

Lingnan University
Course Syllabus

Course Title	:	Calculus
Course Code	:	CDS1002
Recommended Study Year	:	1
No. of Credits/Term	:	3
Mode of Tuition	:	Sectional Approach
Class Contact Hours	:	3 hours per week
Category in Major Prog.	:	Required
Prerequisite(s)	:	Nil
Co-requisite	:	Nil
Exclusion	:	Students are not allowed to take both this course and SSC2114 Calculus
Exemption Requirement	:	Nil

Brief Course Description:

Calculus plays an important role in the understanding of today's world. This is an introductory course that presents the ideas and techniques of calculus using an informal, intuitive and geometric approach. Students need to learn both differential calculus and integral calculus and their applications to real-life situations in business, economics, the social sciences, natural sciences and visual arts. This course will equip students with the calculus background required for further study in many disciplines.

Aims:

This course aims to:

1. Develop a firm conceptual understanding of the fundamental ideas underlying calculus;
2. Apply calculus to solve problems in daily life;
3. Review the ideas of different tools needed for doing calculus;
4. Improve students' abilities to read a mathematics book independently;
5. Increase students' skills in communicating in/through mathematics, and
6. Enhance students' abilities to work collaboratively with their peers.

Learning Outcomes (LOs):

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

1. Demonstrates a comprehension of the value of calculus in daily life applications related to business, economics, the social sciences, natural sciences and visual arts.
2. Apply mathematical reasoning in the analysis of real world problems.
3. Formulate problems and convey solutions in mathematics.
4. Conduct calculus related calculations.

Indicative Contents:

1. Preliminary:
Real numbers, inequalities, interval, absolute value, functions (independent variable, dependent variable, domain, range, composition, increasing and decreasing functions), graphs, limits, continuity, the role of calculus in scientific methodologies.
2. Differentiation:
Definition, derivatives of some basic functions, linearity of derivative, product and quotient rules, chain rule, derivatives of inverse functions, implicit differentiation, higher order derivatives, L'Hopital's rule, concavity, optimization, first and second derivative tests, applications.
3. Integration:
Integrable functions, the fundamental theorem of calculus, integration by parts, substitution, indefinite and definite integrals, numerical integration, applications.
4. Vector-valued functions: Rectangular coordinate systems, vectors, dot product, projection, cross product, parametric equations of lines, planes, quadric surface, vector-valued functions, derivative of vector-valued functions, derivatives of dot and cross products.
5. Partial derivative: Limits along curves, partial derivative, implicit partial differentiation, higher-order partial derivatives, mixed partials, several cases of chain rule, the extreme-value theorem, the second partial test, applications.
6. Multiple integrals: Double integrals, properties and evaluation of double integrals, double integrals over nonrectangular regions, reversing the order of integration, change of variables in multiple integrals, applications.

Teaching Method:

Basic concepts are discussed during lectures. Theories are explained in terms of practical examples. The instructor will provide in-class examples while students need to work on in-class exercises.

Measurement of Learning Outcomes:

	Attendance and In-class Participation	Assignments	Midterm Exam	Final Exam
1. Demonstrates a comprehension of the value of calculus in daily life applications related to business, economics, the social sciences, natural sciences and visual arts.	X	X	X	X
2. Apply mathematical reasoning in the analysis of real world problems.	X		X	X
3. Formulate problems and convey solutions in mathematics.		X	X	X
4. Conduct calculus related calculations.	X	X	X	X

- 1. Attendance and In-class Participation:** In class, students need to understand various applications of single variable calculus in business, economics, the social sciences, natural sciences and visual arts and the logic in the theories of calculus. Furthermore, they need to learn the calculations involved in taking derivative and integration. Attendance will be taken in each lecture and grade also depends on whether a student actively participates in discussion and offers constructive views.
- 2. Assignments:** Students will individually work on several after-class calculus assignments. These assignments will test whether students are able to apply calculus in various contexts and use mathematical language to formulate the problem and whether they are able to solve the problem based on taking derivative and integration.
- 3. Midterm and Final Examinations:** Each of the two close-book exams will include around 8 calculus problems, most of which have strong application background. Each problem requires students to use mathematical language to formulate problem and convey ideas and solutions, and apply appropriate calculus technique. For some problems, students are also required to obtain the solutions via taking derivatives and integration. Midterm covers the first three topics (in indicative content) while the final exam covers the remaining topics.

Assessment:

Attendance and In-class Participation	5%
Assignments	20%
Midterm Examination	25%
<u>Final Examination</u>	<u>50%</u>
Total	100%

Required/Essential Readings:

1. Laurence Hoffmann, Gerald Bradley, David Sobecki, and Michael Price, *Applied Calculus: For Business, Economics, and the Social and Life Sciences, 11th Expanded Edition*, McGraw-Hill. (2012), ISBN: ISBN-13 978-0073532370
2. Morris Kline, *Calculus: An Intuitive and Physical Approach, 2nd Edition*, Dover Publications. (1998), ISBN: ISBN-13 978-0486404530

Important Notes:

- (1) Students are expected to spend a total of 9 hours (i.e. 3 hours of class contact and 6 hours of personal study) per week to achieve the course learning outcomes.
- (2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations and Coursework. In particular, plagiarism, being a kind of dishonest practice, is “the presentation of another person’s work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student’s own work”. Students are required to strictly follow university regulations governing academic integrity and honesty.
- (3) Students are required to submit writing assignment(s) using Turnitin.
- (4) To enhance students’ understanding of plagiarism, a mini-course “Online Tutorial on Plagiarism Awareness” is available on <https://pla.ln.edu.hk/>.
- (5) Students must adhere to the University’s guidelines and practices when using Generative Artificial Intelligence (GAI) tools. The official documents “*Guidelines for Using GAI Tools at Lingnan University*” and “*Best Practices for Ethical and Responsible Use of GAI Tools in Course Assessments*” can be found here: <https://www.ln.edu.hk/tlc/generative-artificial-intelligence/gai-guidelines-best-practices>.

Rubric for Attendance and In-Class Participation of CDS1002 – Calculus

Criteria	Excellent	Good	Needs Improvement	Unacceptable
Attendance (75%)	Less than three absence throughout the semester (75 marks)	Three to five absences throughout the semester (50 marks)	Six to eight absences throughout the semester (25 marks)	Nine or more absence throughout the semester (0 mark)
In-Class Participation (25%)	Proactively shares views and thoughts in class (25 marks)	Able to respond to questions properly without any hint (16 marks)	Able to respond to questions with some hints (8 marks)	Unable to respond to questions (0 mark)

Rubric for Assignment of CDS1002 – Calculus

Criteria	Excellent	Good	Needs Improvement	Unacceptable
Familiarity with calculus related calculations (40%)	Grasps all the major techniques to perform calculus related calculations (31-40 marks)	Understands most of the major techniques to perform calculus related calculations (21-30 marks)	Understands some techniques to perform basic calculus related calculations (11-20 marks)	Fails to apply suitable techniques to perform most calculus related calculations (0-10 marks)
Applications of calculus in various contexts (40%)	Understands what concrete techniques to apply in all application problems (31-40 marks)	Understands what concrete techniques to apply in most application problems (21-30 marks)	Capable of identifying relevant techniques for some applications (11-20 marks)	Can occasionally identify relevant techniques for applications (0-10 marks)
Conveys ideas in mathematical language (20%)	Capable of using mathematical language to convey all ideas clearly (16-20 marks)	Capable of using mathematical language to convey most ideas smoothly (11-15 marks)	Capable of using mathematical language to convey basic ideas (6-10 marks)	Unable to convey ideas in mathematical language, though with sporadic mathematical notations (0-5 marks)

Rubric for Mid-Term Examination of CDS1002 – Calculus

Criteria	Excellent	Good	Needs Improvement	Unacceptable
Mathematical reasoning (15%)	Demonstrates a strong mathematical reasoning capability in all analyses (13-15 marks)	Demonstrates good mathematical reasoning capability in most analyses (9-12 marks)	Demonstrates an adequate level of mathematical reasoning in some analyses (5-8 marks)	Demonstrates an inadequate level of mathematical reasoning (0-4 marks)
Familiarity with calculus related calculations (35%)	Grasps all the major techniques to perform calculus related calculations (28-35 marks)	Understands most of the major techniques to perform calculus related calculations (19-27 marks)	Understands some techniques to perform basic calculus related calculations (10-18 marks)	Fails to apply suitable techniques to perform most calculus related calculations (0-9 marks)
Conveys ideas in mathematical language (15%)	Capable of using mathematical language to convey all ideas clearly (13-15 marks)	Capable of using mathematical language to convey most ideas smoothly (9-12 marks)	Capable of using mathematical language to convey basic ideas (5-8 marks)	Unable to convey ideas in mathematical language, though with sporadic mathematical notations (0-4 marks)
Applications of calculus in various contexts (35%)	Understands what concrete techniques to apply in all application problems (28-35 marks)	Understands what concrete techniques to apply in most application problems (19-27 marks)	Capable of identifying relevant techniques for some applications (10-18 marks)	Can occasionally identify relevant techniques for applications (0-9 marks)

Rubric for Final Examination of CDS1002 – Calculus

Criteria	Excellent	Good	Needs Improvement	Unacceptable
Mathematical reasoning (15%)	Demonstrates a strong mathematical reasoning capability in all analyses (13-15 marks)	Demonstrates good mathematical reasoning capability in most analyses (9-12 marks)	Demonstrates an adequate level of mathematical reasoning in some analyses (5-8 marks)	Demonstrates an inadequate level of mathematical reasoning (0-4 marks)
Familiarity with calculus related calculations (35%)	Grasps all the major techniques to perform calculus related calculations (28-35 marks)	Understands most of the major techniques to perform calculus related calculations (19-27 marks)	Understands some techniques to perform basic calculus related calculations (10-18 marks)	Fails to apply suitable techniques to perform most calculus related calculations (0-9 marks)
Convey ideas in mathematical language (15%)	Capable of using mathematical language to convey all ideas clearly (13-15 marks)	Capable of using mathematical language to convey most ideas smoothly (9-12 marks)	Capable of using mathematical language to convey basic ideas (5-8 marks)	Unable to convey ideas in mathematical language, though with sporadic mathematical notations (0-4 marks)
Applications of calculus in various contexts (35%)	Understands what concrete techniques to apply in all application problems (28-35 marks)	Understands what concrete techniques to apply in most application problems (19-27 marks)	Capable of identifying relevant techniques for some applications (10-18 marks)	Can occasionally identify relevant techniques for applications (0-9 marks)