Pre-Lab 6

Ian, Lauren, Melissa

My group worked on the pre-lab together. Please see my personal writeup titled `Lab6_report.ipynb`.

In [ ]:
```
# Imports
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import csv

# Imports and setup
from pint import UnitRegistry

# Use pint
units = UnitRegistry()
units.default_format = "~P"

# Define Tesla
ureg = UnitRegistry()
Q_ = ureg.Quantity
ureg.define('Tesla = units.kilogram*units.second**(-2)*units.amp**(-1) = T')
```

In [ ]:
```
# Givens
Vg = 18 * units.volt
Vo = 10 * units.volt
Pout = 20 * units.watt
fs = 50 * units.kilohertz
Ts = 1/fs * units.second
R_load = 5 * units.ohm
D = 0.35
alpha = 0.8

Amin = 59.1 * (units.millimeter**2) # from datasheet
Bmax = 300 * units.milliT # max peak flux density

# Solved values (Ian)
Lm = 16.53 * units.microhenry # Magnetizing Inductance
a = 1.16

# Solve for Pmax
M = Vo/Vg
Ipk = (2/(np.sqrt(alpha)))*(M+1)*(Vo/R_load)
Ipk = Ipk.to(units.amp)
Irms = np.sqrt(D/3)*Ipk

delta_W = (1/2)*Lm*(Ipk**2)
delta_W = delta_W.to(units.microjoule)
```

```python
flux_limit = Bmax * Amin

Pmax = (flux_limit**2)/(2*delta_W)

print("Pmax =", Pmax.to(units.microhenry))
print("Irms =", Irms)
print("Ipk =", Ipk)
```

```
Pmax = 0.3929556789140338 μH
Irms = 2.3761503603474727 A
Ipk = 6.9566559299993465 A
```

In [ ]:
```python
# Solve for N1 minimum
N1_min = np.sqrt(Lm/Pmax)
print("Minimum N1=", N1_min.to_base_units(), "(Can't be fractional)\n")

# N1 and Pm
N1 = 8
print(f"N1 = {N1}")
Pm = Lm / (N1 ** 2)
print("Magnetizing Permeance =",Pm)

# Solve for Pmin
D2 = 18.0 * units.millimeter
D3 = 8.8 * units.millimeter
H2 = 14.3 * units.millimeter
Aw = (D2 - D3) * H2 / 2
Jmax = Bmax / Amin
Fmax = Jmax * Aw * 0.8
# Pmin = (2*delta_W)/(Fmax**2)
# print("Minimum Permeance",Pmin.to(units.microhenry))
# print("Fmax",Fmax)
```

```
Minimum N1= 6.485816273146599 (Can't be fractional)

N1 = 8
Magnetizing Permeance = 0.25828125 μH
```

In [ ]:
```python
# Find air gap length
Ae = 75.7013290956038 * (units.millimeter**2)
# 4π x 10-7 N/A2
air_permeability = 4*np.pi*1e-7 * (units.newton/(units.amp**2))
gap_length = (air_permeability * Ae) / Pm
print("Pm =", Pm.to_base_units())
print("Ae =", Ae.to_base_units())
print("Air Permeability =", air_permeability.to_base_units())
print("Gap length =", gap_length.to(units.milliinch))
```

```
Pm = 2.5828125×10⁻⁷ kg·m²/A²/s²
Ae = 7.57013290956038×10⁻⁵ m²
Air Permeability = 1.2566370614359173×10⁻⁶ kg·m/A²/s²
Gap length = 14.500626699857435 min
```

In [ ]:
```python
# Using a, find N2

N2 = a*N1
```

```
print(f"N1 = {N1}")
print(f"N2 = {N2}")
print(f"a = ", a)
```

```
N1 = 8
N2 = 9.28
a =  1.16
```