Stampare su carta intestata del CdS

General information	
Academic subject	**ORGANIC CHEMISTRY and POLYMER TECHNOLOGY** **Module B POLYMER CHEMISTRY**
Degree course	**MATERIAL'S SCIENCE and TECHNOLOGY-L-30**
Academic Year	**2nd**
European Credit Transfer and Accumulation System (ECTS)	**4**
Language	**ITALIAN**
Academic calendar (starting and ending date)	**First semester**
Attendance	**NO**

Professor/ Lecturer	
Name and Surname	Francesco Babudri
E-mail	francesco.babudri@uniba.it
Telephone	0805442075
Department and address	Dipartimento di Chimica
Virtual headquarters	
Tutoring (time and day)	Tuesday 11-13, Thursday 12-13, Friday 16-18. The teacher is also available in other days by e-mail appointment. Tutoring can be also done in remote way on the TEAMS platform using the access code 36a8 bll

---

Syllabus	
Learning Objectives	Knowledge of polymeric organic materials: i) chemical processes for their synthesis, ii) chemical-physical and mechanical properties and relationship with their structure, iii) applications of main classes of organic polymers.
Course prerequisites	General and Inorganic chemistry. Basic principles of thermodynamics. Basic knowledge of mathematics. Organic chemistry developed in the module A of this course.
Contents	**<u>Introduction</u> (basic concepts of the polymer chemistry 0,3 CFU lessons**). Definitions, polymerization processes, polymer nomenclature. Industrial polymers: thermoplastic resins, fibres, elastomers, thermosetting resins. Molecular weights of polydisperse materials. **<u>Polymerization processes</u>** (polymer synthesis by chain-growth and step-growth polymerization) 1) <u>Chain-growth polymerization: vinyl polymers</u> (0,7 CFU lessons) Radical polymerization: initiators, kinetic and mechanism, diene polymerization, ceiling temperature, copolymerization and Alfrey and Price Q-e plot. Radical polymerization techniques: bulk, suspension, and emulsion polymerization. Radical living polymerization (ATPR, NMPO, RAFT). Ionic polymerization: mechanisms, kinetic and monomer reactivity in cationic and anionic polymerizations. Living polymerization: block copolymers. Polymerization promoted by transition metal complexes: heterogeneous (Ziegler- Natta) and homogeneous processes. Outlines of polymer stereochemistry: atactic and syndiotactic polymers. Post-polymerization processes: cross-linking and vulcanization. Graft copolymers. Main classes of vinyl polymers.

	2) Step-growth polymerization: non-vinyl polymers (0,5 CFU lessons) Step-growth polymerization techniques. Linear and branched polymers. Carothers equation and gel point. Ring opening polymerization. Main classes of non-vinyl polymers. Outlines of some natural polymers: natural rubber, cellulose, and regenerated cellulose. Biodegradable polymers. **Basic concepts of characteristics of polymeric materials in the different aggregation states.** 1) Solid and plastic state of polymeric materials (0,2 CFU lessons). Amorphous, crystalline, and semicrystalline polymers. Glass transition and fusion. Outlines of the crystalline structure of polymers. Outlines of the amorphous polymers structure: rheological properties of polymeric materials (Newtonian behaviour, dilatant and pseudoplastic behaviour, viscosity). 2) Polymers in solution (0,4 CFU lessons) Mixing enthalpy, outlines of solubility parameters and their measurement. Outlines of the Flory-Huggins theory of polymer solutions: interaction parameter, hydrodynamic volume, expansion factors, Flory temperature and theta solvents. Viscosity of polymers solutions, Mark-Houwink-Sakurada equation. 3) Polymer molecular weight measurement methods (0,4 CFU lessons). Osmometry, light scattering, viscosimetry, gel-permeation chromatography. **Basic concepts of mechanical properties of polymers** (0,5 CFU lessons) Stress-strain plot. Module and temperature-module relationship. Viscoelastic properties: creep and stress-relaxation. Viscoelastic transition. Temperature-time equivalence. Theoretical models of viscoelastic systems. **Practical lessons** (1 CFU) 1) Analysis of exercises and problems requiring the practical application of concepts developed in the theoretical course. 2) Short seminars presented by the students as in-depth study of main relevant topics treated in the theoretical course. 3) Middle course and end course tests for learning check.
Books and bibliography	1) S. Bruckner, G. Allegra, M. Pegoraro, F.M. La Mantia "Scienza e Tecnologia dei Materiali Polimerici" EdiSes 2a ed. 2011. 2) M. P. Stevens "Polymer Chemistry: an introduction" 3a ed. Oxford University Press 1999. Lesson slides are available
Additional materials	Only some chapters of the above texts.

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
100	24	15	61
ECTS			
	3	1	

Stampare su carta intestata del CdS

Teaching strategy	Lectures (62%) with the aid of power-point presentations and practical lessons (38%) for the application of concepts developed in the theoretical course in solving exercises and problems. Short seminars presented by the students as in-depth study of main relevant topics treated in the theoretical course. E-learning is not available.
Expected learning outcomes	
Knowledge and understanding on:	○ Knowledges of the molecular structure of organic polymers an of the polymerization processes. ○ Knowledges of polymer properties in solid state and solution. ○ Basic knowledges of mechanical properties of organic polymers
Applying knowledge and understanding on:	○ Expertises on molecular structure, synthesis, chemical-physical and mechanical properties of polymeric materials
Soft skills	• *Making informed judgments and choices* *At the end of the course the student will be able to* ○ Define the structure of a polymer from that/those of monomer/monomers and the polymerization process to produce it, ○ Correlate the chemical-physical properties of a polymer with the molecular structure. ○ Evaluate the fitness for a specific use of a polymer considering its mechanical properties • *Communicating knowledge and understanding* *At the end of the course the student will be able to* ○ talk with suitable terms used in the scientific community with expert or unskilled persons on the chemical aspects of polymeric materials. • *Capacities to continue learning* *At the end of the course the student will be able to* ○ continue, using the basic knowledges acquired in this course, a deeper study and to face up a personnel selection for a position in a polymer industry

Assessment and feedback	
Methods of assessment	1) <u>Middle course and end course written tests</u> consisting of up to ten questions (mulpile choise and open response). To each of these questions a highest score, out of thirthy, is assigned, and the final mark attributed will assessed following the evaluation criteria below. Each test is passed if the sum of marks reached for each question is at least 18/30. The mark calculated by averaging the marks reached in the two passed tests may be considered as the final examination mark, that the student may accept or refuse. If refused, the student must take an oral examination as in the following point. 2) <u>Partial examination for this module of the course</u>. A partial oral examination is scheduled monthly on ESSE3 platform for students that have not passed the tests of the previous point or have not participated or have refused the result. The final mark will be assessed following the evaluation criteria as above.
Evaluation criteria	• *Knowledge and understanding* ○ <u>Lowest level of knowledges required for passing the examen</u> Knowledge of the main classes of organic polymers, their

	nomenclature, structure and parent monomers ○ Intermediate level Basic knowledge of the mechanisms of the polymerization processes and of the related kinetic and thermodynamic features. Knowledge of the polymer aggregation states properties. ○ High level Detailed knowledge of the polymerization processes also directed towards the synthesis of polymers with specific features (eg block copolymers, graft copolymers, living polymerization). • *Applying knowledge and understanding* ○ Lowest level of knowledges required for passing the examen To be able to derive the structure of a polymer from that of the monomer/monomers and its typology. ○ Intermediate level To be able to describe the polymerization processes for a specific polymeric structure ○ High level Detailed knowledge of the polymerization processes with the kinetic and thermodynamic features • *Autonomy of judgment* (This point can be evaluated only if the intermediate or high level of the two points above are reached) ○ To evaluate, on the basis of the knowledge on the chemical-physical and mechanical properties of the main classes of polymers acquired during the course, the suitable applications • *Communicating knowledge and understanding* ○ For all levels: to prove a good knowledge of scientific terms and to present in a consistent speech the topics of the examination questions. • *Capacities to continue learning* ○ The examination questions will have a growing level of in-depth analysis, in order to evaluate the learning ability reached by the student. ○
Criteria for assessment and attribution of the final mark	The final mark is the average of the marks achieved by the student in the partial examinations (or in the middle and end tests if passed and accepted by the student for module B) related to the two modules of the course.
Additional information	