The main goal of this course is to estimate complex integrals of an analytic function as well as to estimate the asymptotic bound of its coefficients. At the end, we will give some applications to analytic combinatorics and to algorithmics such as : Stirling's formula, the asymptotics of thecentral binomial coefficients, the involution numbers and the Bell numbers associatedto set partitions, the asymptotic enumeration of integer partitions.

1. ELEMENTARY COMPLEX ANALYSIS

1.1. **Complex Derivative and Analytic Functions.**

1.2. **Complex Line Integrals.**

1.3. **Goursat's Lemma and the Cauchy Integral Theorem.**

1.4. **Cauchy Integral Formula.**

1.5. **Taylor's Theorem.**

1.6. **Local Properties of Analytic Functions.**

1.7. **Logarithms and Winding Numbers.**

1.8. **Operations on Taylor Series.**

1.9. **Argument Principle.**

1.10. **Residue Theorem and Evaluation of Definite Integrals.**

2. INTEGRAL TRANSFORMS

2.1. **Fourier Transforms.**

2.1.1. *Formal properties.*

2.1.2. *The inversion theorem.*

2.1.3. *The Plancherel theorem.*

2.2. **LaplaceTransforms.**

2.2.1. *Formal properties.*

2.2.2. *Applications to Differential Equations.*

2.3. **Mellin transforms.**

3. SADDLE-POINT ASYMPTOTICS

3.1. **Landscapes of analytic functions and saddle-points.**

3.2. **Saddle-point bounds.**

3.3. **Overview of the saddle-point method.**

3.4. **Saddle-points and linear differential equations.**

3.5. **Some combinatorial examples and applications.**