Task 2, $y[n] = f(x[n])$ $\qquad x[n] = A\cos(\theta_0 n)$

$$\hat{f}(x[n]) = \sum_{k=0}^{K} \frac{1}{k!} \frac{d^k f(z)}{dz^k}\Big|_{z=c} (x[n]-c)^k$$

$$\hat{f}(x[n]) = \alpha_0 + \alpha_1 \cos(\theta_0 n) + \alpha_2 \cos(2\theta_0 n) + \alpha_3 \cos(3\theta_0 n)$$

$$\hat{f}(x[n]) = \sum_{k=0}^{K} \frac{1}{k!} \frac{d^k f(z)}{dz^k}\Big|_{z=c} (x[n]-c)^k$$

$$= 1 f(c) \cdot 1 + 1 f^1(c)(x[n]-c)^1 + \frac{1}{2!} f^2(c)(x[n]-c)^2 + \frac{1}{3!} f^3(c)(x[n]-c)^3$$

$$= f(c) + f^1(c)(x-c)^1 + \frac{1}{2} f^2(c)(x^2 - 2xc + c^2) + \frac{1}{6} f^3(c)(x^3 - 3x^2c + 3xc^2 - c^3)$$

$$= f(c) + f^1(c)x - f^1(c)c + \frac{1}{2} f^2(c)x^2 - f^2(c)xc + \frac{1}{2} f^2(c)c^2 + \frac{1}{6} f^3(c)x^3 - \frac{1}{2} f^3(c)x^2c + \frac{1}{2} f^3(c)xc^2 - \frac{1}{6} f^3 c^3$$

$\cos^2(\theta_0 n) = \frac{1}{2}(1 + \cos(2\theta_0 n))$

$\cos^3(\theta_0 n) = \frac{1}{4}(3\cos(\theta_0 n) + \cos(3\theta_0 n))$

$$= f(c) + f^1(c) A\cos(\theta_0 n) - f^1(c)c + \frac{1}{2} f^2(c) A^2 \cos^2(\theta_0 n) - f^2(c) A\cos(\theta_0 n)c + \frac{1}{2} f^2(c)c^2 + \frac{1}{6} f^3(c) A^3 \cos^3(\theta_0 n) - \frac{1}{2} f^3(c) A^2 \cos^2(\theta_0 n)c + \frac{1}{2} f^3(c) A\cos(\theta_0 n)c^2 - \frac{1}{6} f^3(c)c^3$$

$$= f(c) + f^1(c) A\cos(\theta_0 n) - f^1(c)c + \frac{1}{2} f^2(c) A^2 \left(\frac{1}{2}(1 + \cos(2\theta_0 n))\right) - f^2(c) A\cos(\theta_0 n)c + \frac{1}{2} f^2(c)c^2 + \frac{1}{6} f^3(c) A^3 \left(\frac{1}{4}(3\cos(\theta_0 n) + \cos(3\theta_0 n))\right) - \frac{1}{2} f^3(c) A^2 \left(\frac{1}{2}(1 + \cos(2\theta_0 n))\right)c + \frac{1}{2} f^3(c) A\cos(\theta_0 n)c^2 - \frac{1}{6} f^3(c)c^3$$

$$= f(c) + f^1(c) A\cos(\theta_0 n) - f^1(c)c + \frac{1}{4} f^2(c) A^2 + \frac{1}{4} f^2(c) A^2 \cos(2\theta_0 n) - f^2(c) A\cos(\theta_0 n)c + \frac{1}{2} f^2(c)c^2 + \frac{1}{8} f^3(c) A^3 \cos(\theta_0 n) + \frac{1}{24} f^3(c) A^3 \cos(3\theta_0 n) - \frac{1}{4} f^3(c) A^2 c - \frac{1}{4} f^3(c) A^2 \cos(2\theta_0 n)c + \frac{1}{2} f^3(c) A\cos(\theta_0 n)c^2 - \frac{1}{6} f^3(c)c^3$$

ohne cos: $f(c) - f^1(c)c + \frac{1}{4} f^2(c) A^2 + \frac{1}{2} f^2(c)c^2 - \frac{1}{4} f^3(c) A^2 c - \frac{1}{6} f^3(c)c^3$

$\cos(\theta_0 n)$: $f^1(c) A\cos(\theta_0 n) - f^2(c) A\cos(\theta_0 n)c + \frac{1}{8} f^3(c) A^3 \cos(\theta_0 n) + \frac{1}{2} f^3(c) A\cos(\theta_0 n)c^2$

$\cos(2\theta_0 n)$: $\frac{1}{4} f^2(c) A^2 \cos(2\theta_0 n) - \frac{1}{4} f^3(c) A^2 \cos(2\theta_0 n)c$

$\cos(3\theta_0 n)$: $\frac{1}{24} f^3(c) A^3 \cos(3\theta_0 n)$

$$\alpha_0 = f(c) - f^1(c)c + \frac{1}{4} f^2(c) A^2 + \frac{1}{2} f^2(c)c^2 - \frac{1}{4} f^3(c) A^2 c - \frac{1}{6} f^3(c)c^3$$

$$\alpha_1 = f^1(c) A - f^2(c) A \cancel{\cos} c + \frac{1}{8} f^3(c) A^3 + \frac{1}{2} f^3(c)c^2$$

$$\alpha_2 = \frac{1}{4} f^2(c) A^2 - \frac{1}{4} f^3 A^2 c$$

$$\alpha_3 = \frac{1}{24} f^3(c) A^3$$