

$$T(f)(x) = \sum_{n=-\infty}^{\infty} a_n T(e^{inx})(x) = \sum_{n=-\infty}^{\infty} a_n \left(\frac{1}{2\pi} \int_{-\pi}^{\pi} g(t) e^{-int} dt \right) e^{inx} = \sum_{n=-\infty}^{\infty} \lambda_n a_n e^{inx},$$