Electrical Drives

Fields of Application 2

(three-phase AC motors)

Applied Mechatronics

Module 5.2.4

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Introduction

- Hints for Learning:
  - Read the chapters in the book carefully. (Can also be part of your homework !!!)
  - Use the key questions to work out the essential learning material.
  - Answer the key questions based on the information from the relevant chapter(s).
  - Create an index of the terms of drive technology with a short description continuously.

Fields of Application 2 (1)

- three-phase asynchronous machines
  - Chapter 2.10:
    Aufbau von Drehstrom-Asynchronmaschinen
    - Helpful links:
      - Schema eines Dreiphasengenerators. Der rotierende Dauermagnet erzeugt in den Spulen durch Induktion ein Dreiphasensystem mit den Außenleiterspannungen UL1, UL2 und UL3: https://commons.wikimedia.org/wiki/File:Simpel-3-faset-generator.gif

Fields of Application 2 (2)

- Three-phase squirrel cage motor
  - Chapter 2.11: Drehstrom-Kurzschlussläufermotor
- Three-phase slip-ring motor
  - Chapter 2.12: Drehstrom-Schleifringläufermotoren

- Terms
  - See Addendum(1-7)

Fields of Application 2 (3)

- Three-phase synchronous machines
  - Chapter 2.18: Drehstrom-Synchronmaschinen
    - Drehstrom-Synchrongenerator
    - Drehstrom-Synchronmotor

- Terms
  - See Addendum(8-9)

Fields of Application 2 (4)

- Single-phase asynchronous motor
  - Chapter 2.24: Einphasen-Asynchronmotor
- Linearmotor
  - Chapter 2.31: Linearmotor
    - Helpful links
      - Schematische Darstellung der Ableitung des Linearmotors von einem Rotationsmotor: https://upload.wikimedia.org/wikipedia/commons/f/f6/Linearmotorprinzip.png
      - Siehe auch Wikipedia: https://de.wikipedia.org/wiki/Linearmotor

Addendum (1)

- Terms
  - Frequency *f*
    - Unit: Hertz *[Hz]*
  - Number of pole pairs *p*
    - Unit: no
  - Synchronous rotation speed n_D
    - Unit: Rotations per minute $[^1/_{min}]$
    - Relation: $n_D = \frac{f \cdot 60}{p}$

Addendum (2)

- Terms (continued)
  - Rotary field speed n_D
    - Unit: Rotations per minute $[^1/_{min}]$
  - Rotor speed n
    - Unit: Rotations per minute $[^1/_{min}]$
  - Slipping speed n_S
    - Unit: Rotations per minute $[^1/_{min}]$
    - Relation: $n_S = n_D - n$

Addendum (3)

- Terms (continued)
  - Slip *s*
    - Unit: no *(in%)*
    - Relation: $s = \frac{n_D - n}{n_D} \cdot 100\%$
    - Relation: $s = \frac{n_S}{n_D} \cdot 100\%$

Addendum (4)

- Terms (continued)
  - Iron losses P_{Fe}
    - Unit: Watts *[W]*
  - Copper losses P_{Cu1} (rotor) *and* P_{Cu2} (stator)
    - Unit: Watts *[W]*
  - Friction losses P_R
    - Unit: Watts *[W]*
  - Supplementary load loss P_{zu1} (rotor) *and* P_{zu2} (stator)
    - Unit: Watts *[W]*

Addendum (5)

- Terms (continued)
  - Power loss P_V
    - Unit: Watts $[W]$
    - Relation: $P_V = P_{Cu1,2} + P_{Fe} + P_R + P_{zu1,2}$
  - Effective electrical input power P
    - Unit: Watts $[W]$
    - Relation: $P = \sqrt{3} \cdot U \cdot I \cdot \cos\varphi$

  More important formulas see Tab 2.23 on Page 58 in textbook

Addendum (6)

- Terms (continued)
  - Excitation field ϕ_E
    - Unit: Weber *[Wb]*
  - Magnetic flux density *B*
    - Unit: Tesla *[T]*
  - Rotor current $\boldsymbol{I}_2$
    - Unit: Ampere *[A]*
  - Phase shift $cos\ \varphi_2$
    - Unit: no

Addendum (7)

- Terms (continued)
  - Torque *M*
    - Unit: Newtonmeter *[Nm]*
    - Relation: $M = B \cdot I_2 \cdot \cos \varphi_2$

Addendum (8)

- Terms
  - Number of windings *N*
    - Unit: no *(Wdg.)*
  - Change of magnetic flux $\Delta\phi$
    - Unit: Weber $[Wb]$
  - Time difference Δt
    - Unit: Second $[s]$

Addendum (9)

- Terms
  - Induced voltage U_0
    - Unit: Volt *[V]*
    - Relation: $U_0 = N \cdot \frac{\Delta\Phi}{\Delta t}$

      Law of induction (Induktionsgesetz)

Bibliography

- Briegler, Adolf; Holzer, Helmut and others. *Elektrotechnik Fachkunde 1*. Wien: Jugend & Volk, 2013. ISBN: 978-3-7100-2911-0.