17/ENG04/006
ELECT/ELECT
300L.

3 Speed of the Motor

$N_s = \frac{120f}{P}$

$N_s = \frac{120 \times 50}{}$

3 $\frac{120 \times 50}{4} = 1500$

$Slip = N_s - N_r$

2 ② No of Poles = 6

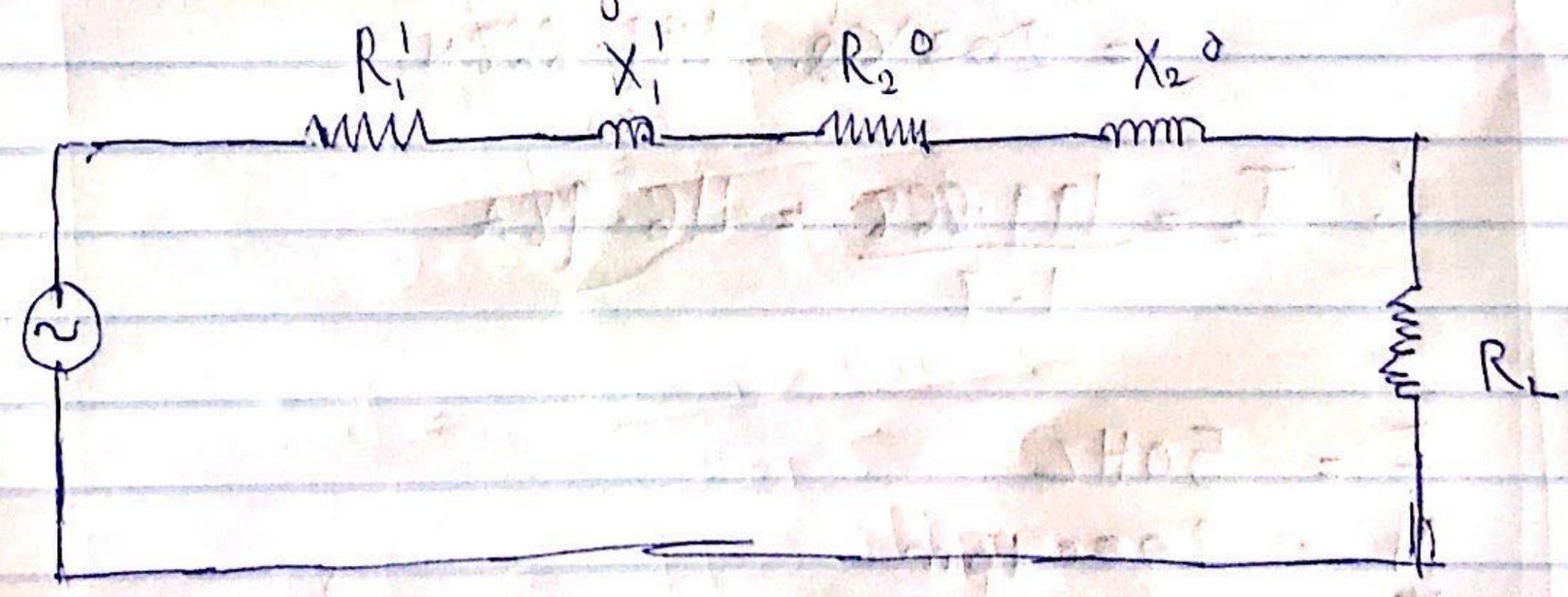
$F = 50Hz$

$V_{ln} = 415V$

$K = \frac{5}{6} = 0.833$

$Z_1 = 0.25 + j0.75$ —— Stator

$Z_2 = 1.175 + j0.52$ —— Rotor



Supply Voltage per phase $V = \frac{415}{\sqrt{3}} = 239.60V$

Referring to the rotor

$R_{o2} = (R_2 + K^2 R_1)$

$= (1.173 + (0.83)^2 \times 0.25)$

$R_{o2} = (1.173 + (0.6889 \times 0.25)$

$R_{o2} = (1.173 + 0.172)$

$R_{o2} = 1.347\Omega$

$X_{o_2} = (X_2 + k^2 X_1)$

$= j(0.52 + (0.83)^2 \times 0.75)$

$= j(0.52 + 0.6889 \times 0.75)$

$= 1.036$

$Z_{o_2} = R_{o_2} + X_{o_2}$

$= 1.347 + j1.036$

$Z_{o_2} = \sqrt{1.347^2 + 1.036^2}$

$Z_{o_2} = \sqrt{1.814 + 1.073}$

$Z_{o_2} = \sqrt{2.887}$

$Z_{o_2} = 1.699\,\Omega$

$Z_{o_2} = 1.7\,\Omega$

To find Rotor Current

$I_2 = \frac{E_2}{Z_{o_2}}$

Recall that $E_2 = kV_1$

$= 239.6 \times 0.83$

$= \cancel{203.66}\ 199.868\,V$

$\therefore I_2 = \frac{199.868}{1.7} = 116.98\,A$

3 $F = 50\,Hz$

$N = 2000\,rpm$

$I = 0.7\,A$

$R = 15\,\Omega$

$L = 0.25\,H$

$E_b = V - IR$

$= 220 - (0.7 \times 13)$

$= 220 - 10.5$

$= 209.5\,V$

$E_{al} = \sqrt{V^2 - (IX_L)^2} - IR$

$IX_L = 0.7 \times 2 \times \frac{22}{7} \times 50 \times 0.25$

$IX_L = \frac{0.7 \times 44 \times 50 \times 0.25}{7}$

$IX_L = 44 \times 5 \times 0.25$

$IX_L = 55V$

$IR = 0.7 \times 15$

$IR = 10.5V$

$\therefore E_{al} = \sqrt{220^2 - 54.98^2} - 10.5$

$E_{al} = \sqrt{48400 - 3022.8} - 10.5$

$E_{al} = \sqrt{45377.2}$

$E_{al} = 213.01 - 10.5$

$E_{al} = 202.51V$

i Speed of the Motor

$\frac{N_{al}}{N_{dc}} = \frac{E_{al}}{E_{dc}}$

$\frac{N_{al}}{2000} = \frac{202.52}{209.5}$

$N_{al} = \frac{2000 \times 202.52}{209.5}$

$\therefore N_{al} = 1933.37 rpm.$

ii Power factor.

$P_f = \frac{E + IR}{V} = \frac{202.51 + 10.5}{220}$

$P_f = \frac{213.01}{220}$

$P_f = 0.968 \simeq 0.97$

iii Torque Developed $= T = \frac{E_b}{2\pi N/60}$

$$\frac{202.52 \times 0.7}{2\pi \times 1933.37/60}$$

$$\frac{202.52 \times 0.7}{2 \times \frac{22}{7} \times 1933.37 \times \frac{1}{60}}$$

Denominator 60

$$\frac{\cancel{44} \times 1933.37}{7 \times \cancel{60}\ 15}$$

$$= \frac{21267.07}{105} = 202.544$$

Inserting the denominator

$$\frac{202.52 \times 0.7}{202.544}$$

$0.999 \times 0.7 = 0.6993\ \Omega$ $0.7\,Nm$