Last update: 23-04-2019

220126 - Thermodynamics of Materials

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 724 - MMT - Department of Heat Engines

Academic year: 2019

Degree: BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: Frida Roman

Others: John M. Hutchinson, Yolanda Calventus

Teaching methodology

The course is divided into parts:
Theory classes
Practical classes
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 provide the syllabus and monitoring of activities (by ATENEA).

Learning objectives of the subject

- Understanding of Thermodynamics applied to the phase transitions and its application to polymeric materials.
- Learn some experimental techniques for detecting phase transitions in polymeric materials.

Study load

Total learning time: 75h	Hours large group:	30h	40.00%
	Self study:	45h	60.00%

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Content

Module 1: Thermodynamic Property Relations

Learning time: 15h
Theory classes: 6h
Self study : 9h

Description:
- Review of The Laws of Thermodynamics
- Gibbs Equation
- Fundamental Thermodynamics relationships
- Maxwell?s Equations
- General equations for internal energy, enthalpy and entropy in terms of P,v , T and specific heats
- Equilibrium and stability criteria

Related activities:
Theory classes

Module 2: First and Second order phase transitions

Learning time: 7h
Theory classes: 3h
Self study : 4h

Description:
- First order phase transitions
- Second order phase transitions

Related activities:
Theory classes

Module 3: First order phase transitions: crystallization and melting in polymeric materials

Learning time: 20h
Theory classes: 8h
Self study : 12h

Description:
- Introduction and concepts of morphology
- Crystallisation kinetics. Nucleation and Growth
- Factors which affect the crystallisation process
- Properties related to the crystalline structure
- Melting temperatures, enthalpies and entropies of Fusion

Related activities:
Theory classes
Practical classes

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Module 4: Glass transition phenomena in polymeric materials	Learning time: 13h Theory classes: 5h Self study : 8h

Description:
- Pseudo second order transitions
- Glass transition
- Effect of different parameters in glass transition
- Physical aging.

Related activities:
Theory classes
Practical classes

Module 5: Curing reactions in thermosetting polymers	Learning time: 20h Theory classes: 8h Self study : 12h

Description:
- Curing reactions
- Curing reactions of thermosetting materials
- Vitrification and devitrification
- Curing kinetics
- Characterisation techniques

Related activities:
Theory classes
Practical classes

Qualification system

The final grade depends on the following criteria:

- Final exam: 50%
- Coursework: 50%

Students that fail or do not present to the final exam (50%) that will take place at the end of the elective classes, will have the chance to repeat it in January, but, in this case, the maximum grade which can be awarded is 5/10.

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Bibliography

Basic:

Adkins, C. J. Equilibrium thermodynamics. 3rd ed. Cambridge [etc.]: Cambridge University Press, 1983. ISBN 0521254450.

Billmeyer, Fred W. Textbook of polymer science. 3rd ed. New York: Wiley-Interscience. Division of John Wiley & Sons, 1984. ISBN 0471828343.

Smith J.M.; Van Ness H.C.; Abbott M.M. Introduction to chemical engineering thermodynamics. 7th ed. New York: McGraw-Hill, 2005. ISBN 9780071247085.

Mandelkern, L. Crystallization of polymers. Vol. 1, Equilibrium concepts. 2nd ed. Cambridge: Cambridge University Press, 2010. ISBN 9780521020138.

Complementary:

Dusek, K. Epoxy resins and composites. Springer-Verlag, 2013. ISBN 9783662159644.