Solution key

BIRZEIT UNIVERSITY
Electrical and Computer Engineering Department
## Electrical Machines ENEE 2408
Short Exam # 4 (10mins)

Student Name: ID: December 18, 2024

A three-phase 50-Hz induction motor runs at 740 r/min at no load and at 720 r/min at full load.

(a) sketch the torque-speed curve

(b) Calculate how many poles does this motor have?

(c) What is the slip at rated (full) load torque?

(d) What is the rotor speed at 1.5 times the rated load torque in rpm? Assume that, 1.5 times the rated load is less than the pullout torque

(e) What is the rotor's electrical frequency at 1.5 times the rated load torque?

(a)
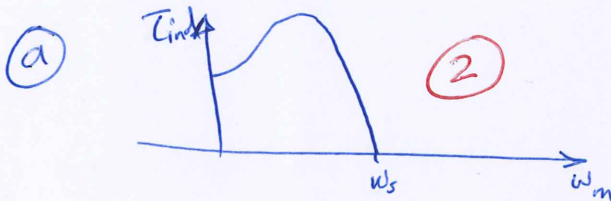
b) $n = \dfrac{120f}{P} \Rightarrow P \triangleq \dfrac{120f}{n_{nl}} \cong \dfrac{120(50)}{740} \approx 8.11$

∴ $\boxed{\text{# of poles} = 8}$ ② Choose the nearest smallest #.

c) $s = \dfrac{n_s - n_{fl}}{n_s} \times 100\%$

$n_s = \dfrac{120(50)}{8} = 750 \text{ rpm}$ ①

$S = \dfrac{750 - 720}{750} \times 100\% \Rightarrow \boxed{S = 4\%}$ ①

(d) Calculate s_2, at $1.5\,T_{fl}$

$\dfrac{1.5 T_{fl}}{T_{fl}} = \dfrac{s_2}{0.04}$

$s_2 = 1.5(0.04) = \boxed{0.06 = s_2}$ ①

$n_{m_2} = (1 - s_2)n_s = (1 - 0.06)(750) = \boxed{1410 \text{ rpm} = n_{m_2}}$ ①

(e) $f_{r_2} = s_2 f_e = 0.06(50) = \boxed{3 \text{ Hz} = f_r}$ ②