Note, to save the writing, all the marker “ ‘ ” on rotor side variables are saved. For example, rotor q-axis damping winding current i'_{kq} is replaced by symbol i_{kq}.

No .2

In steady state, in qd (or dq) reference frame, all the stator and rotor side currents are constants. Therefore all the stator and rotor side flux linkages are also constants. Differentiation of the flux linkage will be zero. The equation can then be greatly simplified.

For the damping winding, e.g.

$V_{kd} = R_{kd} i_{kd} + \frac{d\lambda_{kd}}{dt} = R_{kd} i_{kd}$ (in steady state)

Because the damping winding is short-circuited, $V_{kd} = 0$, therefore, $i_{kd} = 0$.

Similarly, $i_{kq} = 0$

Therefore, the motor equation becomes:

$V_d = R_s i_d - \omega_r \lambda_q$ $\quad\quad$ $\lambda_d = L_{ls} + L_{md}(i_d + i_{fd}) = L_d i_d + L_{md} i_{fd}$

$V_q = R_s i_q + \omega_r \lambda_d$ $\quad\quad$ $\lambda_q = L_{ls} + L_{mq} i_q = L_q i_q$

$V_{fd} = R_{fd} i_{fd}$

When the stator windings are open-circuited, $i_d = i_q = 0$, therefore

$V_d = -\omega_r \lambda_q = 0$ $\quad\quad$ $\lambda_d = L_{md} i_{fd}$

$V_q = \omega_r \lambda_d$ $\quad\quad$ $\lambda_q = 0$

At the rated speed, when stator windings are open-circuited, the rated rotor field winding current will produce the rated phase terminal voltage. So,

$V_q = \sqrt{2} V_{rat} = \omega_{r,rat} L_{md} i_{fd}$

The needed field current can then be found as:

$$i_{fd} = \frac{\sqrt{2} V_{rat}}{\omega_{r,rat} L_{md}} \quad\quad (1)$$

Where $\omega_{r,rat}$ should be the rated rotor electrical speed.

No .3

In case of No. 2, what are the stator d,q-axes flux linkage values?

Knowing the currents, as $i_d = i_q = 0,\ i_{kd} = i_{kq} = 0$, i_{fd} is determined by (1), which is a DC current, then substituting the currents into the flux linkage equations, the corresponding flux linkage values can be found. For example,

$\lambda_d = L_{md} i_{fd}$

$\lambda_q = 0$

$\lambda_{fd} = L_{fd} i_{fd}$