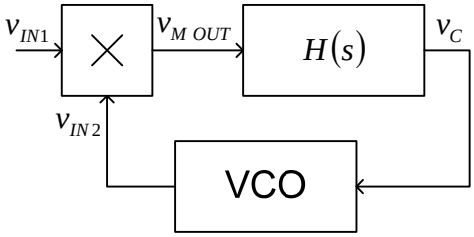
5. Na slici 5 je prikazan PLL kod koga je $v_{IN1} = 2\ \text{V}\sin(\omega_X t)$, $v_{IN2} = 2\ \text{V}\sin(\omega_X t - \varphi)$, $v_{M\,OUT} = (v_{IN1}\, v_{IN2})/(0.5\ \text{V})$, $H(s) = 1/(1+(s/\omega_P))$, $f_{VCO} = 1\,\text{MHz} + 10(\text{kHz/V})\, v_C$.

a) [4] Odrediti prenosnu karakteristiku faznog detektora $\overline{v_{M\,OUT}}(\varphi)$.

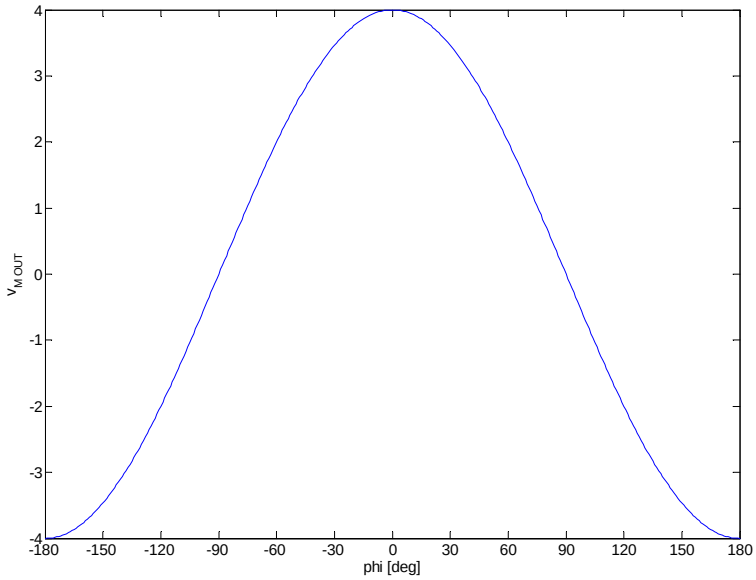
b) [6] Nacrtati vremenske dijagrame v_{IN1}, v_{IN2}, $v_{M\,OUT}$ i v_C za $v_{IN1} = 2\ \text{V}\sin(2\pi(1020\ \text{kHz})t)$. Smatrati $\omega_P << \omega_X$.



Slika 5

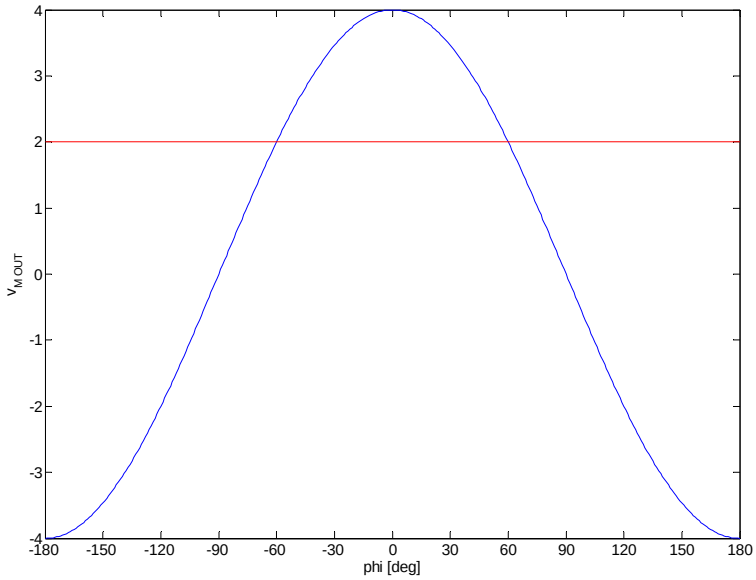
a) $v_{M\,OUT} = 8\ \text{V}\sin(\omega_X t)\sin(\omega_X t - \varphi) = 4\ \text{V}\,(\cos(\varphi) - \cos(2\omega_X t - \varphi))$

$\overline{v_{M\,OUT}} = 4\ \text{V}\cos(\varphi)$



b) $1020\ \text{kHz} = 1000\ \text{kHz} + 10(\text{kHz/V})\, v_C$, $v_C = 2\ \text{V}$

$2\ \text{V} = 4\ \text{V}\cos(\varphi)$, $\cos(\varphi) = 1/2$, $\varphi_1 = -60°$, $\varphi_2 = 60°$



nas zanima stabilno rešenje; $\alpha = \omega_X t$, $\beta = \omega_X t - \varphi$, $\varphi = \alpha - \beta$; $v_C \uparrow$, $\omega_{VCO} \uparrow$, $\beta \uparrow$, $\varphi \downarrow$, treba da dovede do $v_{M\,OUT} \downarrow$ da bi $v_C \downarrow$; $\varphi = -60°$