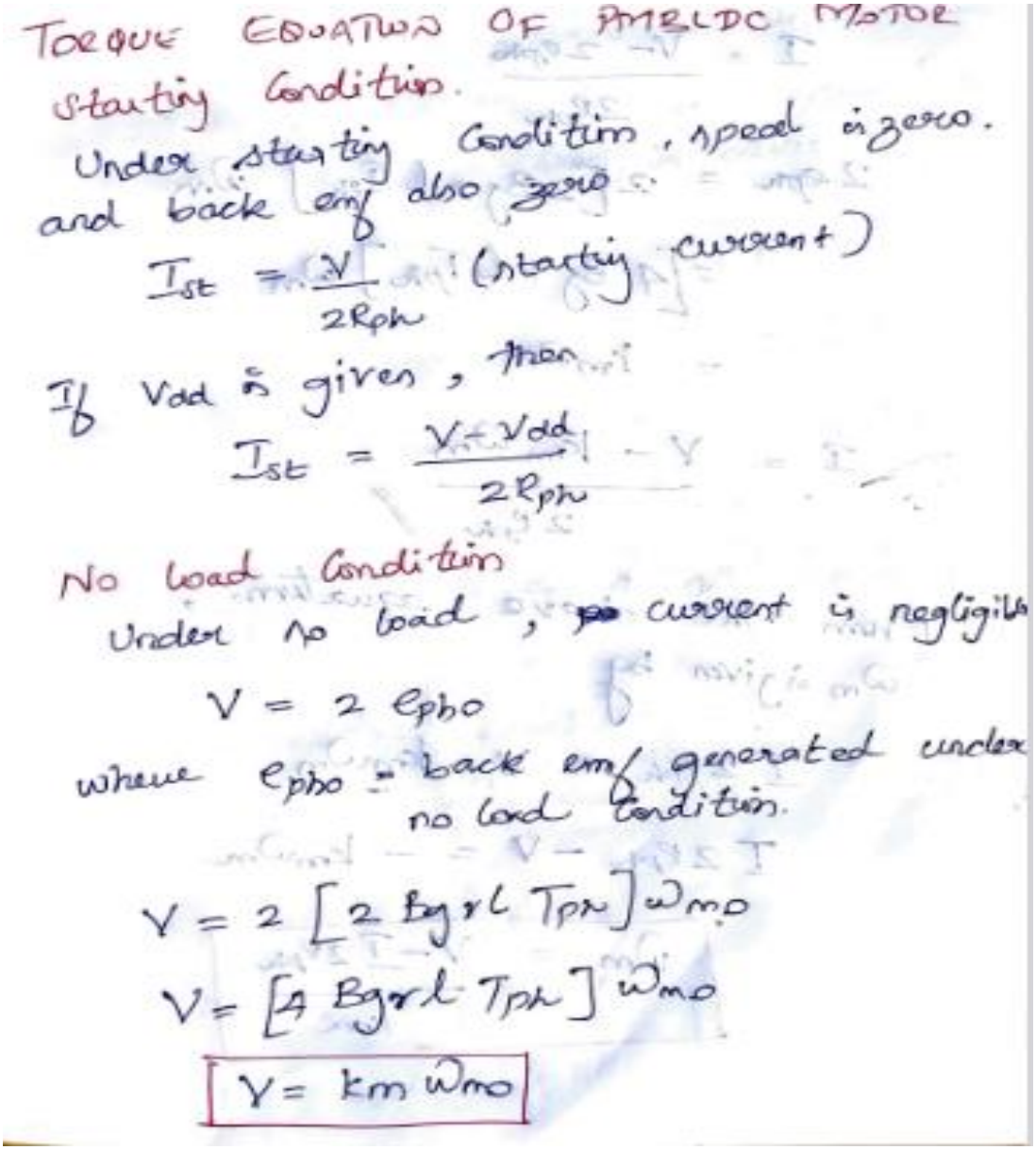

POWER SYSTEM ANALYSIS
UNIT – I
PERMANENT MAGNET BRUSHLESS DC MOTOR



From the above equations, the no load speed is given by

$$\omega_{mo} = \frac{V}{k_m}$$

$$\boxed{\omega_{mo} = \frac{V}{k_m}}$$

ON - load Condition

$$V = 2e_{ph} + 2IR_{ph}$$

$$I = \frac{V - 2e_{ph}}{2R_{ph}}$$

$$2e_{ph} = 2[2B_g r l T_{ph}]\omega_m$$

$$= [4B_g r l T_{ph}]\omega_m$$

$$= k_m \omega_m$$

$$I = \frac{V - k_m \omega_m}{2R_{ph}}$$

From the above equations, ω_m is given by

$$I 2R_{ph} = V - k_m \omega_m$$

$$I 2R_{ph} - V = -k_m \omega_m$$

$$\boxed{\omega_m = \frac{V - I 2R_{ph}}{k_m}}$$

$$\text{Torque} = \frac{P_m}{\omega_m}$$

Power input to the motor is given by VI

$$VI = [2e_{ph} + 2IR_{ph} + 2V_{dd}]I$$

$$= 2Ie_{ph} + 2I^2R_{ph} + 2IV_{dd}$$

where

VI = Electrical I/p power

$2Ie_{ph}$ = Power Converted as mechanical

$2I^2R_{ph}$ = Resistive loss (or) copper loss

$2V_{dd}I$ = Power loss in device

$$P_m = 2[2B_g r l T_{ph} \omega_m] I$$

$$= 4B_g r l T_{ph} \omega_m I \quad \text{—(1)}$$

$$\text{Torque developed} = \frac{4B_g r l T_{ph} \omega_m I}{\omega_m}$$

$$T = 4B_g r l T_{ph} I$$

$$T = k_m I$$

Under starting condition

$$T_{st} = k_m I_{st}$$

Speed Ratio

Defined as ratio between under load speed to no-load speed.

$$SR = \frac{\omega_m}{\omega_{no}}$$

$$= \frac{V - 2IR_{pa}}{\frac{k_m}{V}}$$

$$= \frac{V - 2IR_{pa}}{V}$$

$$\boxed{SR = 1 - \frac{2IR_{pa}}{V}}$$

Torque Ratio (TR)

$$TR = \frac{I}{I_{st}} = \frac{k_m I}{k_m I_{st}}$$

$$\boxed{TR = \frac{I}{I_{st}}}$$