

Be familiar with Chapter 1 of the text. Some important topics:

1. Definition of complex numbers, and the operations: addition, multiplication, conjugation, real and imaginary parts, absolute value, argument. Know how to do computations in rectangular and polar coordinates. For example, know how to find powers and roots.
2. Definition of open sets in \mathbb{C} , connected open sets in \mathbb{C} (also called regions).
3. Definition of analytic function. Properties of complex derivatives: product rule, chain rule, etc (all the usual rules).
4. Examples of functions that are analytic, such as polynomials, rational functions, exponential and trigonometric functions. Also know examples of functions that are not analytic, such as conjugation, real - valued functions, etc. Know how to show that a function is or is not analytic.
5. Know the Cauchy - Riemann equations and how to derive them from the definition of analytic function. Know how to use these equations to show that a function is or is not analytic.
6. If $A \subset \mathbb{C}$ is a region, $f : A \rightarrow \mathbb{C}$ is analytic, and $f'(z) = 0$ for all $z \in A$, then f is constant.
7. If $A \subset \mathbb{C}$ is a region, $f : A \rightarrow \mathbb{R}$ is analytic (meaning f is analytic and real-valued), then f is constant.
8. Conformal maps. An analytic function f is conformal at all points where $f'(z) \neq 0$.
9. Know the basic “elementary” functions, various formulas, how to visualize them as conformal maps, etc:
 - (a) z^n for $n \in \mathbb{Z}$, polynomials, rational functions (= quotient of two polynomials).
 - (b) $e^z = 1 + z + z^2/2! + z^3/3! + \dots = e^x(\cos y + i \sin y)$.
 - (c) $\cos z = \cos(x+iy) = \cos x \cosh y - i \sin x \sinh y = (e^{ix} + e^{-ix})/2 = 1 - x^2/2! + x^4/4! \dots$
 - (d) $\sin z = \sin(x + iy) = \sin x \cosh y + i \cos x \sinh y = (e^{ix} - e^{-ix})/2i = x - x^3/3! + x^5/5! \dots$
10. For all these functions understand the issues involved in defining inverse functions. In each case, know how to define branches of the inverse function.
11. Harmonic functions, conjugate harmonic functions.

Probably the best way to prepare for the midterm is to know how to do all the assigned homework problems from Chapter 1, including the review problems.