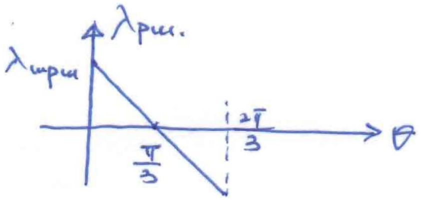
For the angle range of: $30^\circ \sim 150^\circ$ (as an example)



$$\lambda_{pm} = \lambda_{mpm} \cdot \left[1 - \frac{\theta}{\pi/3}\right] \Rightarrow \frac{d\lambda_{pm}}{dt} = \frac{d\lambda_{pm}}{d\theta}\frac{d\theta}{dt} = -\frac{3}{\pi}\lambda_{mpm} \cdot \omega$$

$$V = Ri + \frac{d\lambda}{dt}$$

Because: $\lambda = \lambda_{pm} + \lambda_a = \lambda_{mpm}\left[1 - \frac{\theta}{\pi/3}\right] + L_a i$

so: $$V = Ri + L_a \frac{di}{dt} + \frac{d\lambda_{pm}}{dt}$$

$$= Ri + L_a \frac{di}{dt} + \left(-\frac{3}{\pi} \cdot \lambda_{mpm}\right) \cdot \omega, \quad \text{where } \omega = \frac{d\theta}{dt}$$

input power

Power: $$Vi = P_{in} = Ri^2 + L_a \cdot i \cdot \frac{di}{dt} + i\frac{d\lambda_{pm}}{dt}$$

mechanical power

$$P_{mec} = i \cdot \frac{d\lambda_{pm}}{dt} = i \cdot \left(-\frac{3}{\pi} \cdot \lambda_{mpm}\right) \cdot \omega \cdot \quad \text{------ (1)}$$

Torque: $$\tau = \frac{P_{mec}}{\Omega} = \frac{\omega}{\Omega} \cdot i\left(-\frac{3}{\pi}\lambda_{mpm}\right) = p \cdot i \cdot \left(-\frac{3}{\pi}\right) \cdot \lambda_{mpm}.$$

Ω: mechanical speed

p: Number of pole pairs.

Therefore: i should be a negative, constant value, the instantaneous torque will be constant and greater than 0.
(This is for the angle range $30^\circ \sim 150^\circ$).

For other angle ranges: * when the PM flux linkage is constant, according to (1), the ~~to~~ output power will be zero, independent of the current, so the current should also be zero to save the loss.
* when the PM flux linkage is not constant, similar analysis as above may be carried out.