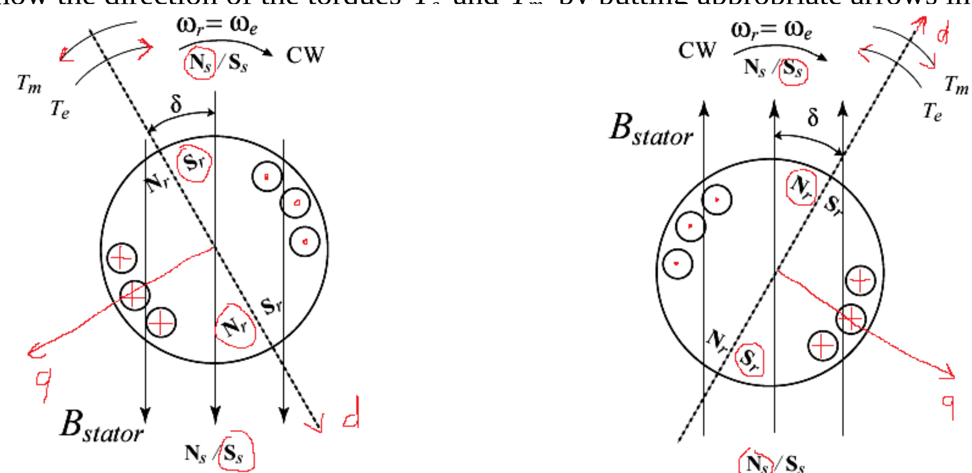
ELEC 342: Quiz 4 April 2, 2026

Name: Solution Student ID: ____________________

Close notes and books. You have 25 minutes to answer the following questions:

Q1 (50pts): Assume a round-rotor **Synchronous Machine** with the stator magnetic field B_{stator} rotating in a **C**lock**W**ise direction as shown in the figures below. The rotor angle is small (about 30 deg.). For each figure:

(a) (10pts) Show / label the rotor direct magnetic ***d***-axis and the quadrature ***q***-axis.
(b) (10pts) Show the current direction in the field winding using "dot" and "+" in each conductor
(c) (10pts) Show the stator and rotor magnetic poles (circle the appropriate **N** and **S**)
(d) (10pts) Identify the mode (circle ***Motoring*** or ***Generating***) and the sign of rotor angle (circle $\delta < 0$ or $\delta > 0$)
(e) (10pts) Show the direction of the torques T_e and T_m by putting appropriate arrows in CW or CCW direction



Motoring / Generating — *Motoring / Generating*

Rotor is leading, $(\delta > 0)$ — *Rotor is leading,* $(\delta > 0)$

Rotor is lagging, $(\delta < 0)$ — *Rotor is lagging,* $(\delta < 0)$

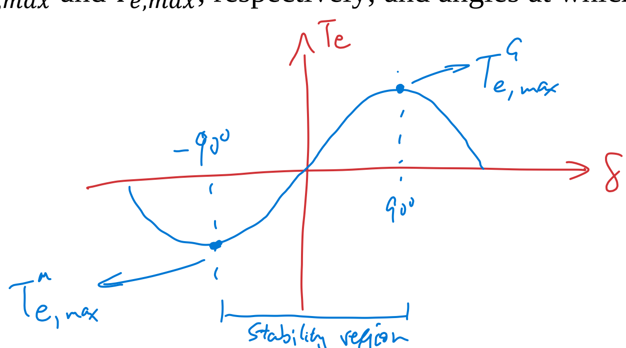
Q2 (30pts): Assume a 3-phase **Synchronous Machine** is supplied with standard 60Hz AC currents. **Circle one number *or* comment:**

a) What would be the most likely **nominal Generator** speed in **rpm** if the machine had **2** poles?
3750 **3600** 3450 1850 1800 1750 1250 1200 1150 935 900 850 750 720 680

b) What would be the most likely **nominal Motor** speed in **rpm** if the machine had **3** poles?
3750 3600 3450 1850 1800 1750 1250 1200 1150 935 900 850 750 720 680
Not possible!

c) What would be the most likely **nominal Motor** speed in **rpm** if the machine had **4** poles?
3750 3600 3450 1850 **1800** 1750 1250 1200 1150 935 900 850 750 720 680

Q3 (10pts): Sketch the **torque-angle (T_e-δ) curve** for a 2-pole Synchronous Machine. Show max motoring and generating torques, $T^M_{e,max}$ and $T^G_{e,max}$, respectively, and angles at which they occur. Also, indicate the stable region of operation.



Q4 (10pts): (a) What variable enables reactive power control in a Synchronous Machine? (b)Why is reactive power not independently controllable in an Induction Machine?

Field excitation (E_f, I_f) enables reactive power control in SM. *Optional: Over-excited – supplies reactive power, under-excited – absorbs reactive power.* In IM, there is no independent field excitation source since rotor currents are induced, so IM does not have reactive power control.