UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2016/2017
BACHELOR'S DEGREE (BSC)	ENERGY ENGINEERING
SUBJECT	TECHNICAL PHYSICS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50299-Ingegneria energetica
CODE	03318
SCIENTIFIC SECTOR(S)	ING-IND/10
HEAD PROFESSOR(S)	MORALE MASSIMO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	12
INDIVIDUAL STUDY (Hrs)	192
COURSE ACTIVITY (Hrs)	108
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**MORALE MASSIMO** Tuesday 11:00 12:00 Dipartimento di Ingegneria Ed. 9, piano primo, Studio 1010 (su appuntamento e previa conferma), anche tramite portale Teams (via chat / e-mail massimo.morale@unipa.it o massimo.morale@community.unipa.it).

DOCENTE: Prof. MASSIMO MORALE

PREREQUISITES	Basic knowledge of: Mathematical Analysis, Linear Algebra, Analytic Geometry, Classical Mechanics, Electromagnetism, Chemistry and Applied Chemistry, Technical Drawing.
LEARNING OUTCOMES	Knowledge and understanding The student, at the end of the course, will acquire knowledge of basic topics related to Heat Transfer, Fluid Mechanics, Thermodynamics and Psychrometry. The written and / or oral exam is the verification tool. Applying knowledge and understanding The student will be able to implement the concepts learned during the course to some real problems, both in design and verify. The written and / or oral exam is the verification tool. Making judgments The student will be able to recognize and classify the physical phenomena learnt for their correct management in working situation. The written and / or oral exam is the verification tool. Communication skills The student will acquire the ability to communicate and express the concepts inherent in the discipline. It will be able to hold conversations and prepare basic documents related to the Heat Transfer, Fluid Mechanics, Thermodynamics and Psychrometry. The written and / or oral exam is the verification tool. Learning ability The student will have learned the basics that will enable him to continue his engineering studies relating to the discipline with greater profit. The written and / or oral exam is the verification tool.
ASSESSMENT METHODS	The assessment is done by an ongoing evaluation and a final exam consisting of a written test and / or an oral examination on the following areas: Thermodynamics, Heat Transfer, Psychrometry, Fluid Mechanics The written tests consist in the commented resolution of 3 or 4 numeric or theoretical exercises (duration 2 h max). The oral exam consists of 3 open questions (duration 1 h max). The aim of the tests is to verify the acquired knowledge and the ability to critique, processing and communication. The final vote is out of thirty, eventually cum laude. A) Excellent (30-30 cum laude): Excellent knowledge of teaching contents; students should show high analytical and synthetic capabilities and should be able to apply their knowledge to solve highly complex problems. B) Very good (27-29): Very good knowledge of the teaching contents and excellent language control; students should show analytical and synthetic skills and be able to apply their knowledge to solve problems of medium and, in some cases, even higher complexity. C) Good (24- 26): Good knowledge of teaching contents and good language control; the students should be able to apply their knowledge to solve problems of medium complexity D) Satisfactory (19-23): Average knowledge of the teaching contents, in some cases limited to the main topic; acceptable ability to use the specific discipline language and independently apply the acquired knowledge. E) Sufficient (18): Minimum teaching content knowledge, often limited to the main topic; modest ability to use the subject specific language and independently apply the acquired knowledge. F) Fail (less than 18): Lack of an acceptable knowledge of the main teaching content knowledge. Very little or no ability to use the specific subject language and apply independently the acquired knowledge.
EDUCATIONAL OBJECTIVES	The Course has the aim to give basics for the applications in: Fluid Mechanics, Thermodynamics, Heat transfer, and Psychrometrics. In addition to the study of the theory, the Course wants to give the acquisition of a useful skill with the most common and simple calculation techniques. It is recommended to add exercises based with the help of the recommended texts.
TEACHING METHODS	Teaching is organized in theoretical lectures and practical exercises. The exercises are numerical drills solved in the classroom by the teacher and / or students under the guidance of professor. The drills are based on the theoretical concepts introduced in class and they are related to typical energy applications both civil and industrial.
SUGGESTED BIBLIOGRAPHY	Testi consigliati/Textbooks 1. Giuseppe Rodono, Ruggero Volpes: “Fisica tecnica: Vol. 1 Trasmissione del calore. Moto dei fluidi”, “Fisica tecnica: Vol. 2: Termodinamica”, Aracne editrice, Roma, 2011 2. “Dati per la Fisica Tecnica”, a cura di Giuseppe Rodono' e Ruggero Volpes, Universita' degli Studi di Palermo, Dipartimento di Energetica, Palermo, 2000

	Testi di utile consultazione/Useful books 1. Gino Parolini, Andrea Del Monaco, Donato Maria Fontana: “Fondamenti di fisica tecnica”, UTET, Torino, 1983 2. Frank Kreith, “Principi di trasmissione del calore”, (curr. Alfano G.; Naso V.), Liguori Editore, Napoli, 1975 Testi per esercitazioni/Exercise books 1. Paolo Gregorio: “Fisica tecnica esercizi svolti”, Levrotto & Bella, Torino, 1995 2. Giancarlo Giambelli, Cesare Magli, “Fisica tecnica esercizi”, CittaStudi, Milano, 1991 3. Stefano Bergero, Paolo Cavalletti, Anna Chiari: “Problemi di Fisica Tecnica: 100 esercizi svolti e ragionati”, Dario Flaccovio, Palermo, 2014 4. Andrea Del Monaco, Alberto Fantini: “Esercizi di Fisica Tecnica”, Sistema, Roma, 1968

SYLLABUS

Hrs	Frontal teaching
72	HEAT TRANSFER Introduction to the thermal transport modes: conduction, convection, and radiation. Conduction: Fourier’s postulate and law, thermal conductivity. One-dimensional, steady state conduction with and without thermal energy generation. The plane wall, radial systems. Transient conduction. Numerical methods. Convection: fluid properties. Laminar and turbulent flow. Velocity and thermal boundary layers. Newton’s law of cooling. Free and forced convection: internal and external flows. Dimensionless parameters and theirs meaning. Summary of convection relationships. Boiling and condensation. Thermal Radiation. Fundamentals definitions. Absorptivity, reflectivity, transmissivity. The black body. Grey surfaces. Emissivity. View factors, emittance, radiative exchange between black and grey surfaces. The electrical circuit analogy for radiation among grey surfaces. Complex Heat transfer: combined convection and radiation. Heat transfer with Extended surfaces, temperature distribution, rate of heat transfer, and fin efficiency. Heat Exchangers, double pipe heat exchanger, temperature distribution, logarithmic mean temperature difference method and effectiveness-NTU method. The work of friction in fluids. Kinetic-energy theorem and Bernoulli equation. APPLIED THERMODYNAMICS Definition of variables and basic concepts: system and thermodynamic state; equilibrium, processes and transformations. Temperature, heat, work. Properties of homogeneous bodies: fundamental transformations. Isothermal and adiabatic compressibility. The ideal gas. The work: the work of the external and internal forces. The first law of thermodynamics: formulation, internal energy, enthalpy, specific heat. Energy balance. The second law of thermodynamics: thermal devices, general formulation, entropy, specific heat, reversibility and irreversibility. Ideal Carnot cycle. Carnot's theorem. Thermodynamic temperature. Maxwell’s relations. State equation, phase transformations in single-component systems and, Clapeyron equation, liquid-vapor system properties. Thermodynamics of open systems. General formulations: mass conservation, first and second law. Gas power cycles. Vapour power cycles. Reverse vapour compression cycles. Heat pumps. Ideal gas mixtures. Psychrometric properties, charts and transformations. Humidity measures, AHU, HVAC plants.

Hrs	Practice
36	Exercises on the Course topics.