DEGREE CURRICULUM

ELECTRICAL ENGINEERING BASICS

Coordination: SAIZ VELA, ALBERT

Academic year 2019-20

ELECTRICAL ENGINEERING BASICS 2019-20

Subject's general information

<table>
<tr><td>Subject name</td><td>ELECTRICAL ENGINEERING BASICS</td></tr>
<tr><td>Code</td><td>102336</td></tr>
<tr><td>Semester</td><td>1st Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Not informed</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's degree in Industrial Organization and Logistics Engineering</td><td>2</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th>PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Number of groups</td><td>3</td><td>2</td><td>2</td></tr>
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<tr><td>Coordination</td><td>SAIZ VELA, ALBERT</td></tr>
<tr><td>Department</td><td>COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>30 hours classroom attendance (Theory) + 45 hours of self-guided work
20 hours classroom attendance (Praula) + 30 hours of self-guided work
10 hours classroom attendance (Pralab) + 15 hours of self-guided work

TOTAL -> 6 ECTS credits (60h classroom attendance + 90h self-guided work)</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Catalan
Some educational lectures can be written in Spanish or English</td></tr>
<tr><td>Distribution of credits</td><td>3 credits (Theory) + 2 credits (Praula) + 1 credit (Pralab)

Theory -> Theory Class
Praula -> Class of Problems / Classroom practices
Pralab -> Practices in the laboratory</td></tr>
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ELECTRICAL ENGINEERING BASICS 2019-20

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
CASELLAS BONET, RICARD	ricard.casellas@udl.cat	2	
SAIZ VELA, ALBERT	albert.saiz@udl.cat	11	

Subject's extra information

You can find educational lectures on the Virtual Campus: http://cv.udl.cat

The use of the Virtual Campus is fundamental to access the resources of the subject, to notifications about the dates of delivery of exercises, delivery of practices and evaluation tests.

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Laboratory gown from UdL
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos
Centre the Cultures i Cooperació Transfronterera

http://www.publicacions.udl.cat/

There will be a specific service for the *Campus Universitari d'Igualada*.

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratoy gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: http://www.sprl.udl.cat/alumnes/index.html

Learning objectives

Once the course has been finished and passed, students should be able to:

- To know the operation of passive electrical components in DC (direct current) and AC (alternating current).
- Understand the basics, laws and basic methods in order to analyze and solve electrical circuits in direct current (DC) and alternating current (AC).
- Understand the physical laws and operational principles of electric machines (electric motors and transformers, single-phase and three-phase circuits with relays, etc.).
- Solve simple problems where transformers and single-phase and three-phase electric machines appear, taking into account the equivalent circuit model.
- Understand and know how to use the different measuring devices that are found in an electricity laboratory.
- Use of the scientific terminology associated with the subject in English.
- Work in a team by doing a division and distribution of appropriate tasks and solve any conflict that may arise when performing the different tasks assigned.

Competences

Specific competences

CE10 Implement the theory of electrical circuits and machines.

Transversal Competences

CT2. Develop meaningful command of a foreign language, especially English.

CT4. Apply basic knowledge of entrepreneurship and professional environments.

CT5. Apply essential notions of scientific thinking.

Subject contents

T1 Basic concepts of electrical circuits

- Electrical Engineering: Panoramic.
- Voltage and Current
- Power and Energy

T2 Elements of electrical circuits

- Voltage and current sources
- Ohm's Law. Electrical resistance.
- Construction of models.
- Kirchoff Laws.
- Analysis of circuits with dependent sources.

T3 Simple resistive circuits

- Serial and parallel associations.
- Voltage and current dividers.
- Measurement of voltage and current.
- Wheatstone Bridge
- Delta-Star equivalent circuits.

T4 Techniques of circuit analysis

- Method of node voltages.
- Method of mesh currents.
- Comparison between the method of node voltages and the method of mesh currents.
- Transformation of sources.
- Millman's theorem.
- Equivalents of Thevenin and Norton.
- The Overlay theorem
- Transfer of the maximum power.

T5 Inductance, capacitance and mutual inductance and RL and RC circuits

- The effect of the electric field: capacitance or capacity.
- The effect of the magnetic field: inductance and mutual inductance.
- The inductor and the capacitor
- Inductor and capacitor associations.
- Answer of the first order RL and RC circuits.

T6 Analysis of circuits in permanent sinusoidal regime

- Sinusoidal generators
- Phasors. Phasographic diagrams.
- Passive elements of the circuit in the frequency domain.
- Kirchoff's laws in a permanent sinusoidal regime.
- Simplifications series, parallel and delta-star.
- Transformation of sources and equivalent circuits.
- Application of the method of node voltages and mesh currents.

T7 Power calculations in permanent sinusoidal regime

- Instantaneous, medium and effective power.
- The effective value in power calculations.
- Complex power
- Transfer of the maximum power.

T8 balanced three phase circuits

- Balanced three-phase voltages.
- Three phase voltage sources.
- Analysis of combinations of delta-star circuits.
- Power calculations in three-phase circuits.
- Power measurements in three-phase circuits.

T9 Introduction to the principles of electric machines

- Operation of the transformer.
- Transformer equivalent circuit.
- Three phase transformers.
- Relay operation
- Circuits with relays.

T10 Electric motors

- Single-phase and three-phase alternating current motors
- DC motors
- Other types of motors

T11 Electrical installations

- Protection of facilities and possible defects
- Fuses
- Automatic or magnetothermic switch

- Differential switch
- Selectivity and affiliation
- Overvoltage protection

T12 Industrial automation

- The contactor
- Command and signaling elements
- Captors, sensors, timers

Methodology

The teaching methodology is divided into four different strategies depending on the teaching-learning activities to be carried out:

Master class / **Participative exhibition sessions**: Sessions where the learning process is centered on the oral presentation by the teacher about the contents of the subject. The exhibition is done using the blackboard and / or computer resources. When transparencies are used, they will be previously available in the virtual campus of the UdL. Short-term activities will be introduced to encourage debate and student participation.

Problem solving: Sessions related to solving exercises and / or carrying out work where the learning process is centered on the students. A problem or exercise is posed and the students are responsible for solving it by applying routines, formulas, the application of procedures and / or carrying out simulations. The students will carry out these tasks both individually and as a team. For group activities, strategies to encourage cooperative work will be used.

Practical sessions: These sessions will be held in the computer room and in the laboratory of the subject in relation to the activities of simulation and / or implementation of the practical activities of the subject in the laboratory.

Problem-based learning: Students are offered a problem that must be solved in a guided manner, providing partial information and then experimentally mounting. The solution will be made by developing an application that contains the different parts of an electronic instrumentation system. The script and other necessary documentation to carry out the activity will be available in the Virtual Campus.

Development plan

Week	Contents	Methodology	Classroom Attendance	Self-guided work
1-2	T1,T2,T3,T4	Master class / Problem solving	8h	12h
3	T4	Master class / Problem solving + **Lab 1**	4h	6h
4-7	T4,T5,T6,T7	Master class / Problem solving	16h	24h
8	T7	Master class / Problem solving + **Lab 2**	4h	6h
9	1rst evaluation exam		2h	3h
10	T8	Master class / Problem solving	4h	6h
11	T8	Master class / Problem solving+ **Lab 3**	4h	6h

12	T9	Master class / Problem solving+ **Lab 4**	4h	6h
13	T10	Master class / Problem solving	4h	6h
14	T11	Master class / Problem solving + **Lab 5**	4h	6h
15	T12	Master class / Problem solving	4h	6h
16	2nd evaluation exam		2h	3h

TOTAL classroom attendance --> 60h / **TOTAL self-guided work**--> 90h

Master class / Problem solving

Evaluation

The process of evaluation of the subject follows the system of continuous evaluation and will consist of the following activities:

- **EX1** Exam (theory and problems) 1st part (Weight in the final evaluation -> 35%) (2 hours)
- **EX2** Exam (theory and problems) 2nd part (Weight in the final evaluation -> 40%) (2h duration)
- **LAB** Assessable practices / Laboratory reports (Weight in the final evaluation -> 15%)
- **PRO** Resolution of questionnaires in class, problems / simulation of exercises via virtual campus, tests, work to be delivered on a specific date, etc ... (Weight in the final evaluation -> 10%)

The FINAL Grade of the subject is determined by the following formula:

FINAL Grade= 0.35 **x EX1 +** 0.40 **x EX2 +** 0.10 **x PRO +** 0.15 **x LAB**

- In order for the **EX1** and **EX2** exams to be included in the FINAL Grade formula, the minimum mark obtained in each exam should be **> = 4 (greater or equal to 4)**.
- Students have the right to recover any evaluation activity that is equal to or greater than 30% of the final mark in a subject or subject, except for the practices of the subject, if applicable (according to the assessment regulations and qualification of the UdL). That is, if a student fails (note <5, less than 5) the **EX1** exam and / or the **EX2** exam has the right to recover them (if you want) during the Recovery evaluation period.
- In no case any **PRO**, **LAB** and / or **PI** or **TE** activity can be deliverded in the Recovery evaluation period in order to be evaluated during this period.
- The subject is passed when FINAL Grade > = 5 greater or equal to 5).

Bibliography

Basic

• Circuitos Eléctricos. James W. Nilsson, Susan A. Riedel. Pearson, Prentice Hall

Additional

• Máquinas Eléctricas. Stephen J. Chapman. Mc Graw Hill

• Circuitos Eléctricos. Problemas y ejercicios resueltos. Julio Usaola. Prentice Hall.

• Análisis de Circuitos en Ingeniería. William H.Hayt, Jack E. Kemmerly y Steven M.-Durbin. Prentice Hall

• Electrotecnia. Pablo Alcalde. Thomson Paraninfo.

• Máquinas Eléctricas- Jesús Fraile Mora. Mc Graw Hill.