distribution and averages. Solid state, glass transition and crystalline state. Processing methods, extrusion and injection molding. Viscoelsticity and master curve (short notes). Industrial polymers and applications
10	Water. Introduction, properties, characteristics and determinations. Water hardness and softening methods: lime and soda, ionic exchange. Treatment processes for industrial water: sedimentation, coagulation and flocculation, aeration, thermal and chemical degassing, demineralization, chloration.
9	Fuels. Introduction, combustion, enthalpy and calorific value. Complete and incomplete combustion. Stoichometry of combustion. Flammability limits, ignition temperature, theoretical flame temperature. Solid, liquid and gaseous fuels. Crude oil, topping, cracking reforming and refining. Gaseous fuels: natural gas and producer gas (air and water gas). Liquid fuels: octane and decane.

Hrs	Practice
25	Metals: Miller indices, theoretical density, phase diagrams, TTT and CCT Binders: modules Polymers: distribution of molecular weights, master curve Water: lime and soda softening, sedimentation Fuels: stoichometry of combustion reactions, theoretical flame temperature