THERMAL ANALYSIS

1.1. Identification

University:	Universidad Politécnica de Valencia																	
School:	Escuela Técnica Superior de Ingeniería del Diseño																	
Course:	Thermal Analysis																	
ECTS:	4																	
Semester:	*Winter*										*Summer*							X
Category	*Fundamental course*								X		*Specialisation course*							
Module	*MFI*		*MFII*		X	*MFIII*					*MSI*		*MSII*			*MSIII*		
Teachers:	Laura Contat, Amparo Ribes																	
Language:	*English*		X	*Italian*			*Swedish*			*Spanish*								

1.2. Learning-outcomes

- Knowledge about the fundamentals of thermal analysis techniques
- knowledge about the structure and properties of polymeric materials and how these can be characterised by thermal analysis
- knowledge about how to implement thermal analysis techniques for quality assessment of polymers in industrial and environmental applications.

1.3. Competencies

- **General**
  - to have critical understanding of technical and scientific tools
  - to work and manage teams
  - communication skills (both written and oral)
  - to work in an international context

- **Specific**
  - to understand the principles of thermal analysis techniques
  - to achieve basic knowledge of the structure and properties of polymeric materials
  - to perform basic interpretation of the measured data by thermal analysis techniques
  - to perform advanced data treatment from thermal analysis techniques, in order to obtain detailed information about the structure of polymeric materials
  - to apply thermal analysis to the study of polymer degradation phenomena

1.4. Contents

1. Introduction to thermal analysis.
2. Thermogravimetric analysis (TGA)
    - Theoretical aspects.
    - Analysis of the composition of blends and mixtures.
    - Thermal decomposition analysis (decomposition, peak, onset and endset temperatures).
    - Kinetic analysis (kinetic equation, isoconversional models, differential and integral methods).
    - Evolved gas analysis (Mass spectrometry, Infrared Spectroscopy).
3. Differential Scanning Calorimetry (DSC)
    - Theoretical aspects.
    - Fusion and crystallisation thermograms. Peak temperatures and enthalpies. Degree of crystallinity.
    - Lamellae thickness distribution.
    - Crystallization kinetics (Avrami equation).
    - Oxidative stability determinations.
4. Dynamic mechanical analysis (DMA) and dielectric analysis
    - Viscoelastic properties of polymers.
    - Characterization of the mechanical and dielectric spectra.
    - Determination of the activation energy of the relaxation processes.
    - Determination of the free volume in amorphous polymers.
5. Application of thermal analysis to polymer degradation studies.

1.5. Teaching Methodology

- Lecture sessions
- Laboratory sessions
- Practical sessions: examples of data analysis from thermal analysis
- Experimental short project

1.6. Evaluation

- written exams
- oral evaluation of the examples of data analysis
- oral evaluation of the experimental project

1.7. Bibliography

- Edith A. Tury. “Thermal characterisation of polymeric materials”. Academic Press
- John Mitchell Jr. “Applied polymer analysis and characterization”. Hanser.
- V. Mathot. “Calorimetry and thermal analysis of polymers”. Hanser.
- M. Sorai. “Comprehensive handbook of calorimetry and thermal analysis”. Wiley
- W. Groenewoud. “Characterisation of polymers by thermal analysis”. Elsevier.