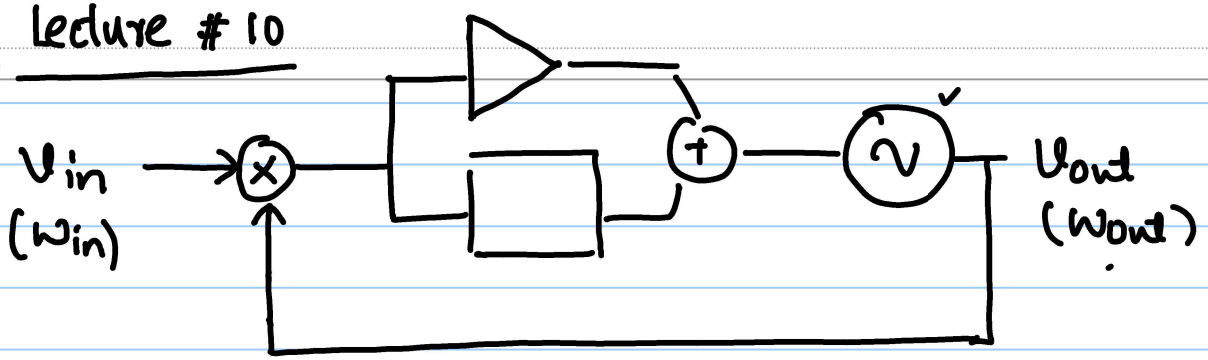
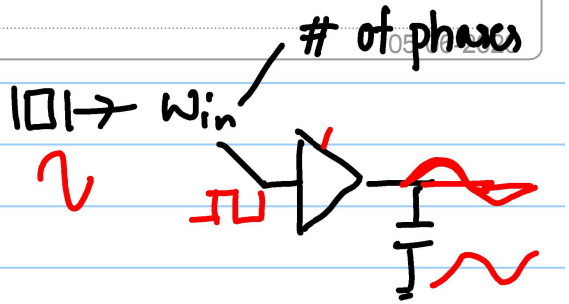
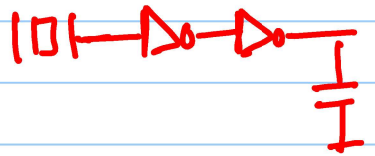
Note Title

Lecture # 10

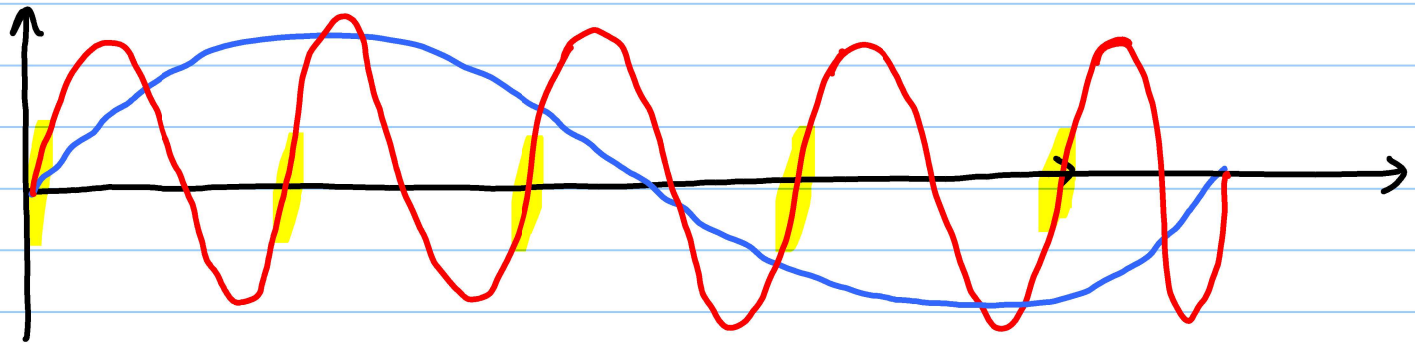






$W_{out} = W_{in}$

$W_{out} = N W_{in}$ | $W_{out} = 5W_{in}$

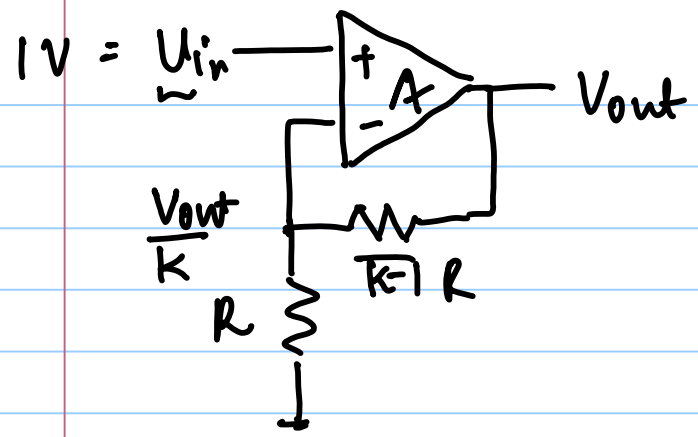


W_{in}

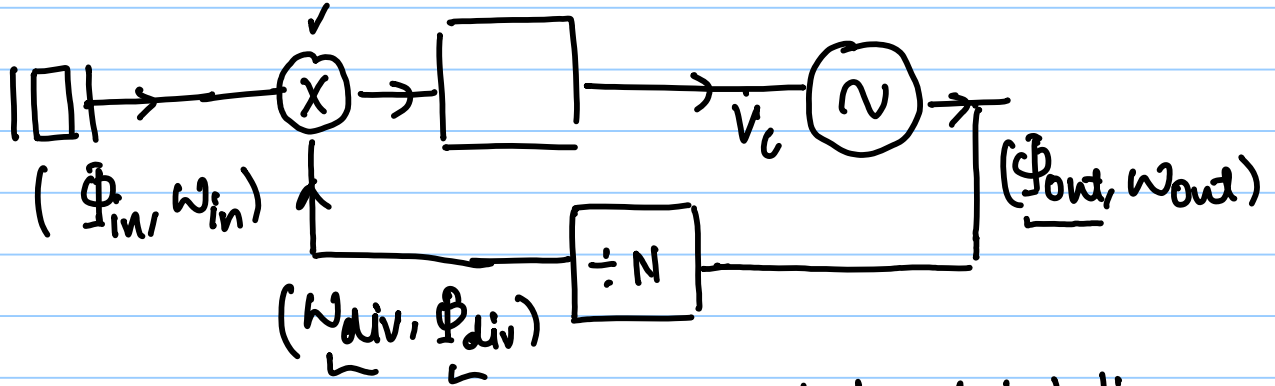
$V_{ref} = 1.0V$

$W_{freq} = 5W_{in} = W_{out}$

$5V + V_n + V_{off} = V_{out}$



$$\frac{V_{out}}{K} = V_{in}$$



$$w_{div} = w_{in} \cdot \frac{w_{out}}{N}$$

$$\frac{d}{dt}(\Phi_{in} - \Phi_{div}) = 0$$

$$\Rightarrow$$

$w_{out} = 5\, w_{in}$.

Clock-Multiplier.

$$V_{in} = \sin(w_{in} \cdot t)$$

$$\Phi_{in}(t) = w_{in} \cdot t$$

$$V_{out} = \sin(w_{out} \cdot t)$$

$$\Phi_{out} = w_{out} \cdot t$$

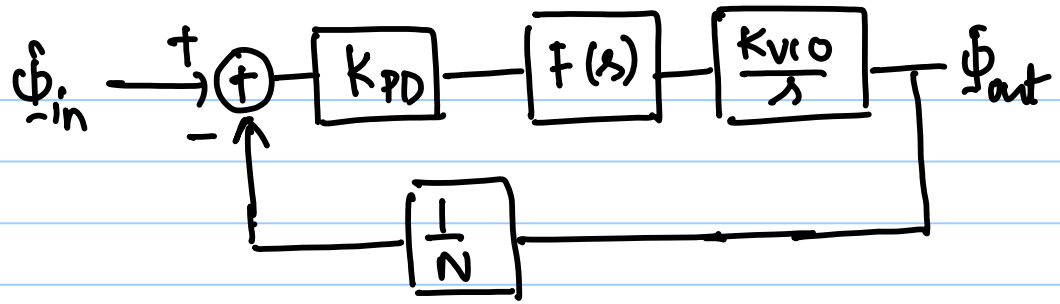
$$\Phi_{out} = 5 w_{in} \cdot t$$

$$w_{div} = \frac{w_{out}}{N}$$

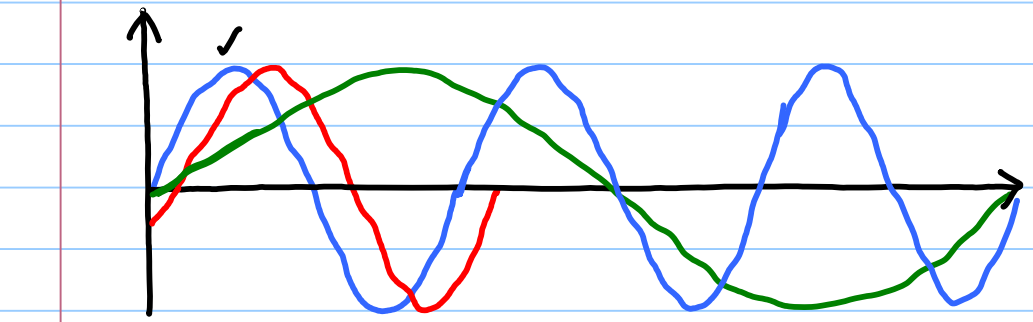
$$\Phi_{div} = w_{div} \cdot t$$

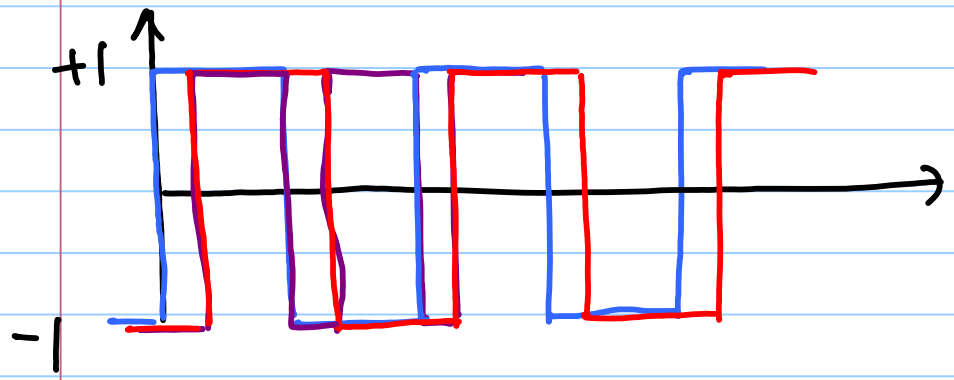
$$= \frac{w_{out} \cdot t}{N}$$

$$= \frac{\Phi_{out}}{N}$$

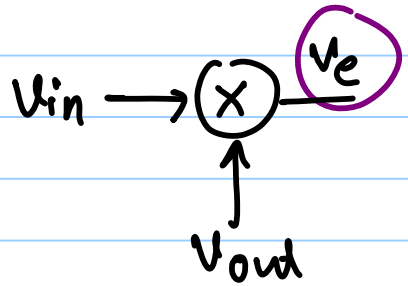


$$H(s) = K_{PD} \cdot F(s) \cdot \frac{K_{VCO}}{s} \cdot \frac{1}{N}$$



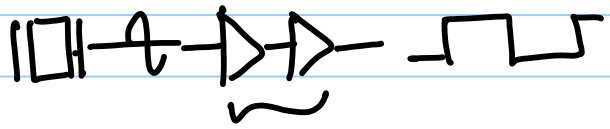


$\Delta\omega_p \to \infty$



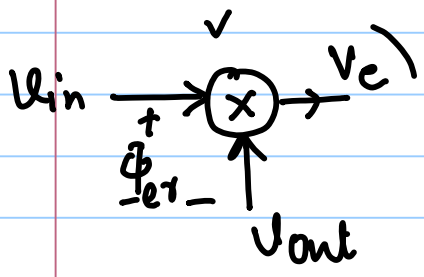
- RF Applications
  - hp conversion
  - DN conversion
    (Sinusoidal clock signals)
- LC Oscillator
  - o/p signals are sine
- Clock as a sampling signal!

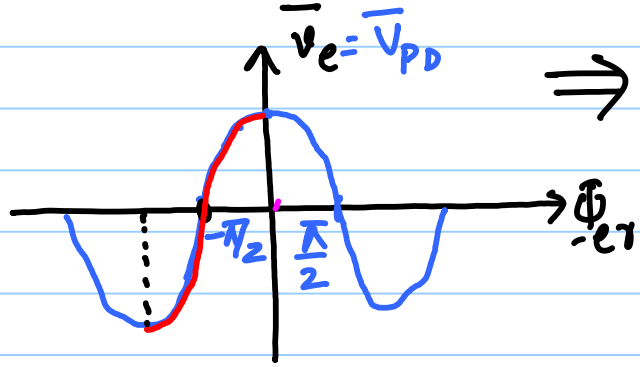
- square wave signals
(PD's / DACs)

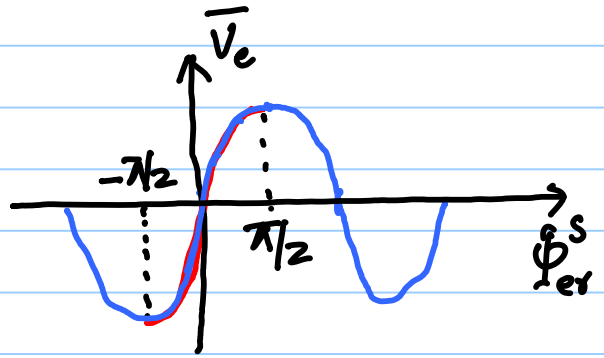


Phase Error Detectors. (PD)

1. Mixer-based phase error detector



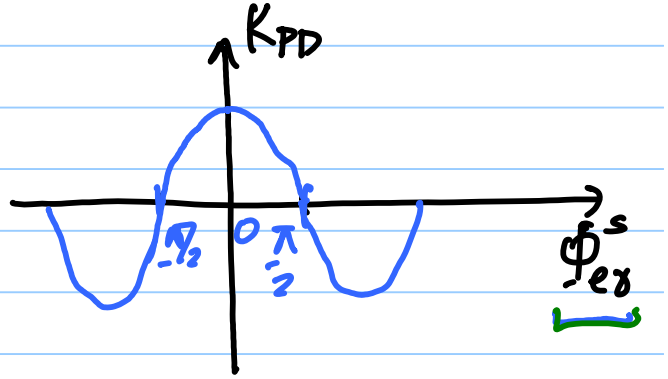




V_{in}: $A_{in} \sin(\omega_{in} t)$

V_{out}: $A_{out} \sin(\omega_{in} t - \Phi_{er}(t))$

$$V_e = \frac{A_{in} \cdot A_{out}}{2} \left[\cos(\Phi_{er}) - \cos(2\omega_{in} t + \Phi_{er}) \right]$$



- Range of PD : $(-\pi/2$ to $\pi/2)$
- Gain of PD

$$\text{Gain of PD}, K_{PD} = \frac{d\bar{V}_e}{d\Phi_e} = -\frac{A_{in} \cdot A_{out}}{2} \sin(\Phi_{er})$$

2. Sampler Based Phase Detector.