(3)

Power: $\bar{f}_{\alpha\beta} = \bar{f}_{dq} \cdot e^{j\theta}$ and $\bar{f}^*_{\alpha\beta} = \bar{f}^*_{dq} \cdot e^{-j\theta}$

$$P = V_a i_a + V_b i_b + V_c i_c$$

$$= \frac{3}{2}\left(V_d i_d + V_q i_q + \cancel{V_0 i_0}^{\,=0}\right)$$

Balanced system, since same RL parameters → hence $V_0 = 0$, $i_0 = 0$

$$= \frac{3}{2} Re\left[(V_d + jV_q)(i_d + j i_q)^*\right]$$

$$= \frac{3}{2} Re\left[(V_d + jV_q)(i_d - j i_q)\right]$$

$$= \frac{3}{2} Re\left[(V_d + jV_q)\cdot e^{j\theta} \cdot (i_d - j i_q) e^{-j\theta}\right]$$

$$= \frac{3}{2} Re\left[\underbrace{\bar{V}_{dq} \cdot e^{j\theta}}_{\bar{V}_{\alpha\beta}} \cdot \underbrace{\bar{I}^*_{dq} \cdot e^{-j\theta}}_{\bar{I}^*_{\alpha\beta}}\right]$$

$$= \frac{3}{2} Re\left[(V_\alpha + jV_\beta)\cdot(i_\alpha - j i_\beta)\right]$$

$$= \frac{3}{2} Re\left[V_\alpha i_\alpha + V_\beta i_\beta + j(V_\beta i_\alpha - V_\alpha i_\beta)\right]$$

$$= \frac{3}{2}\left(V_\alpha i_\alpha + V_\beta i_\beta\right)$$

Problem 2

1) By vector projection of the L_q and L_d values on the ~~coord~~ respective stator axes → ~~of~~ equation

2) $$M_{bscs} = L_{aad} \cdot Re\left(\frac{e^{j\theta}}{e^{j120°}}\right) Re\left(\frac{e^{j\theta}}{e^{j-120°}}\right)$$

$$+ L_{aaq} \cdot Re\left(\frac{e^{j(\theta+90°)}}{e^{j120°}}\right) Re\left(\frac{e^{j(\theta+90°)}}{e^{j-120°}}\right)$$

$$= L_{aad} \cos(\theta - 120°)\cos(\theta + 120°)$$

$$+ L_{aaq} \sin(\theta - 120°)\sin(\theta + 120°)$$

with $L_{aad} = L_1 + L_2$, $L_{aaq} = L_1 - L_2$

$$= L_1\left(\cos(\theta - 120°)\cos(\theta + 120°) + \sin(\theta - 120°)\sin(\theta + 120°)\right)$$

$$+ L_2\left(\cos(\theta - 120°)\cos(\theta + 120°) - \sin(\theta - 120°)\sin(\theta + 120°)\right)$$

$$= L_1 \cdot \cos(\theta - 120° - (\theta + 120°)) + L_2 \cos(\theta - 120° + \theta + 120°$$