

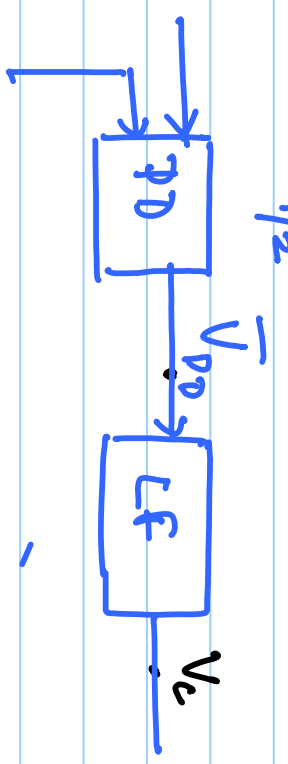
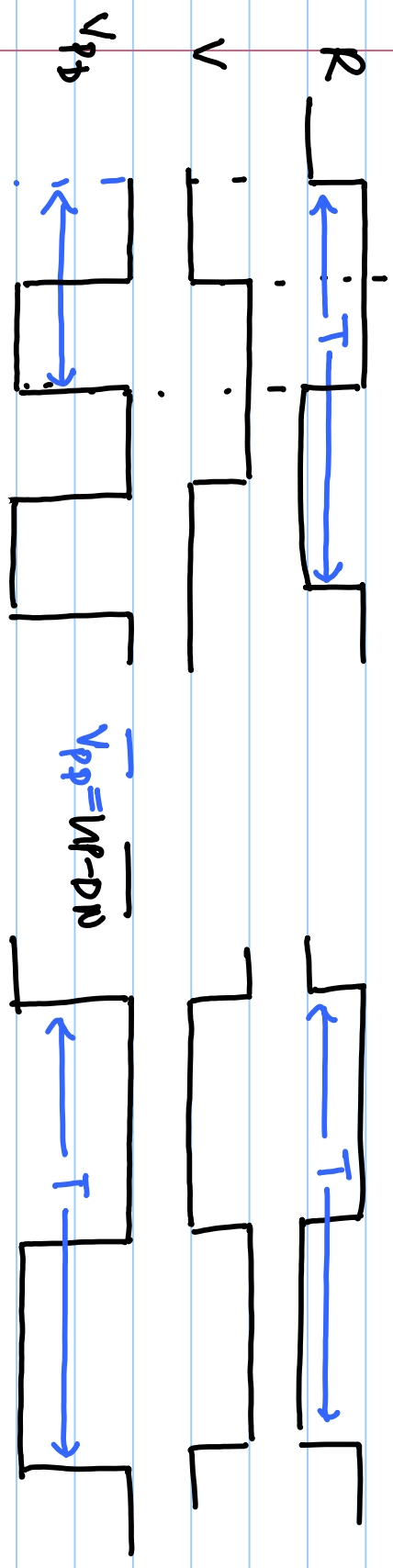
Lecture # 13

EXOR-based PD ($-\frac{\pi}{2}$ to $+\frac{\pi}{2}$)

$\phi_a = \pi/2$

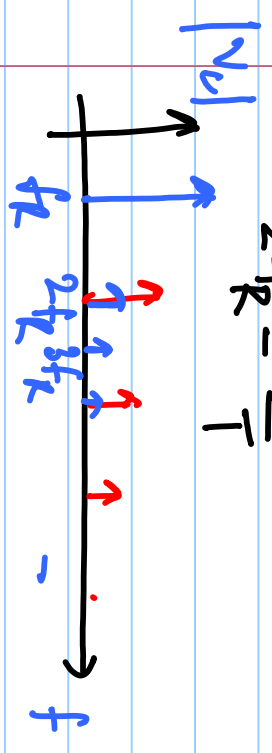
S-R PD ($-\pi$ to π)

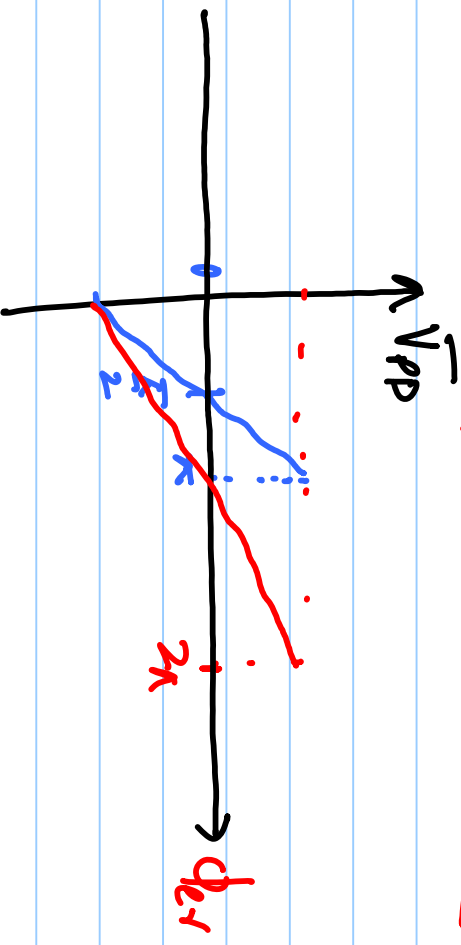
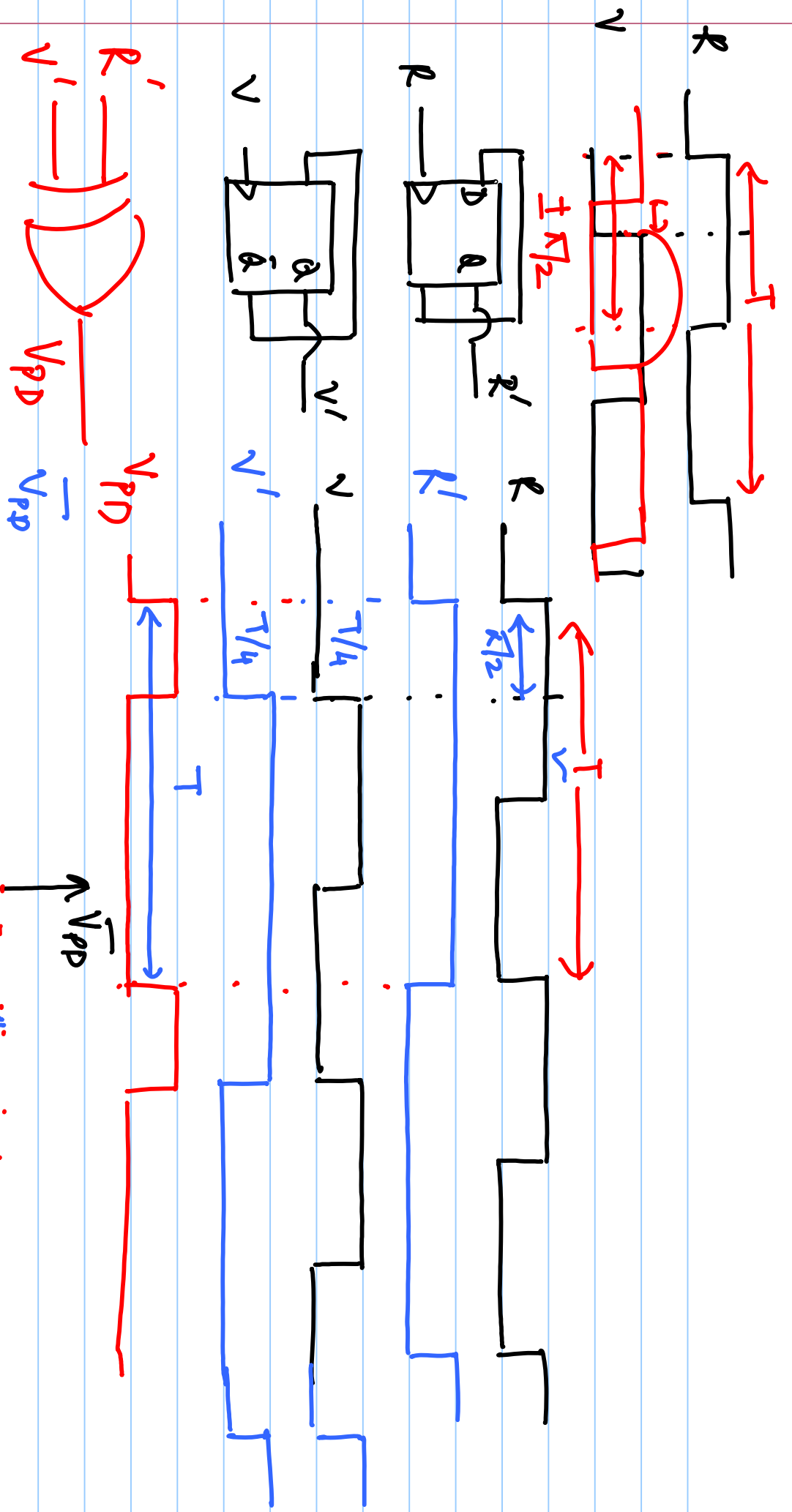
$\phi_a = \pi$

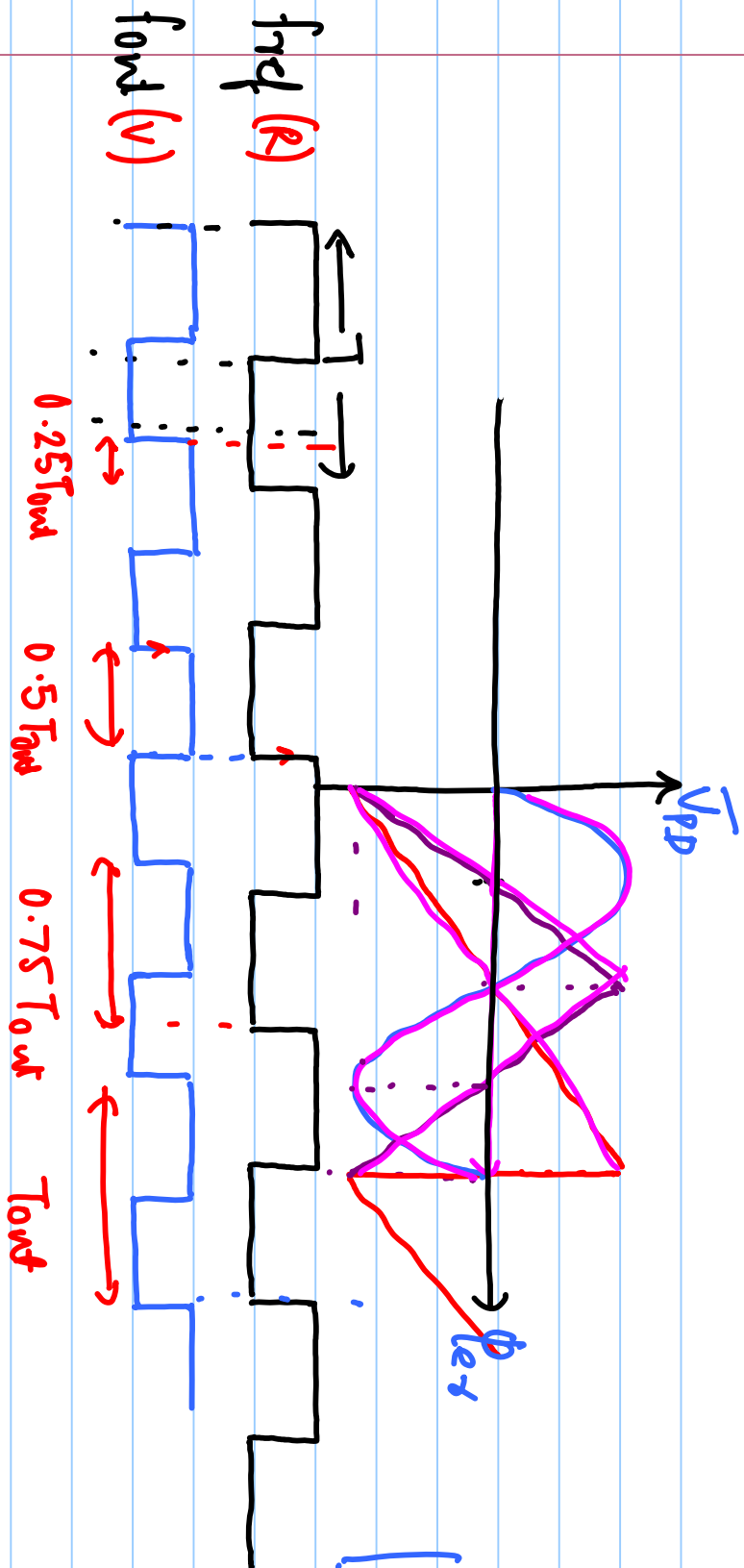


$f_R = \frac{1}{T}$

$2f_R = \frac{2}{T}$







$$f_{out} = 1.25 f_{req}$$

$$T_{req} = 1.25 T_{out}$$

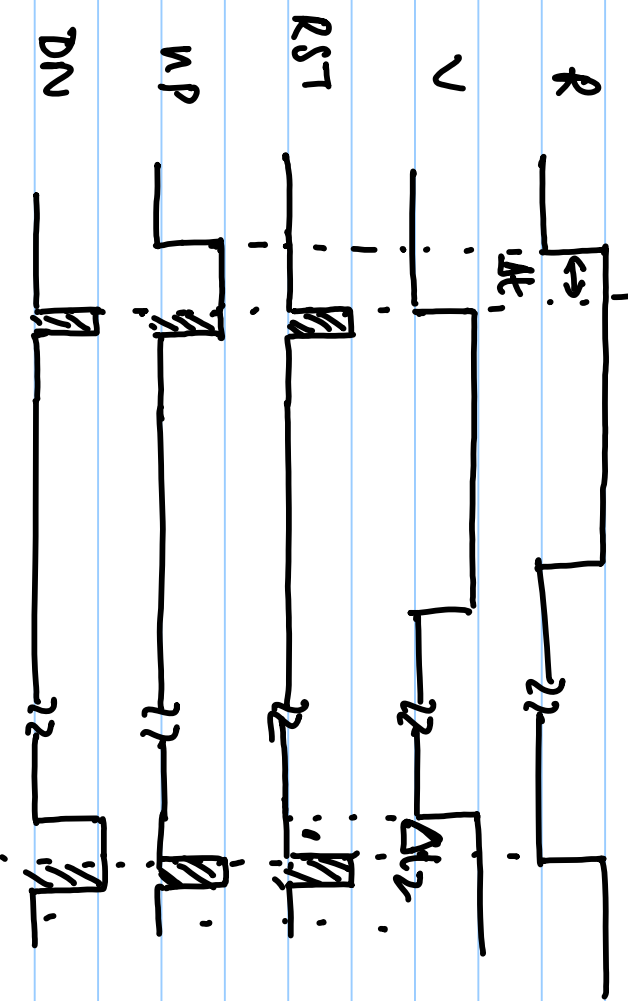
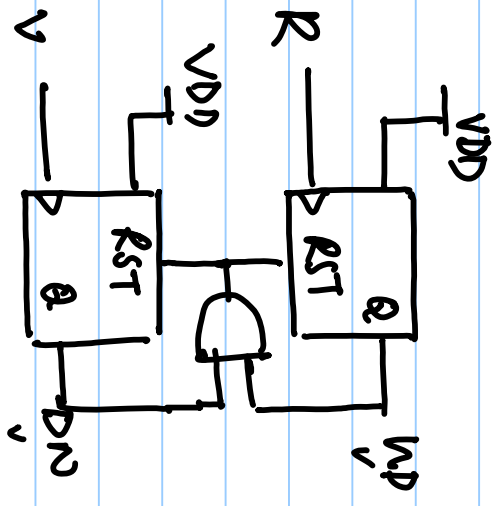
$$4 \cdot T_{req} = 5 T_{out}$$

$$\Delta t = (T_{req} - T_{out})$$

$$\Delta f = f_{req} - f_{out}$$

$$\text{if } \Delta f > 0, \quad \bar{V}_{PP} \propto \Delta f$$

Phase Frequency Detector (PFD) (3-state)



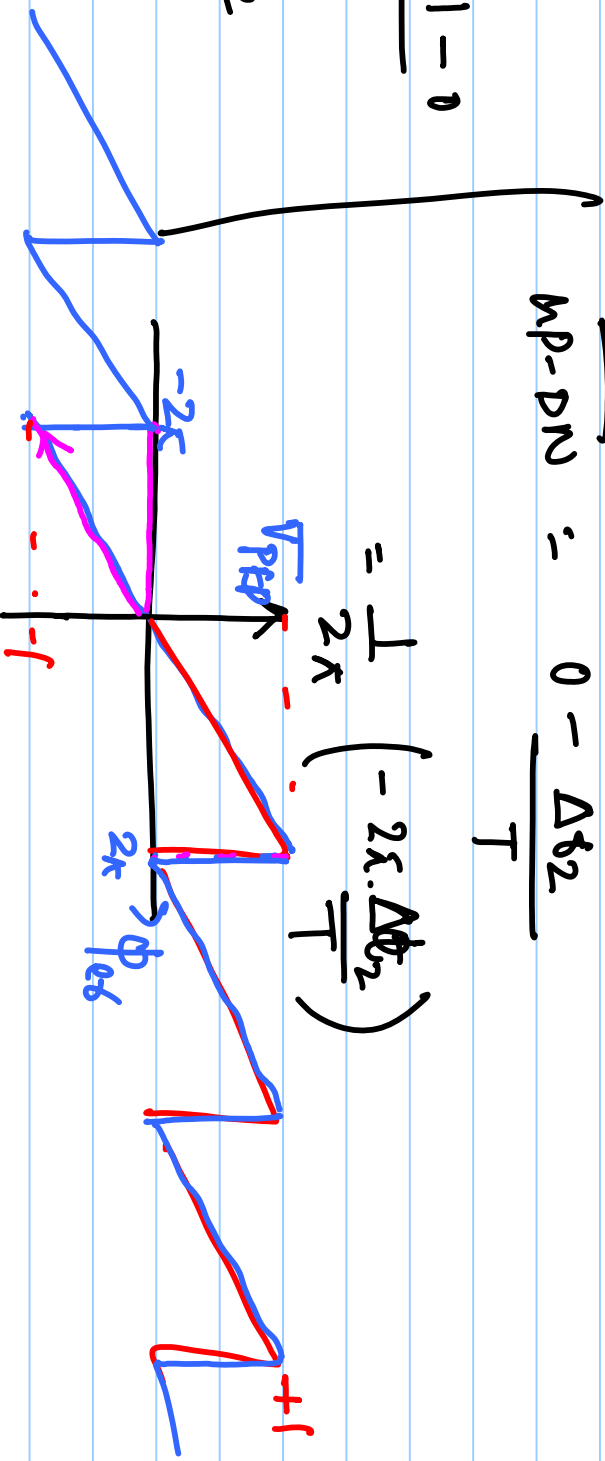
$$\phi_{e1} = 2\pi \cdot \frac{\Delta t}{T}$$

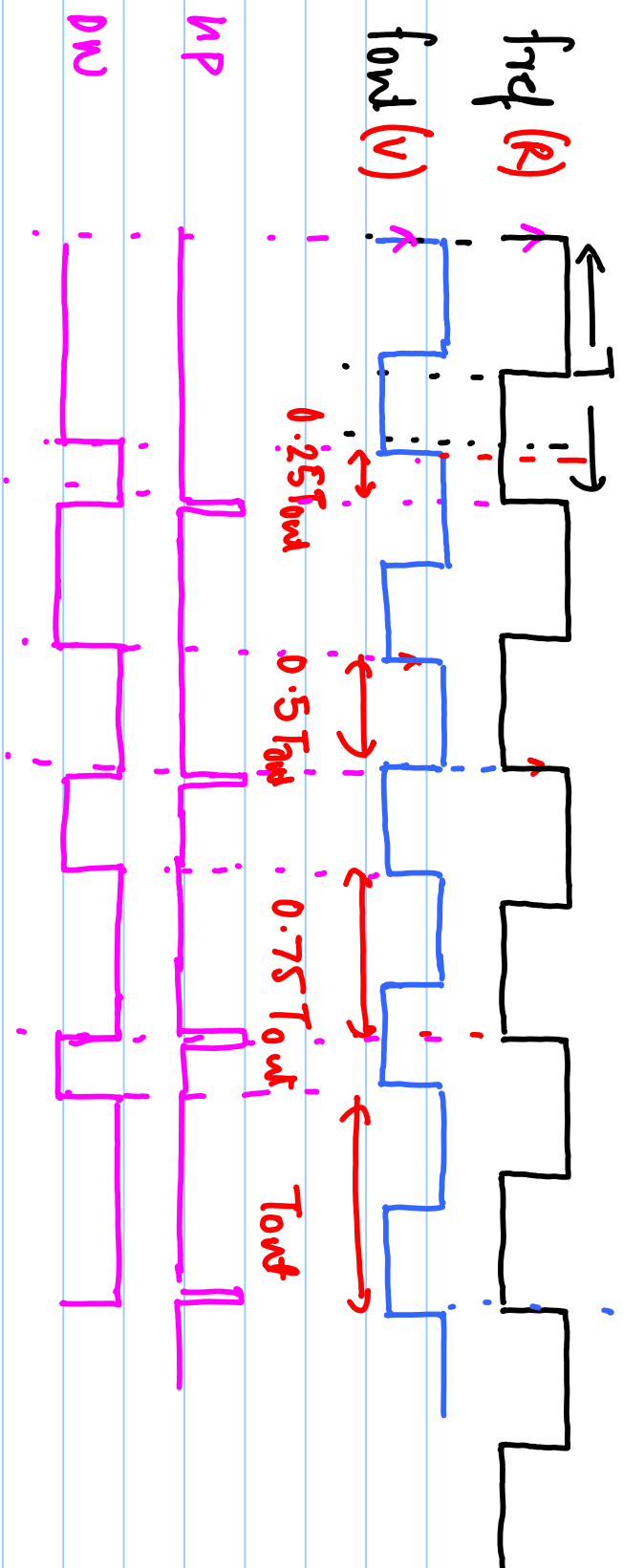
$$\overline{MP-DN} = \frac{\Delta t \times 1 - 0}{T}$$

$$\overline{MP-DN} = \frac{1}{2\pi} \phi_e$$

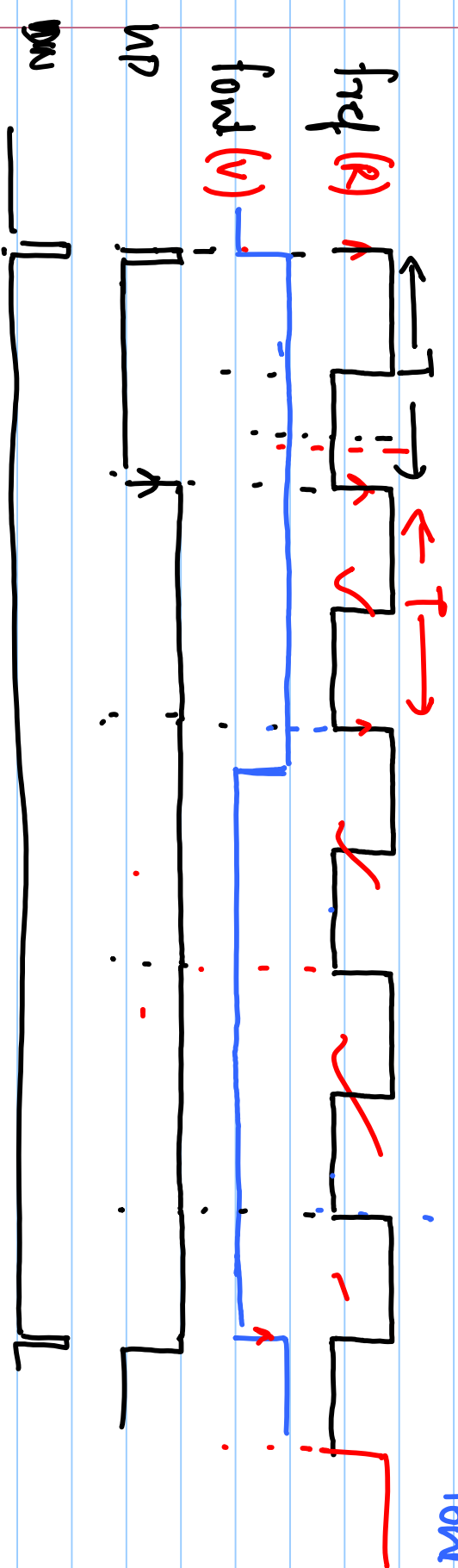
$$\overline{MP-DN} = 0 - \frac{\Delta \phi_2}{T}$$

$$= \frac{1}{2\pi} \left(-2\pi \cdot \frac{\Delta \phi_2}{T} \right)$$





MP-DW



$$T_{\text{MP}} = 4.5 T_{\text{fwd}}$$

$$\frac{\text{MP-DW}}{5 T_{\text{fwd}}} = \frac{1 \times 3.5 T_{\text{fwd}}}{5 T_{\text{fwd}}}$$