1. Find the integrals over the unit circle $C$ :
(a) $\int_{C} \frac{\cos (z)}{z} d z$
(b) $\int_{C} \frac{\sin (z)}{z} d z$
(c) $\int_{C} \frac{\cos \left(z^{2}\right)}{z} d z$
2. Prove the Extended Liouville Theorem:

If $f$ is entire and for some integer $k \geq 0$ there exists positive constants $A$ and $B$ such that

$$
|f(z)| \leq A+B|z|^{k}
$$

then $f$ is a polynomial of degree at most $k$.
3. Show that $\alpha \in \mathbb{C}$ is a zero of multiplicity $k$ if and only if

$$
P(\alpha)=P^{\prime}(\alpha)=\cdots=P^{(k-1)}(\alpha)=0, \quad P^{(k)}(\alpha) \neq 0
$$

4. Prove that a nonconstant entire function cannot satisfy the two equations:
(i) $f(z+1)=f(z)$
(ii) $f(z+i)=f(z)$
5. Prove that every polynomial with real coefficients is equal to a product of real linear and quadratic polynomials.
