UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2019/2020
BACHELOR'S DEGREE (BSC)	ELECTRICAL ENGINEERING FOR THE E-MOBILITY
SUBJECT	TECHNICAL PHYSICS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	10657-Attività formative affini o integrative
CODE	03318
SCIENTIFIC SECTOR(S)	ING-IND/11
HEAD PROFESSOR(S)	COSTANZO SILVIA Ricercatore Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**COSTANZO SILVIA** Tuesday 13:00 15:00 Stanza T133 1°piano, Edificio 9 Thursday 13:00 15:00 Stanza T133 1°piano, Edificio 9

DOCENTE: Prof.ssa SILVIA COSTANZO

PREREQUISITES	Basic knowledge of mathematical analysis. Basic knowledge of linear algebra. Classical mechanics.
LEARNING OUTCOMES	KNOWLEDGE AND COMPREHENSION ABILITIES At the end of the course, students will have acquired the knowledge and methods needed to address the issues more recurrent in the engineering design concerning the problems of thermodynamics, heat transfer and power systems. The knowledge will concern thermodynamics' laws and its practical applications, thermal exchange phenomena and the fluid mechanics. ABILITY TO APPLY KNOWLEDGE AND COMPREHENSION Thanks to the acquired knowledge, the student will be able to: - identify more suitable analysis methods to address thermodynamics' problems, heat transfer and engineering plant; - set up and properly deal with the problems concerning to heat transfer. JUDGEMENT AUTONOMY At the end of the course, students will be able to single out the most appropriate solutions for each specific question in the field of thermodynamics and heat transfer, evaluating the effectiveness of different solutions. In detail students will be able to: - compare processess for the production of energy and work and assess its efficency; - estimate the effectiveness of different solutions for improving energy efficiency of components and systems through a proper identification and computation of involved heat exchanges; COMMUNICATION ABILITIES The student will have acquire the ability to communicate and express issues concerning to the themes of the course. He/she will be able to support conversations on thermodynamics and heat transfer. LEARNING ABILITIES The student will have acquired the update capability by consultation of its scientific publications. Thanks to the acquired knowledge, students will be able to learn new methods of analysis to address energy and environmental issues. EDUCATIONAL OBJECTIVES The aim of the course is to provide to the student the knowledge and methods needed to address the issues more recurrent in the engineering design concerning the problems of thermodynamics, heat transfer and power systems. In detail the knowledge will concern: - thermodynamics' laws of thermodynamic systems both closed and control volume; - the properties of pure substances; - gas mixtures, humid air mixtures and psychrometry; - direct and inverse cycles; - fluid mechanics; - heat transfer: conduction, convection, radiation.
ASSESSMENT METHODS	The assessment of learning will be carried out through an oral examination. The final evaluation aims at appraising whether the student possesses a good knowledge and comprehension of the topics acquired during the course, and whether he/she has acquired the ability to apply theoretical concepts to practical situations. In detail, the examination is aimed to evaluate the student's ability to use the acquired knowledge for solving problems and numerical exercises. The exercises will be chosen among some topics concerning thermodynamics, heat transfer and fluid mechanics. Student will be evaluated on the basic of two key criteria: (1) adequacy and accuracy of the oral answers and numerical exercises; (2) student's ability to express in a thecnical correct language and to present to the examiner the topics of the program in a successful way. The student will have to solve at least one numerical exercise and answer at least six oral questions on all topics described in the list below (see"Programma dell'insegnamento"). The lowest evaluation grade will be achieved if the student proves his/her knowledge and comprehension of the main subjects, at least within a general framework, and can apply that knowledge. The evaluation range is comprised between 18/30 and 30/30. In detail, the final assessment, properly graded, will be formulated on the basis of the following conditions: a) Sufficient knowledge of the topics and theories; sufficient awareness and autonomy in the application of theories to solve problems; sufficient expressive capacity, rework and multidisciplinary connection (18-21 rating);

	b) Fairly good knowledge of the topics and theories; fairly good awareness and autonomy in the application of theories to solve problems; discrete expressive capacity, rework and multidisciplinary connection (22-25 rating); c) Good knowledge of the topics and theories; good awareness and autonomy in the application of theories to solve problems; good expressive capacity, rework and multidisciplinary connection (26-28 rating); d) Excellent knowledge of the topics and theories; excellent level of awareness and autonomy in the application of theories to solve problems; excellent expressive capacity, rework and multidisciplinary connection (29-30 cum laude rating).
EDUCATIONAL OBJECTIVES	The aim of course is to provide all the knowledge and methods to address the issues more recurrent in the engineering design concerning the problems of thermodynamics and heat transfer. Teaching methods consist in theoretical lectures and numerical exercises, aimed at applying the learned knowledge. In detail, the exercises will concern: - properties of pure substances; - thermodynamics' laws of thermodynamic systems both closed and control volume; - thermodynamics cycles; - fluid mechanics; - heat transfer.
TEACHING METHODS	Teaching takes place in the second half of the 1st year and consists of theoretical lectures and numerical exercises, aimed at applying the learned knowledge.
SUGGESTED BIBLIOGRAPHY	The aim of course is to provide all the knowledge and methods to address the issues more recurrent in the engineering design concerning the problems of thermodynamics and heat transfer. Teaching methods consist in theoretical lectures and numerical exercises, aimed at applying the learned knowledge. In detail, the exercises will concern: - properties of pure substances; - thermodynamics' laws of thermodynamic systems both closed and control volume; - thermodynamics cycles; - fluid mechanics; - heat transfer.

SYLLABUS

Hrs	Frontal teaching
2	INTRODUCTION TO THERMODYNAMICS: Definition of heat, energy and power - Unit of measurament - Thermodynamics systems - Property of thermodynamic systems - Thermodinamic state and equilibrium - Thermodynamic processes.
4	PROPERTIES OF PURE SUBSTANCES: Chemically and physically homogeneous substances - The T-v diagram - The P-v diagram - The P-T diagram - Two-phase mixtures of a pure substance - Thermodynamics properties of liquid, satured vapor and superheated vapor - Ideal gas - The ideal-gas equation of state - Property and thermodynamic processes of ideal gases - Thermodynamics properties of real gases.
4	THERMODYNAMICS OF CLOSED SYSTEM: The first law of thermodynamics - Equivalence between heat and work - Internal energy - Enthalpy.
3	THERMODYNAMICS OF THE CONTROL VOLUME: Mass balance and energy balance - First law of thermodynamics for control volumes - Steady-flow processes - Some steady-flow engineering devices.
4	THE SECOND LAW OF THERMODYNAMICS: The statements of Kelvin and Clausius - Heat engines, refrigeration engines and heat pump - Thermodynamics efficiency - Reversible and irreversible processes - The Carnot Cycle - The Carnot principles - The thermodynamics temperature scale - Entropy - Entropy diagram (T-S) - Enthalpy diagram (H-S)
6	THERMODYNAMICS CYCLES: Gas power cycles: Otto cycle - Diesel cycle - Joule cycle - Bryton cycle - Vapor and combined vapor cycles: Carnot vapor cycle - Rankine cycle - Refrigerating cycles - Heat Pump.
2	FLUID DYNAMICS: Physical aspect of the fluid low - Laminar and turbolent flow - Viscosity - Dynamic boundary layer - Thermal boundary layer - Fundamental equations of isothermal flow.
3	THERMAL CONDUCTION: Fourier's law - Heat conduction equation - Steady-state conduction and transient conduction - Global exchange thermal coefficient.
4	CONVECTIVE HEAT TRANSFER: Physical mechanism on convection - Laminar and turbulent flow - Thermal boundary layer - Reynolds, Nusselt, Prandt and Grashof numbers - Forced, natural and mixed convection - Dimensional analysis.
3	RADIATION HEAT TRANSFER: Thermal radiation - Black body - Stefan-Boltzmann's law - Plank's law - Wien's law - Lambert's law - Radiative properties: Emissivity, absorptivity, reflectivity and transmissivity - Kirchhoff's law - Gray bodies.
1	SIMULTANEOUS PRESENCE OF DIFFERENT TYPES OF THERMAL EXCHANGE: Mixed thermal exchange phenomena - The Newton's law - Overall heat transfer coefficient.

Hrs	Practice
18	NUMERICAL EXERCISES