MI1134 CALCULUS III

Version: 2020.1.0

1. GENERAL INFORMATION

Course title: Calculus III

Course ID: MI1134

Course Units: 3(2-2-0-6)
- Lecture: 30 hours
- Seminar: 30 hours

Previous module:

Prerequisites: - MI1114

Companion module: - MI1124

2. DESCRIPTION

This course provides basic knowledge on infinite series, ordinary differential equations and Laplace operator method.

3. OBJECTIVES AND EXPECTED OUTCOMES

On successful completion of this course, students will be able to:

Objectives	Objectives description/Expected Outcomes	Expected outcomes/Level (I/T/U)
[1]	[2]	[3]
M1	**Master the basic knowledge on infinite series, ordinary differential equations and Laplace operator method**	
M1.1	Master the basic knowledge.	IT
M1.2	Have the ability to apply knowledge in solving problems related to contents of the course.	TU
M2	**Have serious work attitude and necessary skills to work effectively**	
M2.1	Be skillful in analyzing and solving problems by logical thinking, in working independently and staying focused.	TU
M2.2	Identify some practical problems that can be solved using the tool of series, differential equations, and the Laplace operator method.	ITU
M2.3	Have serious work attitude, initiative and creativity, adapting to a highly competitive working environment.	IT

4. COURSE MATERIALS

Textbooks

[1] Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2015). Bài tập *Toán học cao cấp tập 3: Chuỗi và phương trình vi phân.* NXB Giáo dục.

[2] Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2017). Bài tập *Toán học cao cấp tập 3: Chuỗi và phương trình vi phân.* NXB Giáo dục.

[3] Nguyễn Đình Trí, Tạ Văn Đĩnh, Nguyễn Hồ Quỳnh (2000). *Bài tập Toán học cao cấp tập II.* NXB Giáo dục.

[4] Nguyễn Đình Trí, Tạ Văn Đĩnh, Nguyễn Hồ Quỳnh (1999). *Bài tập Toán học cao cấp tập III.* NXB Giáo dục.

References

[1] Trần Bình (2005). *Giải tích II và III*, NXB KH và KT.

[2] 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.

[3] Lê Ngọc Lăng, Tống Đình Quỳ, Nguyễn Đăng Tuấn, Mai Văn Dược (1998). *Giúp ôn tập tốt môn Toán cao cấp.* NXBKH.

[4] Đinh Bạt Thẩm, Nguyễn Phú Trường (1993). *Bài tập Toán học cao cấp tập II.* NXB Giáo dục.

[5] Nguyễn Xuân Thảo (2010). *Bài giảng Phương pháp Toán tử Laplace.*

[6] Nguyễn Thiệu Huy: Infinite series and differential equations.

download: http://sami.hust.edu.vn/tai-lieu/

5. ASSESSMENT

Components	Evaluation method	Description	Objectives	Proportion
[1]	[2]	[3]	[4]	[5]
A1. Evaluation of the process (*)	**Evaluation of the process**			**30%**
	A1.1. Exercises and Homework	Essay	M1.1, M1.2, M2.1, M2.2, M2.3	
	A1.2. Midterm exam	Essay		
A2. Final evaluation	**A2.1. 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 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**. Series **(11LT+ 11BT)** **1.1** Infinite number series - Definitions: Number series, general term, partial sums, remainder, convergence, divergence, sum of a series. Note: including geometric series $\sum_{n=0}^{+\infty} aq^n$. - Necessary condition for convergence (with proof). Note: including the harmonic series $\sum_{n=1}^{+\infty} \frac{1}{n}$. - Fundamental properties of convergent series (proofs for self-study) **1.2** Series of non-negative terms - Definition - Comparison tests (including proof of the first comparison test, proof of the second one is for self-study) - Tests for convergence (D'Alambert's test, Cauchy's test, integral test) (including the proof of D'Alambert's test, the proofs of the other are for self-study). Note: including $\sum_{n=1}^{+\infty} \frac{1}{n^\alpha}$	M1, M2	- Introduction to the course, course materials and study methodolody - Lecture	A1 A2
2	**1.3** Series of sign-changing terms - Series of sign-changing terms: definitions of absolute convergence, conditional convergence. Theorems on absolutely convergent series (proofs for self-study) - Alternating series: definition, Leibniz's test (with proof) - Properties of absolutely convergent series. Properties of rearrangement of terms and the product of two series (proofs for self-study)	M1, M2		A1 A2
3	**1.4** Series of functions	M1, M2		A1 A2

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
	- Definitions: series of functions, domain of convergence (pointwise convergence), sum of a function series - Uniform convergence: definition, Cauchy's test, Weierstrass' test (without proof) - Properties of uniformly convergent function series: continuity, differentiation, integration (proofs of the last two properties are for self-study)			
4	**1.5** Power series - Definition, Abel's theorem (with proof), radius, interval and domain of convergence - Properties: uniform convergence, continuity of the sum, termwise differentiation and integration (proofs for seld-study). Applications in finding sum of a series (one example, self-study) - Representation of functions by power series (Taylor's series, Maclaurin's series). Theorems on expandability of a function in a power series (without proof)	M1, M2		A1 A2
5	- Expansion of some elementary functions. Applications in approximating the value of functions and definite integrals (for self-study) **1.6** Fourier series - Trigonometric series, Fourier series - Conditions for expanding a function to Fourier series. Dirichlet theorem (without proof)	M1, M2		A1 A2
6	- Fourier expansion of odd and even 2π periodic functions of period 2π - Fourier expansion of 2π periodic functions, $2l$ period functions. Fourier expansion of functions defined on an interval $[a,b]$ **Chapter 2. Ordinary differential equations (11+ 12)**	M1, M2		A1 A2

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
	2.1 Introduction - Definition: ordinary differential equations (ODEs), order of an ODE, solutions to an ODE **2.2** First order ODEs - Outlines about first order ODEs: general forms, existence and uniqueness theorem (without proof), Cauchy problem, general solutions, particular solutions. Introductory practical examples of first order ODEs			
7	- Equations without x or without y - Separable equations - Homogeneous equations - Linear equations - Bernoulli equations - Exact equations	M1, M2		A1 A2
8	**2.3** Second order differential equations - Outlines about first order ODEs: general forms, existence and uniqueness theorem (without proof), Cauchy problem, general solutions, particular solutions. Introductory practical examples of second order ODEs - Equations without y and y'; without y; or without x - Linear equations $y''+p(x)y'+q(x)=f(x)$ Homogeneous linear equations: structure of general solutions (proofs of the construction of the formula $y=C_1y_1(x)+C_2y_2(x)$)	M1, M2		A2
9	**MIDTERM EXAM:** FROM CHAPTER I TO THE SECTION 2.2 CHAPTER 2			
10	Nonhomogeneous linear equations: structure of general solutions (proof for self-study)	M1, M2		A2

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
	Lagrange method of variation of parameters Superposition principle - Second order linear ODEs with constant coefficients Homogeneous linear equations			
11	Nonhomogeneous linear equations with right-hand side of the forms $f(x) = e^{\alpha x} P_n(x)$ $f(x) = e^{\alpha x}[P_n(x)\cos\beta x + Q_m(x)\sin\beta x]$	M1, M2		A2
12	- Euler equations (by examples) **2.4** Systems of first order ODEs - Definition, general form, solutions, convert higher order ODEs into systems of first order equations and vice versa. Existence and uniqueness theorem - Solving by substitution: illustrated by a simple example (this part is for self -study)	M1, M2		A2
13	**Chapter 3. Laplace transform and applications (8+7)** **3.1** Laplace transform and inverse Laplace transform - Laplace transform, linearity property, tables of Laplace transform, piecewise continuous functions, existence of Laplace transform. Examples - Inverse Laplace transform, uniqueness of inverse Laplace transform. Examples	M1, M2		A2
14	**3.2** Transform of initial value problems - Transform of the derivative of a function, solutions of initial value problems, examples of solving second order linear ODEs with constant coefficients - Systems of second order linear ODEs, introduction to mathematical modeling	M1, M2		A2

Week	Topics	Objective	Activities	Exercises
[1]	[2]	[3]	[4]	[5]
	- Transform of the integral of a function			
15	**3.3** Shifting properties and partial fractions - Linear partial fractions, irreducible quadratic partial fractions, *s*- shifting - Solving higher order (greater than or equal to 3) ODEs with constant coefficients	M1, M2		A2
16	**3.4** Derivatives, integrals and product of Laplace transforms - Convolution of two functions, Laplace transform of convolution - Derivative of Laplace transform - Integral of Laplace transform - Solving homogeneous linear second order ODEs with variable coefficients - Solving linear second order ODEs with constant coefficients and piecewise continuous righthand side	M1, M2		A2

7. COURSE REGULATIONS

(Possible course regulations)

8. DATE OF APPROVAL: .....

School of Applied Mathematics and Informatics

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