4.2 Output equation of Induction motor

Output equation is the mathematical expression which gives the relation between the various physical and electrical parameters of the electrical machine.

In an induction motor the out put equation can be obtained as follows Consider an 'm' phase machine, with usual notations

Output Q in kW = Input x efficiency

Input to motor = $mV_{ph}\ I_{ph} \cos \Phi$ x 10-3 kw

For a 3 Φ machine m = 3 ,

Input to motor = $3V_{ph}\ I_{ph} \cos \Phi$ x 10-3 k_W Assuming

$V_{ph} = E_{ph}$, $V_{ph} = E_{ph}$ $= 4.44\ f\ \Phi\ T_{ph} K_w$

$= 2.22\ f\ \Phi Z_{ph} K_w$

$f = PN_S/120 = Pn_s/2$,

Output $= 3 \times 2.22 \times Pns/2 \times \Phi Z_{ph} K_w\ I_{ph}\ \eta \cos \Phi$ x 10-3 k_W

Output = 1.11 x PΦ x $3I_{ph}\ Z_{ph}$ x ns Kw η cos Φ x 10-3k_W,

PΦ = BavπDL, and $3I_{ph}\ Z_{ph}/\ \pi D = q$

Output to motor = 1.11 x BavπDL x πDq x ns Kw η cos Φ x 10-3 kW

Q = (1.11 π2 Bav q Kw η cos Φ x 10-3) D^2L ns kW

Q = (11 Bav q K_w η cos Φ x 10-3) D^2L ns k_W Therefore

Output Q = Co $D^2L\ n_s$ kW

where Co = (11 Bav q Kw η cos Φ x 10-3)

V_{ph} = phase voltage;

I_{ph} = phase current

Z_{ph} = no of conductors/phase

T_{ph} = no of turns/phase

Ns = Synchronous speed in rpm

ns = synchronous speed in rps

p = no of poles,

q = Specific electric loading

Φ = air gap flux/pole;

B_{av} = Average flux density

kw = winding factor.

η = efficiency

cosΦ = power factor

D = Diameter of the stator,

L = Gross core length

Co = Output coefficient