SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME: 19EEB201-DC Machines and Transformers

II YEAR / III SEMESTER

Unit 2 – DC Motor

Topic 4: Torque Equation of DC Motor

What We'll Discuss

TOPIC OUTLINE

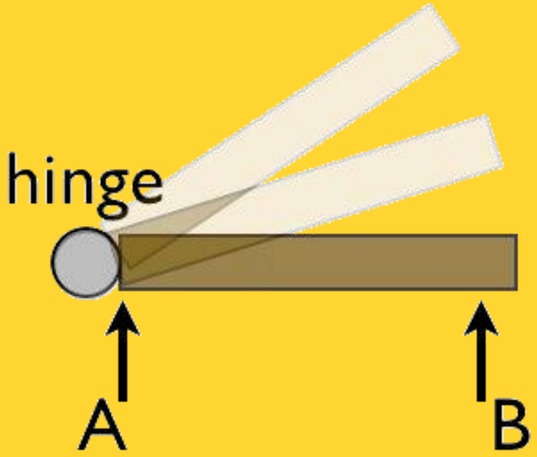
Analogy

Torque Equation of DC Motor

Output power Equation of DC Motor

Assessment

Analogy



Consider opening a door. Which of the two locations would you push on to best open the door?

Torque Equation of DC Motor

- The term torque means 'Turning movement of the force about an axis.'

$T = F \times r$ Newton – meter

Where T = Torque

F = Force in Newton

r = Radius in Meter

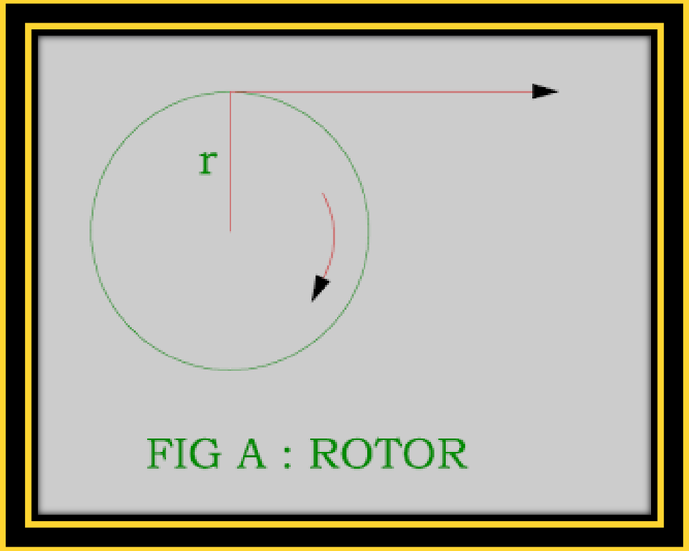


FIG A : ROTOR

Torque Equation of DC Motor

When the armature rotates one revolution, it cuts distance $2\pi r$ in time of $60 / N$ second. Therefore the work done per revolution

$= \text{Force} \times \text{distance}$

$= F \times 2\pi r$

But $F \times r = T$

So the work – done / revolution $= 2\pi T$ Newton – meter

Now the Power developed = Work done per unit second

$= 2\pi T / (60 / N)$

$= 2\pi NT / 60$

$= T\omega$

Where ω = Angular velocity in radian / second

$= 2\pi N / 60$

The electrical equivalent to mechanical power developed by the armature is given by

$E_b I_a = 2\pi NT / 60$

$T = (60 / 2\pi N) E_b I_a$ …….(1)

Shaft Torque of DC Motor

$T = 0.159 (EbIa / N)$

Substitute Eb in the equation (1)

$$T = [1 / (2\pi \times 9.81)] (\Phi ZNP / A) Ia \text{ Kg} - m$$

$$T \propto \Phi Ia$$

Shaft Torque

The shaft torque Tsh always less than the armature torque due to small amount of friction losses in the motor.

Shaft torque = Armature torque – Friction and windage losses

Tsh = Ta – Friction and windage losses

Output Equation DC Motor

Output power = Power developed in the armature

$P = T \times (2\pi NT / 60)$ Watt

$Psh = Tsh \times (2\pi NT / 60)$ Watt

The mechanical power developed at the shaft is called as brake horse power (BHP).

One HP = 735.5 watt

$Psh = (Tsh \times 2\pi N / 60)(1 / 735.5)$ HP

RECALL

1. Write the Torque Equation of DC Motor

THANK YOU