Q1 (40pts): Assume a conventional squirrel-cage 2-pole Induction Machine with rotating magnetic field $B_{stator}$ that rotates in the counterclockwise (CCW) with the speed $\omega_e$ as shown. The rotor bars (rotor winding conductors) shown as small circles. An external mechanical torque $T_m$ is applied to the shaft in such a way that rotor bars move counterclockwise (CCW) relative to the stator rotating field. On this figure:
(a) (10pts) Label and/or show the magnetic poles on the stator $N_s$ and $S_s$, respectively
(b) (10pts) Show the current direction in the rotor bars using “dot” and “+” in each conductor
(c) (10pts) Label and/or show the magnetic poles on the rotor $N_r$ and $S_r$, respectively
(d) (10pts) Show the direction of torques $T_m$ and $T_e$ (draw an arrow in CW or CCW) and identify the mode (circle Motoring or Generating)

Q2 (30pts): A conventional Squirrel-Cage Induction Machine is supplied from a 60 Hz AC source. Circle one number or comment:

a) What would be the most likely nominal motor speed in rpm if the machine has 6 (six) poles?
3750 3600 3450 1850 1800 1750 1250 1200 1150 935 900 850 750 720 680

b) What would be the most likely nominal generator speed in rpm if the machine has 4 (four) poles?
3750 3600 3450 1850 1800 1750 1250 1200 1150 935 900 850 750 720 680

c) What would be the most likely nominal generator speed in rpm if the machine has 8 (eight) poles?
3750 3600 3450 1850 1800 1750 1250 1200 1150 935 900 850 750 720 680

Q3 (20pts): Sketch the torque-speed characteristic ($T_e$ vs. $n$) of a squirrel-cage induction machine and show or label: motoring and generating regions (M and G); maximum motoring torque $T_{max}^M$ and maximum generating torque $T_{max}^G$, a typical operating motoring torque $T_{eT}^M$ and a starting motoring torque $T_{Start}^M$; On the same characteristic, also label the points of slip, $S = 0$ and $S = 1$.

Q4 (10pts): What was your favorite ELEC class and topic for this semester? Briefly state why.