Applied Mathematics 104. Complex analysis and series expansions for applications to science, engineering and finance

Instructors:
- Prof. Efthimios Kaxiras [kaxiras@physics.harvard.edu]
- Prof. George Tsironis [gtsironis@fas.harvard.edu]
- Teaching Staff: Dr. George Neofotistos [neofotistos@seas.harvard.edu]
- TF1: George Abraham [gabraham@g.harvard.edu]
- TF2: Juspreet Singh Sandhu [jus065@g.harvard.edu]
- TF3: Petur Bryde [bryde@g.harvard.edu]
- TF4: Shruti Mishra [shrutimishra@g.harvard.edu]

Lectures: Tu-Th. 12:00pm-1:15pm, Maxwell-Dworkin G 115

Office Hours: Saturday 11:00am-12.30pm, Cruft Lab 403
Monday 5:45pm-7:00pm, Jefferson Lab J 256

Sections: Thursday 6:00pm-7:30pm, Cruft Lab 403
Friday 4:30pm-5:45pm, Jefferson Lab J 256
Monday 4:30pm-5:45pm, Jefferson Lab J 256

Text: Lecture Notes to be posted on course website

Course work (and percentage of final grade):

- in-class problems to be solved during lecture **(20 p.)**
  - students are expected to be present in class and solve the assigned problems in small groups, which will be collected and graded
    20 highest grades will be counted (1 p. each)

- homework and projects **(65 p.)**
  - homework problems and projects will be assigned weekly, which will contain both analytic and computational components;
    [10 problem sets (5 p. each) and 2 projects (7.5 p. each)]
    students can work in small groups but **must turn in solutions written individually**

- final project **(15 p.)**
  - will cover more than one topic and will be due during reading period;
    students can work in small groups but **must turn in solutions written individually**

Typical range of letter grades:

A	96-100
A-	91-95
B+	86-90
B	81-85
B-	76-80
C+	71-75
C	66-70
C-	61-65

Course Description (based on 26 Lectures)

Unit 1: Complex number and functions of complex variables: (7 Lectures)

- Complex numbers – the complex plane
- Functions of complex variables
- Cauchy-Riemann relations for analytic functions
- Taylor and Laurent series

Unit 2: Complex Analysis and analytic functions: (5 Lectures)

- Singularities and the Residue Theorem
- Contour integration using residues
- Branch points and branch cuts

Unit 3: Series Expansions of signals: (6 Lectures)

- Fourier series expansion and the Fourier Transform
- FT of special functions (delta, theta), convolution, correlation
- Applications to signal analysis
- Fast Fourier Transform (FFT) and its applications

Unit 4: Applications to differential equations: (8 Lectures)

- Introduction to differential equations
- Introduction to partial differential equations – separation of variables
- The wave, diffusion, Laplace and Poisson equations in FT form
- Applications to physical and financial problems