**Nazwa przedmiotu:**

Calculus I

**Koordynator przedmiotu:**

Andrzej Fryszkowski, Professor

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Mechatronics

**Grupa przedmiotów:**

Obowiązkowe

**Kod przedmiotu:**

CAL1

**Semestr nominalny:**

1 / rok ak. 2020/2021

**Liczba punktów ECTS:**

7

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

1) Number of hours that require the presence of a teacher - 80, including:
a) attendance at the lectures - 30 hours;
b) attendance at the exercises - 45 hours;
c) consultancy meetings - 5 hours.
2) The number of hours of independent work of student:
• systematic preparation for classes - 45 hours;
• work on homework (solving tasks) – 20 hours;
• preparation for class tests – 15 hours;
• preparation for the final examination – 15 hours.
TOTAL = 175 hours

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

3,5 ECTS credits – number of hours that require the presence of a teacher - 80, including:
a) attendance at the lectures - 30 hours;
b) attendance at the exercises - 45 hours;
c) consultancy meetings - 5 hours.

**Język prowadzenia zajęć:**

angielski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład: | 30h |
| Ćwiczenia: | 45h |
| Laboratorium: | 0h |
| Projekt: | 0h |
| Lekcje komputerowe: | 0h |

**Wymagania wstępne:**

High school mathematics

**Limit liczby studentów:**

130 osób na wykładzie, 30 osób w 1 grupie ćwiczeniowej

**Cel przedmiotu:**

To convey and reinforce the knowledge on real number sequences, functions of one variable, the constant e, one-variable differential, and integral calculus, definite and improper integrals, and their application, to acquire a thorough understanding of basic concepts and computational processes, and to master skills of using them, to acquire the skill of correct mathematical reasoning and inference.

**Treści kształcenia:**

1. Real sequences . Definition of sequence limit - convergent and divergent sequences. Indeterminate forms. Squeezing theorem. The constant e. 2. Function domain and counterdomain. Inversion and composition of functions. Elementary functions - linear, quadratic and rational functions. Properties of the exponential and logarithmic functions. Even and odd functions. Periodic functions. Trigonometric and cyclometric functions and their properties. 3. Function limit at a given point and at infinity. Horizontal, vertical and oblique asymptotes. Function continuity at a point and in the interval. One-sided continuity. Properties of continuous functions. 4. Function increment. Definition of the derivative of a function at a given point and its geometric interpretation. Derivatives of some common functions. The derivative of a sum, a product and a quotient of functions. The derivative of a composition. Tangent and normal lines at a point to a curve f(x). 5. De l'Hospital's rule. Function differential. Higher order derivatives and differentials. Taylor and MacLaurin formulas - approximate values of expressions. 6. Function extrema, necessary and sufficient condition. Rolle's theorem. The Lagrange Mean Value theorem. And its implications. 7. Derivatives of higher order with the use to identify extrema. Inflection points. Concave and convex functions. Necessary and sufficient conditions for inflection points. Examining the function and plotting its graph. 8. Indefinite integral - definition; antiderivative; integral of some common functions; properties. Techniques of integration. 9. Properties of definite integrals. The Fundamental Theorem of Calculus. Integration by parts and by substitution for definite integrals. 10. Definite integrals: definition and geometrical interpretation. Improper integrals of the first and the second kind. Applications of integrals; computing areas of planar figures, arc length of the curves, surface areas, volumes of revolved solids. 11. Convergence of an R2 sequences. Functions of two variables. Heines definition for function limit. 12. Gradient of a function at a point. Higher order partial derivatives. Taylor formula with the second and higher order. 13. Differential. Computing approximate values of expressions. Local extrema and necessary condition for them. Sufficient condition for an extremum. Functions of three variables: partial and directional derivatives and differentials. Taylor formula with the second order differential. 14. Implicit functions of one variable. Implicit function derivatives of first and second order. Extrema of implicit functions. Conditional extrema of the functions of two and three variables. Parametric representation of the two and three dimensional curves. Some common surfaces: sphere, cylinder, cone, paraboloid, hyperboloid. Planar regions in polar coordinates. Frenet trihedron.

**Metody oceny:**

50% continuous assessment based on tutorial and tests, 50% written final exam.

**Egzamin:**

tak

**Literatura:**

Recommended texts (reading):
1. Thomas “Calculus” .
2. Robert A. Adams, Calculus. A complete course.
3. Thomas G. Finney: Calculus, ed. Addison-Wesley.

**Witryna www przedmiotu:**

brak

**Uwagi:**

## Charakterystyki przedmiotowe

### Profil ogólnoakademicki - wiedza

**Charakterystyka CAL1\_W01:**

Student knows basic concepts of the analysis such that a metric space, convergence in a metric space, metric space transformations and their properties.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_W01

**Powiązane charakterystyki obszarowe:** P6U\_W, I.P6S\_WG.o

**Charakterystyka CAL1\_W02:**

Student knows fundamentals of the differential calculus of single-variable functions.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_W01

**Powiązane charakterystyki obszarowe:** P6U\_W, I.P6S\_WG.o

**Charakterystyka CAL1\_W03:**

Student knows fundamentals of the integral calculus of single-variable functions, including the first and the second theorems of the integral calculus.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_W01

**Powiązane charakterystyki obszarowe:** P6U\_W, I.P6S\_WG.o

**Charakterystyka CAL1\_W04:**

Student knows fundamentals of the multi-variable differential calculus, including the concept of a partial derivative, a directional derivative and a gradient.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_W01

**Powiązane charakterystyki obszarowe:** I.P6S\_WG.o, P6U\_W

### Profil ogólnoakademicki - umiejętności

**Charakterystyka CAL1\_U01:**

Student can work with the elementary functions of a single variable, determine proper and improper limits of functions, investigate continuity properties of functions.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_U06

**Powiązane charakterystyki obszarowe:** P6U\_U, I.P6S\_UW.o, III.P6S\_UW.o

**Charakterystyka CAL1\_U02:**

Student can calculate derivatives of single-variable function (also derivatives of composite functions), determine monotonicuty and extremal points, determine an equation of a line tangent to a function's graph, use the de l'Hospital rule to evaluate function limits.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_U06

**Powiązane charakterystyki obszarowe:** P6U\_U, I.P6S\_UW.o, III.P6S\_UW.o

**Charakterystyka CAL1\_U03:**

Student can evaluate indetermined integrals (antiderivatives) using the integration by part and integration by substitution methods. Student knows how to evaluate integrals of rational functions.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_U06

**Powiązane charakterystyki obszarowe:** P6U\_U, I.P6S\_UW.o, III.P6S\_UW.o

**Charakterystyka CAL1\_U04:**

Student can calculate determined integrals and use them in physics and geometry. Student is able to evaluate simple improper integrals.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_U06

**Powiązane charakterystyki obszarowe:** P6U\_U, I.P6S\_UW.o, III.P6S\_UW.o

**Charakterystyka CAL1\_U05:**

Student can calculate derivatives of multiply-variable functions, including partial derivatives of composite functions. Student can determine the directional derivative.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_U06

**Powiązane charakterystyki obszarowe:** P6U\_U, I.P6S\_UW.o, III.P6S\_UW.o

**Charakterystyka CAL1\_U06:**

Student is able to find extrema of functions of two variables and the plane tangent to the surface plot of such function. Student knows how to use the implicit function theorem.

Weryfikacja:

Tutorial tests grades and exam

**Powiązane charakterystyki kierunkowe:** K\_U06

**Powiązane charakterystyki obszarowe:** P6U\_U, I.P6S\_UW.o, III.P6S\_UW.o

### Profil ogólnoakademicki - kompetencje społeczne

**Charakterystyka CAL1\_K01:**

Student is aware of the necessity of self-study and thoroughness and exactitude.

Weryfikacja:

exam

**Powiązane charakterystyki kierunkowe:** K\_K01

**Powiązane charakterystyki obszarowe:** P6U\_K, I.P6S\_KK, I.P6S\_KO