Name: Date:

Lab Section:

# ECE 431 Electric Machinery
## Spring 2020

Pre-lab assignment #2

Due at the beginning of your lab session – no late Pre-lab assignments accepted.

1. List the tests that you will perform in experiment 2.

(1 pt) Polarity, coil turns, DC resistance, open circuit, short circuit, load test, saturation

2. Figure 2.4 in the lab manual shows the setup for measuring saturation in a transformer. Assuming full 120 Volts (at 60 Hz) is applied (this is $v$), compute the exact current (RMS magnitude) through the capacitor and compare it to the approximation $i_c \approx v/R$. Explain why this approximation is needed to form a B vs. H curve. (Hint: $v = d\lambda/dt$, $i_c = Cdv_c/dt$, and B vs. H is proportional to $\lambda$ vs. $i$.)

(5 pt)

For primary coil: $[\lambda = N\Phi]$

$$V = \frac{d(\Phi \cdot N)}{dt} = \frac{d(NBA)}{dt}$$

$$B = \frac{1}{NA}\int V\,dt \quad -(1)$$

$$i_c = C\frac{dv_c}{dt} \approx \frac{V}{R} \quad -(2)$$

$$120 = (1000 + \tfrac{1}{j\omega C})I_c$$
$$= (1000 - j\,55.26)I$$
$$\therefore |I_c| = 0.1198\ A$$

Approximation. $\Rightarrow i_c = \frac{120}{R} = 0.12\ A$

(1) & (2) gives: $B \approx \frac{RC}{NA} \cdot v_c$ — $v_c$ is a measure for B

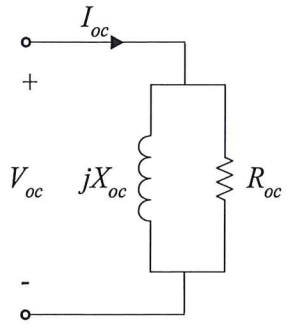
For the mag. circuit;

$$\oint \bar{H}\cdot d\bar{l} = NI$$
$$Hl = Ni$$

$i$ is a measure for H.

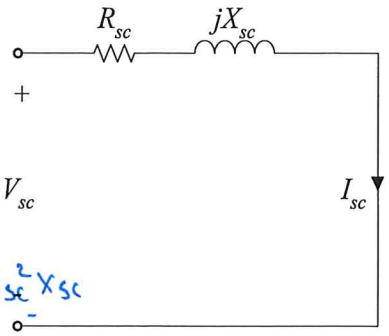
$\therefore v_c, i$ can be used to form B-H loop.

(4 pt) 3. Given:




$|V_{oc}| = 120$ V
$|I_{oc}| = 1.00$ A
$P_{oc} = 40$ W

$$P_{oc} = \frac{V_{oc}^2}{R_{oc}}$$
$$R_{oc} = 120^2/40 = 360\ \Omega$$
$$Q_{oc} = \sqrt{S_{oc}^2 - P_{oc}^2} = \frac{V_{oc}^2}{X_{oc}}$$
$$X_{oc} = \frac{120^2}{\sqrt{120^2 - 40^2}} = 127.3\ \Omega$$




$|V_{sc}| = 30$ V
$|I_{sc}| = 5.0$ A
$P_{sc} = 75$ W

$$P_{sc} = I_{sc}^2 R_{sc}$$
$$R_{sc} = 75/5^2 = 3\ \Omega$$
$$Q_{sc} = \sqrt{S_{sc}^2 - P_{sc}^2} = I_{sc}^2 X_{sc}$$
$$X_{sc} = \frac{\sqrt{150^2 - 75^2}}{5^2} = 5.2\ \Omega$$

Find: $X_{oc}$, $R_{oc}$, $X_{sc}$, $R_{sc}$.

$X_{oc} = 127.3\ \Omega$ $\quad$ $X_{sc} = 5.2\ \Omega$

$R_{oc} = 360\ \Omega$ $\quad$ $R_{sc} = 3\ \Omega$