ELEC 344

Pre-Lab for Experiment: #4 Section: L1E Bench #: 6	
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1 - Winding Resistance Test

$Measure: V_{DC}$ and I_{DC}	$R_1 = \frac{V_{DC}}{2I_{DC}}$

2 - No Load Test

$Measure: V_{l-l,NL}, I_{NL}$ and P_{NL}	$P_{loss} = P_{NL} - R_1(I_{NL})^2$ $V_1 = \frac{V_{l-l,NL}}{\sqrt{3}}$ $Q_{NL} = \sqrt{(3I_{NL}V_1)^2 - (P_{NL})^2}$ $X_1 + X_m = X_{NL} = \frac{Q_{NL}}{3(I_{NL})^2}$

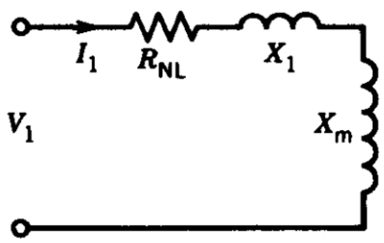

Figure 1. Equivalent circuit diagram for a no load test

3 - Blocked Rotor Test

$Measure: V_{l-l,BR}, I_{BR}$ and P_{BR}	$R_1 + R_2' = R_{BR} = \frac{P_{BR}}{3(I_{BR})^2}$ $V_1 = \frac{V_{l-l,BR}}{\sqrt{3}}$ $X_{BR} = \sqrt{(\frac{V_1}{I_{BR}})^2 - (R_{BR})^2}$	$X_1 \approx X_2' = \frac{X_{BR}}{2}$ $X_m = X_{NL} - X_1$ $R_2' = R_{BR} - R_1$

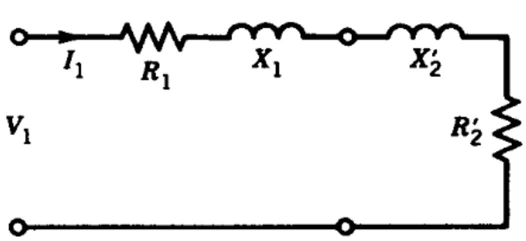

Figure 2. Equivalent circuit diagram for a blocked rotor test

4 - Torque Speed Characteristic

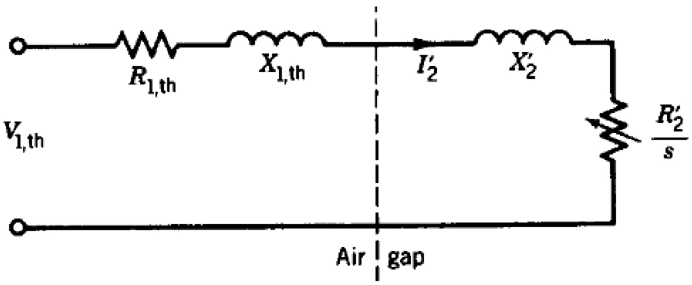

Figure 3. Thevenin equivalent circuit diagram

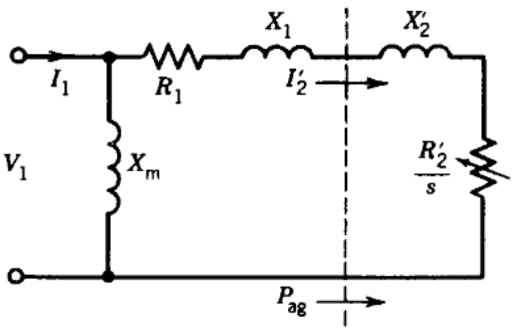

Figure 4. Approximate equivalent circuit diagram

$Thevenin:$	$\tau_e = (\frac{3 \cdot P \cdot (V_{1,th})^2}{2 \cdot \omega_e})(\frac{R_2'/S}{(R_{1,th}+R_2'/S)^2+(X_{1,th}+X_2')^2})$ $where\ \omega_e = 2\pi(60)$
$Approximate:$	$\tau_e = (\frac{3 \cdot P \cdot (V_1)^2}{2 \cdot \omega_e})(\frac{R_2'/S}{(R_1+R_2'/S)^2+(X_1+X_2')^2})$ $where\ \omega_e = 2\pi(60)$

5 - Torque Speed Characteristic

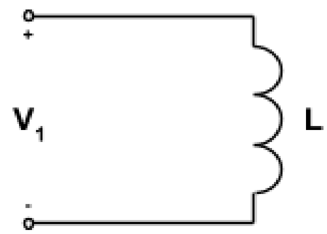

Figure 5. Single inductor circuit

$V_1 = L\frac{di}{dt}$

$V_1 = \sqrt{2}V_{rms}cos(\omega t)$

$\sqrt{2}V_{rms}\int cos(\omega t)dt = L\int \frac{di}{dt}dt$

$\frac{\sqrt{2}V_{rms}}{\omega}sin(\omega t) + C_1 = Li + C_2\ assume\ C_1 = C_2 = 0$

$\frac{\sqrt{2}V_{rms}}{\omega}sin(\omega t) = Li$

$L = \frac{N\Phi}{i}$

$\frac{\sqrt{2}V_{rms}}{\omega}sin(\omega t) = i\frac{N\Phi}{i} = N\Phi$

$\Phi = \frac{\sqrt{2}V_{rms}}{N\omega}sin(\omega t) = \frac{\sqrt{2}V_{rms}}{2\pi Nf}sin(\omega t)$

As can be seen from the derivation above the flux through an inductive element is proportional to the voltage applied to it and inversely proportional to the frequency. As such to maintain a constant flux voltage and frequency should be adjusted together. As such if the voltage is increased, the frequency should also be increased.