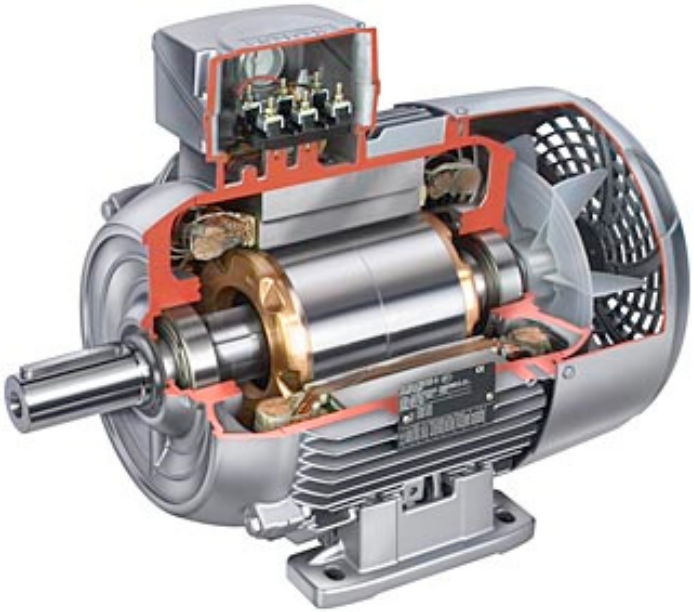
EEE 3352

Electromechanics & Electrical Machines



Lecture 5: Examples

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Examples:

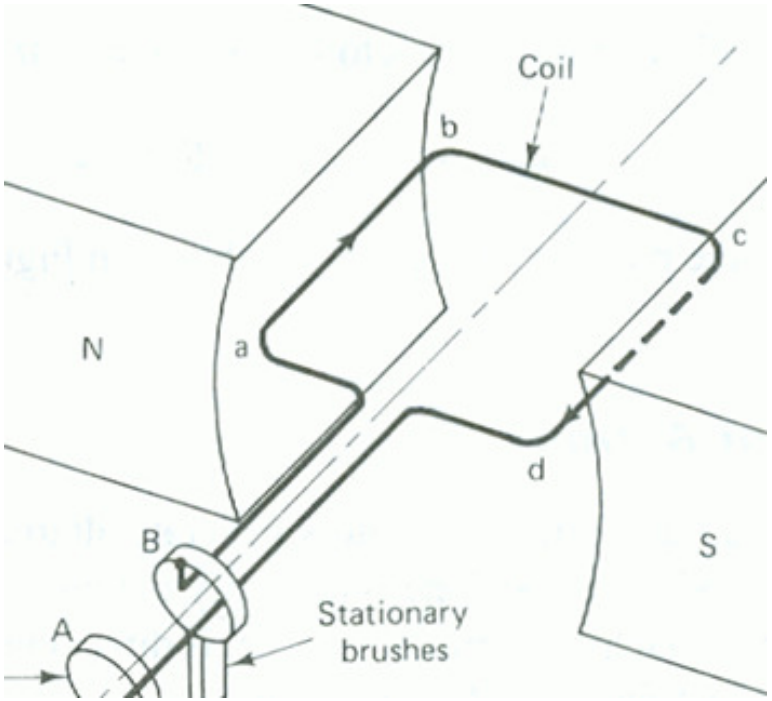
5.1

For the generator shown in the caption (slip ring output), $ab = cd = 20$ cm and assume a uniform magnetic field $B = 0.5$ T. For a peripheral speed of the coil sides of 12 m/s, what is the maximum voltage appearing at the slip rings?

$l = 20\text{cm}$

$B = 0.5\ \text{T}$

$u = 12\ \text{m/s}$



$$V_{in} = \text{"}Blu\text{"} = B(2l)u = 0.5 \times (2 \times 0.2) \times 12 = \underline{\underline{2.4\ \text{V}}}$$

5.2

A 60-kW, 4-pole generator has a lap winding placed in 48 armature slots, each slot containing 6 conductors. The pole flux is 0.08 Wb and the speed of rotation is 1040 r/min

$$
\begin{aligned}
P &= 60\ \text{kW} \\
Z_s &= 48 \\
N &= 6 \\
\phi &= 0.08\ \text{Wb} \\
n &= 1040\ \text{r/min}
\end{aligned}
$$

a) what is the generated voltage?

$$V = \frac{2pZ}{c} n\phi$$

$$c = 2p$$

$$V = \frac{2\times 2\times (48\times 6)}{2\times 2} \times \frac{1040}{60} \times 0.08 = \underline{\underline{400\ \text{V}}}$$

b) what is the current flowing in the armature conductors when the generator delivers full load?

$$P = VI \rightarrow I = \frac{P}{V} = \frac{60 \times 10^3}{400} = 150 \text{ A}$$ → supply

# of parallel paths = $2p = 4$

$$I_{\text{conductor}} = \frac{I}{c} = \frac{150}{4} = \underline{\underline{37.5 \text{ A}}}$$

5.3

The armature of a dc motor has 320 conductors, only 70% of which lie directly under poles, where the flux density is 1.1 T. The armature diameter is 26 cm and its length is 18 cm. The conductor current is 12 A.

Z_{total} = 320, *70% under poles*
B = 1.1 T
R = 26/2 = 13 cm
l = 18 cm
I = 12 A

Find

a) the total force created by the conductors

$$F = Bli = 1.1 \times 0.18 \times 12 = 2.376 \text{ N}$$

For 320 conductors, with 70 % effective

$$F_{\text{total}} = 2.376 \times 320 \times \frac{70}{100} = \underline{\underline{532 \text{ N}}}$$

Find

b) the shaft torque developed

$$T = F \cdot R = 532 \times 0.13 = \underline{\underline{69.2 \text{ Nm}}}$$