MATH4023 Complex Analysis
L1 (Spring 2024) Course Outline

1. Instructor

Name:	Dr. CHENG Kam Hang Henry
Office:	Room 3486 (L25–26)
Email:	keroc@ust.hk
Office hours:	(Tentative) Wed 15:30 – 17:30; You may also just drop in my office any time or make an email appointment beforehand to ensure I am there.

2. Teaching assistants

(T1A)
Name: Mr. ZOU Huaiyang
Email: hzouad@connect.ust.hk

(T1B)
Name: Mr. ZHANG Jinyang
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3. Meeting time and venue

Lectures:	(L1)	Tue & Thu 12:00 – 13:20	2465 (L25–26)	
Tutorials:	(T1A)	Thu 19:00 – 19:50	1409	(Starting on **Feb 8**)
	(T1B)	Fri 12:30 – 13:20	CYT G009B	(Starting on **Feb 9**)

4. Course description

This course is about the study of **functions of one complex variable**. Major topics include: point-set topology; limits and continuity; holomorphic functions; Cauchy-Riemann equations; power series; complex line integrals; Cauchy's theory and its consequences; Taylor series; isolated singularities and Laurent series; Cauchy's residue theorem; conformal mappings.

Credit points: 3

Prerequisite: **Multivariable calculus** (MATH2011/2023/3043) and **mathematical analysis** (MATH2033/2043)
For those who have not taken **real analysis** (MATH2043/3033): Although MATH3033 is not listed as an official prerequisite, it will be quite helpful if you are already familiar with the machinery of uniform convergence.

5. Intended learning outcomes (ILOs)

Upon successful completion of this course, students are expected to be able to:

1. apply the concept of limits to analyze and solve problems related to continuity and approximation in the mathematical profession;
2. compute contour integrals of complex functions and Laurent series of meromorphic functions, and explain these computations clearly using concepts from complex analysis;
3. recognize the power of Cauchy's theory that made some difficult problems solvable, and apply logical reasoning to investigative mathematical work; and
4. develop mathematical maturity to undertake higher level studies in mathematics and related fields.

6. Assessment scheme

- **Assignments (14%)**: Assessing ILOs 1, 2, 3 and 4
  Homework will be assigned from time to time. You will be required not only to compute numerical answers, but also to write down full solutions in a rigorous manner. You are allowed to have peer discussion on the solutions, but you need to submit solutions that are individually written **on your own**. Feedback will be given on your work so that you can improve.
  You should submit each homework in the form of either a clearly written and scanned or a neatly LaTeX-typed **PDF file** on the **Canvas** system before the deadline.

- **Midterm Test (30%)**: Assessing ILOs 1, 2, 3 and 4
  The mid-term test will be scheduled on **Wednesday, March 27 from 19:30 to 21:30**. It will tentatively cover all materials from chapters 1 to 3 of the lecture notes.

- **Final Exam (60%)**: Assessing ILOs 1, 2, 3 and 4
  The final exam will take three hours, and the date and time will be announced in due course. All materials taught in the course will be tested in the final exam.

The mid-term test and the final exam will normally be **closed-book written tests**, and **HKEAA-approved calculators will be allowed** during the tests. The exact exam arrangements may be modified in the event of unexpected emergencies.

7. Student learning resources

- Main reference: Lecture note by the instructor
  (Accessible via our course website https://canvas.ust.hk/courses/55479)

- Other reference texts:
  J. Bak and D. Newman, *Complex Analysis* (3rd ed.), Springer UTM.
  T. W. Gamelin, *Complex Analysis*, Springer UTM.
  E. M. Stein and R. Shakarchi, *Complex Analysis*, Princeton Uni. Press. (Ch. 1 – 3 only)
  Y. K. Kwok, *Applied Complex Variables for Scientists and Engineers* (2nd ed.), Cambridge Uni. Press. (this is a reference containing many applications suitable for engineers)

8. Tentative course schedule

Week	Lecture dates	Topics
1	Feb 1, Feb 6	Complex number arithmetics Sequences and series of complex numbers
2	Feb 8	Point-set topology in $\mathbb{C}$: open sets, closed sets Compactness, connectedness
3	Feb 15, Feb 20	Functions in a complex variable, Limits and continuity
4	Feb 22, Feb 27	Holomorphic functions, Cauchy-Riemann equations Complex exponential and trigonometric functions
5	Feb 29, Mar 5	Sequences and series of complex functions Power series
6	Mar 7, Mar 12	Line integrals in the complex plane Antiderivatives, Cauchy-Goursat Theorem
7	Mar 14, Mar 19	Cauchy integral formula Complex logarithms
8	Mar 21, Mar 26	Taylor series of a holomorphic function Morera's Theorem
9	Apr 9, Apr 11	Maximum modulus principle, Schwarz lemma Liouville's Theorem
10	Apr 16, Apr 18	Isolated singularities Laurent series
11	Apr 23, Apr 25	Residues
12	Apr 30, May 2	Argument principle, Rouché's Theorem
13	May 7, May 9	Any other selected topic(s) and/or Final review