UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
BACHELOR'S DEGREE (BSC)	MECHANICAL ENGINEERING
SUBJECT	TECHNICAL PHYSICS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	10657-Attività formative affini o integrative
CODE	03318
SCIENTIFIC SECTOR(S)	ING-IND/10
HEAD PROFESSOR(S)	PIACENTINO ANTONIO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**PIACENTINO ANTONIO** Monday 11:30 13:30 Stanza T121 - 1° piano Edificio n 9, Dipartimento di Ingegneria

DOCENTE: Prof. ANTONIO PIACENTINO

PREREQUISITES	The student is supposed to have a basic knowledge about the fundamentals of algebra and mathematics, with the capability to solve algebraic equations and study of simple functions. Also, the student is supposed to have a basic knowledge abouth the laws of physics, with regard to the principles of statics and dynamics and to the principle of dimensional consistence of analytical expressions representing physical phenomena.
LEARNING OUTCOMES	Knowledge and capability to understand: At the end of the course, the student will have acquired a knowledge of the principles of applied thermodynamics, thermophysical properties of substances and the different heat transfer modes. Also, the student will acquire basic understanding of fluid mechanics. Assessment: during the oral examination, by questions focused on theoretical aspects. Applying knowledge and understanding: The student will be able to apply the principles of thermodynamics and heat transfer to simple engineering systems. In particular, the student will be able to analyse direct and inverse thermodynamic cycles, to apply the principles of thermodynamics to gas-vapor mixtures in air conditioning systems and the heat transfer equations. Assessment: during the oral examination, by practical/ numerical exercises. Autonomous evaluation: The student will be able to identify, in full autonomy and by the light of the principles of thermodynamics, the correctness of simple models, and to evaluate the efficiency of elementary energy conversion systems. Also, the student will be able to identify solutions for the technical exploitation of heat transfer. Assessment: during the oral examination, by analysing the capability of the student to interpret correctly practical configuration based on the theoretical principles of thermodynamics and heat transfer, while identifying those more suited for the specific examined configuration. Capabilities to explain: The student will be able to discuss with engineers or people with technical/ practical skills about thermodynamic transformations of substances and propagation and utilization of heat, thanks to the knowledge of both the technical principles and the appropriate vocabulary of specialistic terms. Assessment: during the oral examination, analysis of the capability to express simple and more complex concepts correctly, clearly and with adequate use of the specialistic terminology. Lifelong learning skills The student will have acquired the basic concepts needed to conduct deeper and more advanced studies on the analysis of energy systems, thermal machines and plants, HVAC plants and equipments and heat transfer devices.
ASSESSMENT METHODS	The evaluation is based on a final oral examination. The student must meet, during the oral examination, at least three theoretical or applicative questions/exercises on all the contents covered by the course, to be developed according to the approaches available in the support material or the recommended textbook. The final assessment is aimed at evaluating the student in terms of knowledge and level of understanding of the topics addressed in the course, capability of interpretation and autonomous analysis of applicative case studies. In order to achieve a sufficient evaluation, the student must at least show knowledge and understanding of general principles and capability to address some basic applicative problems concerning thermodynamics of pure fluids and heat transfer; at meantime, the student must expose sufficient capabilities in discussing and argumenting the topics, demonstrating the possibility to transfer his knowledge to the examiner. Below this threshold, the examination is considered not sufficient. The duration of the final oral examination covering all the contents of the course is approximately 50 minutes. The evaluation marks are out of thirty. Rating - Votes Excellent 30 - 30 with distinction: excellent knowledge and understanding of the topics, excellent evidence of capability to apply the theoretical and technical knowledge for solving provlems, excellent ability to communicate knowledge in terms of clearness, fluency and correct use of language Very good 26-29: very good knowledge and understanding of the topics, evidence of more than adequate capability to apply the theoretical and technical knowledge for solving provlems, very good ability to communicate knowledge with clearness and appropriate use of language Good 24-25: basic knowledge of the main topics, good capability to explain concept with a good use of technical language, reasonable ability to independently apply the knowledge to the solution of the

	proposed problems Satisfactory 21-23: student does not have full capabilities but has the basic knowledge, more than sufficient control of the technical language, more than sufficient ability to address autonomously practical problems by applying the theroretical knowledge Sufficient 18-20: student has minimal knowledge of topics and minimal capability to use the appropriate language, very little or no ability to independently apply the knowledge Insufficient: student does not have an acceptable knowledge of the topics.
EDUCATIONAL OBJECTIVES	The course is aimed at providing an adequate knowledge and understanding of the principles of thermodynamics, fluid mechanics and heat transfer and the capability to apply this knowledge to examine and solve typical problems in different engineering areas.
TEACHING METHODS	Lessons and numerical applications
SUGGESTED BIBLIOGRAPHY	* "Elementi di Fisica Tecnica", Y.A. Cengel, J.M. Cimbala, R.H. Turner. McGraw Hill Education, 2017.

SYLLABUS

Hrs	Frontal teaching
9	Extensive, intensive and specific properties - Continuity equation - Thermodynamic properties of pure substances - Phase transitions and pVT surfaces - Thermodynamic processes of vapours - Internal Energy - State and transformation properties - Principle of corresponding states.
12	First principle of Thermodynamics for closed and open systems - Specific heat of ideal gases, solids and liquids - Polytropic transformations
9	The second Principle of Thermodynamics, as formulated by Kelvin-Planck and Clausius - Carnot Cycle, reversible and irreversible processes - Carnot theorems - Thermodynamic Scale of temperature
5	Clausius inequality, entropy, Gibbs diagram, TdS expressions, higher efficiency of Carnot cycle compared to any internally reversible cycle at same extreme temperatures, entropy balances.
4	Direct cycles: Rankine cycle, solutions to increase the conversion efficiency
5	Inverse cycles: cooling machines and heat pumps, Four-way valves, Coefficient of Performance and solutions to increase it
7	Heat transfer by thermal conduction: thermophysic properties,Fourier equation, electric analogy, single- and multi-layer walls, heat conduction in cylindres and spheres
8	Natural and forced convection: analysis of the phenomena, thermal and mechanical boundary layers, fluid velocity and temperature profiles for fluxes on a flat wall or inside tubes, adymensional numbers and Buckingham theorem, empirical correlations, use of extended surfaces and fins
6	Heat transfer by thermal radiation: black body, total and spectral emission, solar radiation and irradiation, gray surfaces, radiosity, heat transfer between bodies and application of electric analogy, view factors

Hrs	Practice
2	Numerical applications on thermodynamic properties of pure substances
5	The first principle of thermodynamics: numerical application on closed systems (ideal gases, polytropic processes, Clapeyron pV representation) and open systems approached as control volumes
1	Numerical applications on the 2nd principle of Thermodynamics and on entropy
3	Exercises on Rankine cycle and on the improved cycle with regeneration: evaluation of thermodynamic efficiency
2	Numerical application on a refrigeration systems operating with R134a: calculation of COP and cooling capacity
3	Numerical exercises on heat transfer in stationary conditions: application to multi-layers wall and cylinders