COURSE PROGRAM

Academic Year: 2019/2020

Identification and characteristics of the course				
Code	501064	ECTS Credits	6	
Course name (English)	Circuit Theory and Electrical Machines			
Course name (Spanish)	Teoría de Circuitos y Máquinas Eléctricas			
Degree programs	Electrical Engineering Electronics and Automatic Engineering Mechanical Engineering Materials Engineering			
Faculty/School	Engineering School			
Semester	3th	Type of course	Common Technologies	
Module	Common Technologies			
Matter	Fundamental on Electrical engineering, Electronic and Automatic			
Lecturer/s				
Name	Office	E-mail	Web page	
Alfredo Álvarez-García	D2.9	aalvarez@unex.es	http://campusvirtual.unex.es/	
Subject Area	Electrical engineering			
Department	Electrical engineering, Electronic and Automatic			
Coordinating Lecturer (If more than one)	Belén Pérez-Caballero			

Competencies*

Basic Competences	Check With an "X"	General Competences	Check With an "X"	Transversal Competences	Check With an "X"	Specific Competences Basic Formation	Check With an "X"	Specific Competences Common to the Industrial Branch	Check With an "X"	Specific Competences Specific Technology	Check With an "X"
CB1	X	CG1	X	CT1	X	CEFB1		CECRI1		CETE1	
CB2	X	CG2		CT2	X	CEFB2		CECRI2		CETE2	
CB3	X	CG3	X	CT3	X	CEFB3		CECRI3		CETE3	
CB4	X	CG4	X	CT4	X	CEFB4		CECRI4	X	CETE4	
CB5	X	CG5	X	CT5	X	CEFB5		CECRI5		CETE5	
		CG6	X	CT6	X	CEFB6		CECRI6		CETE6	
		CG7	X	CT7	X			CECRI7		CETE7	
		CG8		CT8	X			CECRI8		CETE8	
		CG9		CT9	X			CECRI9		CETE9	
		CG10		CT10	X			CECRI10		CETE10	
		CG11	X					CECRI11		CETE11	
		CG12	X					CECRI12		CETFG	

* The sections concerning competencies, course outline, educational activities, teaching methodologies, learning outcomes and assessment systems must conform to that included in the ANECA verified document of the degree program.

Contents

Course outline*

AC current. Phasor analysis. Theorems. Magnetic coupling. Electrical motors and generators. Three-phase systems.

Course syllabus

Name of lesson 1: AC CIRCUITS. (19.5 hours)
Contents of lesson 1:
1.1 Periodic signals Sinusoidal signals. Generation.
1.2 Phasor Representation of Sinusoidal Variables.
1.3 Sinusoidal steady-state responses of RLC circuits.
1.4 Circuit analysis. Theorems.
1.5 Active, reactive and apparent power. Power triangle.
1.6 Power factor (*pf*). Consequences of *pf* in power delivery. *pf* improvement.

Description of the practical activities of lesson 1:
Laboratory class 1:
Sinusoidal steady-state I. Voltmeter and Ammeter. (1h).
Seminary class 1:
Analysis of parameters in sinusoidal steady-state. (1h).
Laboratory class 2:
Sinusoidal steady-state II. Wattmeter. (1h).
Seminary class 2:
Power measurement in single-phase sinusoidal steady-state. (1h).
Laboratory class 3:
Power factor correction. (1.5h).

Name of lesson 2: SINGLE PHASE TRANSFORMER (13 hours)
Contents of lesson 2:
2.1 Classification of Electrical Machines. Constitution. Losses.
2.2 Analysis of coupling coils. Coupling coefficient. Ideal and real coupling.
2.3 Fundamental of electromagnetic conversion
2.4 Nameplate. Rating.
2.5 Fundamental of ideal transformer.
2.6 Equivalent circuits of real transformer.
2.7 Basic transformer tests.
2.8 Voltage regulation.
2.9 Efficiency.

Description of the practical activities of lesson 2:
Seminary class 3:
Single-phase transformer analysis (1h).

Name of lesson 3: BALANCED THREE-PHASE CIRCUITS. (9.5 hours)
Contents of lesson 3:
3.1 Three-phase generation. Phase and phase sequence.
3.2 Way and delta connections. Voltage and current relationships.
3.3 Balanced load study.
3.4 Three-phase power. Power measurement.
3.5 *pf* Improvement in balanced three-phase circuits

Description of the practical activities of lesson 3:
Seminary 7:
Fundamentals of three-phase circuits (1.5h).
Laboratory class 4:
Power measurement in 3-phase sinusoidal steady-state. (2h).

Name of lesson 4: THREE-PHASE TRANSFORMERS. (8 hours)
Contents of lesson 4:

4.1 Tree-phase transformer. Constitution.
4.2 Connection types. Phase shift. Clock notation.
4.3 Tests on the 3-phase transformer
4.4 Analysis of 3-phase transformers.

Description of the practical activities of lesson 4:
Seminary 5:
Three-phase transformer on-load. (1.5h).
Laboratory class 5:
Three-phase transformer tests (1h).

Name of lesson 5: ASINCHRONOUS MOTOR (3 hours)
Contents of lesson 5:
5.1 Construction. Operating principle.
5.2 Ferraris theorem. Synchronous speed. Slip.
5.3 Equivalent circuit.
5.4 Speed-torque characteristic.
5.5 Nameplate. Rating.

Name of lesson 6: SYNCHRONOUS GENERATOR. (4 hours)
Contents of lesson 5:
6.1 Construction. Operating principle.
6.2 Equivalent circuit. Synchronous impedance.
6.3 Voltage regulation.
6.4 Nameplate. Rating.

Description of the practical activities of lesson 6:
Laboratory class:
Rotating machines analysis (1h).

Educational activities *

Student workload in hours by lesson		Lectures	Practical activities				Monitoring activity	Homework
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
T1: AC circuits.	38,5	14		3,5		2		19
T2: Single phase transformer	32,5	12				1	1,5	18
T3: Balanced three-phase circuits.	26,5	6		2		1,5		17
T4: Three-phase transformers.	17	5		1,5		1,5		9
T5: Asynchronous motor.	9	3						6
T6: Synchronous generator.	12,5	3				1	1,5	7
Assessment **	14	2		1				8 (Ex esc) + 3 (Ex Prác)
TOTAL	150	45		8		7	3	87

L: Lectures (100 students)
HI: Hospital internships (7 students)
LAB: Laboratory or field practices (15 students)
COM: Computer room or language laboratory practices (30 students)
SEM: Problem classes or seminars or case studies (40 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS: Personal study, individual or group work and reading of bibliography

** Indicate the total number of evaluation hours of this subject.

Teaching Methodologies*

Among the teaching methodologies included in the formative program, in this course the following are used:

Teaching methodology	Check with an "X" the ones used
1. Explanation and discussion of contents	X
2. Solution, analysis and discussion of examples and exercises	X
3. Oral presentation of assignments	
4. Development of practical cases in labs, computer rooms, seminars, etc.	X
5. Attention to the student and advice of the assignments in small groups	X
6. Search of information prior to the explanation of the contents of an unit or search of complementary information once the activities of a unit have been developed	X
7. Elaboration of assignments either individually or in groups	
8. Study of each unit: study of contents, preparation of exercises or cases, preparation of the final exam, etc.	X

Learning outcomes *

Students have to know: the basic magnitudes of electric circuits and electrical machines, the resolution of sinusoidal steady-state circuits with linear elements, the power balance and energy in single- and three-phase circuits, and the operation of single- and three-phase transformers, synchronous generators and induction motors.

Assessment systems *

Assessment criteria

CE1. Appropriate assimilation of concept, theorems, laws, etc. Clarity, concision and a correct use of language will be valued.

Related competences: CB1, CB3, CB5, CG3, CG6, CECRI4, CT1.

CE2. If the proceeding to solve a problem is correct, a clear explanation of the problem approach.

Related competences: CB1, CB2, CB3, CB5, CG1, CG4, CG5, CG11, CT1, CT2, CT6, CT8, CT9, CT10, CECRI4.

CE3. Use of graphical proceedings (diagrams, plots, etc.) with clarity and accuracy.

Related competences: CB2, CB3, CB4, CT2, CECRI4.

CE4. Use of scientific method in engineering practical applications.

Related competences: CB4, CB5, CG1, CG4, CG5, CG11, CT1, CT2, CT3, CT6, CT7, CT9, CT10, CECRI4.

CE5. Appropriate choice of information sources, if necessary.

Related competences: CB1, CG6, CG7, CT4, CT5.

Assessment activities

Among the assessment activities included in the formative program, in this course the following are used:

	Range fixed	Ordinary call	Extraordinary call	Global assessment
1.Final exam and/or partial examinations.	0%–80%	80%	80%	80%
2.Practical activities in: classroom, lab, computers room, visits, etc.	0%–50%	10%	10%	20%
3.Solution and submission of activities (cases, exercises, assignments, projects, etc.), individually and/or in groups.	0%–50%	10%	10%	
4.Active participation in earning activities.	0%–10%			---
5.Attendance to learning activities.	0%–10%			---

Description of the assessment activities for ordinary and extraordinary calls

AE1. WRITTEN EXAM

The so call **Final exam** consists of 2 parts:

Part 1. Problems from Unit 1 and 6. A pass is achieved with 4 marks out of 10 if the mark of all and each of the problems is greater than 3 out of 10. Otherwise, the maximum mark of Part 1 will be 3 marks out of 10.

Part 2. Questions from Unit 1 and 6. A pass is achieved with 3 marks out of 10.
The mark of Final exam is calculated as following:

2/3 (Part 1) + 1/3 (Part 2)

A pass is achieved with 5 marks out of 10. If any of the parts is fail, the final mark will be equal or less than 4 marks out of 10.

AE2. LABORATORY ACTIVITIES/EXAM

There are 5 laboratory activities which will be assessed along the class term. If all the activities are pass, the mark of this part AE2 is the mean value of the activities marks. Otherwise, the students with a pass in the Written exam can do a Laboratory exam (not mandatary).

AE3. RESOLUTION AND SUBMISSION OF ACTIVITIES

Non-recoverable activities (only scoring during the classes period). Submissions are only compatible with 5 marks out of 10.

FINAL MARK

The final mark is calculated as following:

a) If AE1≥5 Mark = 0.8 (AE1) + 0.1 (AE2) + 0.1 (AE3)
b) If AE1<5 Mark = (AE1)

Description of the global assessment activities

The global assessment will be held the same day scheduled for the final exam of each call. It will consist of the following parts:

AE1. WRITTEN EXAM

Just as in the Ordinary call.

AE2. LABORATORY EXAM

Laboratory exam (not mandatory) about the content of the 5 laboratory activities done during the class period. The students must demonstrate adequate knowledge of the electrical principles of the activities, and enough skills with the laboratory instruments and proceedings. The mark AE2 is from 0 to 10.

GLOBAL ASSESSMENT FINAL MARK

The final mark is calculated as following:

a) If AE1≥5 Mark = 0.8 (AE1) + 0.2 (AE2)
b) If AE1<5 Mark = (AE1)

Bibliography (basic and complementary)

Bibliografía básica

1. Boylestad, R. L. "Análisis introductorio de circuitos" Ed. Trillas, S.A.
2. Dorf, R. C. "Circuitos eléctricos. Introducción al análisis y al diseño." Ed. Marcombo, S.A.
3. Edminister, J.A. "Circuitos eléctricos" Ed. McGraw – Hill.
4. Fraile Mora, J. "Electromagnetismo y circuitos eléctricos" Servicio de Publicaciones del C.I. de Caminos, Canales y Puertos. Madrid.
5. Parra, V.M. "Teoría de Circuitos (Vol I y II)" Universidad Nacional de Educación a Distancia.
6. Fraile, J. Máquinas Eléctricas. Mc Graw-Hill; Madrid, 2003 (1ª edición).
7. Ras, E. Transformadores de potencia, medida y protección. Aguilar S.A. Ediciones; Madrid, 1978.
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9. Sanz Feito, J. Máquinas eléctricas. Prentice Hall; Madrid, 2002.
10. Chapman, S. *Máquinas Eléctricas.* Mc Graw-Hill L; Madrid, 2000 (3ª edición).

Bibliografía complementaria

1. Salcedo Carretero, J.M. Análisis de Circuitos eléctricos. Problemas resueltos. Addison Wesley Iberoamericana.
2. Charles I. Hubert. Circuitos Eléctricos CA/CC. Un enfoque sistémico. Mc Graw-Hill.
3. Hayt & Kemmerly. Análisis de Circuitos en Ingeniería. Mc Graw-Hill.
4. González Sánchez &Toledano Gasca. Sistemas Polifásicos. Paraninfo.
5. González Sánchez & López Moreno. Sistemas Polifásicos Ejercicios de aplicación. Paraninfo.
6. Ortega, G.; Gómez, M.; Bachiller, A. Problemas resueltos de Máquinas Eléctricas. Thomson Paraninfo, S.A.; Madrid, 2002.
7. Kingsley; Kusko; Fitzgerald. Teoría y análisis de las máquinas eléctricas. Hispano Europea; Barcelona, 1994.
8. Sanjurjo, R. Máquinas Eléctricas. Mc Graw-Hill; Madrid, 1989
9. Nasar, S.A. Máquinas Eléctricas y Electromecánicas. Mc Graw-Hill; Madrid, 1988

Other resources and complementary educational materials

Páginas web

http://campusvirtual.unex.es/portal/