

Course Title	<b>Properties of Polymers and Polymer Processing</b>				
Course Code	<b>MME 456</b>				
Course Type	Technical Elective Course				
Level	Undergraduate				
Year / Semester	4 <sup>th</sup> year / 7 <sup>th</sup> or 8 <sup>th</sup> Semester				
Teacher's Name	Theodora Krasia-Christoforou				
ECTS	6	Lectures / week	3 hours	Laboratories / week	1 hour
Course Purpose and Objectives	<p>The course MME 456 aims in the acquiring of special knowledge and skills on topics involving the structure-to-property relationship in polymers, their rheological behavior, the polymers' mechanical properties and the use of various methods in polymer processing. Besides the theoretical background, the students come are also exposed to the aforementioned on a practical level by performing laboratory exercises and attend laboratory demonstrations involving the investigation of the thermomechanical properties of polymers, fabrication of different plastic products starting from polymer films and powders, and the processing of polymer solutions towards the generation of ultrathin fibers by electrospinning. Moreover, during the course the students visit a local company (polymer processing manufacturer).</p>				
Learning Outcomes	<ul style="list-style-type: none"> <li>• Associate the chemical structure and architecture of polymers to their thermal and mechanical properties and predict polymer properties from chemical and structural information.</li> <li>• Describe the rheological behavior of polymer solutions and melts.</li> <li>• Define and discuss on different mechanical properties of polymers at the solid state (elastic, elastomeric, viscoelastic).</li> <li>• Describe the techniques employed for determining the mechanical properties of polymers (creep, stress-relaxation, dynamic mechanical analysis).</li> <li>• Discuss polymer additives and their roles and describe methodologies employed for the incorporation of additives in polymers.</li> <li>• Describe and discuss on extrusion, injection molding as well as on different mixing systems employed in polymer processing.</li> <li>• Investigate experimentally the thermomechanical properties of polymers by means of Dynamic Mechanical Analysis.</li> <li>• Perform polymer processing experiments on an electrospinning set-up towards the production of polymer nanofibers.</li> </ul>				
Prerequisites	MME 155	Required	None		

Course Content	<p>The course is divided into two parts. In the first part, the mechanical properties of polymers (e.g., elasticity, viscoelasticity, strength, etc.) and the effect of their structural and chemical characteristics on their mechanical behavior are discussed. The structure-properties correlation, the thermal transitions of polymers and how these are capable of affecting their properties, as well as the rheological characteristics of polymeric solutions and melts are analyzed. In the second part, different methods used in polymer processing such as mixing, reinforcement, molding, etc. are discussed. Moreover, the students are involved in laboratory demonstrations and exercises including the synthesis of physically-crosslinked polymer networks having variable crosslinking density, the fabrication of polymer nano/micro fibers by electrospinning and the determination of the thermomechanical properties of polymers by Dynamic mechanical analysis.</p> <p><b>Laboratory Exercises</b></p> <ul style="list-style-type: none"> <li>• Thermomechanical testing by Dynamic Mechanical Analysis</li> <li>• Fabrication of polymer nanofibers by electrospinning</li> <li>• Rheological characterization of polymers</li> <li>• Synthesis of physically crosslinked polymer networks</li> </ul>
Teaching Methodology	<ul style="list-style-type: none"> <li>• PowerPoint presentations</li> <li>• Experimental demonstrations</li> <li>• Laboratory exercises</li> <li>• Visit at the premises of a local company involved in polymer processing</li> <li>• During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.</li> </ul>
Bibliography	<ul style="list-style-type: none"> <li>• MME 456 Course handouts (<a href="http://www.eng.ucy.ac.cy/krasia/">http://www.eng.ucy.ac.cy/krasia/</a>).</li> <li>• Panayiotou, K., <i>Science and Technology of Polymers</i>, 2<sup>nd</sup> Edition, Pigasus (in Greek).</li> <li>• Cowie, J.M.G., <i>Polymers: Chemistry and Physics of Modern materials</i>, Stanley Thornes.</li> <li>• Kalpakjian, S. and S.R. Schmid, <i>Manufacturing Processes for Engineering Materials</i>, 4th ed. Prentice Hall.</li> </ul>
Assessment	<ul style="list-style-type: none"> <li>• Laboratory exercises and written laboratory reports      10%</li> <li>• Midterm examination      40%</li> <li>• Final examination      50%</li> </ul>
Language	Greek/English