UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2017/2018
MASTER'S DEGREE (MSC)	ELECTRICAL ENGINEERING
SUBJECT	POWER PLANTS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50363-Ingegneria elettrica
CODE	01782
SCIENTIFIC SECTOR(S)	ING-IND/33
HEAD PROFESSOR(S)	FAVUZZA SALVATORE Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**FAVUZZA SALVATORE** Monday 12:00 13:30 Studio proprio sito al terzo piano del DEIM (ex DIEET) - edificio 9 Wednesday 14:00 15:00 Polo decentrato di Caltanissetta

DOCENTE: Prof. SALVATORE FAVUZZA

PREREQUISITES	Knowledge of: - main thermodynamic cycles and heat transfer processes; - electrical machines, with particular reference to the characteristics and to the principles of operation of the transformer, the synchronous machine and related faults; - power systems, with particular reference to faults, short-circuit currents, protections.
LEARNING OUTCOMES	Knowledge and understanding The student at the end of the course will have acquired knowledge and understanding of the various aspects of electrical energy generation from traditional fossil fuels (coal, fuel oil, diesel, gas) and the hydraulic source, and also regarding the evolution of the electrical power system towards the integration of centralized production and distributed generation. The issues covered in the course are in engineering filed, but also economical, environmental and social considerations are faced. To achieve these objectives, the course consists of lectures and guided exercises. The verification of these objectives is expected within the final oral exam. Applying knowledge and understanding The student at the end of the course will be able to apply his knowledge and understanding to identify the major issues related to the centralized production of electrical energy, both from thermodynamic and electrically aspects, identifying connections even with the topics covered in other courses. To achieve these objectives, the course will include lectures, discussion of case studies and tutorials. The verification of these objectives is expected within the final oral exam. Making judgments The student at the end of the course will have acquired the ability to gather and interpret all the data necessary for the identification and analysis of the main issues related to the conversion into electrical energy of other primary forms of energy, being constantly stimulated during the course on the formation of an independent judgment on the above mentioned issues. To achieve these objectives, the course consists of lectures and discussion of case studies. The verification of these objectives is expected within the final oral exam. Communication skills The student at the end of the course will have acquired the ability to communicate competently, consistency and using a correct language on the different issues and problems relating to electrical energy generation, also in correlation with the topics covered in other courses; it will be able to interact with professionals from other fields of engineering, highlighting problems and prospecting solutions too. To achieve these objectives, the course consists of lectures and discussion of case studies, placing particular emphasis on presentation and exhibition of the topics covered. The verification of these objectives is expected within the final oral exam. Learning skills The student at the end of the course will have acquired knowledge not only on the aspects related to the specific technical-engineering issues related to electrical energy generation, but also on other aspects such as economic, environmental and social. He will have acquired knowledge overall on the need to work always and in any case a continuous self-study, because of the constant changes in regulations and legislation and the technical and technological progress. He will be able, therefore, to continue his engineering studies with greater autonomy, awareness and discernment, recognizing that independent learning will characterize throughout his professional life. To achieve these objectives, the course consists of lectures and discussion of case studies. The verification of these objectives is expected within the final oral exam.
ASSESSMENT METHODS	The exam is oral. It consists on a discussion during which the student must answer to at least four open questions on the entire program of the course. Oral exam looks at: - the degree of knowledge and understanding of course programme; - the ability to apply the knowledge gained with competence, consistency, efficiency and independence of judgment, to solve problems or applications related to course and/or related contexts; - the ability to reprocess the knowledge and skills acquired by identifying disciplinary and interdisciplinary links; - the clearness capacity and correct use of language.

	The evaluation is done at the end of the exam depending of the overall results achieved according to what follows: - 28-30/30 e lode The student demonstrates a very good / excellent knowledge and understanding of the course contents, which declines in absence of errors and with self-correction of some inaccuracies; the answers to the questions posed are organized with a rigorous approach by providing complete solutions and demonstrating good / excellent application capabilities with a high degree of autonomy. The ability to communicate is characterized by very good / excellent clearness, fluency and use of language and articulated arguments which show a full ability to rielaborate and make judgments both in the same discipline and in interdisciplinary fields. - 24-27 The student demonstrates a satisfactory / good knowledge and understanding of the course contents, which declines with few minor errors or omissions partially corrected or integrated by means the professor guide; the answers to the questions posed are basically correct, showing a satisfactory / good ability of independent analysis. The ability to communicate is characterized by a satisfactory / good consistency in connecting the concepts both in the same discipline and in interdisciplinary fields; adequate clearness and substantially correct use of language. - 18-23 The student demonstrates a sufficient/decent knowledge and understanding of discipline contents, which declines with not excessively several and critical errors and/or omissions; the answers, even if adequate, are characterize by a limited level of autonomy and effectiveness. The ability to communicate is of acceptable level of clearness, fluency and use of language, but with some limitations of concepts reinterpretation and connection in disciplinary context. - below 18 The student shows to have not reached the minimum level of learning outcomes. Insufficient knowledge, with many several and siginificant errors or inaccuracies; insufficient capacity in the analysis and resolution of the problems, lack of autonomy in the methodological approach, inability to orient in an autonomous way or to conduct disciplinary and interdisciplinary links; deficient presentation skills and argumentation, unclear and inadequate use of language.
EDUCATIONAL OBJECTIVES	Teaching goal is to allow that the student acquires the knowledge and skills related to centralized production mode from traditional source of electricity (coal, fuel oil, diesel, gas) and hydroelectric, and to recognize and solve the general problems of electrical energy production, management and related facilities protection. A further objective is to gain awareness about the need to make a continuos self-study during the whole of the future professional activity, because of the constant changes in regulations and legislation and the technical and technological progress.
TEACHING METHODS	Lectures, exercises, projects/case studies analysis and classroom discussion. Teaching activities are organized to help the achievement learning outcomes and educational objectives. The course is characterized by theoretical contents and practical aspects; it is done in order to stimulate the participation of students by providing interactive lectures, in which priority is given not only to the connections among topics of the same course, but even those interdisciplinary; during exercises and discussion of case studies, the student is encouraged to critically analyze the issues proposed by developing their skills of analysis, of independent evaluation, communication, argumentation and of use of language, being called upon to deal with the professor and other students.
SUGGESTED BIBLIOGRAPHY	- Zanchi: “Centrali elettriche” – Vol. I, II, III - Tamburini Editore. - Rova: “Centrali elettriche” - CLEUP - Battaglia: “Metodi di previsione statistica” – Springer Verlag Italia. - El-Wakil: “Power plant technology” – McGrow-Hill. - Drbal: “Power plant engineering” – Chapman & Hall.

SYLLABUS

Hrs	Frontal teaching
6	Planning of electrical energy production- Planning: strategic and executive planning. Long, medium, short and instantaneous management. Analysis of load diagrams - Load diagrams: chronological and load duration. Parameters of the load diagram: average power and peak power, load and peak factors, duration of use. Deviance, shape index, dilation. Forecasting electricity needs - Classical methods: extrapolation and regressive. analytical functions of adaptation to the analysis of time series data: exponential, logistic, polynomial. Adaptation by the least deviations method. Annual energy subdivision: daily and seasonally coefficients. Prediction of power peaks - Indirect method. Direct methods: simple extrapolation, separate extrapolations. Overall cost considerations.

SYLLABUS

Hrs	Frontal teaching
11	Hydroelectric power plants - Catchment. Analysis of rain regimes: continental, sublittoral, mediterranean. Basins. Hydrodynamic characteristic of a water course: frequency curve, probability density function, duration curve. Coefficient of utilization of a water course, coefficient of use of the system. Maximum derivable delivery. Regulation of outflows - integral curves of natural inflows and outflows. Determination of the volume of the tank in the event of a total adjustment of a basin. Weirs: a massive dam and lightened gravity dam in time, dam spurs, mobile and fixed beams. Notes on water hammer and mass movements.
2	Pumping stations - Peak systems, static and dynamic services, types of plants to cover peaks, share of production diagram assignable, pumps / reversible turbines. Ternary and binary groups. Start-up of the groups: the launch of asynchronous motor, synchronous and semisynchronous, asynchronous reduced voltage starter.
13	Thermal power plants - Types, classification, general indications on size, cost, flexibility. Carnot cycle. Rankine - Clausius Cycle. Hirn cycle. Influence on the performance of the discharge pressure and of the initial parameters. Supercritical pressure cycles. Reheated cycle. Determination of the reheating pressure. Regenerative cycles. Continuous regeneration. Cycles 1, 2, .. z spills. Fuel cycle. Types and characteristics of fuels. Excess air. Mills for pulverized coal. Burners. Boiler. Regenerative heating exchanger. Mechanical and electrostatic filters. Draw blown, vacuumed and balanced. Feed water cycle. Steam generator. Mechanisms of heat exchange between the flue gas and working fluid. Average temperature of pipes. Irradiated and convective superheater. Disposition of the sections in cocurrent or in countercurrent. Attemperators tubes. Sizing of the pipe thickness. Boiler type: natural circulation, assisted circulation and crossing (Sulzer and Benson). Instability of driving at low loads. Steam turbines: action and reaction. Regenerative heating exchangers. Extraction and feeding pump. Degasser. Cycle of condensation. Wet and dry cooling towers. Notes on voltage and frequency regulation .
7	Gas turbines power plants - Operating principle and classifications. Simple closed cycle: performance and mass work. Simple open cycle: performance and work. Real simple open cycle. Self-sufficiency condition of the real simple-cycle . Performance and mass work of real simple cycle. Ideal and real cycle intercooler compression: performance and mass work. Ideal and real-combustion cycle. Regenerative cycles. Total and partial regeneration: performance. Cycle with intercooling, afterburning and regeneration. Ericsson cycle. Power plants with combined cycle - Principle of overall operation. Fired and unfired cycles. Combined cycles with a single level of pressure, at two pressure levels and with three pressure levels with and without reheat.
8	Auxiliary services - Classification: group services, general, emergency, safety. Power schemes. Outline of excitation systems. Power stations - Features and functions. Busbar schemes: dual main system, classic, duplex, H, H modified, ring. Protection systems of the central electrical machines - Differential protection for central transformers. Rotor fault protection. Stator protection against internal faults. Alternatores capability curves.
2	Evolution of the power system: integration of centralized production and distributed generation.

Hrs	Practice
1	Determination of the amount of steam, of the specific fuel consumption and of the refrigerant required for the production of a kWh of electric energy.
1	Determination of the surface and length of the condenser tubes.
1	Case study: thermal power plant with reheater and 7 spills regeneration cycle. Calculation of specific consumption and performance.
1	Calculation of the efficiency of a combined cycle power plant.

Hrs	Others
1	Presentation of course, objectives, exams outline, texts.