

Respostas dos Exercícios do Livro
Principles of Electric Machines and Power Electronics

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5.1

- (a) 4 pólos
 - (b) 3%
 - (c) 1,8 Hz
 - (d.i) 1800 rpm
 - (d.ii) 0 rpm
-

5.2

- (a) 1164 rpm (mesmo sentido)
 - (b) 1,8 Hz
 - (c) 1200 rpm
 - (d) 1200 rpm
 - (e.i) 36 rpm
 - (e.ii) 1200 rpm
 - (e.iii) 0 rpm
-

5.3

- (a) 1236 rpm (mesmo sentido)
 - (b) 1,8 Hz
 - (c) 1200 rpm
 - (d) 1200 rpm
 - (e.i) 36 rpm (sentido contrário ao de rotação)
 - (e.ii) 1200 rpm
 - (e.iii) 0 rpm
-

5.4

- (a) 600 rpm (sentido contrário)
 - (b) 90 Hz
 - (c) 1200 rpm
 - (d) 1200 rpm
 - (e.i) 1800 rpm
 - (e.ii) 1200 rpm
 - (e.iii) 0 rpm
-

5.5

- (a.i) 5 %
 - (a.ii) 3 V e 3 Hz
 - (a.iii) 60 rpm (em relação ao rotor), 1200 rpm (em relação ao estator)
 - (b.i) Direção oposta (pela Lei de Lenz-Faraday)
 - (b.ii) 7,21 V e 1,8 Hz
-

5.6

- (a) $R_1 = 0,076 \Omega$, $R_2 = 0,0638 \Omega$, $X_1 = 0,1947 \Omega$, $X_2' = 0,1947 \Omega$, $X_m = 6,3870 \Omega$
 - (b) $I_1 = 125,10 \angle -27,16^\circ$ A, $P_1 = 88,68$ kW, $P_{ag} = 85,11$ kW, $P_2 = 2,55$ kW, $P_{mec} = 82,56$ kW, $P_{out} = 78,72$ kW, $\eta = 88,77$ %
-

5.7

- (a) 465,78 W
 - (b) $R_1 = 0,27 \Omega$, $R_2 = 0,4143 \Omega$, $X_1 = 0,3834 \Omega$, $X_2' = 0,3834 \Omega$, $X_m = 17,67 \Omega$
 - (c) Máquina de Indução tipo D.
 - (d) 18,18 HP
-

5.8

- (a) 1710 rpm (179,07 rad/s)
 - (b) $75,85 \angle -23,55^\circ$ A
 - (c) 2,07 kW
 - (d) 31,65 kW
 - (e) 1,58 kW
 - (f) 29,67 kW
 - (g) 167,90 N·m e 165,66 N·m
 - (h) 87,98 %
-

5.9

- (a) 383,33 V
 - (b.i) 1500 rpm (síncrona), 1455 rpm (eixo), 1,5 Hz
 - (b.ii) $32,88 \angle -20,98^\circ$ A, 0,93 (indutivo), 124,61 N·m, 86,17%
-

5.10

- (a) 100,69 N·m
- (b) 362,99 N·m, 13,21%
- (c) 1199,6 rpm

5.11

1131,6 rpm, 178,35 N·m, 21,14 kW

5.12

- (a) $R_{Th} = 0,0659 \Omega$, $X_{Th} = 0,1947 \Omega$
- (b) 624,26 N·m (partida), 2266,8 N·m (máximo), 787,55 rpm
- (c) 0,24 Ω

5.13

- (a) 4 pólos
- (b) 39,57 N·m
- (c) 2,07 Ω

5.14

- (a) 4 pólos
- (b) 40,88 N·m
- (c) 2,11 Ω

5.15

89,32%

5.16

- (a) 987,5 W
- (b) 48,27 HP
- (c) 90,03%
- (d) 293,93 N·m

5.17

- (a) 1800 rpm, 30 Hz, 3 pu, -2 pu
- (b) 1800 rpm, 150 Hz, 0,6 pu, 0,4 pu

5.18

- (a) motor ($s=5\%$)
- (b) 16,66<-22,56° A
- (c) 5542,6 W e 2303,2 VAr (entrando na máquina)
- (d) 266,72 W
- (e) 20,24 A (gerador)

5.19

- (a) gerador ($s=-5\%$)
- (b) 17,79<-155,81° A
- (c) 5847,2 W (saindo da máquina) e 2627,1 VAr (entrando na máquina)
- (d) 304,23 W
- (e) 33,07 A (motor)

5.20

- (a) modo frenante ($s=1,95\%$)
- (b) 71,77<-75,48° A
- (c) 6482,6 W e 25,03 kVAr (entrando na máquina)
- (d) 5108,1 W
- (e) 13,70 A (motor)

5.21

Obs: Corrigir $s = -2,5\%$

- (a) 922,5 rpm
- (b) 264,94 V (fase)
- (c) 138,12 kW, 0,91
- (d) 93,71 %

5.22

- (a) 196,67%
- (b) 118 Hz
- (c) 109,22 N·m (sentido contrário ao de rotação)

5.23

0,45 Ω

5.24

- (a) 40,84%
 - (b) 8,52%
 - (c) 4,53 pu
 - (d) 3,46 pu
-

5.25

- (a) 1455 rpm
 - (b) 0,92 pu
 - (c) 1,05 Ω
 - (d) 1424,3 rpm
-

5.26

(a)

$$\frac{I_{outer}^{partida}}{I_{inner}^{partida}} = 1,06, \quad \frac{I_{outer}^{plena\ carga}}{I_{inner}^{plena\ carga}} = 0,14$$

(b)

254,63%

(c)

$$\frac{T_{outer}^{partida}}{T_{partida}} = 89,99\%, \quad \frac{T_{inner}^{partida}}{T_{partida}} = 10,01\%$$

$$\frac{T_{outer}^{plena\ carga}}{T_{plena\ carga}} = 13,06\%, \quad \frac{T_{inner}^{plena\ carga}}{T_{plena\ carga}} = 86,94\%$$

Nota: ver apêndice ao final do gabarito.

5.27

$$T_{inner} = 43,90 \text{ N}\cdot\text{m}, \quad T_{outer} = 11,33 \text{ N}\cdot\text{m}, \\ T_{total} = 55,23 \text{ N}\cdot\text{m}$$

5.28

Será 3 vezes maior, ou seja, 737,7 A

5.29

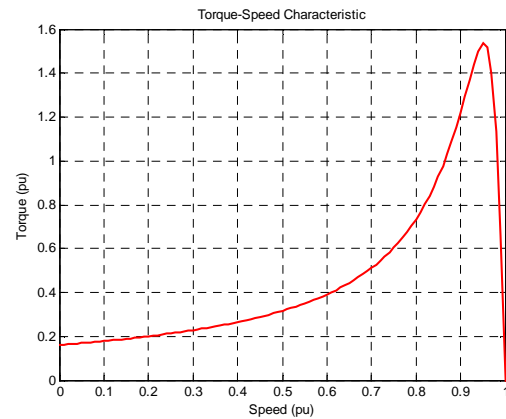
- (a) 244,79 A
 - (b) 153,33 V (linha)
 - (c) 11,11%
-

5.30

- (a) 383,33 V
 - (b) 1455 rpm
-

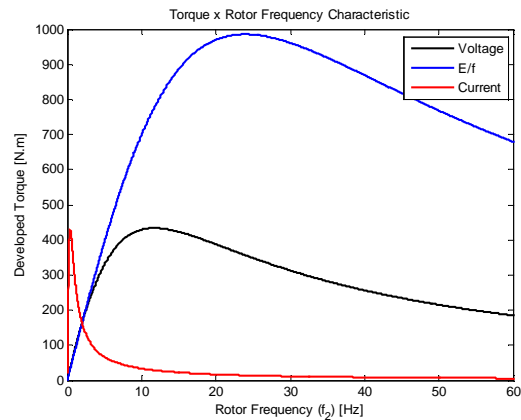
5.31

- (a) 58,64 A, 301,69 N·m
- (b)



5.32

- (a.i) 433,51 N·m
- (a.ii) 985,68 N·m
- (a.iii) 429,23 N·m
- (b)



5.33

-

5.34

-

5.35

-

5.36

- (a) 180 km/h (síncrona) e
135 km/h (veículo)
(b) Da direita para a esquerda

5.37

- (a) 30,56%
(b) 194,69 A, 74,59 kW, 0,7374, 57,54 kW,
39,96 kW, 17,58 kW, 1,92 kN

5.38

- (a) gerador ($s = -8,33\%$)
(b) 65 Hz
(c) $-8,33\%$
(d) 140,40 km/h
(e) $-92,82$ kW (do rotor para o estator)
(f) $-2,58$ kN

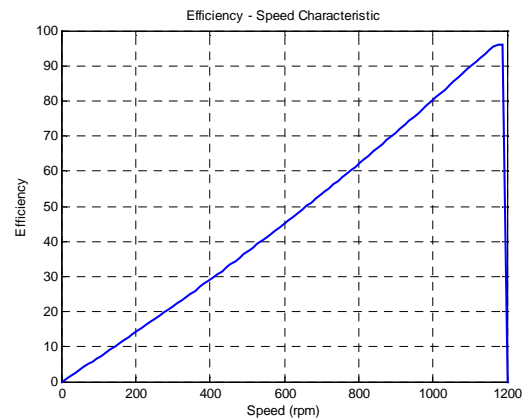
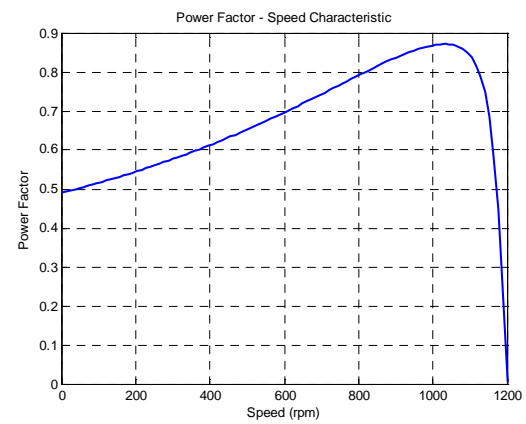
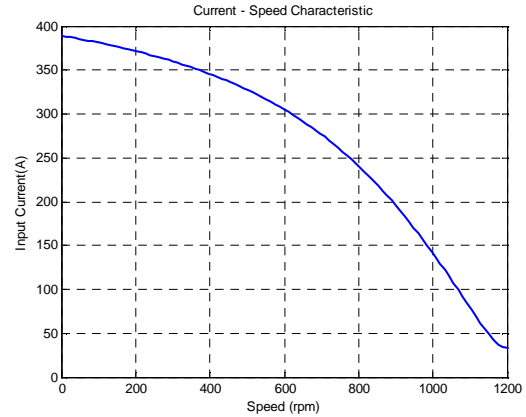
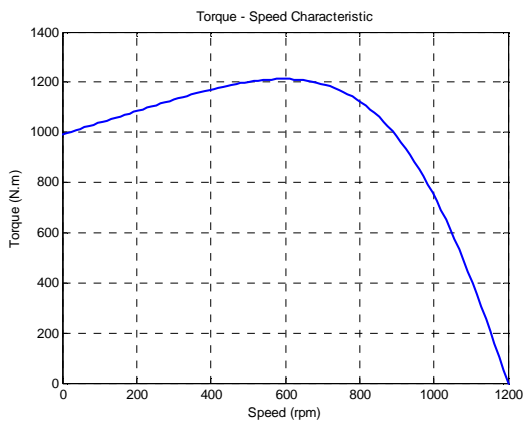
5.39

- (a) motor ($s = 8,33\%$)
(b) 55 Hz
(c) $8,33\%$
(d) 118,80 km/h
(e) $92,82$ kW (do estator para o rotor)
(f) $2,58$ kN

5.40

611,31 N

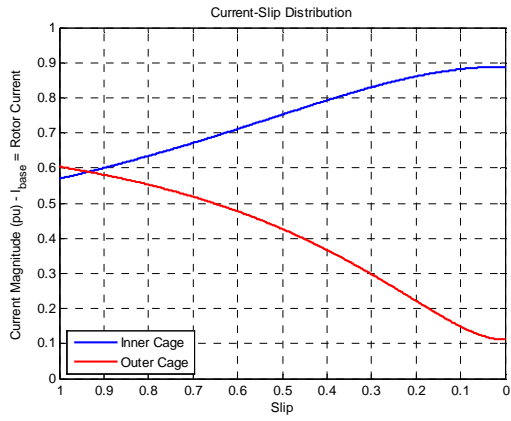
5.41



Apêndice:

5.26

(a)



(b)

