JOAQUIN SALAS | 73100141

1.

FIND L_m

$$L_m = \frac{N^2}{\left(\frac{l_m}{\mu_0\mu_r A}\right) + \left(\frac{l_g}{\mu_0 A}\right)} = \frac{46^2}{\frac{0.7\times10^{-3}}{(4\pi\times10^{-7})(0.0001)}}$$

$$\underline{L_m = 37.98\ mH}$$

2.

$$C = \frac{D}{R \cdot f \cdot \left(\frac{\Delta V_o}{V_o}\right)}$$

$$100\times10^{-6} = \frac{0.51}{8\cdot(40\times10^3)(x)}$$

$$\frac{\Delta V_o}{V_o} = 0.0159$$

$$\underline{1.60\%}$$

Find D.

$$D = \frac{V_o}{V_o + V_{in}(N_2/N_1)} \qquad D = 0.51$$

$$= \frac{5}{5 + 24\left(\frac{1}{5}\right)} = 0.51$$

3. Find DF

$$DF = \frac{I_1}{I_{rms}}$$

$$I_{rms} = \sqrt{\left(\frac{10.1}{\sqrt{2}}\right)^2 + (7.9/\sqrt{2})^2 + (6.9/\sqrt{2})^2 + \left(\frac{4}{\sqrt{2}}\right)^2}$$

$$I_{rms} = 10.6778$$

$$I_1 = \frac{10.1}{\sqrt{2}} = 7.14$$

$$DF = \frac{7.14}{10.6778} = \underline{0.6686}$$

4.

$$V_d = V_{in}\frac{N_2}{N_1} + V_o$$

$$\rightarrow = 36\left(\frac{1}{2}\right) + 12 = \underline{30}$$

$$\underline{V_d = 30}$$

$$\frac{V_o}{V_{in}} = \frac{D}{1-D}\cdot\frac{N_2}{N_1} \rightarrow V_o = \frac{D}{1-D}\cdot\frac{N_2}{N_1}\cdot V_{in}$$

$$12 = \frac{0.4}{1-0.4}\cdot\left(\frac{1}{2}\right)\cdot 36$$

$$V_{sw} = 36 + 12(2) = \underline{60} \qquad \underline{V_{sw} = 60}$$

5. FIND DF.

JOAQUIN SALAS 731000141

6.

$$PF = \frac{I_1}{I_{RMS}} \cos(\phi_1)$$

$$= \frac{111/\sqrt{2}}{I_{RMS}} \cos(34) = 0.575$$

$$PF = 0.5754$$

7.

$$L_m = \frac{N^2}{\left(\frac{l_m}{\mu_0 \mu_r A}\right) + \left(\frac{l_g}{\mu_0 A}\right)} = \frac{N^2}{\frac{1\times10^{-3}}{(4\pi\times10^{-7})(0.000007)}} = 71\times10^{-6}$$

$$\underline{N = 90}$$

8.

$$B = \frac{\Phi}{A}, \quad \phi = \frac{Ni}{\frac{l_m}{\mu_0 \mu_r A} + \frac{l_g}{\mu_0 A}} = \frac{(234)(2)}{\frac{0.8\times10^{-3}}{(4\pi\times10^{-7})(0.0001)}}$$

$$B = \frac{7.35\times10^{-5}}{0.0001} = \underline{0.735} \qquad \phi = 7.35\times10^{-5}$$

9.

JOAQUIN SALAS 731000141

12. Find L_m for 77% output load

$P_o = 10 \times 0.77 = 7.7W$

$\cancel{L_m =}$

$$P_i = \frac{1}{2} \frac{V_i^2 D^2}{f L_m} = 7.7 = \frac{1}{2} \frac{(10^2)(0.25)^2}{(51000)(x)} = 3.125$$

$$7.7 = \frac{3.125}{(51000)(x)} \cdot 51000$$

$$392700 = \frac{3.125}{x}$$

$$2.546 \times 10^{-6} = \frac{x}{3.125}$$

$$x = 7.96 \times 10^{-6}$$

13.

14. $P = VI_1 \cos(\theta_1)$

$$= \left(\frac{170}{\sqrt{2}}\right)\left(\frac{14.6}{\sqrt{2}}\right) \cos(47) = 846.4$$

15. $$L_m = \frac{N^2}{\frac{l_m}{\mu_0 \mu_r A}} = \frac{214^2}{\frac{0.01}{\mu_0 (9743)(0.0002)}}$$

17.

18. $$C_d = \frac{P_{in}}{V_d^2 \cdot 2\omega \cdot \left(\frac{\Delta V_d}{V_d}\right)} = \frac{37.113}{(120^2) \cdot 2\pi(60)(x)} = 674 \times 10^{-6}$$

$$P_{in} = \frac{V^2}{R} = \frac{\cancel{2003}\ 120^2}{388} = 37.113$$

$$\frac{\Delta V_d}{V_d} = 0.01014$$

1.014

19. FIND V_d

$$V_d = V_{in} \frac{N_2}{N_1} + V_o = 26\left(\frac{1}{5}\right) + 9 = \underline{14.2V}$$

20. FIND THD.

$$THD = \frac{\sqrt{I_3^2 + I_5^2}}{I_1}$$

5. $P = \left(\frac{321}{\sqrt{2}}\right)(1.5)(0.76) = 258$

$\cos(x) = 40$

$PF = DF \cdot DPF$

$0.76 = x\ ($[illegible]$)$

20. $\cos(x) = 45.57$

$PF = \cancel{\frac{I}{I_{RMS}}}\ \cancel{\cos(45.57)}$

$DF = \frac{I_1}{I_{RMS}}$

17.

$i_s = \sqrt{2} I_s \sin \omega t$

13.

Complex Power

$P = \frac{V_pI_p}{2}\cos(\phi)$ $V_{Rms} = V_p/\sqrt{2}$

$I_{Rms} = I_p/\sqrt{2}$

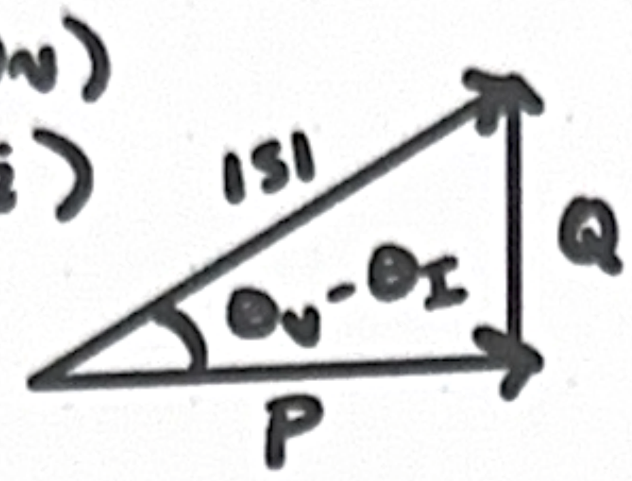
$Q = \frac{V_pI_p}{2}\sin(\phi)$ $\phi = \theta_v - \theta_I$

$v(t) = V_p\cos(\omega t + \theta_v)$

$i(t) = I_p\cos(\omega t + \theta_i)$

$\bar{V} = V_{Rms}\angle\theta_v$

$\bar{I} = I_{Rms}\angle\theta_I$



S: Complex power (VA, KVA, MVA)

|S|: Apparent Power (VA, KVA, MVA) = $V_{Rms}\cdot I_{Rms}$

P: Real Power (W, kW, MW)

Q: Reactive Power (Var, kVar, MVar)

Power Triangle

$S = \bar{V}\bar{I}^* = V_{Rms}I_{Rms}\angle(\theta_v-\theta_I)$

$S = \bar{V}\bar{I}^* = P + jQ$

$P = V_{Rms}I_{Rms}\cos(\phi)$ [By Load]

$Q = V_{Rms}I_{Rms}\sin(\phi)$

Power Factor / Rms

$I = V/Z$ $PF = \cos(\phi)$

$$PF = \frac{\text{Real Power}}{\text{Apparent Power}} = \frac{P}{V_{Rms}\cdot I_{Rms}} = \frac{P}{|S|}$$

$$THD = \frac{\sqrt{I_3^2 + I_5^2}}{I_1} = \frac{\sqrt{I_{Rms}^2 - I_1^2}}{I_1} = \sqrt{\frac{1}{DF^2} - 1}$$

$DF = I_1/I_{Rms}$, $DPF = \cos(\theta_1)$

Given $v(t) = \sqrt{2}V\cdot\cos(\omega t)$ V

$i(t) = \sqrt{2}I_1\cos(\omega t - \theta_1) + \sqrt{2}I_3\cos(\omega t + \theta_3)$

$V_{Rms} = \sqrt{\left(\frac{V_1}{\sqrt{2}}\right) + \left(\frac{V_1}{\sqrt{2}}\right)}$ $I_{Rms} = \sqrt{I_1^2 + I_2^2 + I_3^2}$

$P = VI_1\cos(\theta_1)$, $|S| = V\cdot I_{Rms}$

$PF = \frac{I_1}{I_{Rms}}\cdot\cos(\theta_1)$

Single Phase PF Correction

$$i_c = \frac{E\cdot I_s}{V_d}\cos 2\omega t$$

$$C_d = \frac{P_{in}}{V_d^2\cdot 2\omega\cdot\left(\frac{\Delta V_d}{V_d}\right)}$$

$$E_d = \frac{P_{in}}{4\omega\cdot(\Delta V_d/V_d)}$$

$E_d = (1/2)C_dV_d^2$

$$L = \frac{V_d}{4\cdot f\cdot RF_L\cdot I_s}$$ $RF_L = \Delta I_{L,max}/I_s$

W/ Transistor

$V_d = \sqrt{2}\cdot E\sin\omega t$ $P_{in} = EI_s(1-\cos 2\omega t)$

$i_s = \sqrt{2}I_s\sin\omega t$ $P_{out} = V_d\cdot I_d$

Two-Winding Transformer

$I_m = \frac{V_1}{\omega L_m}$ $L_m = \frac{\mu V_1^2 A_m}{\lambda_m}$

$I_{PEAK} = \sqrt{i_1^2 + I_m^2}$

Magnetic Circuit Concepts

Flux density - $B = \phi/A$ Magnetic field strength - $H = N\cdot i/l$

$\phi = N\cdot i/(l/\mu\cdot A)$ $B = \mu H$ $\mu = \mu_0\mu_r$, $\mu_r = 1$ for Air

$1cm^2 = 0.0001m^2$

With an Air Gap $[\mu_0 = 4\pi\cdot 10^{-7}]$

$$\phi = \frac{Ni}{\frac{l_m}{\mu_0\mu_rA} + \frac{l_g}{\mu_0A}}$$

l_m - core

l_g - gap

flux linkage - $\lambda_m = N\cdot\phi_m = L_m\cdot i$

$L_m = \lambda_m/i = N^2/\left(\frac{l_m}{\mu_0\mu_rA} + \frac{l_g}{\mu_0A}\right)$

$$i = \frac{H_ml_m}{N}$$

Energy Stored in Core - $W_{core} = 1/2\cdot B^2/\mu_0\mu_r$

in Airgap - $W_{airgap} = 1/2\cdot B^2/\mu_0$

Flyback DC-DC Converter

$P_i = \frac{1}{2}\frac{V_i^2D^2}{fL_m}$

$V_{in}\cdot I_{in} = V_o\cdot I_o$

$V_d = V_{in}N_2/N_1 + V_o$ $V_{sw} = V_{in} + V_oN_1/N_2$

$I_{in} = \frac{V_o}{V_{in}}I_o = \frac{D}{1-D}\cdot\frac{N_2}{N_1}I_o$

$\frac{V_o}{V_{in}} = \frac{D}{1-D}\cdot\frac{N_2}{N_1}$ $L_m = \frac{V_{in}\cdot D}{\Delta i_{Lm}\cdot f}$ $C = \frac{D}{R\cdot f\cdot(\Delta V_o/V_o)}$ $D = \frac{V_o}{V_o + V_{in}(N_2/N_1)}$

$I_{Diode} = I_o = V_o/R$

$I_{offset} = \frac{I_o(N_2/N_1)}{1-D}$, $I_{Lm,peak} = I_{offset} + \frac{\Delta I_L}{2}$

$\frac{i_1}{i_2} = \frac{N_2}{N_1}$