1. Are the following series convergent? Why?

   (i). $\sum_{n=1}^{\infty} e^{in}$

   (ii). $\sum_{n=1}^{\infty} \frac{1}{n^2} - \frac{i}{n}$

   (iii). $\sum_{n=1}^{\infty} \frac{e^{in}}{n^2}$

2. If $\lim_{n\to\infty} z_n = z$, prove $\lim_{n\to\infty} |z_n| = |z|$.

3. If $\sum_{n=1}^{\infty} z_n = z$, prove $\sum_{n=1}^{\infty} \bar{z}_n = \bar{z}$

4. Find the Taylor series expansion of $f(z) = \frac{1}{z}$ at $z_0 = 2$.

5. Find the Taylor series expansion of $f(z) = \frac{z}{z^4+4}$ at $z_0 = 0$.

6. Consider $f(z) = \log z$ in the branch $a < \theta < a + 2\pi$, where a is a constant real number such that $a \notin 2\pi\mathbb{Z}$. Find the Taylor series expansion of $f(z)$ at $z_0 = 1$.