Problem 1 (10 Points) Prove that the set of complex exponential functions \( \{e^{k\omega_0 t}, k = \pm 1, \pm 2, \ldots \} \) is orthogonal.

Problem 2 (10 Points) Represent a periodic signal with fundamental frequency \( \omega_0 \) as a complex Fourier series, and derive the formula for the Fourier coefficients.

Problem 3 (10 Points) State and prove Nyquist sampling theorem.

Problem 4 (10 Points) Plot the approximate Bode plot (magnitude and phase) for

\[
H(\omega) = \frac{10^4(1 + j\omega)}{(10 + j\omega)(100 + j\omega)}
\]