MI1016 CALCULUS 1

Version: 2023.1.0

Objective: This is the first course in calculus and analytic geometry. It covers basic notions of functions given in Cartesian coordinate system as well as in polar coordinate including techniques of curve sketching, basic techniques of differentiation and integration with variety applications, and partial derivatives and applications in the domain of functions of several variables.

Contents: Limits and continuity. The derivative of functions of one variable and applications to related rates, maxima and minima. Transcendental functions. An introduction to the indefinite and definite integrals and areas. Differentiation of functions of several variables, maxima and minima of functions of several variables. Lagrange's multipliers.

1. GENERAL INFORMATION

Course title: Calculus 1

Course ID: MI1016

Course Units: 4 (3-2-0-8)

- Lecture: 45 hours
- Exercises: 30 hours

Previous module:

Prerequisites:

Companion module: None

2. DESCRIPTION

An introduction to the basic ideas and techniques of differential and integral calculus. Topics include differentiation and integration of functions of one variable, differentiation of functions of several variables, partial derivatives, Lagrange's multipliers.

3. OBJECTIVES AND EXPECTED OUTCOMES

Students who complete this module should have the abilities to:

Objectives	Objectives description/Expected Outcomes	Outcome standards allocated for modules/ Levels (I/T/U)
[1]	[2]	[3]
M1	**Master the basic knowledge of calculus 1 and apply in practice to solve related exercises**	
M1.1	Master the basic concepts of analysis such as: limit of sequences, limit of functions, continuous functions, higher order derivatives and differentials, extremals of single-variable functions and multi-variable functions; antiderivative and integrals of single-variable functions	I/T
M1.2	Be able to apply the knowledge to solve exercises	T/U
M2	**Achieve serious attitude and necessary skills for highly effective works**	

Objectives	Objectives description/Expected Outcomes	Outcome standards allocated for modules/ Levels (I/T/U)
M2.1	Be skilled at analyzing and solving problems with strong logical thinking; work independently and be able to stay focused	T/U
M2.2	Identify some practical problems that can be solved by using tools of calculus	I/T/U
M2.3	Gain serious working attitude, proactive creativity, adaptation to highly competitive working environment	I/T

4. COURSE MATERIALS

Textbooks

[1] James Stewart (2020). *Calculus: early transcendentals (9th ed)*. Cengage Learning.

[2] Nguyen Van Ho (2012). *Calculus I.* Bach Khoa Publishing House.

References

[1] Herbert Amann, Joachim Escher (2006). *Analysis I*. Birkhäuser Basel.

[2] Herbert Amann, Joachim Escher (2006). *Analysis II*. Birkhäuser Basel.

[3] Malik, S. C. (1982), *Principles of Real Analysis (2nd ed)*. New Academic Science.

[4] Zorich, V. A. (2008), *Mathematical Analysis I, II (Universitext*), Springer.

5. ASSESSMENT

Components	Evaluation method	Description	Rated outcome standards	Proportion
[1]	**[2]**	**[3]**	**[4]**	**[5]**
A1. Attendance mark	**A1.1.** Learning attitude	Attendance check		**20%**
A2. Process mark (*)	**A2.1.** Midterm exam 1 (KT1 points on the 15-point scale) (Contents: from week 1 to week 5)	Multiple-choice	M1.1, M1.2, M2.1, M2.2, M2.3	**30%**
	A2.2. Midterm exam 2 (KT2 points on the 15-point scale) (Contents: from week 6 to week 10)			
A3. Final exam mark	**A3.1. Final exam**	Essay	M1.1, M1.2, M2.1, M2.2, M2.3	**50%**

(*) *The process mark is one third of the sum of the two midterm exams' marks. The process mark is adjusted by adding points for the performance of students during the course. These points vary from -1 to +1 according to the Regulations of Higher Education of Hanoi University of Science and Technology.*

6. COURSE PLAN

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
1	**Chapter 1: Functions. Essential functions** 1.1. Notions and definitions • Function, mapping, domain, independent and dependent variables • Symmetry. Odd and even functions • Increasing and decreasing functions 1.2. Mathematical Models. Essential functions • Power functions • Rational functions • Trigonometric functions • Exponential functions • Logarithmic functions 1.3. New functions from old functions • Transformations of functions • Composition of functions. Operations on functions	M1.1 M1.2 M2.1 M2.3	Lecturer: - Self-introduce - Introduce the course outline - Explain the teaching, learning methods and evaluation methods (mid-terms exam – final exam) - Lecture, exchange and answer questions with students during the lecture. Student: - Read in advance the next lesson. - Master the basic concepts and apply to solve exercises according to the content and progress of the subject.	A2.1, A3.1
2	**Chapter 2: Limits** 2.1. Limit of number sequences • Number Sequences • Limit of number sequences • Limit Laws • Particular limits 2.2. Limit of functions • Definitions. Left-hand and right-hand limits. Theorems • Limit laws • Particular limits • Indeterminate Forms and Elimination of Indeterminate Forms		Lecturer: - Lecture, exchange and answer questions with students during the lecture. Student: - Read in advance the next lesson - Master the basic concepts	A2.1, A3.1

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
3	2.3. Infinites and infinitesimals Theorems Applications in eliminating indeterminate forms **Chapter 3: Continuity of functions** 3.1. Definitions. Continuity from the left and from the right 3.2. Properties 3.3. Theorems 3.4. The continuity of elementary functions 3.5. The continuity of composite functions 3.6. The intermediate value theorem		and apply to solve exercises. according to the content and progress of the subject	A2.1, A3.1
4	**Chapter 4: Derivatives** 4.1. Problems: tangents, velocities 4.2. Derivatives: definitions, properties 4.3. Differentiation rules 4.4. Table of elementary derivatives 4.5. Derivatives of implicit functions 4.6. Higher order derivatives			A2.1, A3.1
5	**Chapter 5: Applications of Derivatives and Differentials** 5.1. Related rates 5.2. Linear approximations 5.3. Differentials 5.4. Higher order differentials 5.5. The n-th degree Taylor and Maclaurin Polynomials			A2.1, A3.1
6	5.6. The mean value theorems 5.7. L'hospital's Rule 5.8. The local and global maximum and minimum values 5.9. Monotonicity and convexity			A2.2, A3.1
7	**Chapter 6: Indefinite Integrals** 6.1. Antiderivatives. Definition. Rules 6.2. Indefinite integrals. Definition. Theorem. Properties 6.3. Table of basic indefinite integrals 6.4. The substitution rules 6.5. The integration by parts			A2.2, A3.1
8	6.6. Integration of trigonometric functions 6.7. Integration of rational functions by partial fractions			A2.2, A3.1

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
	6.8. Integration of irrational functions: rationalizing substitutions, trigonometric substitutions			
9			Mid-term break	
10	**Chapter 7: Definite Integrals** 7.1. Problems: Area, distance traveled 7.2. Definite integrals: Definition. Rules' Theorem 7.3. The fundamental Theorem of calculus (part 1): derivative with respect to upper limit 7.4. The fundamental Theorem of calculus (part 2): Newton-Leibniz's Theorem. 7.5. The substitute Rule and the integration by parts	M1.1 M1.2 M2.1 M2.2 M2.3	Lecturer: - Lecture, exchange and answer question with students during the lecture. Student: - Read in advance the next lesson - Master the basic concepts and apply to solve exercises according to the content and progress of the subject	A2.2, A3.1
11	7.6. Applications Area under a curve. Area between curves. Volume of solids. Volume of solids of revolution. Works. Arclengths. Surface areas 7.7. Curves defined by parametric equations and by polar coordinates equation: Lengths and Areas 7.8 Approximate Integrations: Midpoint, trapezoidal and Simpson Rules, Error bounds			A3.1
12	7.9. Improper Integrals type1: Convergence, Divergence, Comparison Theorems 7.10. Improper Integrals type 2: Convergence, Divergence, Comparison Theorems	M1.1 M1.2 M2.1 M2.3		A3.1
13	**Chapter 8: Functions of Several Variables** 8.1. Definitions 8.2. Limits and continuity 8.3. Partial derivatives. Rule for finding the partial derivatives			A3.1
14	8.4. Higher partial derivatives. Schwarz's theorem. 8.5. Tangent planes and approximations 8.6. Differentials: Differentiability condition			A3.1
15	8.7. Higher differentials. 8.8. The chain rules			A3.1

Week	Topics	Objecti ve	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
	8.9. Directional Derivatives. Gradient vector			
16	8.10. Maximum and minimum values 8.11. Method of Lagrange multipliers ***Summary and revision***			A3.1

7. RULES OF THE MODULE

8. DATE OF APPROVAL: ……..

School of Applied Mathematics and Informatics