UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2018/2019
BACHELOR'S DEGREE (BSC)	SAFETY ENGINEERING
SUBJECT	PRINCIPLES OF INDUSTRIAL SAFETY
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50299-Ingegneria energetica
CODE	19482
SCIENTIFIC SECTOR(S)	ING-IND/25
HEAD PROFESSOR(S)	GRISAFI FRANCO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**GRISAFI FRANCO** Tuesday 17:00 18:00 Studio personale (Ed. 6 - piano 3) Wednesday 16:00 17:00 Studio personale (Ed. 6 - piano 3)

DOCENTE: Prof. FRANCO GRISAFI

PREREQUISITES	In order to understand the topics and to easily achieve the learning goals of the teaching course, the student must be confident with mass and energy balances, physic and basic chemical equilibria, basic mathematical skills (derivatives, integrals, differential equations).
LEARNING OUTCOMES	Knowledge and understanding ability The student, at the end of the teaching class, will possess knowledge of the main topics regarding the general structure of a risk analysis and will be aware of the design procedures and operating countermeasures to minimize risk. Students will acquire some skill on atmospheric dispersions of dangerous substances in order to understand environmental pollution or chemical hazards (toxic and/or flammable releases). Ability to apply knowledge and understanding The student will be able to: -chose the most suitable risk analysis approach (qualitative or quantitative) -choose between different solutions the more suitable one regarding the design and the operative procedures to ensure a suitable safety level relevant to the studied system, process or operative procedure as regard chemical and/or fire/ explosion risks. Judging autonomy The student will be able to evaluate advantages and disadvantages of the different approach to the risk analysis and to the different devices able to minimize risk level. Communication ability The student will acquire the capability to communicate and express problems inherent the course topics. The student will be able to highlight questions related to risk analysis and assessment, by proposing solutions to solve possible shortcomings and critically assessing their effectiveness. Moreover, the student will be able to represents graphically risk or damage levels relevant to single or multiple risk sources.
ASSESSMENT METHODS	The evaluation will be based on an oral discussion with a formal solution of a practical problem. The interview will verify: acquired knowledge; elaboration capability; talking capability; ability to build autonomous connections not explicitly bounded to the referring textbooks; capability to produce autonomous evaluations inherent the course topics; capability to understand the applications connected with the discipline areas; capability to connect the discipline topics with the referring professional and technological context. The final assessment is on a 30 basis according to the criteria reported below: 30-30+: excellent knowledge of the topics, excellent language and vocabulary, good to excellent analytical capability, the student is able to apply knowledge to solve the proposed problems 27-29: Good management of the topics, appropriate language and vocabulary, the student is able to apply knowledge to solve the proposed problems; 24-26: 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 capability to apply autonomously the acquired knowledge. The exam will be not passed if the student will show a not acceptable knowledge of the topics.
EDUCATIONAL OBJECTIVES	The main goals of this course is knowledge of the basic skills industrial safety. The course consists in the description of the main risk indicators, risk analysis tools with particular reference to dangerous substances exposure (acute and continuous), to fire and explosion risk. Procedure as well as design countermeasures are also considered to minimize risk with reference to the pertinent legislation.
TEACHING METHODS	Teaching takes place in the second year and consists of lectures and numerical exercises.
SUGGESTED BIBLIOGRAPHY	oR. Rota - G. Nano, "Introduzione alla Affidabilita' e Sicurezza nell'Industria di Processo", Pitagora, ISBN: 8837116675, ©2007 oN. Piccinini, R. Galvagni, C. Ciarambino, I. Ciarambino, "L'Analisi dei Rischi", AIDIC (Associazione Italiana di Ingegneria Chimica), ISBN: 9788895608594, ©2011 Consultation only: oD. Crowl, J. Louvar, "Chemical Process Safety: Fundamentals with Applications", 3rd edition, ISBN: 9789332524057 ©2011 oRay Asfahl - David W. Rieske, "Industrial Safety and Health Management", 6th edition. ISBN: 9780132076500, ©2010

SYLLABUS

Hrs	Frontal teaching
4	Risk Analysis: basic concepts and terminology; classification, limits of acceptability, risk minimization methods, graphical representation of risk level (area risk).
5	Source Terms: simplified methods for atmospheric release estimation of liquids, gas and two-phase flows of dangerous substances.
4	Toxicology: How Toxicants Enter Biological Organisms, Effects of Toxicants on Biological Organisms, Dose versus Response Curves; ED, effective dose; TD, toxic dose; LD, lethal dose, probit function and parameters.
4	Industrial hygiene: Threshold Limit Values for Continuous or Acute Exposures to Volatile Toxicants, Countermeasures for safety exposure to toxicants, Ventilation. Personal Protective Devices.
2	Toxic Release and Dispersion Models. Simplified modelling approaches for gaseous environmental dispersions of neutrally buoyant substances, atmospheric stability, dense gas dispersion.
6	Fires and Explosions, Combustion reactions and the Fire Triangle, flammable materials, flammability limits, fire extinguishing materials and systems, explosions of gaseous and powders, confined and unconfined cloud explosions (detonations and deflagrations), BLEVE and Fireball.
4	Simplified modeling of fires and explosions: Simplified models for shock waves and thermal energy emissions, relevant damage estimation, Fireball modeling.
3	Confined spaces: characterization and typical examples of confined spaces, risk relevant to accessing and working inside confined spaces, operative rules to reduce risk into confined spaces, basic references to relevant regulation.
4	Pressure relief systems: definitions, Relief Types and Characteristics, Spring-Operated valve, pin and piloted valves, Rupture Discs. Design criteria for gaseous, liquid and gas-liquid flows.
4	Hazard evaluation techniques: (dedicated data base investigation, check lists, HAZOP, FMEA, FMECA, Event and Fault Tree Analysis, LOPA).
4	Regulation: industrial safety and hygiene regulation in EU and Italy.

Hrs	Practice
2	Source terms
2	Simplified modeling of fires and explosions
2	Industrial hygiene
2	Toxicology
2	Pressure relief systems