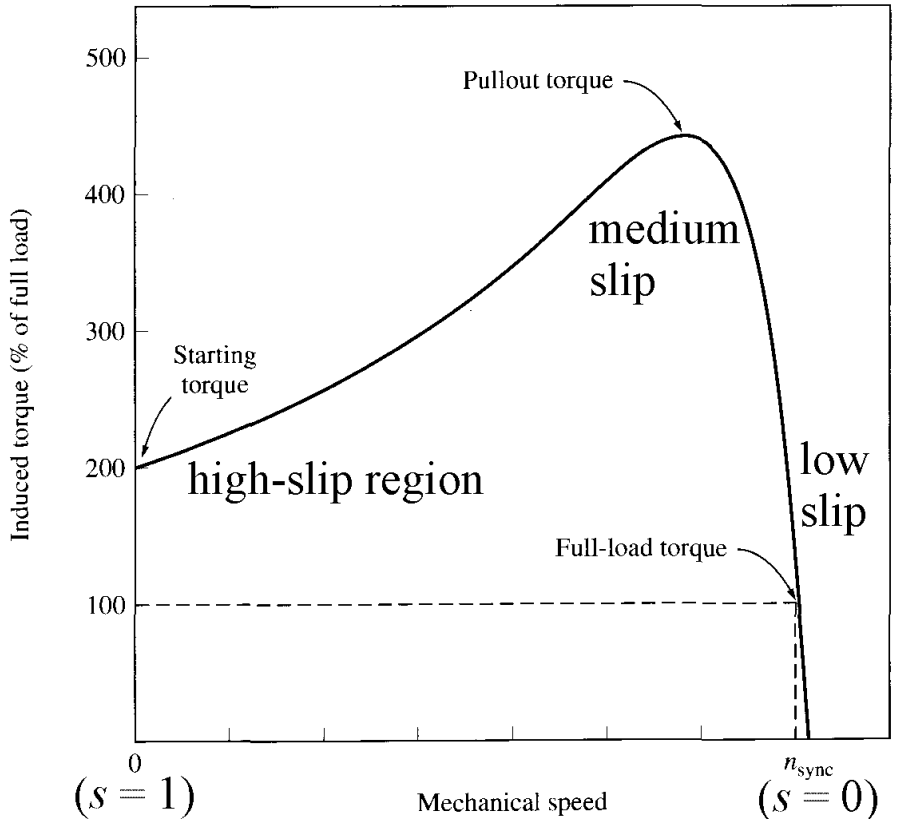
Based on $\tau_{ind} = \dfrac{3V_{TH}^2 (R_2 / s)}{\omega_{sync} \left[(R_{TH} + R_2 / s)^2 + (X_{TH} + X_2)^2 \right]}$ (7-48),

a typical induction motor torque-speed curve is shown below.

Figure 7–17 | A typical induction motor torque–speed characteristic curve.



Comments:

- As expected when $s = 0$, $\tau_{ind} = 0$.
- Torque-speed curve is nearly linear at low slip where $R_2/s >> X_2$.
- The maximum induced torque (AKA: pullout or breakdown torque) is usuall 2 to 3 times larger than the rated full-load torque.
- The starting torque is larger than the rated full-load torque. [It needs to be or else motor wouldn't start turning with a full-load.]
- Torque $\propto V_{TH}^2 \propto V_\phi^2$.
- $P_{conv} = \tau_{ind}\, \omega_m = \tau_{ind}\, n_m\, (\pi/30)$ will have a slightly different looking curve. It starts at 0 @ $n_m = 0$ and finishes at 0 @ $n_m = n_{synch}$. However, the peak occurs at a different speed n_m than τ_{max}.

What happens if the motor is turned faster than n_{sync}?

$\Rightarrow \tau_{ind} < 0$, i.e., the induced torque reverves, and it becomes a generator (generator region shown below in Figure 7-18).

What happens if the motor is turning backward relative to rotating magnetic fields (i.e., we swap two power phases and reverse magnetic field rotation direction, called *plugging*)?

$\Rightarrow \tau_{ind}$ will slow the motor $\Rightarrow$ braking region shown below in Figure 7-18.

Figure 7–18 | Induction motor torque–speed characteristic curve, showing the extended operating ranges (braking region and generator region).

