MI1111E CALCULUS 1

Version: 2024.2.0

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 system 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. Derivatives and differentials of functions of single variable and multi-variables, integrals of functions of single variable.

1. GENERAL INFORMATION

Course title: Calculus 1

Course ID: MI1111E

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

- Lecture: 45 hours
- Seminars: 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 have the abilities to:

Objectives	Objectives description/Expected Outcomes	Outcome standard 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 1 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 integral 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 work**	

Objectives	Objectives description/Expected Outcomes	Outcome standard allocated for modules/ Levels (I/T/U)
M2.1	Be skilled at analyzing and solving problems with strong logical thinking; working independently and staying 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] Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2023). *Toán học cao cấp tập 2: Giải tích.* NXB Giáo dục.

[2] Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2023). *Bài tập Toán học cao cấp tập 2: Giải tích.* NXB Giáo dục.

References

[1] Trần Bình (1998). *Giải tích I: Phép tính vi phân và tích phân của hàm một biến*. NXB Khoa học và kỹ thuật, Hà Nội.

[2] Trần Bình (2005). *Giải tích II và III: Phép tính vi phân và tích phân của hàm nhiều biến*. NXB Khoa học và kỹ thuật, Hà Nội.

[3] Đoàn Công Định, Trịnh Ngọc Hải, Phạm Thị Hoài, Trần Ngọc Thăng, Nguyễn Thị Toàn (2021). *Bài giảng Giải tích 1.* NXB Bách Khoa Hà Nội.

[4] James Stewart (2016). Calculus: Concepts and Contexts, eighth edition. Thomson, Brooks/Cole Publishing Company

5. ASSESSMENT

Components	Evaluation method	Description	Assessed expected outcomes	Proportion
[1]	[2]	[3]	[4]	[5]
A1. The process mark				**50%**
A1.1. Attendance and performance *	Attendance and performance in class		M2.3	**10%**
A1.2. Continuous assessment	Continuous assessment test	Online multiple choice tests	M1.1, M1.2	**10%**
A1.3. Midterm	Midterm exam	Multiple	M1.1,	**30%**

exam	**Content: From the 1st week to the 7th week**	choice and constructed response test	M1.2, M2.1, M2.2, M2.3	
A2. Final exam	**Final exam**	Essay	M1.1, M1.2, M2.1, M2.2, M2.3	**50%**

** Attendance and performance in class are evaluated according to the Rule of Faculty of Mathematics and Informatics accompanied with 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: Differentiation of functions of single variable** 1.1. Introduction 1.2. Functions: definition, basic notions, composite functions, inverse functions 1.3. Essential functions: inverse trigonometric functions; hyperbolic functions; the concept of elementary functions 1.4. Number sequences: definition, basic notions. Limits law: squeeze theorem; monotone convergence theorem; Cauchy's criterion	M1.1 M1.2 M2.1 M2.3	Lecturer: - Self-introduce - Introduce the course outline - Explain teaching and learning methods; and forms of subject assessment - Lecture, exchange questions and answers 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	A1.1, A1.2, A1.3, A2

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
2	1.5. Limit of functions: two equivalent definitions; algebraic limit theorems and properties. Limits of composite functions; one-sided limits; limits at infinity; infinite limits 1.6. Infinites and infinitesimals; comparison of infinites and infinitesimals; theorems 1.7. Continuity; one-sided continuity; uniform continuity and properties. Points of discontinuity: definition and classification. Piecewise continuity		Lecturer: - Lecture, exchange questions and answers with students during the lecture Student: - Read in advance the next lesson - Master the basic concepts and apply to solve exercises as well as some practical models connected with the subject	A1.1, A1.2, A1.3, A2
3	1.8. Derivatives and differentials - Basic concepts - One-sided derivatives, relationship between derivative and one-sided derivatives, relationship between differentiability and continuity - Derivatives of composite functions. Derivatives of inverse functions - Differentials: definition, geometric interpretation, approximation by differentials. Relationship between functions having derivatives and differentiable. Differentials of composite functions and invariance property of first order differentials			A1.1, A1.2, A1.3, A2
4	- Higher order derivatives and differentials 1.9. Mean value theorems and applications - Fermat's, Rolle's, Lagrange's and Cauchy's theorems			A1.1, A1.2, A1.3, A2
5	- Taylor and Maclaurin expansions - L'Hospital's rules for eliminating indeterminate forms, application of finite expansion in finding limits - Monotone functions and properties - Convex functions - Local extrema: Local minimum, local maximum - Newton's method			A1.1, A1.2, A1.3, A2
6	1.10. Curves sketching - Functions $y=f(x)$	M1.1 M1.2		A1.1, A1.2, A1.3,

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
	- Curves defined by parametric equations - Curves given in polar coordinates	M2.1 M2.2 M2.3		A2
7	**Chapter 2: Integration of functions of single variable** 2.1. Antiderivatives - Basic concepts - Integration of rational functions	M1.1 M1.2 M2.1 M2.3		A1.1, A1.2, A1.3, A2
8	- Trigonometric integrals; Integration of irrational functions. Simple examples of Euler substitutions 2.2. Definite Integrals - Definition, geometric and mechanical interpretations	M1.1 M1.2 M2.1 M2.2 M2.3		A1.1, A1.2, A2
9	- Criteria for integrability. Properties of definite integrals - Differentiation with respect to endpoints, Newton-Leibniz formula - Techniques of Integration 2.3. Improper Integrals - Improper integrals of type 1: definitions, geometric interpretation, notions of convergence, divergence, the value of improper integrals	M1.1 M1.2 M2.1 M2.3	Lecturer: - Lecture, exchange questions and answers with students during the lecture Student: - Read in advance the next lesson - Master the basic concepts and apply to solve exercises as well as some practical models connected with the subject	A1.1, A1.2, A2
10	- Improper integrals of type 1: improper integrals of nonnegative functions, comparison theorems, absolute convergence, conditional convergence - Improper integrals of type 2: definitions, geometric interpretation, notions of convergence, divergence, the value of improper integrals, improper integrals of nonnegative functions, comparison theorems, absolute convergence, conditional convergence 2.4. Applications of definite integrals - Integration summation diagram and differentiation diagram			A1.1, A1.2, A2
11	- Areas of plane regions, solids of revolution; volume of solids, arc length	M1.1 M1.2 M2.1		A1.1, A1.2, A2

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
		M2.2 M2.3		
12	**Chapter 3: Functions of Several Variables** 3.1 Basic concepts - Domain, distance, neighborhood, boundary, closed and open sets, bounded sets - Definition of functions of multivariable, geometric interpretation, domain of definition, range - Pointwise limit of functions of multivariable, algebraic limit theorems - Continuity: definition, operations, properties, uniform continuity	M1.1 M1.2 M2.1 M2.3		A1.1, A1.2, A2
13	3.2. Partial derivatives and total differentials - Partial derivatives: definition, rules for calculation - Total differential: definition, relationship between functions having partial derivatives and differentiable functions, approximation by differentials - Implicit functions: definition, existence theorems and methods for implicit differentiation			A1.1, A1.2, A2
14	- Higher partial derivatives and differentials: definition, Schwarz' theorem on equality of mixed partials, non-invariance property of higher differentials - Taylor expansion 3.3. Extrema of functions of multi-variables - Definition - Rules for finding extrema	M1.1 M1.2 M2.1 M2.2 M2.3		A1.1, A1.2, A2
15	- Constrained extrema - Maxima and minima			A1.1, A1.2, A2
16	Review session			

7. RULES OF THE MODULE

8. DATE OF APPROVAL: ……

Faculty of Mathematics and Informatics