Universidade Federal do Rio Grande do Sul
Instituto de Química
Graduate Program in Chemistry (Grade 7/CAPES)
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COURSE SYLLABUS

1. Identification

Code and title: QUP 008 – Physico-Chemical of Polymers
Professor: Cesar Liberato Petzhold and Nádya Pesce da Silveira
Level: Master and Doctorate
Credit hours: 3
Revised: August_2019

2. Summary

Chain Dimensions. Thermodynamics of Polymer Solutions. Determinations of Molecular Weight in Solution. Thermo-Mechanical and Viscoelastic Properties and Elasticity Theory of Rubber; Relationship Structure and Physical Properties.

3. Objective

The aim of the course is to develop theoretical skills on the physicochemistry of polymers.

4. Contents

- Polymers in Solution: Introduction, Thermodynamics of polymer solutions, Flory-Huggins theory, Phase equilibrium, Fractionation, Flory-Krigbaum theory, Theta temperature and its location, Critical solution temperatures, Solubility parameters.
- Determination of molar mass by viscosity, gel permeation chromatography, vapor pressure, osmosis, light scattering.
- Mechanical properties: Viscoelastic state, Mechanical properties, Inter-relationship between modules, Viscoelastic behavior of the amorphous state, Principle of Boltzmann superposition, Relaxation, Principle of time-temperature superposition.
- The Elastic State: Introduction, Properties of elastomers, Thermodynamic aspects of rubber elasticity, Affine Theory, Phantom, Mooney-Rivlin, Non-ideal elastomers, Elastomeric lattice elongation, Lattice defects, Elastomer resilience.
- Crystalline State and Amorphous State: Vitreous and crystalline transitions, Determination thereof, Thermodynamics and crystallization kinetics, Crystalline state morphology, Glass transition thermodynamics.
- Structure-Property Relation: Relation between glass transition and melting temperatures and the chemical structure of the polymers, Crystallinity and mechanical response, Application to fibers, elastomers and plastics.

5. Assessment

The evaluation will take place through exercises, seminars and a final written test. The student, who obtains a final grade of A, B or C, awarded as per the list below, will be considered approved:
A: grade equal to or above 9.0
B: grade equal to or above 7.5 and below 9.0
C: grade equal to or above 5.0 and below 7.5
D: grade below 5

FF: lack of frequency

6. Methodology

The classes will be theoretical-expositive and will be taught involving different didactic resources including reading of texts, projections, online activities.

7. Bibliography

- M. Doi, S. F. Edwards, Theory of Polymer Dynamics, Oxford Press, 1986.
- H. G. Elias, Makromoleküle, 4.a ed., Basel, Hüthig & Wepf Verlag, 1981.
- J. D. Ferry, Viscoelastic Properties of Polymer, 3.a ed., John Wiley & Sons, 1980.
- P. J. Flory, Principles of Polymer Chemistry, Ithaca, Cornell Univ. Press, 1953.
- P. J. Flory, Statistical Mechanics of Chain, John Wiley & Sons, 1969.
- P. C. Hiemenz, Polymer Chemistry, Marcel Dekker, 1984.
- H. Morawetz, Macromolecules in Solution, (High Polymers, vol 21) 2.a ed., John Wiley & Sons, 1975.
- C. Tanford, Physical Chemistry of Macromolecules, J. Wilwy & Sons, Inc., 1961.
- L. R. G. Treloar, The Physics of Rubber Elasticity,3.a ed., Oxford, Claredon Press, 1975.