UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria		
ACADEMIC YEAR	2017/2018		
MASTER'S DEGREE (MSC)	ENERGETIC AND NUCLEAR ENGINEERING		
INTEGRATED COURSE	THERMOTECHNIQUE AND TECHNICAL PLANTS - INTEGRATED COURSE		
CODE	18039		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	ING-IND/10, ING-IND/11		
HEAD PROFESSOR(S)	LA ROCCA VINCENZO	Cultore della Materia	Univ. di PALERMO
OTHER PROFESSOR(S)	LA ROCCA VINCENZO ORIOLI ALDO	Cultore della Materia Professore Ordinario	Univ. di PALERMO Univ. di PALERMO
CREDITS	15		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	2° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**LA ROCCA VINCENZO** Thursday 10:00 11:00 Stanza T128 **ORIOLI ALDO** Monday 12:00 13:00 DEIM - Stanza T206 Tuesday 12:00 13:00 DEIM - Stanza T206 Wednesday 12:00 13:00 DEIM - Stanza T206 Thursday 12:00 13:00 DEIM - Stanza T206 Friday 12:00 13:00 DEIM - Stanza T206		

DOCENTE: Prof. VINCENZO LA ROCCA

PREREQUISITES	For a good understanding of the topics discussed during the lectures, a good knowledge of Mathematics and Applied Physics is required.
LEARNING OUTCOMES	TERMOTECNICA Knowledge and ability 'to understand The student at the end of the course will have 'in-depth knowledge of Heat applied to energy processes and design methodologies for the characterization of the heat exchange equipment operation, boilers and industrial furnaces. To achieve this objective, the course includes: lectures; Analysis and discussion of case studies. For verification of this objective examination it includes an oral test on the program's arguments. Capacity 'to apply knowledge and understanding The student will be 'able to actually implement the real issues, is verification that project, the concepts learned during the course. To achieve this objective, the course includes lectures and guided practical lessons. For verification of this objective part of the oral exam and 'dedicated to the solution of simple exercises. Making judgments The student will be 'able to recognize and classify the physical phenomena studied the Course for a correct management of the same in working practices. To achieve this objective, the course includes lectures and guided practical lessons. For verification of this objective part of the oral exam and 'dedicated to the solution of simple exercises. Enable 'communication The student will acquire 'the ability' to communicate and express concepts inherent in the discipline. Sara 'can sustain conversations and prepare basic documents regarding the material covered during the course. To achieve this objective, the course includes lectures and guided practical lessons. For verification of this objective part of the oral exam and 'dedicated to the solution of simple exercises. Capacity 'Learning The student at the end of the course will be 'able to design heat exchangers, boilers, furnaces and to study the operating characteristics with appropriate simulation models, to design the components of complex energy systems and to deal with the study of components related to processes complex for technological innovation of systems and energy plants. To achieve this objective, the course includes lectures and guided practical lessons. For verification of this objective part of the oral exam and 'dedicated to the solution of simple exercises. TECHNICAL SYSTEMS Knowledge and ability 'to understand The course aims at the acquisition of knowledge of the legislation and the technical design of heating, cooling and ventilation of buildings. The assessment of knowledge and skills' will take place in 'understanding through a final examination during which the student must' expose the topics covered in the course. Knowledge and ability 'to apply understanding: The course allows the application of knowledge and methodological tools to intervene with specific expertise in the design of heating, cooling and ventilation of buildings. To make more 'effective understanding of theoretical knowledge will be carried out exercises for the calculation and dimensioning of plant components. The ability 'to apply the knowledge learned will be' even developed through the use of IT tools normally used in a professional environment. The examination of knowledge and ability to apply understanding acquired by the student will take place during the final exam, through the discussion of the topics and the application of some of the numerical methods described in the course. Making judgments: The course aims to achieve integration between the knowledge derived from the study of other disciplines, basic and vocational skills, included in the three-year Bachelor and Master of Science (mathematics, physics, technical physics, machinery, energy, heat engineering, systems electrical, etc.) so as to allow to manage, in a critical and autonomous way, decisions related to the complexity 'of the design process. The student will be 'able to select the design solutions more' appropriate and dimension all components of giving due consideration to the ethical and social consequences related to energy and economic policies that do not follow the rules of good technique dictated by the acquired knowledge. The acquisition of autonomy of judgment on the part of the student will be 'checked during the final exam, through a critical illustration of the possible design choices.

	Enable 'communicative: The course allows you to develop the ability 'to communicate, clearly and without ambiguity, to any type of party, the reasons for the design choices made and their connection with the underlying theoretical knowledge. The acquisition of skills 'communication from the student will be' checked during the final exam. Capacity 'to learn: The course aims to develop the skills' learning to get you through the study, in an autonomous or self-directed way, the successor framework of the MSc course and what must 'be further learned in order to maintain the most' appropriate level professional and / or scientific updates during future career of energy and nuclear engineer. Such capacity 'will be' developed urging the student to draw independently from theoretical sources and information, other than those proposed during the course, looking texts, regulations, laws, websites, scientific articles, etc. in which the arguments are handled in languages other than English and according to cultural and technological approaches that do not belong to the Italian tradition. The ability 'to learn will be' checked in the final examination during which the student will give 'proof of achieved awareness and capacity' critical analysis and synthesis of theoretical and applied aspects of the discipline studied
ASSESSMENT METHODS	The candidate will have to answer at least four oral questions regarding any of the topics covered by the program which can be found in the recommended textbooks. Final assessment aims to evaluate whether the student has knowledge and understanding of the topics, has acquired a critical thinking and is able of taking decisions independently. A successful outcome can be achieved if the student shows a good knowledge and understanding of the topics at least in general terms and reaches a good level of problem solving; good presentation and communication skills are also important to show the examiner confidence on the topics. If these requirements are not met, the outcome of the examination will be negative. The more, however, the examinee with its argumentative and presentation skills can interact with the examiner and the more his knowledge and application capabilities go into detail on the subject of the discipline, the more the assessment is positive. The assessment is carried out of thirty according to the following schedule. Outcome Rating Rating Excellent30-30 laude The candidate shows an excellent knowledge of the topics, excellent communication skills, good analytical ability. The student is able to apply the knowledge to solve problems proposed. Very good 26-29 The candidate has a good knowledge of the subject, good communications skills. The student is able to apply knowledge to solve problems proposed. Good 24-25 The candidate has a basic knowledge of the main topics, discrete properties language, with limited ability to independently apply the knowledge to solve the proposed problems. Satisfactory21-23The candidate does not fully know the main topics but patly know them, satisfactory property language, poor ability to independently apply the knowledge gained. Sufficient18-20 The candidate has a very basic understanding of the main topics and of the technical language, very little or no ability to independently apply the knowledge gained. InsufficientThe candidate does not show an acceptable knowledge of the topics covered during the module.
TEACHING METHODS	Lectures and exercises

MODULE
TECHNICAL PLANTS

Prof. ALDO ORIOLI

SUGGESTED BIBLIOGRAPHY

C. Pizzetti “Condizionamento dell’aria e refrigerazione”, Masson Italia Editori
A. Briganti “Manuale della climatizzazione”, Tecniche Nuove
A. Briganti “Il Condizionamento dell’aria”, Tecniche Nuove
Normativa tecnica UNI
Materiale didattico messo a disposizione durante il corso

AMBIT	50367-Ingegneria energetica e nucleare
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54

EDUCATIONAL OBJECTIVES OF THE MODULE

The course intends providing the knowledge necessary for the modern design, energy oriented and economically sustainable, of the HVAC systems for civil buildings.

SYLLABUS

Hrs	Frontal teaching
1	Presentation of the course and teaching aids.
2	Psychrometrics. Moist air. Saturation. Humidity definitions. Dew point temperature. Moist air enthalpy. Adiabatic saturation temperature. Wet bulb temperature. Temperature measurements. Humidity measurements. Psychrometric chart. ASHRAE chart. Main psychrometic processes.
3	Environmental conditions for comfort. Thermohygrometric comfort. Energy balance of the human body. Human body thermoregulation. Conditions for thermohygrometric comfort. Prediction of thermal comfort. Environmental indexes. Design environmental conditions. Fanger equation. Sensation indexes.
7	Heating loads. Load calculations. Design temperatures. Thermal transmittance of outside elements. Thermal transmittance of simple windows. Thermal transmittance of double windows. Thermal transmittance of glass windows. Total heat loss of heated spaces. Outward heat losses. Heat loss toward non-heated spaces. Heat loss toward the ground. Heat losses toward or from heated spaces with different air temperatures. Intermittently heated spaces. Ventilation heat losses. Design heating load.
3	Air conditioning loads. Cooling load calculations. Solar heat gains thru windows. Heat gains thru walls. Internal loads. Air infiltrations.
7	HVAC system typologies. HVAC system classification. All-air systems. All-air systems for single thermal zone. Single duct systems for multiple thermal zones. Dual duct system. Dual conduit system. Air-water systems. Primary air fan-coil system. Primary air induction unit system. Radiator and radiant panel systems. Direct expansion systems. Criteria for selecting HVAC systems.
2	Air quality. Air pollutants. Indoor air quality. Air change mechanisms. Ventilation. Indoor air flows. Italian standards on ventilation. Air filtration. Air filter types. Selection of air filters.
2	Air conditioning processes. Air used to transfer energy. Air handling units. Mixing of airstreams. Simple heating and cooling. Air humidification. Air dehumidification. Internal loads compensation. All-air cooling. All-air heating.
3	Space air diffusion. Room air movement. Mixed-air systems. Outlet classification. Air diffusion system performance. Fully stratified systems. Partially mixed systems. Outlet types. Selection and location of exhaust inlets.
2	Air ducts. Bernoulli equation. Friction losses. Dynamic losses. Fan selection. Duct construction. Air duct design methods. Construction foresights. Duct thermal insulation.
3	Water piping. Piping materials. Bernoulli equation. Friction losses. Dynamic losses. Water pump selection. Water piping components. Expansion tank. Air venting. Piping installation. Piping thermal insulation.
5	Heating and cooling system equipment. Boilers. Chillers. Vapor-compression chillers. Absorption chillers. Heat pumps. Cooling towers and remote condensers. HVAC system schemes.
2	Automatic HVAC control systems. Types of control action. Sensors. Controllers. Controlled devices and actuators. Automatic control schemes.

Hrs	Practice
5	Air-handling unit design.
5	Air duct design.
2	Water piping design.

MODULE
THERMOTECHNICS

Prof. VINCENZO LA ROCCA

SUGGESTED BIBLIOGRAPHY

Dispense, appunti e copie di articoli e manuali distribuiti durante il corso
D.Annaratone, Generatori di vapore, CLUP, 1998
S.S.Kutateladze, A councise encyclopedia of heat transfer, 1971
W.Trinks, M.H.Mawhinney; Industrial furnaces, J.Wiley, 1953
A.Bejan, G.Tsatsaronis, Michael Moran – Thermal design and optimization – J.Wiley, 1996

AMBIT	50367-Ingegneria energetica e nucleare
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81

EDUCATIONAL OBJECTIVES OF THE MODULE

Objective of the module and 'to deepen the study of Heat applied to energy processes and design methodologies for the characterization of the heat exchange equipment operation, boilers and industrial furnaces.
Purpose of the course, in addition to the study of the theory, and 'the acquisition of a certain familiarity' with the various computational techniques. At what 'tend exercises, to which it is recommended to add the performance of exercises with the help of the recommended texts.

SYLLABUS

Hrs	Frontal teaching
25	Heat exchangers: types of exchangers, shell and tube, rod cover, mantle, head cover, the tube bundle, baffles, other components of the heat exchanger, plate heat exchangers, finned tubular exchangers, logarithmic mean temperature difference, the design and calculation verification of a heat exchanger, calculation of the load losses, plant regulating valves; two-way valves, three-and four-way, calculation of the regulating valves.
22	Boilers constructive characteristics of the boilers, various types of boilers: fire tube, water tube, to cast iron elements, boilers for the production of saturated and superheated steam, sizing from boilers, combustion chambers, the adiabatic flame temperature , calculation of the combustion chamber, yields of boilers, calculation for directly and indirectly.
15	Industrial furnaces: construction characteristics of industrial furnaces, types of industrial furnaces, thermal load, heat transfer in furnaces, calculation and verification of the ovens.

Hrs	Practice
19	Various exercises on the arguments developed during the lectures