<table>
<tr><td>Course code</td><td></td></tr>
<tr><td>Type and description</td><td>Background Course</td></tr>
<tr><td>ECTS credit</td><td>2</td></tr>
<tr><td>Course name</td><td>Modern Mathematical Analysis</td></tr>
<tr><td>Course name in Polish</td><td>Nowoczesna Analiza Matematyczna</td></tr>
<tr><td>Language of instruction</td><td>English</td></tr>
<tr><td>Course level</td><td>8 PRK</td></tr>
<tr><td>Course coordinator</td><td>Wojciech Kryszewski</td></tr>
<tr><td>Course instructors</td><td>Marek Balcerzak, Wojciech Kryszewski</td></tr>
<tr><td>Delivery methods and course duration</td><td>
<table>
<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>
<tr><td>Contact hours</td><td>15</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>15</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></td></tr>
<tr><td>Assessment criteria (weightage)</td><td>0,00</td><td></td><td></td><td></td><td></td><td>0,00</td><td></td></tr>
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<tr><td>Course objective</td><td>1. Acquisition of knowledge concerning modern methods of mathematical analysis; abstract measure theory and the theory of differentiation in Banach spaces.

2. Acquisition of knowledge on the rudiments of the Fourier analysis: convergence of Fourier series and Fourier transform.

3. Acquisition of knowledge concerning Sobolev spaces and their applications in boundary value problems</td></tr>
<tr><td>Learning outcomes</td><td>After the course a PhD student we be able to:

1. understand and apply notions, theorems and methods of abstract measure theory and the differential calculus in Banach spaces: effects W1, U3, K2;

2. understand and study problems in function spaces with the use of the Fourier analysis methods – effects W4, U1, K1-K2

3. . understand and apply theorems in theory of Sobolev spaces: effects W1, U2, K2

4. apply the acquired knowledge in order to study various problems in concrete mathematical problems: effects U3, K1-K2</td></tr>
<tr><td>Assessment methods</td><td>Effects W1, W4– oral examination

effects U3, K1, K2…. – presentation

The final evaluation is based on:

Exam - 80%</td></tr>
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	Presentation - 20%
Prerequisites	The contents of the master degree course on the differential and integral calculus
Course content with delivery methods	Lecture 1. Abstract measure theory: construction of measure, Borel measure, Haar and Hausdorff measures. 2. Measurability and strong measurability of vector-valued functions; abstract theory of integration; product measures; the general Fubini theorem. 3. Differentiability of mappings between Banach spaces; the Lusternik Theorem on submanifolds; elements of the calculus of variations. 4. Elements of Fourier analysis; Fourier series and their convergence; Fourier series in Hilbert spaces. Fourier and Laplace transforms; applications to theory of partial differential equations. 6. Weak derivatives calculus; Sobolev spaces; emebeddings of Sobolev spaces. Presentation topics: The Radon-Nikodym theorem. The Rademacher theorem. Compactness in function spaces: Ascoli-Arzela, Riesz-Kolmogorov theorems; duality in spaces of continuous, integrable or Sobolev functions.
Basic reference materials	1. W. Ziemer, Modern Real Analysis, Springer GTM 278, 2017. 2. E. Lieb, M. Loss, Analysis, Graduate Studies in Mathematics 134, AMS, 2002 3. W. Rudin, Analiza rzeczywista i zespolona, PWN 1987
Other reference materials	
Average student workload outside classroom	35 h
Comments	
Last update	