EE255: ELECTRICAL POWER

TRANSFORMER DESIGN

GROUP EE.21.B.23

PRE-LAB

VA Rating = 7

Primary voltage = 110 V

Secondary voltage = 20V

Data:

core size:

T = 25 mm

S = 26 mm

H = 38 mm

L = 12 mm

① Calculate the number of turns required for the primary.

for a sine wave supply,

$$E = 4.44 \phi_m . N . f$$

$$E = 4.44 \times B_m . A . N . f . S_f$$

$$E = 4.44 \times 1 \times (T \times S \times 10^{-6}) \times N \times 50 \times 0.9$$

$$(N/E) = 5005/(T \times S)$$

for an ideal transformer, $E = V$

$$N_p/V = 5005/(T \times S)$$

$$(N_p/120) = 5005/(T \times S)$$

$$N_p = 924$$

② Calculate the number of turns required for the secondary.

$(N/V) = 5005/(T \times S)$

$N_S/20 = 5005/(T \times S)$

$N_S = 154$

③ Calculate $I_{load,primary}$, $I_{load,secondary}$, I_m and total primary current.

$I_{load,primary} = VA/V_{primary}$

$= 7/120$

$= 58.33mA$

$I_{load,secondary} = VA/V_{secondary}$

$= 7/20$

$= 0.35A$

$I_m = I_{load,primary} \times 0.3$

$= 17.499mA$

Total primary current $= \sqrt{I^2_{load,primary} + I^2_m}$

$= \sqrt{58.33^2 + 17.499^2}$

$= 60.90mA$

④ Select suitable coils for primary and secondary windings using table in Appendix.

Wire Gauge for primary = 36

Wire Gauge for Secondary = 26

⑤ Calculate the total available window area consumed by the coils.

Available window area = H X L − area loss when bobbin inserted.

$= H \times L - 1.5 \times 2 \times L - 1.5 \times (H - 1.5 - 1.5)$

$= 38 \times 12 - 1.5 \times 2 \times 12 - 1.5 \times (38 - 1.5 - 1.5)$

$= \underline{\underline{367.5 \text{ mm}^2}}$

Ratio of effective copper area $= \frac{(\pi \times d^2/4)}{d^2} = 0.78$

Total area consumed by the coils $= \frac{(N_p \times A_p + N_s \times A_s)}{0.78}$

$= \frac{(924 \times 0.024 + 154 \times 0.38)}{0.78} \text{ mm}^2$

$= \underline{\underline{103.46 \text{ mm}^2}}$

$103.46 \text{ mm}^2 < 367.5 \text{ mm}^2$

Area consumed by coils < Available window Area

∴ windings can be accommodate with the window area available