Bachelor in Agricultural Engineering

Course information

Year 2019-20

GENERAL SPECIFICATIONS			
English name			
Electrical technology and Installations			
Spanish name			
Electrotecnia e Instalaciones Eléctricas			
Code	**Type**		
606110208	Obligatory		
Time distribution			
	Total	**In class**	**Out class**
Working hours	150	60	90
ECTS: 6			

Standard group	**Small groups**			
	Classroom	**Lab**	**Practices**	**Computer classroom**
4.5		1.5	0	0

Departments	**Knowledge areas**
Electrical Engineering	Electrical Engineering
Year	**Semester**
2nd	2nd

TEACHING STAFF			
Name	**E-Mail**	**Telephone**	**Office**
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SPECIFIC INFORMATION OF THE COURSE
1. Contents description
1.1. In English:
- Circuit devices. - Circuit analysis methods. - Steady state alternating current. - Components of an electric network. - Indoor electrical installations. - Safety and protection at electrical installations.
1.2. In Spanish
- Elementos de circuitos. - Técnicas de análisis de circuitos. - Corriente alterna en estado estacionario. - Constitución de la red eléctrica. - Instalaciones eléctricas de interior. - Protección y seguridad en las instalaciones eléctricas.
2. Background
2.1.Situation within the Degree:

This subject offers the possibility of knowing electrical technology and electrical installations to the students. Both topics are very important for any engineering degree, including agricultural engineering, since whatever agricultural or livestock production requires the use of electricity.
This subject is located in the second semester of the second course, so the students have already acquired the minimum knowledge of mathematical and physics to face this subject.
Apart from that, after passing this subject, the students will be ready for subsequent subjects.

2.2. Recommendations:

It is recommended that the student has already passed the subjects related to mathematics and physics of the first course, and specially has developed skills related to solve equations systems, derivatives and integrals.

3. Objectives (as result of teaching):

- Knowing how to analyze electrical circuits of direct and alternating current.
- Knowing the main elements of alternating and polyphasic electrical installations.
- Knowing the main electrical machines, such as transformers and asynchronous motors.
- Knowing how to measure electrical magnitudes in electrical installations.

4. Skills to be acquired

4.1. Specific Skills:

- **C07:** Ability to know, understand and use the principles of rural engineering: calculation of structures and construction, hydraulics, engines and machines, electrical engineering, technical projects

4.2. General Skills:

- **G01:** Ability to solve problems
- **G04:** Ability to apply knowledge in practice
- **G05:** Ability to work as a team
- **G07:** Capacity for analysis and synthesis
- **G17:** Capacity for critical reasoning
- **CT2:** Development of a critical attitude in relation to the capacity of analysis and synthesis
- **CT3:** Development of an attitude of inquiry that allows the revision and permanent advancement of knowledge

5. Training Activities and Teaching Methods

5.1. Training Activities:

- Theoretical lessons about the subject contents.
- Problem solving sessions.
- Experimental laboratory sessions.
- Computer assisted sessions.

5.2. Teaching Methods:

- Master Class with students' participation.
- Development of Practices in Specialized Laboratories or Computer Classrooms in small

groups.

- Problem Solving and Practical Exercises.
- Evaluations and Exams.

5.3. Development and Justification:

Theory sessions: A general and systematic overview of the topics will be offered to the students highlighting the most important aspects, offering to the student motivation, dialogue and exchange of ideas. The theoretical classes will be developed in the classroom. Resolution of numerical problems will be included at appropriate times to reinforce the theoretical concepts. The video projector with support of the blackboard will be used as a means of instruction. The student will be provided with abundant study material for the subject, full notes of the topics, as well as other documents of interest, including links to web pages related to the subject.

Laboratory practice sessions: In this subject it is essential an extensive application in the laboratory of the theory, since some of the objectives of the subject, such as knowing how to measure electrical magnitudes and learn the discipline and prudence necessary in the handling of electrical circuits, can only be obtained in the laboratory. In these practices, students must perform certain assemblies and measurements, usually in small groups (between 2 and 4 people). From the beginning of the semester, it will be available to students a list of scripts of the practices to be done so they can prepare in advance. The practice sessions will be of 1.5 hours of duration. Attendance to all the laboratory practices is not mandatory to pass the course, but it will be necessary to have attended a minimum of 70% to be able to take the practice exam.

6. Detailed Contents:

1. ELEMENTS OF CIRCUITS
1.1. Introduction.
1.2. Current, voltage and power.
1.3. Passive elements: resistors, capacitors and inductors.
1.4. Active elements: independent voltage sources.
1.5. Topology of the circuit: knots, branches, loops and meshes.
2. CIRCUIT ANALYSIS
2.1. Kirchhoff's Laws.
2.2. Association of elements.
2.3. Mesh analysis.
2.4. Linearity principle.
2.5. Thévenin's theorem.
2.6. Maximum power transfer theorem.
3. ALTERNATE CURRENT CIRCUITS
3.1. Periodic waveforms.
3.2. RMS value.
3.3. Phasorial representation.
3.4. Impedance and admittance.
3.5. Analysis of circuits in alternating current.
4. POWER IN ALTERNATE CURRENT CIRCUITS
4.1. Instant power.
4.2. Active, reactive, apparent and complex powers.
4.3. Power factor. Compensation of reactive power.
4.4. Measurement of electrical power.
4.5. Measurement of electrical energy.
5. THREE-PHASE CIRCUITS

5.1. Three-phase systems. Phase and line voltages and currents.
5.2. Analysis of balanced three-phase circuits.
5.3. Power in three-phase circuits.
5.4. Correction of the power factor.
5.5 Measurement of power in three-phase circuits.
6. ELECTRICAL MACHINES: TRANSFORMER
6.1. Introduction. Electric machines. Magnetic circuits.
6.2. Ideal transformer.
6.3. Real transformer. Equivalent circuits. Constructive features.
6.4. Tests to determine parameters.
6.5. Voltage drop in a transformer.
6.6. Losses and performance.
7. ELECTRICAL MACHINES: INDUCTION MOTOR
7.1. Introduction. Types of motors.
7.2. Constructive characteristics and operating principle of the asynchronous machine.
7.3. Equivalent circuit. Essays.
7.4. Power and torque.
7.5. Start and speed regulation.
7.6. Technical characteristics and nameplates.
8. LOW VOLTAGE ELECTRICAL INSTALLATIONS
8.1. Transport and distribution network.
8.2. General characteristics of Low Voltage lines.
8.3. Calculation of conductor sections.
8.4. Low voltage electrical switchgear.
8.5. Protection of facilities.
LABORATORY PRACTICES.
1. Resistance association. Laws of Ohm and Kirchhoff.
2. Capacitor and inductor: Behavior in DC and AC. Principle of linearity.
3. Thévenin's Equivalent of a circuit. Maximum power transfer.
4. Alternating current. Oscilloscope. RC, RL and RLC loads.
5. Power measurement and correction of the power factor.
6. Three-phase circuits. Wye and delta connection.
7. Three-phase circuits. Power measurement and reactive compensation.
8. Transformers. Three-phase motor.
9. Protections in electrical installations.

7. Bibliography

7.1. Basic Bibliography

- "Electric circuits". James W. Nilsson, Susan A. Riedel. Pearson Educación, 2006.
- "Introductory circuit analysis". Robert Boylestand. Pearson Prentice Hall, 2011.
- "Electric circuits". J. A. Edminister, Mahmood Nahvi. Serie Schaum, McGraw-Hill. 2005.
- "Electric machinery fundamentals". S. J. Chapman, Editorial McGraw-Hill, 2005.

7.2. Additional Bibliography:

- "Pinciples of electric circuits". Thomas L. Floyd. Prentice-Hall. 2007.
- "Electric circuits". Norman Balabanian. McGraw Hill. 1994.
- "Electric circuits". David A. Bell. Prentice Hall. 1998.
- "Introduction to electric circuits". R.C. Dorf, J.A. Svoboda. Wiley. 2010.

- "Electrical circuits and systems". A. M. Howatson. Oxford University Press. 1996.

  "Higher electrical principles". D.C. Green. Adison Wesley Longman. 1997.

8. Systems and Assessment Criteria

8.1. System for Assessment:

- Theory / problems exam
- Practice exam

8.2. Assessment Criteria and Marks:

The evaluation will be based on the results of the practical exam and a written final exam. The percentages of the evaluation activities are as follows:

• Final written exam of theory and problems (80%).

• Examination of practices (20%).

WRITTEN FINAL EXAM (80%): This exam will consist of the resolution of 3-4 blocks of theoretical and practical problems related with the subject contents. The acquisition of the C07, G01, G04, G07 and G17 competences will be evaluated with this exam.

EXAMINATION OF PRACTICES (20%): If you do not attend a minimum of 70% of the laboratory practices, you will not be able to take the practice exam. This exam will be done only once, at the end of the semester. In case you have attended the practice sessions and have not taken the practice exam, if you pass the final written exam and the total score does not reach 5 points, you will be entitled to take the practice exam afterwards. The practice note is maintained for future academic years. Competencies C07, G04 and G05 will be evaluated with this exam.

To pass the subject you must pass the final written exam (get a 5 out of 10). Once the exam is approved, the note obtained in practices is added. A total grade of 5 out of 10 must be obtained to pass the subject.

Students who take part in a single evaluation will have to do only one academic act. To pass the subject they must obtain a total score of five (5 points, 50%) with the condition of achieving at least one point in the practice test. The following is a description of the tests: 1.- The written test will consist of the resolution of 3-4 blocks of theoretical and practical problems on the subject's subject (8 points, 80%). It will be held in a classroom and the duration will be three hours. 2.- The practical test will be done in the laboratory of practices (2 points, 20%). The duration of this test will be half an hour.