

THEORY OF ELECTRICAL CIRCUITS

Degree in Electrical and Computer Engineering

Code: 10002

Main Scientific Area: Electronics and Instrumentation

Lecturer: José Henrique de Araújo Silveira de Brito

Language of Instruction: Portuguese

Regime: S1

Contact Hours: 60h Total Workload: 100h

ECTS: 6,0

Objectives

Applies to both degrees (Degree in Medical Informatics Engineering and Degree in Electrical and Computer Engineering):

This curricular unit is intended to provide a solid background about fundamental principles of electricity, as well as basic knowledge about electric and electronic devices, to the students.

Learning Outcomes

Applies to the Degree in Electrical and Computer Engineering:

At the end of this curricular unit, the students should be able to:

Recognize the fundamental electrical units;

Calculate the equivalent resistance of an electric circuit;

Analyze circuits with real or ideal, dependent or independent current and voltage sources;

Analyze DC circuits;

Recognize the common voltage or current measuring devices and understand their operation.

Applied to the Degree in Medical Informatics Engineering:

At the end of this curricular unit, the students should be able to:

Recognize the fundamental electrical units;

Calculate the equivalent resistance of an electric circuit;

Analyze circuits with real or ideal, dependent or independent current and voltage sources;

Analyze DC circuits;

Acquire skills in the analysis of real direct current circuits;

Recognize the common voltage or current measuring devices and understand their operation

Handle of real electronic components, namely resistors, capacitors and coils.

Course Contents

Applies to the Degree in Electrical and Computer Engineering:

1. Systems of Units
2. Basic Concepts
3. Circuit Basic Elements
 - 3.1. Circuit element definition
 - 3.2. Absorbed/Generated power and energy in a circuit element
 - 3.3. Active and passive elements
 - 3.4. Real or ideal, dependent or independent current and voltage sources
4. Circuit Basic Laws
 - 4.1. Ohm's Law
 - 4.2. Kirchhoff's Laws for voltage and current
 - 4.3. Series and parallel resistor associations
 - 4.4. Equivalent resistor concept
 - 4.5. Triangle-Star equivalent resistor
 - 4.6. Voltage and current divider
5. Techniques for Analysis of Circuits with ideal sources
 - 5.1. Maxwell method
 - 5.2. Nodal Analysis
 - 5.3. Superposition method
 - 5.4. Thévenin's method and Norton's method
6. Capacitors and Inductances
7. Measuring Devices

Applied to the Degree in Medical Informatics Engineering:

1. Systems of Units

2. Basic Concepts

3. Circuit Basic Elements

3.1. Circuit element definition

3.2. Absorbed/Generated power and energy in a circuit element

3.3. Active and passive elements

3.4. Real or ideal, dependent or independent current and voltage sources

4. Circuit Basic Laws

4.1. Ohm's Law

4.2. Kirchhoff's Laws for voltage and current

4.3. Series and parallel resistor associations

4.4. Equivalent resistor concept

4.5. Voltage and current divider

5. Measuring Devices

6. Techniques for Analysis of Circuits with ideal sources

6.1. Maxwell method

6.2. Nodal Analysis

6.3. Superposition method

6.4. Thévenin's method

Recommended Bibliography

Aplica-se a ambas Licenciaturas (Licenciatura em Engenharia Informática Médica e Licenciatura em Engenharia Electrotécnica e de Computadores):

- Circuitos Eléctricos, Vítor Meireles, Lidel, 2003.

- ABC do Multímetro, 1a Edição, Mário Alves, Instituto Superior de Engenharia, 1999.

- Basic Circuit Analysis, 2nd Edition, John O' Malley, McGraw-Hill, 1992.

Learning and Teaching Methods

Applied to the Degree in Electrical and Computer Engineering:

The syllabus is presented in order to explore in a sustained way the topics needed to complement the training

students in the field of circuit analysis seeking to deepen concepts related areas of major importance to the design activities of electronic circuits. The content of the proposed syllabus addresses the various aspects essential to the fulfillment of these objectives, particularly in respect to current topics and recent developments.

Applied to the Degree in Medical Informatics Engineering:

The syllabus is presented in order to explore in a sustained way the topics needed to complement the training students in the field of circuit analysis seeking to deepen concepts related areas of major importance to the design activities of electronic circuits. The content of the proposed syllabus addresses the various aspects essential to the fulfillment of these objectives, particularly in respect to current topics and recent developments. The program also includes laboratory classes in order to allow the student to apply the concepts learned in real situations.

Assessment Methods

Applies to the Degree in Electrical and Computer Engineering:

The student performance will be evaluated through two written tests that are intended to assess the knowledge retention. The minimum grade of each test is 8.5 values in a 0-20 scale. There are also two compulsory practical works about measurement devices. The practical component is only evaluated by continuous and periodic evaluation, grade improvement is not allowed.

The final classification of the students is obtained based on the following evaluation elements:

1st test – 42.5% (minimum grade 8.5 values)

2nd test – 42.5% (minimum grade 8.5 values)

Two practical evaluations - 15% (minimum grade 9.5 values to each practical work, these practical works are compulsory).

The student who has not obtained the minimum grade in the practical component, or has not performed one of the two practical works, will be not approved in the continuous and periodic evaluation.

The student will be approved when the average of the three evaluation components is greater or equal to 9.5 values, otherwise the students can always submit to the respective exam seasons, this exam have a weight of 100% in final grade with a minimum grade of 9.5 values.

In the first test, if the student does not obtain the minimum grade of 8.5 values, the student can take one global test (with a weight in final evaluation of 85% and a minimum grade of 8.5 values). This global test is performed on the same date as the second test. The student approved in the first test can always choose to perform the global test (the global test is performed on the same date as the second test), since he abdicates of the classification obtained in the first exam.

Applies to the Degree in Medical Informatics Engineering:

The student performance will be evaluated through two written tests that are intended to assess the knowledge retention. The minimum grade of each test is 8.5 values in a 0-20 scale. It is also considered two compulsory practical works about measurement devices. The practical component is only evaluated by continuous and periodic evaluation, grade improvement is not allowed.

The final classification of the students is obtained based on the following evaluation elements:

1st test – 37.5% (minimum grade 8.5 values)

2nd test – 37.5% (minimum grade 8.5 values)

Two practical evaluations with written report - 25% (minimum grade 9.5 values to each practical work, these practical works are compulsory).

The student will be approved when the average of all evaluation components is greater or equal to 9.5 values, otherwise the students can always submit to the respective exam seasons, if they have obtained the minimum grade in the practical component. The practical component is only evaluated by continuous and periodic evaluation.

Grade improvement of the practical component is not allowed. At exam time (with a percentage of 75% of the final grade) the minimum grade is 9.5 points. A student who has not been approved at the practical component cannot submit to the exam seasons.