

<b>Course code</b>																																	
<b>Type and description</b>	EC - elective subjects from the discipline of Material Engineering																																
<b>ECTS credit</b>	1																																
<b>Course name</b>	Physics of Thermal and Flow Processes																																
<b>Course name in Polish</b>	Procesy cieplne i przepływowe																																
<b>Language of instruction</b>	English																																
<b>Course level</b>	8 PRK																																
<b>Course coordinator</b>	dr hab. Inż. Michał Frydrysiak																																
<b>Course instructors</b>	prof. dr hab. inż. Ryszard Korycki, dr hab. inż. Michał Frydrysiak																																
<b>Delivery methods and course duration</b>	<table border="1"> <thead> <tr> <th></th> <th>Lecture</th> <th>Tutorials</th> <th>Laboratory</th> <th>Project</th> <th>Seminar</th> <th>Other</th> <th>Total of teaching hours during semester</th> </tr> </thead> <tbody> <tr> <td>Contact hours</td> <td>0</td> <td>0</td> <td>0</td> <td>5</td> <td>0</td> <td>0</td> <td>5</td> </tr> <tr> <td>E-learning</td> <td>no</td> <td>no</td> <td>no</td> <td>no</td> <td>no</td> <td>no</td> <td>no</td> </tr> <tr> <td>Assessment criteria (weightage)</td> <td>0</td> <td>0</td> <td>0</td> <td>100%</td> <td>0</td> <td>0</td> <td>100%</td> </tr> </tbody> </table>		Lecture	Tutorials	Laboratory	Project	Seminar	Other	Total of teaching hours during semester	Contact hours	0	0	0	5	0	0	5	E-learning	no	no	no	no	no	no	no	Assessment criteria (weightage)	0	0	0	100%	0	0	100%
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<b>Course objective</b>																																	
<b>Learning outcomes</b>	<ol style="list-style-type: none"> <li>1. Recognize thermal and flow processes, carry out measurements of thermodynamic parameters in the working environment, describe the construction and principle of operation of modern machines and devices, including textronic products related to thermal and flow processes</li> <li>2. Analyze the heat transfer inside the multilayer textile garments defined as the composite structures also in textronics fabrics.</li> <li>3. Determine the user's heat comfort as a result of the thermal balance also in textronics fabrics</li> </ol>																																
<b>Assessment methods</b>																																	
<b>Prerequisites</b>																																	
<b>Course content with delivery methods</b>	The project involves theoretical studies and modelling in the field of thermal and flow processes in textile technologies and modern textiles. Basic concepts and indicators for quantitative analysis of changes will be analyzed - internal energy, heat, work, enthalpy and entropy and heat transfer: conduction, convection and radiation. The project consists in the numerical modeling of heat transport inside the multilayer textile garments defined as the composite structures also in textronics product. The description by the heat transfer equation accompanied by the adequate boundary condition is applied. The material constants typical for textile materials will be introduced. The mathematical solution can be verified in laboratory condition by means of physical interpretation of solutions. Moreover, the thermal comfort of the clothing user can be determined as a result of the thermal balance (i.e. the heat produced by the organism and returned by the different methods). Based on that, a layered structure of the product with active textronics layers will be proposed. It will enable compensation of temperature changes in the underclothing layer of the textile product.																																
<b>Basic reference materials</b>	<ol style="list-style-type: none"> <li>1. Szargut J.: Termodynamika, PWN, 2000.</li> <li>2. Orzechowski Z., Prywer J., Zarzycki R.: Mechanika płynów w inżynierii środowiska, WNT, 1997.</li> </ol>																																

	<p>3. Li, Y.: The science of clothing comfort, <i>Textile Progress</i> 15; 1,2; 2001</p> <p>4. Sybilska W., Korycki R.: Analysis of coupled heat and water vapour transfer in textile laminates with a membrane, <i>Fibres and Textiles in Eastern Europe</i>, 18 (3), 65-69</p>
<b>Other reference materials</b>	<p>1. Staniszewski B.: Wymiana ciepła, PWN, 1980,</p> <p>2. Raznjevic K.: Tablice cieplne z wykresami, WNT</p> <p>3. Grzyboś R.: Podstawy mechaniki płynów, WNT, 1998.</p> <p>4. Haghi, A.K.: Factors effecting water-vapor transport through fibers, <i>Theoret. Appl. Mech.</i>, 30, 4, 277-309, 2003</p> <p>5. ISO 7933:2004 Ergonomics of the thermal environment — Analytical determination and interpretation of heat stress using calculation of the predicted heat strain</p>
<b>Average student workload outside classroom</b>	15 h
<b>Comments</b>	
<b>Last update</b>	September 2020