# MI1124 CALCULUS II

Version: 2020.1.0

1. **GENERAL INFORMATION**

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| **Course title:** | Calculus II |
| **Unit in charge** | School of Applied Mathematics and Informatics |
| **Course ID:** | MI1124 |
| **Course Units:** | 3(2-2-0-6)   * Lecture: 30 hours * Seminar: 30 hours |
| **Previous module:** | Calculus I |
| **Prerequisites:** |  |
| **Companion module:** |  |

1. **DESCRIPTION**

This course provides some applications of differential calculus in geometry, the basic ideas and techniques of parameter-dependent integrals, double integrals and triple integrals, line integrals of scalar fields and vector fields, surface integrals of scalar fields and vector fields, and vector fields.

**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 Caculus II and apply in practice to solve related exercises** |  |
| M1.1 | Master the basic concepts such as: double integrals, triple integrals, line integrals, surface integrals, vector fields as well as applications of differential calculus | 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** |  |
| 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 |

1. **COURSE MATERIALS**

**Textbooks**

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| [1] | James Stewart (2016). *Calculus: Concepts and Contexts, eighth edition*. Thomson, Brooks/Cole Publishing Company | |
| [2] | | Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2015). *Toán học cao cấp tập 1.* NXB Giáo dục. | |

**References**

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| [1] | Trần Bình (2005). *Giải tích II*. NXB Khoa học và Kỹ thuật. | |
| [2] | Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2017). *Bài tập Toán học cao cấp tập 1.* NXB Giáo dục. | |
| [3] | | Nguyễn Đình Trí, Tạ Văn Đĩnh, Nguyễn Hồ Quỳnh (2000). *Bài tập Toán học cao cấp tập III.* NXB Giáo dục. | |
| [4] | Lê Ngọc Lăng, Nguyễn Chí Bảo, Trần Xuân Hiển, Nguyễn Phú Trường. *Ôn thi học kỳ và thi vào giai đoạn II*. NXB Giáo dục. | |

1. **ASSESSMENT**

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| **Components** | **Evaluation method** | **Description** | **CĐR được đánh giá** | **Proportion** |
| **[1]** | **[2]** | **[3]** | **[4]** | **[5]** |
| **A1. Mid-term exam (\*)**  Writing, 60 minutes, after the eighth week, content: chapter 1 to | **Process evaluation** |  |  | **30%** |
| A1.1. Classwork and homework | Exercises | M1.1, M1.2, M2.1, M2.2, M2.3 |  |
| A1.2. Midterm exam | Essay |
| **A2. Final exam** | **Final exam** | Essay | M1.1, M1.2, M2.1, M2.2, M2.3 | **70%** |

*\* The process marks are adjusted by adding points for the performance of students during the course. These points vary from -2 to +2 according to the Regulations of School of Applied Mathematics and Informatics, and the Regulations of Higher Education of Hanoi University of Science and Technology.*

1. **COURSE PLAN**

| **Week** | **Topics** | **Objective** | **Activities** | **Exercises** |
| --- | --- | --- | --- | --- |
| **[1]** | **[2]** | **[3]** | **[4]** | **[5]** |
| 1 | **Chapter 1: Applications of differential calculus in geometry**  1.1. Applications in plane geometry  - Normal vector and equations for tangent lines and normal lines of a curve at a point.  - Curvature: mean curvature, curvature at a point, formula of curvature at a point (no proof) and examples.  - Envelope of a family of parametric curves: definition, formula, examples.  1.2. Applications in spatial geometry  - Vector functions, derivative of vector functions () and properties. | 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, A2.1 |
| 2 | - Curves: equations of tangent lines and normal planes at a point of curves, curvature at a point of curves (formulas).  - Surfaces: equations of tangent planes and normal lines at a point of surfaces (formulas).  **Chapter 2. Multiple integrals**  **2.1. Double integrals**  **-** Definition, geometric meaning, properties.  - Calculations of double integrals in the Cartesian coordinate system. | 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 according to the content and progress of the subject | A1.1, A1.2, A2.1 |
| 3 | - Change of variables in double integrals: general change of variables formula, change of variables in polar coordinate system. | M1.1  M1.2  M2.1  M2.3 | A1.1, A1.2, A2.1 |
| 4 | - Applications of double integrals: Calculate the volume of an object, the area of a plane domain, the area of a surface (formulas and examples).  **2.2. Triple integrals**  **-** Definition, geometric meaning, properties. | M1.1  M1.2  M2.1  M2.2  M2.3 | A1.1, A1.2, A2.1 |
| 5 | - Calculations of triple integrals in the Cartesian coordinate system.  - Change of variables in triple integrals: general change of variables formula, change of variables in cylindrical coordinate system, change of variables in spherical coordinate system. | M1.1  M1.2  M2.1  M2.3 | A1.1, A1.2, A2.1 |
| 6 | - Applications: Calculate the volume of an object.  **Chapter 3. Parameter Dependent Integrals**  **3.1. Definite Integrals depending on parameters**  - Definition  - Theorems on continuity. | M1.1  M1.2  M2.2  M2.1  M2.3 | A1.1, A1.2, A2.1 |
| 7 | - Theorems on differentiation under integral sign, integration under integral sign.  **3.2. Improper Integrals depending on parameters**  - Definition  - Uniform convergence, Weierstrass theorem. | M1.1  M1.2  M2.1  M2.3 | A1.1, A1.2, A2.1 |
| 8 | - Properties: continuity, differentiation under integral sign, integration under integral sign.  **3.3. Euler’s integrals**  **-** Introduce Gamma function () and properties**:** definiteness, continuity, infinite differentiability.    (no proof).  - Beta function: Introduce Beta function () with its two types and properties (no proof): symmetry. | M1.1  M1.2  M2.1  M2.3 |  | A1.1, A1.2, A2.1 |
| 9 | **MID-TERM EXAM** |  | Exam | A1.2 |
| 10 | **Chapter 4. Line Integrals**  4.1. Line integrals of scalar fields  - Definition  - Calculation  4.1. Line integrals of vector fields  - Definition, physical meaning.  - Properties | M1.1  M1.2  M2.1  M2.2  M2.3 | - 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, A2.1 |
| 11 | - Relation of line integrals of scalar fields and line integrals of vector fields.  - Calculation  - Green’s Theorem (proof for the case of a simple region). | M1.1  M1.2  M2.1  M2.3 | A1.1, A2.1 |
| 12 | - Path independence of line integrals (no proof); find a function such that .  **Chapter 5. Surface integrals**  5.1 Surface integrals of scalar fields  - Definition  - Calculation | M1.1  M1.2  M2.1  M2.3 | A1.1, A2.1 |
| 13 | 5.2 Surface integrals of vector fields  - Definition, properties.  - Relation of surface integrals of scalar fields and surface integrals of vector fields.  - Calculation | M1.1  M1.2  M2.1  M2.3 | A1.1,  A2.1 |
| 14 | - Ostrogradsky’s Theorem, Stoke’s Theorem (no proof).  **Chapter 6.** Field Theory  6.1 Scalar Fields  - Notions of scalar fields and level surfaces.  - Directional derivative: Definition, Theorem on relation between directional derivative and partial derivative. | M1.1  M1.2  M2.1  M2.3 | A1.1,  A2.1 |
| 15 | - Gradient: Definition of vector  and theorem  (no proof) and properties.  6.2 Vector Fields  - Notions of vector fields and flow lines, system of differential equations of flow lines.  - The flux, dive, incompressible fields: the flux of a vector field across oriented surface *S*, dive(divergence), properties, incompressible fields, source (point), sink (point). | M1.1  M1.2  M2.1  M2.2  M2.3 | A1.1, A2.1 |
| 16 | - Circulation and curl vector: the circulation of a vector field around an oriented closed curve, curl vector, curly point.  - Conservative vector fields: notions of conservative vector fields , the potential function for , conditions for a vector field to be conservative , conditions for an expression to be the total differential, path independence of spatial line integrals. | M1.1  M1.2  M2.1  M2.2  M2.3 | A1.1, A2.1 |

1. **RULES OF THE MODULE**
2. **DATE OF APPROVAL: …………………..**

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|  | **School of Applied Mathematics and Informatics** |