



## *The Hebrew University of Jerusalem*

### *Syllabus*

## **PRINCIPLES OF POLYMERS SCIENCE - 69900**

*Last update 06-03-2023*

*HU Credits:* 4

*Degree/Cycle:* 1st degree (Bachelor)

*Responsible Department:* Chemistry

*Academic year:* 0

*Semester:* 2nd Semester

*Teaching Languages:* Hebrew

*Campus:* E. Safra

*Course/Module Coordinator:* Prof. Roy Shenhar

*Coordinator Email:* [roys@huji.ac.il](mailto:roys@huji.ac.il)

*Coordinator Office Hours:* By appointment

*Teaching Staff:*

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Prof Roy Shenhar

Course/Module description:

Basic course in Polymer Science, covering basic concepts, polymerization chemistry (mechanisms and kinetics), behavior of polymer chains, and main physical properties

Course/Module aims:

See Learning Outcomes.

Learning outcomes - On successful completion of this module, students should be able to:

Recognize and classify polymers by the mechanism of their creation

Explain the influence on the polymerization mechanism on the distribution of molecular mass

Plan a synthetic strategy for the creation of polymer and copolymers with different architectures

Evaluate the behavior of polymers in solution and in the melt

Know the main characterization methods

Analyze the main properties of polymers

Attendance requirements(%):

80%

Teaching arrangement and method of instruction: Lecture

Course/Module Content:

Introduction - evolution of polymer science, basic concepts, nomenclature.

Step polymerization - mechanism, Carothers' theory, Flory's statistical theory, kinetics, synthesis methods, non-linear polymerization, gelation.

Free radical polymerization - initiation, propagation, termination, and chain transfer; kinetics; polymerization processes: bulk, solution, suspension and emulsion.

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*Controlled radical polymerization – principles and strategies, NMP, ATRP, RAFT.*

*Anionic polymerization – living polymerization, solvent and counterion effects.*

*Stereochemistry and coordination polymerization – tacticity, Ziegler-Natta polymerization.*

*Ring opening polymerization and specialized polymers - ROP, ROMP, conductive polymers by oxidative coupling*

*Copolymerization – different mechanisms, Q-e scheme.*

*Block and graft copolymers – synthesis methods*

*Polymers in solution – Flory-Huggins theory, solubility parameter, size of a polymer,  $\theta$  conditions.*

*Characterization methods – gel permeation chromatography, light scattering, viscometry, end-group analysis*

*Amorphous polymers – the glass transition, chemical structure effect*

*Semi-crystalline polymers – transitions, melting, structure, melt crystallization*

*Multicomponent systems – blends and block copolymers*

Required Reading:

None.

Additional Reading Material:

Course/Module evaluation:

End of year written/oral examination 0 %

Presentation 0 %

Participation in Tutorials 0 %

Project work 70 %

Assignments 20 %

Reports 0 %

Research project 0 %

Quizzes 0 %

Other 10 %

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*Active participation in class*

*Additional information:*

*A visit to a polymer factory/company is planned toward the end of the course.  
Participation in the visit is not mandatory.*