MAT 305-201 Applied Complex Analysis
2018/2019-Term 2

Instructor: Yong Liu, Office: LSK 303

Time and Place: Mon-Wed-Fri: 12:00 noon to 1:00 pm, LSK 200

Textbook: Fundamentals of Complex Analysis for Mathematics, Science and Engineering, Third Edition, by E. Saff and A. Snider.

Grading: Final Exam: 50%, Two Midterms: 20% each, HW: 10%. First midterm will be Feb 8. Second midterm will be Mar 15. There are no make-up midterms. If missing a midterm for valid reason, the final exam weighting will be adjusted accordingly.

Assignments: There will be 7-10 assignments(To be posted on webpage). No late homeworks will be accepted. Lowest HW score will be dropped.

Webpage: TBA. Office hour: TBA. More information: TBA. Old notes available at `www.math.ubc.ca/~ward` and `www.math.ubc.ca/~jcwei`

Teaching scheme(an approximate outline of the materials to be covered):

1. Fundamentals of complex variable. Euler's formula. Polar coordinate. Principal value of argument $\operatorname{Arg}(z)$
2. $\operatorname{Arg}(z)$ and $\arg(z)$. De Moivre's formula. Roots of unit. Roots of a complex variable
3. Complex exponential. Sets in the complex plane. Functions of complex variables
4. Functions of complex variables. Image under linear and Mobius map $w = \frac{a+bz}{c+dz}$
5. Image under $w = z^2$. Continuous, differentiable, analytic. Cauchy-Riemann equation
6. Consequences of Cauchy-Riemann equation. Harmonic Functions. Conformal Mapping. Level Sets

7. Laplace under analytical mappings. $\partial_{\bar{z}} f(z) = 0$. Conformal Mappings. Elementary Functions

8. Elementary functions e^z and $\sin z$. Images under e^z and $\sin z$

9. Properties of $\sin z$ and $\sinh z$. Introduction of $\mathrm{Log}(z)$

10. Multi-valued functions. introduction of $\log z$ and $\mathrm{Log}(z)$ and their properties

11. Multi-valued functions. Introduction of z^α and branch cuts

12. Multi-valued functions. Branch cuts for $\left(z^2-1\right)^{\frac{1}{2}}$

13. Branch cuts for $\left(z^3-z\right)^{\frac{1}{2}}, \left(z^3-z\right)^{\frac{1}{3}}, \left(z^2+1\right)^{\frac{1}{2}}$

14. Inverse function of $\sin z$. Solving Laplace equation with $\mathrm{Arg}(z)$

15. Complex integrals. Contours (Paths)

16. Fundamental Theorem of Calculus in the Complex Case. Examples

17. Cauchy-Coursat Theorem. simply-connected domains. Path independence and deformation of path

18. Path Independence. Cauchy Integral Formula. Examples

19. Applications of Cauchy Integral Formula. Computation of real integrals

20. Consequences of Cauchy Integral Formula. Functions with finite order singularity

21. Consequences of Cauchy Integral Formula. Liouville Theorem: bounded entire functions are constants

22. Maximum Modulus Principle

23. Argument Principle, Nyquist Criterion

24. Argument Principle, Nyquist criterion, applications to ODE

25. Rouche's Theorem. Classification of Singularities

26. Classification of singularities and computations of residues

27. Cauchy Residue Theorem. Computation of residues and contour integrals

28. Applications of Cauchy Residue Theorem

29. Type I, Type II real integrals

30. Type III real integrals

31. Type IV and Type V integrals. Integrals involving Multi-valued functions

32. Type V integrals

33. Fourier transforms and inverse Fourier transforms. Two Properties. Applications to ODE and PDE