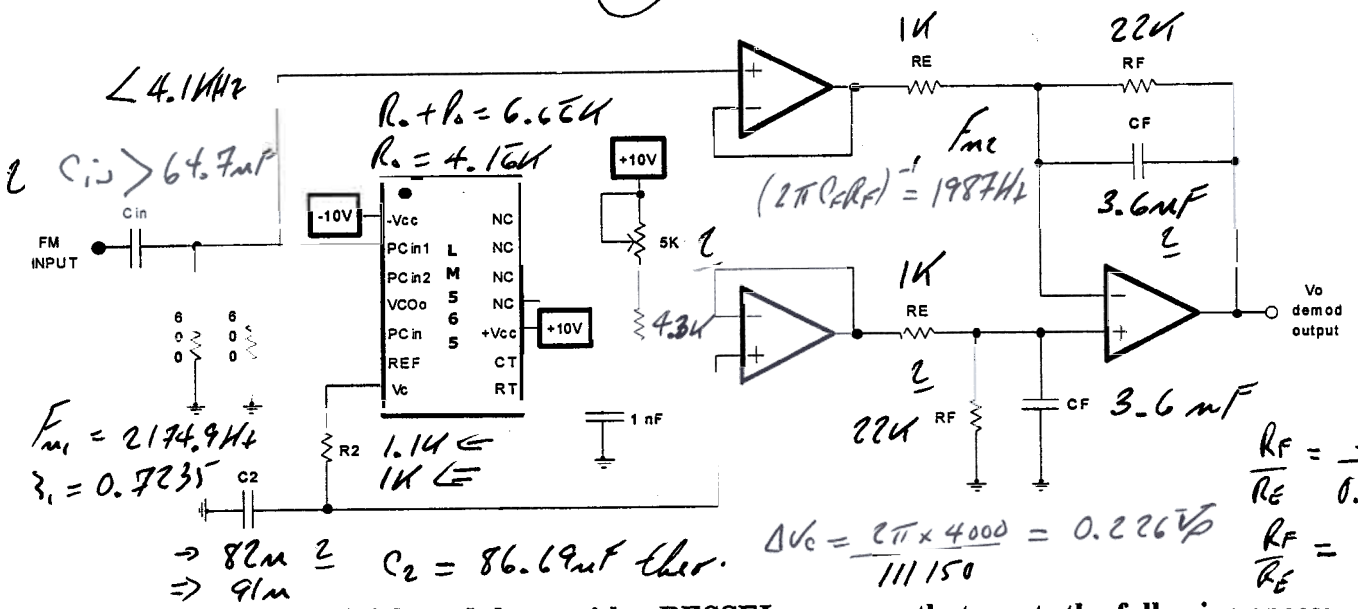
LINEAR QUIZ **PLL** **NOV 2002**

NAME: SOLUTIONS (25)



(12) A) Design a 3rd order FM demodulator with a BESSEL response that meets the following specs: 4

F_{mod} = 0 to 1000 Hz F_{car} = 45 kHz FM frequency deviation = 0 to 4 kHz (peak)

Demodulator response: low-pass Bessel response with bandwidth of 1500 Hz

Normalised demodulator poles: 1.32475 $\angle 180°$ 1.44993 $\angle \pm 136.348°$ $\zeta = 0.7835$ ✓4

Demod output: 0 to 5 V_p 12485.5 $\angle 180°$ 13665 $\angle \pm 136.348°$

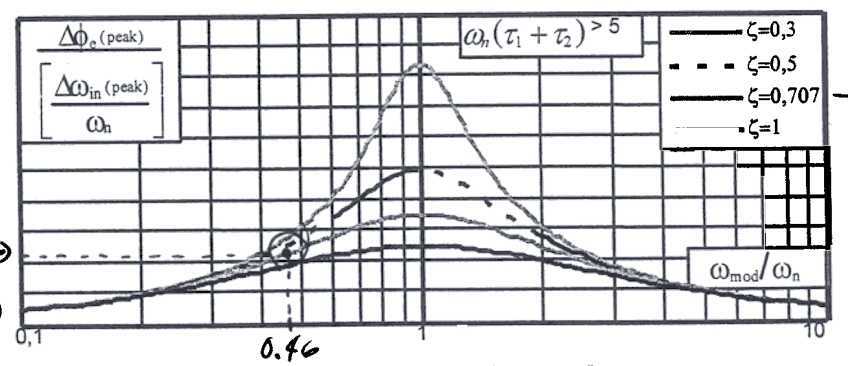
$F_{cen} \approx 0.3 / ((R_o + P_o)C_o)$ $K_d \approx 0.68 \frac{V}{rad}$ $K_o = \frac{\Delta\omega_{in}}{\Delta V_{C(Thev)}} \approx \frac{49.4 F_{cen}}{\Delta V_{CC}}$ = 111 150 rad/s/V

$\tau_1 = R_1 C_2$ $\tau_2 = R_2 C_2$ R_1 = 3.6K $\tau_1 + \tau_2 = \frac{K_O K_d}{\omega_n^2}$ $\tau_2 = \frac{2\zeta}{\omega_n} - \frac{1}{K_O K_d}$ = 92.665 µs

312.08µs 92.665µs 4 404.75µs τ_1 = 312.08µs

(14) B) Determine the maximum peak phase error if modulation is assumed to be sinusoidal.

Normalised phase error for FM sinusoidal modulation



→ 0.7235 closest

≈ 0.45

$\omega_n(\tau_1 + \tau_2) = K_O K_d / \omega_n$

= 5.53 > 5

curves valid

$\frac{F_{mod}}{F_{in}} = \frac{0 \to 1000}{2174.9} = 0 \to 0.46$

Show clearly point used

5% standard capacitors and resistors

1	1.1	1.2	1.3	1.5	1.6	1.8	2	2.2	2.4	2.7	3	x 10^N
3.3	3.6	3.9	4.3	4.7	5.1	5.6	6.2	6.8	7.5	8.2	9.1	N= ... -3,-2,-1,0,1,2,3 ...

$\Delta\phi_e$ (peak) ≈ 0.45 × 4000 / 2174.9 = 0.8276 rad