

**KARTA PRZEDMIOTU****I. Dane podstawowe**

Nazwa przedmiotu	Topologia przestrzeni metrycznych
Nazwa przedmiotu w języku angielskim	Topology of metric spaces
Kierunek studiów	Matematyka – grupa w języku angielskim
Poziom studiów (I, II, jednolite magisterskie)	I
Forma studiów (stacjonarne, niestacjonarne)	stacjonarne
Dyscyplina	matematyka
Język wykładowy	angielski

Koordinator przedmiotu/osoba odpowiedzialna	dr Wiesław Głowczyński
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Forma zajęć ( <i>katalog zamknięty ze słownika</i> )	Liczba godzin	semestr	Punkty ECTS
wykład	30	4	5
konwersatorium			
ćwiczenia	30	4	
laboratorium			
warsztaty			
seminarium			
proseminarium			
lektorat			
praktyki			
zajęcia terenowe			
pracownia dyplomowa			
translatorium			
wizyta studyjna			

Wymagania wstępne	
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**II. Cele kształcenia dla przedmiotu**

C-1 The aim of the lecture is to introduce students to the basic concepts of topology of metric spaces, in particular those which are applied in other fields of mathematics.

### III. Efekty uczenia się dla przedmiotu wraz z odniesieniem do efektów kierunkowych

Symbol	Opis efektu przedmiotowego	Odniesienie do efektu kierunkowego
<b>WIEDZA</b>		
W_01	The student understands the structure of mathematical theories, can use mathematical formalism to construct and analyse simple mathematical models in other areas of science	K_W03
W_02	The student knows basic theorems from topology of metric spaces	K_W04
W_03	The student knows basic examples both those that illustrate concrete topological notions, and those that allow false hypotheses or unsupported argumentation	K_W05
<b>UMIEJĘTNOŚCI</b>		
U_01	The student uses language and metric topology methods in mathematical analysis and geometry	K_U09, K_U24
U_02	The student has the ability to check the correctness of inferences in building formal evidence	K_U03
U_03	The student knows how to use the topological properties of sets and functions to solve qualitative problems	K_U24, K_U29
<b>KOMPETENCJE SPOŁECZNE</b>		
K_01	The student knows limitations of his own knowledge and understands the need of further studies	K_K01
K_02	The student can formulate questions in a precise manner, which serve the deepening of his own understanding of a given problem or finding the missing elements of his reasoning	K_K02

### IV. Opis przedmiotu/ treści programowe

1. Metric spaces. Convergence. Cauchy sequences. Continuous mappings.
2. Closed and open sets. Closure and interior of the set. Dense and boundary sets.
3. Subspace of a metric space. Cartesian product of the metric spaces.
4. Complete spaces. Baire theorem. The Cantor's theorem about a nested sequence of closed sets. The Banach fixed point theorem.
5. Compact spaces. Characterization of a compact subspace of  $R^n$ .  $\varepsilon$ -nets. Lebesgue number lemma. Borel- Lebesgue theorem.
6. Separable spaces. Hereditary separability a metric spaces. Gorss-Lindelof theorem.
7. The Tietze extension theorem.
8. Connected spaces. The Darboux property of continuous functions and its applications. Information of the Borsuk's antipodal theorem and the Brouwer's fixed point theorem.
9. Homeomorphism of the metric spaces and topological properties.
10. Embeddings in a metrics space. Completion.
11. Basis for topology. Tychonoff of the product of metric spaces. Hilbert cube.
12. Topology of the uniform convergence in  $C([0, 1])$ .

### V. Metody realizacji i weryfikacji efektów uczenia się

Symbol efektu	Metody dydaktyczne (lista wyboru)	Metody weryfikacji (lista wyboru)	Sposoby dokumentacji (lista wyboru)
<b>WIEDZA</b>			
W_01	Conventional lecture	Exam	Protocol
W_02	Conventional lecture	Exam	Protocol
W_03	Conventional lecture	Exam	Protocol
<b>UMIEJĘTNOŚCI</b>			
U_01	Practical classes	Test	Protocol
U_02	Practical classes	Test	Protocol
U_03	Practical classes	Test	Protocol
<b>KOMPETENCJE SPOŁECZNE</b>			
K_01	Conventional lecture/Practical classes	Exam/Test	Protocol
K_02	Conventional lecture/Practical classes	Exam/Test	Protocol

#### **VI. Kryteria oceny, uwagi:**

Exam (for students who passed classes):

- in groups of less than 8 students – oral exam
- in groups of 8 or more students – written exam (and oral exam for students who didn't received 50% points at written exam).

Exam, passing level is 50% of the sum of points;

91% – 100% excellent (5.0)

81% – 90% very good (4.5)

71% – 80% good (4.0)

61% – 70% satisfactory (3.5)

50% – 60% sufficient (3.0)

less than 50% fail (2.0)

W1 - discussion on lessons, colloquium, exam

W2 - discussion on lessons, colloquium, exam

U1 - discussion on lessons, colloquium, exam

U2 - discussion on lessons, colloquium, exam

U3 - discussion on lessons, colloquium, exam

K1 - discussion on lessons,

K2 - discussion on lessons.

In groups of less than 8 students credits are given by active participation in classes.

Colloquium, passing level is 50% of the sum of points;

91% – 100% excellent (5.0)

81% – 90% very good (4.5)

71% – 80% good (4.0)

61% – 70% satisfactory (3.5)

50% – 60% sufficient (3.0)

less than 50% fail and lack of active participation in classes (2.0)

**VII. Obciążenie pracą studenta**

Forma aktywności studenta	Liczba godzin
Liczba godzin kontaktowych z nauczycielem	90
Liczba godzin indywidualnej pracy studenta	60

**VIII. Literatura**

Literatura podstawowa
Basic: 1. K.Kuratowski , Introduction to set theory and topology, Pergamon Press and PWN, 1961; 2. J. Munkres, Topology. First course, Prentice- Hall, 1975
Literatura uzupełniająca Advances: 1. J.C. Oxtoby, Measure and category, Springer, 1980 2. .N.R.Howes Modern Analysis and Topology, Springer, 1995 3. G.J.O. Jameson Topology and Normed Spaces, Chapman and Hall, 1974 4. I. Kaplansky Set theory and metric spaces, Allyn and Bacon, 1972

