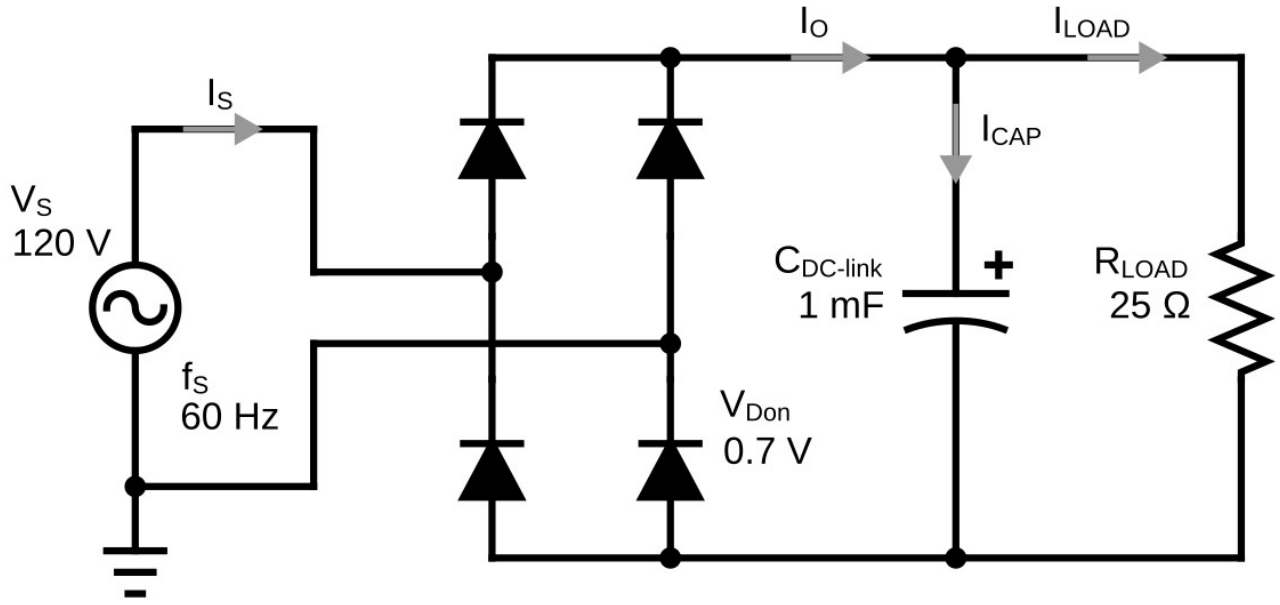
Prelab 1: Calculations Worksheet

ECE 401 *– Power Electronics*



Parameters: V_S = 120V, f_S = 60Hz, C = 1mF, R_{LOAD} = 25Ω, V_{Don} = 0.7V

i. Use the included iteration method template to calculate θ_C, V_R, V_{DC} and I_{DC}.
(Show your work in the space provided).

Step 1: Use these equations to calculate starting values for V_R, V_{DC} and I_{DC}. assume: $\theta_C \approx 0$.			
Assume: $\theta_C \approx 0$ I_{DC} not known $V_{PK} \approx V_{DC}$		$V_m = \sqrt{2} V_s$ $V_{DC} \approx V_m - 2V_{Don}$ $V_{DC} \approx$	$I_{DC} = \frac{V_{DC}}{R_{LOAD}}$ $I_{DC} =$
	$V_R = \frac{I_{DC}}{2 f_S C}$ $V_R =$	$V_{DC} = V_{PK} - \frac{V_R}{2}$ $V_{DC} =$	$I_{DC} = \frac{V_{DC}}{R_{LOAD}}$ $I_{DC} =$

Step 2: Use these equations for an iteration approach to obtain values for θ_C, V_R, V_{DC} and I_{DC}			
$\theta_C = 2 \times \cos^{-1}\left(1 - \frac{V_R}{V_m}\right)$	$V_R = \frac{I_{DC}}{2 f_S C}\left(1 - \frac{\theta_C}{\pi}\right)$	$V_{DC} = V_{PK} - \frac{V_R}{2}$	$I_{DC} = \frac{V_{DC}}{R}$
1st Iteration			
2nd Iteration			
3rd Iteration			
4th Iteration			

ii. Calculate the rms and peak of the output and capacitor currents (I_M, $I_{O,rms}$, I_C, $I_{C,pk}$).
(Show your work in the space provided).

$I_m = \frac{\pi^2}{2\theta_C} I_{DC}$	I_m =
$I_{O,rms} = I_S = I_{DC}\sqrt{\frac{\pi^3}{8\theta_C}}$	$I_{O,rms}$ =
$I_C = I_{DC}\sqrt{\frac{\pi^3}{8\theta_C} - 1}$	I_C =
$I_{C,pk} = I_m - I_{DC}$	$I_{C,p}k$ =

iii. Calculate diode rectifier input power factor (PF).
(Show your work in the space provided).

$P_S = P_{LOAD} + 2 I_{DC} V_{Don}$	P_S =
$S_S = I_S V_S$	S_S =
$PF = \frac{P_S}{S_S}$	PF =

iv. Calculate the following remaining parameters.
(Show your work in the space provided).

$V_{O,RMS}$ =		P_{LOAD} =	
$V_{O,AC}$ =		S =	
$V_{R,RMS}$ =		P_S =	
$I_{O,RMS}$ =		P_F =	
I_S =		$I_{LOAD,DC}$ =	
$I_{O,AC}$ =		$I_{LOAD,AC}$ =	
$I_{C,RMS}$ =			