Universidad Rey Juan Carlos

TEACHING GUIDE

Circuit Theory

GRADO EN INGENIERÍA BIOMÉDICA (INGLÉS) (1º y 2º curso)

ACADEMIC YEAR 2026-27

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I.-Subject Identification	
Type	OBLIGATORIA
Teaching period	1 course, 2Q semester
Nº of credits	3
Language in wich the subject is taught	English

II.-Presentation

Circuit Theory is fundamental knowledge for biomedical engineers. Understanding circuit theory allows biomedical engineers to analyze biological signals, and work collaboratively with many other disciplines such as electronics and communications. This subject introduces the theory of circuits, presenting the active and passive components of electrical circuits, along with techniques for analyzing circuits under direct current (DC) and sinusoidal steady state conditions.
Previous knowledge: To take this subject it is necessary to have completed the subjects Mathematics I and Mathematics II. Especially, it is necessary for the student to master the algebra of complex numbers, linear systems and basic concepts of trigonometry.

III.-Learning outcomes

COM17. Ability to develop and design complex products (devices, artefacts, etc.), processes and systems in their field of study to meet established requirements, that can include an awareness of non-technical ¿ societal, health and safety, environmental, economic and industrial¿ considerations; to select and apply relevant design methodologies. (EURACE 3.1)
CON04. Understanding and mastery of basic concepts related to the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism, as well as their application to solving engineering problems.
CON21. Knowledge and understanding of engineering fundamentals underlying their specialisation, at a level necessary to achieve the other programme outcomes, including some awareness at their forefront. (EURACE 1.2)

- Key for degrees not adapted to RD 822/21: **CB** - basic competences, **CG** - generic competences, **CE** - specific competences, **CT** - transversal competences.
- Key for degrees adapted to RD 822/21: **CON** - knowledge, **COM** - competences, **HAB** - skills.

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IV.-Contents

IV.A.-Syllabus

Theoretical concepts:

Topic 1.Circuit theory.

1.1. Circuits, active and passive elements.
1.2. Ohm's and Kirchhoff's laws.
1.3. Dependent sources.
1.4. Node voltage and mesh current methods.
1.5. Source transformations.
1.6. Thevenin and Norton equivalents.
1.7. Maximum power transfer.

Topic 2.Transient phenomena and sinusoidal steady state.

2.1. Phasor equivalents.
2.2. Passive elements in sinusoidal regime.
2.3. Impedance and phasor Kirchhoff's laws.
2.4. Power in sinusoidal steady state.

Circuit laboratory:

•Elementary circuits.
•Power supplies and signal generators.
•Measurements with oscilloscopes.

IV.B.-Training activities

Type	Title
Theoretical sessions	Attendance at theoretical sessions in which students receive lectures (blackboard explanations, slides, ...) from professors.
Academic tutorials	Academic tutorials to solve doubts regarding theory, problem resolution and/or practices.
Experimental and/or technological laboratories	Circuits laboratory.
Resolution of exercises, problems, case studies	Attendance at sessions devoted to solving problems by applying the theoretical and practical concepts of the course.
Test and/or exams	Problem-solving exams (taken during the course without previous announcement of the specific dates).
Test and/or exams	Final exam (in the ordinary call).
Other activities	Studying course materials to prepare for and follow up on class sessions.
Other activities	Studying and reviewing of course materials aimed at preparing for exams held throughout the course and at the end of the term.

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V.-Student workload	
Theoretical sessions	17
Resolution of exercises, problems, case studies, etc.	4
Practical sessions in experimental, technological and clinical laboratories, fieldwork, etc.	5
Tests and/or exams	4
Academic tutorials	5
Related activities: conferences, seminars, etc.	19
Preparation of theoretical sessions and self-study	8
Preparation of practical tasks, exercises, case studies, projects, etc.	13
Preparation for tests and/or exams	15
Total student workload	90

VI.-Methodology and academic programme

Type	Period	Content
Theoretical sessions	Week 1 to Week 15	Presentation of the course contents, and master classes and problem solving about circuit theory.
Resolution of exercises, problems, case studies	Week 1 to Week 15	Problem solving sessions.
Experimental and/or technological laboratories	Week 4 to Week 12	Circuit laboratory. Three practical sessions will take place in the electronics laboratory.
Tests and/or exams	Week 5 to Week 15	Problem-solving exams. Three problem-solving exams will be conducted throughout the course, in which students will apply the theoretical and practical concepts covered in the course.
Tests and/or exams	Week 15 to Week 20	Final exam (in the official date of the ordinary call).

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VII.-Assessment methods

The general assessment method is continuous as established in the *Regulation for the Assessment of Learning Outcomes* of Rey Juan Carlos University.
All the assessment systems established in the degree report must be employed, except for those that have a minimum weight of 0%, which can be used by professors in the academic years they consider relevant. Each assessment system may be applied through one or more assessment activities, consistent with the system. No assessment activity can exceed individually 60% of the overall grade for the subject.
The sum of non re-evaluable activities cannot exceed 40% of the overall grade for the subject and, in general, should not have an established minimum grade (except for practical activities in which, strictly speaking, the conditions of the ordinary call cannot be reproduced in the extraordinary call).
Those students who do not manage to pass the subject in the ordinary call, or do not attend this first call, may attend the extraordinary call only for failed re-evaluable assessment activities.
The distribution and characteristics of the assessment activities are described below.

VII.A.-Description and weight of the assessment activities

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Assessment activities						
Activity	**Character**	**Type**	**Minimum mark**	**Weighing**	**Period**	**Contents**
Problem-solving exam **ExP1**	Individual	**No** re-assessable	NO	5%	Week 5-7	Exam focused on Topic 1, until section 1.5. (included).
Problem-solving exam **ExP2**	Individual	**No** re-assessable	NO	5%	Week 9-11	Exam focused on all contents of Topic 1.
Problem-solving exam **ExP3**	Individual	**No** re-assessable	NO	5%	Week 14-15	Exam covering all course content, with special emphasis on Topic 2.
Final exam **ExF**	Individual	Re-assessable	4.5	60%	Ordinary call	Written exam related to the **theoretical and practica**l contents of the course.
Practice **Pr0**	Group	**No** re-assessable	NO	5%	Week 4-5	Initial practical session in the electronics laboratory.
Practice **Pr1**	Group	**No** re-assessable	NO	10%	Week 6-8	Practical session in the electronics laboratory, focused on resistive circuit analysis.
Practice **Pr2**	Group	**No** re-assessable	NO	10%	Week 10-12	Practical session in the electronics laboratory, focused on sinusoidal permanent regime.

1 - Ordinary assessment:

- Problem-solving exams ExP1, ExP2 and ExP3 (No re-assessable):

Students will take three problem-solving exams throughout the course, which will assess their ability to **apply the practical and theoretical contents studied in previous sessions**. These exams will be held during the regular course schedule. The assessed content will be based on the application of the theoretical and practical concepts taught from the beginning of the course up to the corresponding section of the syllabus for each exam (as indicated in the Contents column of the previous table). These problem-solving exams do **not require a minimum** passing grade and **cannot be re-assessed**.

- Final exam (Re-assessable):

On the ordinary call, a final exam will be conducted covering the theoretical and practical contents of the course. The final grade for this activity (**ExF**) must be higher or equal to 4.5 (**ExF>=4.5**) to pass the course.

- Laboratory practices (No re-assessable):

The evaluation of the laboratory practices (**Pr0, Pr1 and Pr2**) will be carried out by considering the **preparation of the laboratory session and the submission of laboratory, the individual or group work during the practice sessions and the reports**. Reports will be completed in groups or individually depending on the number of students. The guidelines for each laboratory session will be available before the corresponding lab practice, and the deadline for submitting the work will be on the

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same day the practice is carried out.
Laboratory reports must be origina. Iit is not allowed the use of solutions made, totally or partially, by other people than those listed as authors of the submitted work, and neither is the use of LLMs allowed. Failure to comply with this rule will lead to failure of the subject as well as to take the actions established in the regulations on the university coexistence regime.

- Evaluation criteria:
Only if the minimum mark in the final exam (ExF) is reached, the **Final Mark (FM)** of the course will be calculated as follows:
FM = ExP1*0.05 + ExP2*0.05 + ExP3*0.05 + ExF*0.6 + Pr0*0.05 + Pr1*0.1 + Pr2*0.1
To **pass the course,** the student's **mark must meet both the following requirements:**
•**ExF >= 4.5** (i.e. the minimum mark must be reached in **the Final exam**).
•The **final mark** must be equal to or higher than **5** (**FM >= 5**).
Only in this case, the student is considered to have acquired the learning outcomes associated with the subject, and will be graded with pass, notable, outstanding, or honors depending on the FM value.
Important considerations:
•If the score **4.5 is not reached** in **ExF**, **FM cannot be calculated**, and the URJC assessment regulations will apply, so the final score in the call will be '**fail**'.
•Students will be marked as **no-show** if they **do not attend any** ExP1, ExP2, ExP3 **neither** ExF, and **do not deliver** Pr0, Pr1 **neither** Pr2. In all other cases, **FM will be calculated as explained above.**
•**All exams must be completed individually and with the absence of all external help except that expressly allowed by professors**. Failure to comply with these rules will lead to fail in the call affected as well as to take pertinent actions established in the regulations of the university.
•Throughout the ordinary assessment period (including the revision of the exams and/or the deliveries), Professors can require an **additional oral exam that can vary the final mark**.

2 - Extraordinary assessment:
- The problem-solving exams are not re-assessable, so their grades (**ExP1, ExP2 and ExP3**) of the ordinary call will be maintained in this call.
- The laboratory practices are not re-assessable, so their grades (**Pr0, Pr1 and Pr2**) of the ordinary call will be maintained in this call.
- If the minimum mark of the **Final exam** is not reached (if **ExF<4.5**), the student must retake the Final exam in the extraordinary call.
- If the minimum marks of the **Final exam** is achieved, but the final mark is lower than 5 (**FM < 5**), **the student must retake the Final exam.**
- To **pass the course,** the student **mark in the extraordinary call must meet both the following requirements: ExF >= 4.5 and FM >= 5**. Only in this case, the student is considered to have acquired the learning outcomes associated with the subject, and will be graded with pass, notable, outstanding, or honors depending on the FM value. If the score **4.5 is not reached** in **ExF**, **FM cannot be calculated**, and the URJC assessment regulations will apply, so the final score in the call will be '**fail**'.
Important considerations:
- Students who passed the course in the ordinary call are not allowed to attend the extraordinary call.
- In the period of extraordinary evaluation, Professors can require an additional **oral exam** that can vary the final mark.

3 – Advanced evaluation call:
The evaluation method of the advanced call will consist of the student taking **the Final exam** (**ExF**). The grades of the problem-solving exams (**ExP1, ExP2 and ExP3**) **and** the Laboratory practices (**Pr0, Pr1 and Pr2**) performed the previous year in which the student was enrolled in this course will be maintained in this call.
To pass the course, the **minimum mark** must be reached in the **Final exam** (**ExF >= 4.5**) and the **Final mark** must be equal to or higher than 5 (**FM >= 5**). If and only if all minimum marks are reached, the student is considered to have acquired the learning outcomes associated with the subject, and will be graded with pass, notable, outstanding, or honors depending on the FM value. However, if the **corresponding minimum score is not reached** in **ExF**, **FM cannot be calculated**, and the URJC assessment regulations will apply, so the final score in the call will be '**fail**'.

Oral defense and academic conduct
If deemed appropriate by the professors, any student may be required to undertake an **oral defense** (either in person or

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remotely) of any assessment activity in the course (both in the **ordinary** and **extraordinary** examination periods).
The outcome of the oral defense may be either the **confirmation of the grade originally awarded** or the assignment of a **new grade different from the previous one**. Failure to attend the required oral defense will result in a **fail grade (mark = 1)** for the assessment activity(ies) concerned.
The professors of the course may use **automatic plagiarism-detection tools** to review submitted coursework. All work submitted for this course must be **original**. Therefore, solutions or materials produced by individuals other than those listed as the authors of the work may not be used.

VII.B. Assessment of students with academic exemption from class attendance

Having Academic Exemption from Class Attendance (DAAC) does not imply that students are automatically exempt from participating in the continuous assessment activities or in the training activities of compulsory attendance as established in the teaching guide. Once the exemption has been granted, students must contact the subject's teaching staff, who will propose the adaptations he/she may consider relevant, as long as they guarantee the acquisition and adequate assessment of the learning goals established. Students must maintain adequate communication with the teaching staff so that they may provide information on the dates for training and assessment activities, if these are not established in the programme and available for students at the time of achieving the exemption.
Subject with possibility of academic exemption: Yes.

VII.C. Review of assessment activities

In accordance with the Regulation for the Assessment of Learning Outcomes of Rey Juan Carlos University.

VII.D.-Students with a disability or special educational needs

In order to guarantee equal opportunities, non-discrimination, universal accessibility and academic success, students with disabilities or especial education needs may request curricular adaptations to follow their studies. These adaptations will be provided by the Unit of Attention to People with Disabilities of Rey Juan Carlos University, in accordance with the regulation which regulates the service for the Attention of People with Disabilities at the University. This Unit will issue a report for curricular adaptations, so that students with disabilities or special education needs must contact the service (at e-mail discapacidad.programa@urjc.es) in order to provide relevant information for different educational alternatives.

VII.E.-Academic behaviour, academic integrity and honesty

Rey Juan Carlos University is fully committed to the highest standards of academic integrity and honesty, so studying at the URJC means assuming and subscribing to the values of integrity and academic honesty set out in the University's Ethical Code. To support this process, the University has Rey Juan Carlos University's Academic Conduct Regulation as well as different tools (anti-plagiarism, supervision...) that offer a collective guarantee for the full development of these essential values.

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VIII.-Teaching resources and materials
Basic bibliography
Nilsson, J. W., & Riedel, S. A. (2001). Electric circuits (6th ed.). Prentice Hall International
Hayt, W. H., Kemmerly, J. E., & Durbin, S. M. (2003). Engineering Circuit Analysis (6th ed.). Mc Graw Hill
Consultation bibliography

IX.-Professors	
Name and surname	FRANCISCO JOSÉ VALVERDE ALBACETE
E-mail address	francisco.valverde@urjc.es
Department	Teoría de la Señal y Comunicaciones y Sistemas Telemáticos y Computación
Campus	Fuenlabrada
Category	Titular de Universidad
Academic degree	Doctor
Person responsible for the subject	No
Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico
Number of quinquennia	3
Number of sexennia	3
No. of positive evaluations by Docentia	1
Name and surname	SARA GARCÍA DE VILLA
E-mail address	sara.garcia.devilla@urjc.es
Department	Teoría de la Señal y Comunicaciones y Sistemas Telemáticos y Computación
Campus	Fuenlabrada
Category	Profesor/a Ayudante Doctor/a
Academic degree	Doctor
Person responsible for the subject	Yes
Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico
Number of quinquennia	0

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