Course guide
205276 - TAT - Thermal Analysis Techniques Applied to Engineering Materials

Last modified: 09/07/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 724 - MMT - Department of Heat Engines.

Degree: BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2024 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Roman Concha, Frida Rosario

Others: Calventus Solé, Yolanda

TEACHING METHODOLOGY

The course is divided into parts:
Theory classes
Practical classes (Laboratory Sessions)
Self-study for doing exercises and activities.
In the theory classes, teachers will introduce the theoretical basis of the concepts, methods and results and illustrate them with appropriate examples to facilitate their understanding.
The practical classes will take place in the Laboratory, and in them, students will observe the different phenomena presented in the theory classes.
Students need to work independently on the materials provided by teachers in order to assimilate the concepts.
The teachers control activities by ATENEA.

LEARNING OBJECTIVES OF THE SUBJECT

Knowing the main thermal analysis techniques used in the industry (chemical, pharmaceutical, electronics, aeronautics, etc.) and learning how to use them in the laboratory.

Knowing how to analyse the thermal behaviour of engineering materials and identifying the different thermal transitions they undergo (such as the glass transition, crystallisation, melting, curing process).

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	40.00
Self study	45,0	60.00

Total learning time: 75 h

CONTENTS

Content 1: Thermal transitions on materials. Differential Scanning Calorimetry (DSC)

Description:
Study and analyse the 1st and 21nd order thermal transitions and the consequences they have on the structure and properties of materials.
Initiate the study and learning of the DSC thermal analysis technique, by means of laboratory practices.

Specific objectives:
Using the experimental results obtained by DSC, identify the thermal transition(s) of the material and also to find out what material it is.

Related activities:
Individual activity
Lab session

Full-or-part-time: 14h
Theory classes: 6h
Self study : 8h

Content 2: Study of the main thermal transitions applied to polymers. Study some polymers of interest by using DSC and Thermogravimetry (TG).

Description:
It gives an overview what kind of polymers we have, its main characteristics and properties. Industrial applications and in daily life. Study by DSC the glass transition region and the crystallization process. Calculate the activation energy and the crystallization kinetics. Determine the thermal stability of the material using Thermogravimetry technique.

Specific objectives:
Learn about the main characteristics and properties of polymers applied to industry . Deepen the knowledge and use of the DSC technique applied to the study of glass transition and crystallization. Introduction to the knowledge and use of thermogravimetry (TG).

Related activities:
Class activities
Lab Sessions

Full-or-part-time: 30h
Theory classes: 14h
Self study : 16h

Content 3: Curing process and thermal conductivity

Description:
Study the characteristics of the curing process using the DSC technique. Measurements of the thermal conductivity of composites for application in electronic devices.

Specific objectives:
Knowing the nature, evolution and final properties of the material that has undergone the curing process. To learn how perform thermal conductivity measurements of cured composites applied to electronic devices.

Related activities:
Class activities
Lab Session

Full-or-part-time: 14h
Theory classes: 4h
Self study : 10h

Content 4: New kind of polymeric materials: vitrimers. Its application to recyclability and sostenibility. Its caracterization by DSC with UV light

Description:
The main benefits of a new emerging class of materials called vitrimers are studied. These materials have great applicability in the aeronautics industry and in 3D printing. They are produced using dual curing: thermal and using UV light.

Specific objectives:
Knowing about the behaviour of vitrimers. Learning the experimental technique of DSC with UV light.

Related activities:
Lab Session

Full-or-part-time: 12h
Theory classes: 4h
Self study : 8h

Content 5: Materials with applications in Photovoltaic panels

Description:
Fundamentals of photovoltaic pannels
New organic materials for photovoltaic cells

Specific objectives:
Learning how photovoltaic cells work and search for new materials to make them more economical and increase their efficiency.

Related activities:
Continuous assesment

Full-or-part-time: 5h
Theory classes: 2h
Self study : 3h

GRADING SYSTEM

The final grade depends on the following criteria:

- Individual tasks: 4 tasks of 7,5% each
- Presentation of an essay: 20%
- Laboratory Reports: 50%

EXAMINATION RULES.

All tests (quizzes) and reports must be uploaded to Athenea within the period indicated by the teacher.s

BIBLIOGRAPHY

Basic:

- Callister, William and Rethwisch David. Material Science and Engineering: An Introduction. 9th. USA: Wiley, 2014. ISBN 978-1-118-32457-8.
- Balart R., López J., García D., Parres F.. Técnicas Experimentales de Análisis Térmico de Polímeros. 1. Valencia: Editorial de la UPV, 2003. ISBN 84-9705-475-X.
- Wagner M.. Thermal Analysis in Practice. Fundamental aspects. 1. Munich: Elsevier, 2018. ISBN 978-1-56990-643-9.