UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2018/2019
BACHELOR'S DEGREE (BSC)	BIOMEDICAL ENGINEERING
SUBJECT	ELECTRICAL DEVICES AND CIRCUITS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50298-Ingegneria elettrica
CODE	02965
SCIENTIFIC SECTOR(S)	ING-IND/31
HEAD PROFESSOR(S)	ALA GUIDO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**ALA GUIDO** Monday 10:00 11:00 ufficio 2022, edificio 9, viale delle Scienze, Palermo

DOCENTE: Prof. GUIDO ALA

PREREQUISITES	Basic principles of calculus and physics, with particular reference to the following topics: properties and study of functions, derivatives, integrals; trigonometry; Matrix equations and algebra of complex numbers; differential equations; Electric and magnetic fields.
LEARNING OUTCOMES	D.1: KNOWLEDGE AND UNDERSTANDING Students are expected to acquire knowledge of the fundamental principles that describe and regulate linear electrical networks and the tools to understand the functions of the fundamental circuit components and the main methods of resolving the linear and invariant time circuits in stationary and sinusoidal mode, as well as the behavior in transient elementary linear circuits. D.2: APPLYING KNOWLEDGE AND UNDERSTANDING Students are expected to apply their knowledge and skills acquired in the analysis and synthesis of complex electrical circuits, becoming able to discern the physical phenomena that those circuits model, and applying in their formulation the appropriate methods, techniques and acquired tools D.3: MAKING JUDGMENTS Students are expected to be able to identify the most appropriate analytical techniques for the object of study applications, to critically approaching problems and make judgments as to the choice of the basic circuit components, in relation to the expected operation and the technical requirements. D.4: COMMUNICATION SKILLS Students are expected to clearly communicate their knowledge, analysis and conclusions concerning information, ideas, problems and solutions concerning the analysis and synthesis of elementary linear and invariant time circuits, addressing both specialist and non-specialist audiences, with correct use of language. D.5: LEARNING SKILLS Students are expected to develop methodological skills and abilities of connection and reworking of knowledge about Circuit Theory and related interdisciplinary contexts, thus acquiring spendable skills to address subsequent studies with a high degree of autonomy, and to apply the acquired knowledge and skills in different contexts
ASSESSMENT METHODS	EXAMS OUTLINE: The examination consists in a test written and an oral exam, both required. WRITTEN TEST The written test consists of the resolution of exercises (in varying number between 2 and 4), on direct current circuits and sinusoidal alternating current circuits. Test duration is about 1,5 hours. The oral exam is a discussion with essay questions on the whole course programme. To access the oral exam, the student must pass the written test. Written test looks at: knowledge, understanding and application of circuits analysis methods; ability to choose the most appropriate analysis techniques, accuracy and correctness of the calculations; ability to organize the concepts in orderly and coherent way. Written test assessment criteria The assessment is based on both the correctness of the procedure (and the developed calculations) and the clarity of the exposure. It is articulated in five grades: very good; good; satisfactory, just sufficient; fail. An additional grade of evaluation (admitted with reserve) is included for not enough written test and that nevertheless potentially introduces a recoverable debt in oral test. Written test judged "not sufficient" will be considered failed. ORAL EXAM The oral examination consists in an interview, with open-response questions on the whole program of the course. To sustain the oral test, the student must have pass the writing test. Oral exam looks at: knowledge and understanding of the course programme; applying such skills for problem solving within the course or related contexts with coherence, effectiveness and autonomy of judgment; correct use of language, clearness, fluency; ability of synthesis; awareness and autonomy in the application of theories to solve the proposed problems; concepts reinterpretation, critical faculties, and connection skills in disciplinary or interdisciplinary contexts. Oral exam assessment criteria

	the assessment, properly graded based on the achieved level on learning outcomes, is articulate as following: excellent results (rating 29-30L), very good results (rating 26-28), good results (rating 24-26), sufficient results (18-23); learning outcomes not sufficiently met (unranked) FINAL ASSESSMENT final assessment, expressed in thirtieths, will result from best fit of levels reached in both oral and written test. Further information on the exam will be provided during the course
EDUCATIONAL OBJECTIVES	The course goal is to provide students with adequate knowledge of the methodological aspects of Circuit Theory, aimed at: - to solve direct current linear circuits, using the most appropriate analysis techniques - to assess the energy exchanges between the electrical components - understand the transient behavior of basic circuits RC, RL, RLC; - to solve sinusoidal steady state circuits by operating in the domain of the phasor and characterize the power in this context; - to have elementary knowledge of basic characteristics of three-phase systems
TEACHING METHODS	Lectures, lessons carried out through dialogues and interactions with students, exercises. Teaching activities are organized to help the achievement learning outcomes (see learning outcomes section, descriptors D.1-D.5). Some classroom exercises will be dedicated to the simulation of the final written test. The course contents are offered emphasizing the applications and the synergy between the different topics (D.1); the solution of numerical problems during the exercises is directed to stimulate the development of the ability to apply the acquired knowledge and skills (D.2). During exercises, dialogue based lectures and interactions with students, students are fostered to critically analyze the proposed issues and to compare the points of strength and weakness of the different possible approaches to the solution of the same, so developing their analytical abilities and autonomous judgment (D.3). At the same time, the dialogue and interaction opportunities foster students to improve their skills of communication, argumentation and use of language (D.4). Finally, through knowledge reworking, links to real and interdisciplinary applications and stimulus in facing new problems autonomously the student is encouraged to the development of learning skills, and also acquire the skill of an operational approach spendable in different disciplinary contexts (D.5).
SUGGESTED BIBLIOGRAPHY	Testo di Riferimento: - R. Perfetti: “Circuiti Elettrici” - Zanichelli, 2013. Testi di consultazione - M. Repetto, S. Leva: Elettrotecnica. Elementi di teoria ed esercizi. CittaStudi Edizioni. 2014 - G. Miano, M. De Magistris. Circuiti. Fondamenti di teoria dei circuiti per l'Ingegneria. Springer, Bologna - F.Della Torre, G.Sapienza, M.Mauri, M.S.Carmeli: Esercitazioni di Elettrotecnica-societa' editrice Esculapio

SYLLABUS

Hrs	Frontal teaching
10	Introduction to electrical engineering course: objectives and organization. Fundamentals of Electric Circuits: hypotheses and validity limits of the circuit model. Circuit Variables: currents, Voltages. Power and Energy concepts. Kirchhoff's Current Law; Kirchhoff's Voltage Law. Basic concepts of electrical networks. Conservation of energy law in electrical circuits. Introductions to Circuit Elements. Circuit elements and their i-v characteristics. Resistors, ideal voltage and current sources; pratical voltage and current sources; controlled sources; electric power and sign convection. Circuit elements in series and parallel, delta-connections, wye-connections and delta/wye equivalences. Sources transformations. Millmann theorem. Voltage divider rule; current divider rule.
5	Resistive network analysis. Systematic application of the Kirchhoff's laws; the node voltage and mesh current methods; network analysis by using series and parallel or delta/wye equivalents. Linearity. The principle of superposition. Thévenin and Norton theorems.
8	Energy-storage circuit elements and analysis of simple dynamic networks Ideal inductors and capacitors. Energy storage in inductors and capacitors. Capacitances and Inductances in series and parallel. Response of simple first-order RC and RL, and second-order RLC circuits.
7	Steady-state sinusoidal network analysis. Sinusoidal currents and voltages. Phasors and complex impedances. AC equivalent circuits. Circuit analysis with Phasors and complex impedances. Power in AC circuits. Power factor correction. Theorem of maximum power transfer.
5	Two-port networks. Introduction and definitions, general principles of two-port networks. The z, y, h, and g parameters. Reciprocal and symmetrical networks. Interconnection of two-port networks
5	Basic concepts of three-phase networks Balanced and Unbalanced three-phase circuits. Wye loads and delta loads. Three-phase power.

Hrs	Practice
14	Application examples and practical methods of resolution of sinusoidal steady state and direct current linear circuits. Examples of analysis and synthesis of circuits. Simulation of examination tests