Onsite Research Seminar Syllabus

1. Overview

Title	Complex Variables for HS	
Mode	Professor Sessions & Teaching Fellow Sessions	
Prerequisites	Required course/knowledge	Calculus of one and several variables
	Recommended Materials for preparing for the course	Review your calculus material; **Brown and Churchill, Complex variable and application, 9th edition**

2. Program Introduction and Objectives

Course Description In a paragraph, please specify: What kind of program is it? What field is the program based in? What knowledge/concepts does the program include? What is the final outcome of the program (types of projects/ What did the students do to demonstrate their learning outcome, etc.)	Complex variables lies at the core of both pure and applied mathematics. Topics like electrostatics, hydrodynamics and other rely on complex variables. This subject is also crucial, for instance, in analytical number theory. The most famous open problem in pure mathematics, the so called Riemann Hypothesis, deals with the location in the complex plane of the zeros of a certain analytical function. This function will be mentioned in class. Some methods for determining its zeros rely on results that will be covered in this class.
Software/Tools (if any)	**N/A**

3. Program Schedule

Session	Session I (by Professor)		Assignment	Reading Materials
1 (online)	Topic	Complex numbers, cartesian and polar representations	Page 13: Prob 5,8 Page 16: Prob 1,9	Chapt 1
	Detail			
2 (online)	Topic	Roots and logarithms, rational functions	Page 23:Prob 1 Page 30: Prob 6	Chapt 1&2
	Detail			
3 (onsite)	Topic	Differentiable functions & Cauchy Riemann equations	Page 43: Prob 1,2 Page 54: Prob 5	Chapt 2
	Detail			
4 (onsite)	Topic	Trigonometric functions, examples of mapping properties	Page 54: Prob 10 Page 61: Prob 8 Page 70: Prob 1	Chapt 3
	Detail			
5 (onsite)	Topic	Integrals along curves in the complex plane & basic examples	Page 89: Prob 3,6 Page 95: Prob 3,6 Page 103: Prob 1 Page 107: Prob 11	Chapt 4
	Detail			
6 (onsite)	Topic	Some important theorems. Cauchy-Goursat theorem.	Page 119: 2a, 3 Page 132: 1 Page 138: 2	Chapt 4&5
	Detail			
7 (onsite)	Topic	Cauchy integral formula, Taylor's and Laurent's expansions	Page 147: 1,2 Page 185: 4	Chapt 5
	Detail			
8 (onsite)	Topic	Cauchy's residue theorem & examples	Page 237: 1a,1c, 2a,2b, 2d	Chapt 5&6
	Detail			
9 (onsite)	Topic	Description of the final project & the Fourier matrix		
	Detail			
10 (onsite)	**Final Presentation**			

Session	Session II (by Teaching Fellow)
1 (online)	Class introduction; review of important concepts of lecture 1; example problems and exercises for students during the class
2 (online)	Review of important concepts of lecture 2; example problems and exercise for students during the class; comments on assignment 1

3 (onsite)	Review of important concepts of lecture 3; example problems and exercise for students during the class; comments on assignment 2
4 (onsite)	Review of important concepts of lecture 4; example problems and exercise for students during the class; comments on assignment 3
5 (onsite)	Review of important concepts of lecture 5; example problems and exercise for students during the class; comments on assignment 4
6 (onsite)	Final project discussion by group
7 (onsite)	Informal presentation by each group in front of the class; there will be questions from the mentor to check whether the students have fully understood everything; Remarks and suggestions based on common problems and students' questions

4. Assignments

Requirements	Clear explanation of the solutions
Submission Deadline	3 days after distribution/ announcement

5. Final Oral and Written Project

- Detailed requirements of the final project:

  - Group Work with each student making part of the presentation.
  - Students are required to meet the following objectives before attending Session#8:
    - The final project will be announced by lecture #5
    - Students should have started working on this by Session#8

  - Students are required to meet the following objectives before attending Session#9:
    - Have determined outline and rough draft of final project and presentation
    - Is ready for a 5-10 min informal presentation followed by discussion with instructor.
    - Submitted the PowerPoint slides before the session if it is prepared.

  - Students are required to meet the following objectives before attending the teaching session#5:
    - Read the question and understand what they are required to do in the final project
    - Have at least a rough idea how to solve the problem
    - Make some attempts trying to solve the problem and have partial results

  - Students are required to meet the following objectives before attending the mentor session#6:
    - Solve the problem in the final project
    - Have at least an informal presentation slide/ written solution in detail of the problem in the final project
    - Be able to present their results clearly

5.1 Final Oral Presentation

- Oral Project Theme: compute four explicit integrals by residues

- Oral Project Requirements: Students will have to solve challenging problems.

5.2 Written Project Requirements

The written report will give all the details of the oral presentation

6. Suggested Future Research Fields/Direction/Topics

After this class, students should be able to take a FULL SEMESTER course in Complex Analysis.

7. Instructor Introduction

Prof F. Alberto Ph.D.

Prof F. Alberto received his Ph.D. diploma at The Rockefeller University in New York. He has taught mathematics at Caltech (Pasadena), the Courant Institute, NYU (NY)and the University

of California in Berkeley. He has been a research scientist at the IBM Reaserch Center in Yorktown Heights, NY, and the Lawrence Berkeley Lab. He has been a visiting professor at many foreign institutions including Tsinghua U. in Beiging and Shanghai Jiao Tong U. He has taught a wide set of classes at the undergraduate and graduate level. He has served as the Chair of the Mathematics Dept in Berkeley for a period of three years and as the Chief Editor of the journal Inverse Problems published by the Institue of Physics in England, for a period of five years.