Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Third year

COURSE

27316 - Analysis & Operation of Electrical Machinery **Credits, ECTS:** 9

COURSE DESCRIPTION

The course is structured around the analysis of the technical features common to all electrical machines and their particularization in the case of static and rotating machines machines, working latter both in motor mode and in generator mode. In particular, the construction and functional characteristics of transformers, AC machines (synchronous and asynchronous) and DC machines are analyzed.

"Analysis and Operation of Electrical Machinery" belongs to the module "M03 - Specific Technologies". In addition to the concepts related to subjects of the "M01-Training Basic" module belonging to the degree (areas of Applied Mathematics and Applied Physics), the knowledge previously acquired in the subject "Electrotechnics" (M02-Common to the Industrial Technology Engineering branch; 2nd Year, Mandatory) is mainly used. On this basis, the principle of operation of various types of electrical machines is studied, their performance is characterized and their application is analyzed.

The subject of "Analysis and Operation of Electrical Machines" has its natural continuity in "Electrical Technology" (M03-Specific Technologies, 4th year; Compulsory) and "Integration of Generation Technologies in the Electric System" (M04-Optional courses belonging to the specialization in "Electrical Technology, Electronics and Control", 4th year). In those subjects, electric machines are treated as part of the facilities that integrate the electric power system.

The skills and knowledge acquired in "Analysis and Operation of Electrical Machinery" are also applied in other subjects where electrical machines are treated from other points of view (mechanical behavior, manufacturing materials, control technologies, etc).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Module competencies developed in this subject:

- M03E5 Capacity for calculation and design of electrical machinery.

Learning results of the module:

- Resolution of multidisciplinary problems in the industrial field. For this purpose, based on the acquired knowledge, the students will learn to:

  - Design and implement industrial facilities, considering such diverse aspects (energy, structural, mechanical, electrical, environmental).

  - Design and implement production processes and control, considering aspects of various kinds (energy, mechanical, structural, electrical, environmental)

Specific learning outcomes of this course relate to electrical aspects indicated in the learning outcomes of the module and, more specifically, those relating to electric machines, such as:

- Knowledge of the basic principles of electromagnetism and the structure of electrical machines, identification of constructive parts and understanding of the operation principle of each type of electric machine, as well as the most relevant operational characteristics and application scope.

- Analysis, synthesis and application of theoretical concepts worked in the classroom in order to solve numerical exercises and practical issues of electrical machines. Qualitative and quantitative interpretarion of results.

- Performance of basic tests in electrical machines in order to obtain their characteristic parameters. Critical assessment of the results, gathering them in a coherent and reasoned technical report.

Theoretical and Practical Contents

Theory contents
UNIT 1: INTRODUCTION TO ELECTROMAGNETISM LAWS
UNIT 2: BASICS OF ELECTRICAL MACHINERY
UNIT 3: POWER TRANSFORMERS
UNIT 4: ANALYSIS OF SINGLE-PHASE TRANSFORMERS

UNIT 5: ANALYSIS OF THREE-PHASE TRANSFORMERS
UNIT 6: OPERATION OF TRANSFORMERS
UNIT 7: SPECIAL TRANSFORMERS
UNIT 8: SYNCHRONOUS MACHINES
UNIT 9: ANALYSIS OF SYNCHRONOUS GENERATORS
UNIT 10: OPERATION OF SYNCHRONOUS GENERATORS
UNIT 11: SYNCHRONOUS MACHINES
UNIT 12: INDUCTION MACHINES
UNIT 13: ANALYSIS OF THREE-PHASE INDUCTION MOTORS
UNIT 14: OPERATION OF THREE-PHASE INDUCTION MOTORS
UNIT 15: SINGLE-PHASE INDUCTION MOTORS
UNIT 16: DIRECT.CURRENT MACHINES

Practical contents
UNIT 1: TESTING INSTALLATIONS AND SAFETY RULES
UNIT 2: TESTS ON STATIC MACHINES
UNIT 3: TESTS ON ROTATING MACHINES

TEACHING METHODS

To achieve the objectives of the course, reflected in learning outcomes to be achieved, the following teaching methods are combined:
- Lectures
- Classroom practices
- Seminars
- Laboratory practices

All teaching methods include references and supporting material in order to encourage the personal work of each student and their active involvement in the learning process.

Teamwork is encouraged during seminars and lab practices.

The course is divided into two blocks:

- Theoretical Block-A (Lectures, Classroom Practices and Seminars).
It is composed of 2 parts: A1 (First Term, Units 1-7) and A2 (Second Term, Units 8-16).

- Practical Block-B (Laboratory Sessions)

The grading assessment is determined by the continuous evaluation system considering the mixed evaluation option.
- During the academic year, evaluation tests are carried out regarding blocks A1 and B of the course.
- In the ordinary (and extraordinary) call, independent exams are carried out for each part of the course (A1, A2 and B).
In this system of continuous evaluation (mixed), the last grading mark obtained in each part of the course during the academic year (including the ordinary call) is maintained until the extraordinary call of the current academic year.

In order to renounce to the continuous evaluation (mixed option) and opt for the final evaluation system, a waiver must be submitted (addressed to the course coordinator) before the end of the 19th week of the course.

In the final evaluation system, 100% of the qualification is determined solely and exclusively by the exams (A1, A2 and B) carried out in the corresponding call (ordinary or extraordinary).

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37,5	12	22,5	18					
Horas de Actividad No Presencial del Alumno/a	56,25	18	33,75	27					

Legend:
M: Lecture-based
S: Seminar
GA: Applied classroom-based groups
GL: Applied laboratory-based groups
GO: Applied computer-based groups
GCL: Applied clinical-based groups
TA: Workshop
TI: Industrial workshop
GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Multiple choice test 80%
- Laboratory tests and corresponding reports 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The weight of each block in the final grade is:

- Theoretical Block (A) = 80 % (A1 up to 4 points and A2 up to 4 points)
- Practical Block (B) = 20 % (B up to 2 points)

In order to pass the subject, it is necessary to have a numerical score in each of the parts of the course (A1, A2 and B) and to pass each of the main blocks (A and B). Therefore, (A1+A2) must be equal or higher than 4 and B must be equal or higher than 1.

To give up the ordinary call, it is enough not to run any assessment test of the ordinary call.

In the event that sanitary conditions prevent the realization of a teaching activity and / or presential evaluation, a non-presential modality will be enabled, of which the students will be informed promptly.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call, the two blocks of the subject and the weight of each block are maintained.

- Theoretical Block (A) = 80 % (A1 up to 4 points and A2 up to 4 points)
- Practical Block (B) = 20 % (B up to 2 points)

In order to pass the subject, it is necessary to have a numerical score in each of the parts of the course (A1, A2 and B) and to pass each of the main blocks (A and B). Therefore, (A1+A2) must be equal or higher than 4 and B must be equal or higher than 1.

To give up the extraordinary call, it is enough not to run any assessment test of the extraordinary call.

In the event that sanitary conditions prevent the realization of a teaching activity and / or presential evaluation, a non-presential modality will be enabled, of which the students will be informed promptly.

MANDATORY MATERIALS

Laboratory practice assigments
Teaching material provided by teachers

BIBLIOGRAPHY

Basic bibliography

1.- Mazón, J.; Miñambres, J.F.; Zorrozua, M.A.; Buigues, G.; Valverde, V.
"Guía de autoaprendizaje de Maquinas Eléctricas"
Pearson-Prentice Hall, 2008

2.- Zorrozua, M.A.; Miñambres, J.F.; Mazón, J.; Zamora, I.
"Makina Elektrikoak"
Servicio Editorial UPV/EHU, 2007

3.- Miñambres, J.F.; Zorrozua, M.A.; Zamora, I.; Mazón, J.; Valverde V.; Buigues G,
"Laboratorio de máquinas eléctricas: Ensayos y medidas"
Servicio Editorial UPV/EHU, 2009

4.- Fraile Mora, J.
"Máquinas Eléctricas"
McGraw Hill. 2003

Detailed bibliography

1.- E. E. Staff del M.I.T.
"Circuitos Magnéticos y Transformadores"
Reverté, 2005

2.- Ras Oliva, E.
"Transformadores de Potencia, de Medida y de Protección"
Marcombo, 1998

3.- Cortés Cherta, M.
"Curso Moderno de Máquinas Eléctricas Rotativas". 5 Volúmenes
Editores Técnicos Asociados, 1994
Tomo 1: La máquina eléctrica en general
Tomo 2: Máquinas de corriente continua
Tomo 3: Máquinas de corriente alterna asíncronas
Tomo 4: Máquinas síncronas y motores c.a. de colector
Tomo 5: Las máquinas eléctricas en régimen dinámico

4.- Fitzgerald A.E., Kingsley Ch., Umans S.D..
"Máquinas Eléctricas"
McGraw Hill, 2004

Journals

Web sites of interest

http://www.abb.es/
http://www.alstom.com/
http://www.alconza.com/
http://www.ingeteam.com/
http://www.ree.es/

OBSERVATIONS

In case of suspension of classroom teaching activities, everything stated in this document will remain valid, with the exception that:
- Teaching and tutoring during the suspension period would be carried out by telematic means (Teams, eGela, e-mail, . . .).
- The evaluation tests during the suspension period would also be carried out by telematic means or in the form indicated by the university.