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P2 - Máquinas 2 - ELE 362 - 15/3/22

Questão 1 Curva "V"

letra C - Diminui e o fator de potência diminui

Questão 2 Curva "V"

letra B - Diminuirá, mantendo-se capacitiva

Questão 3 $P_1 = \frac{V_T E_F \operatorname{sen}(\delta_1)}{X}$ $P_2 = \frac{V_T E_F \operatorname{sen}(\delta_2)}{X}$

letra D - $60°$ $\left\{ \frac{P_1}{P_2} = \frac{\operatorname{sen}\delta_1}{\operatorname{sen}\delta_2} \Rightarrow \operatorname{sen}\delta_2 = \operatorname{sen}(\delta_1)\frac{P_2}{P_1} \Rightarrow \delta_2 = \operatorname{arcsen}\left(\frac{\sqrt{3}}{2}\right) = 60° \right.$

Questão 4

letra B - I, II, III, IV, V, VI

Questão 5

letra A - I, II, III, IV

Questão 6

letra B - Ajusto a corrente de campo de G2 para se produzir a mesma tensão nominal entre as linhas a', b' e c'.

Questão 7

letra E - II e III

Questão 8

letra b - 4 questões verdadeiras

Questão 9) Gerador síncrono: 3Ø, Y, 22KV, 5KVA, FP=1.

$X_d = 12\,\Omega$, $X_q = 7\,\Omega$, corrente nominal, tensão nominal, $R_A = 0$.

$$I_A = \frac{5000}{\sqrt{3}\ 22K} = 0.13122 \quad ; \quad V_t = \frac{22K}{\sqrt{3}} = 12.701\ KV \quad ; \quad \theta = 0°$$

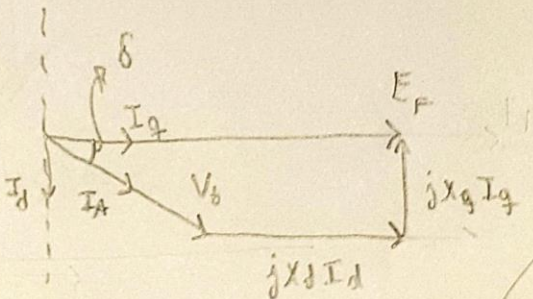
$$\psi = tg^{-1}\left(\frac{V_t \times sen(0°) + I_A \times X_q}{V_t \cos(0°)}\right) = tg^{-1}\left(\frac{0.13122 \times 7}{12701.7059}\right) = \boxed{0.00414°}$$

$$\delta = \psi - \theta \Rightarrow \boxed{\delta = 0.00414°}$$

$$I_d = I_A\ sen\ \psi \angle \delta - 90° = 0.00001 \angle -89.996°$$

$$I_q = I_A \cos \psi \angle \delta = 0.13122 \angle 0.00414°$$

$$E_F = V_t \angle 0° + I_d X_d j + I_q X_q j = \boxed{12.701 \angle 0.00414°}\ KV$$



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Questão 10) M.S 2300V, 400 HP, 60 Hz, 8 Polos, Y, FP = 0.85 adiantado

Plena carga: $\eta = 85\%$, $R_A = 0.4\,\Omega$, $X_s = 4.4\,\Omega$.

Encontrar: τ_{out}, P_{in}, ω, E_f, I_A, P_{des}

$P_{out} = 400 \times 745.7 = 298.28\,KW$

$n_s = \frac{120f}{P} = 900\,RPM \Rightarrow \tau_{out} = \frac{P_{out}}{\omega} = \frac{298.28K}{900.\frac{\pi}{30}} = \underline{3164.85\ N.m}$

$\eta = \frac{P_{out}}{P_{in}} \Rightarrow P_{in} = \frac{298.28K}{0.85} = \underline{350.92\,KW}$

$|I_A| = \frac{P_{in}}{\sqrt{3}\,V_T\,FP} = \frac{350.92}{\sqrt{3} \times 2300 \times 0.85} = 103.633A \Rightarrow \boxed{|I_A| = 103.633\angle 31.79°\ A}$

$E_F = V_t - (R_A + jX_s)I_A = \frac{2300}{\sqrt{3}} - (0.4 + j4.4)(103.633\angle 31.79°) =$

$\boxed{E_F = 1586.62\angle -14.95°\ V}$

$P_{cobre} = 3R_A I_A^2 = 12887.75843\,W$

$P_{des} = P_{in} - P_{cobre} = 350.92K - 12.887K = \underline{338.0299\,KW}$

Questão 11) M $\leq 3\phi$, Saliente, 100 MVA, 12 kV, 60 Hz, $X_d = 1$ pu, $X_q = 0.7$ pu

$R_A = 0$.

BI → absorvida 72 MW, FP = 0.9 atrasado.

$$I_{Base} = \frac{100M}{\sqrt{3}\,12K} = 4811.25\angle 25.22$$

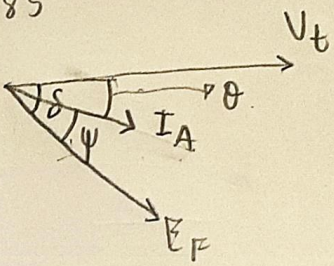
$$I_A = \frac{72M}{\sqrt{3}\times 12K\times 0.9} = 3849,0018$$

$$i_A = \frac{I_A}{I_{Base}} = 0.8_{pu} \qquad \theta = -25.84°$$

a) E_F e δ, Diagrama

$V_t = 1$ pu

$$\delta = \tan^{-1}\left(\frac{i_A X_q \cos(\theta)}{V_t - X_q I_a \operatorname{sen}(\theta)}\right) = 33.69° \Rightarrow \psi = \delta - \theta = 7.85°$$



$\boxed{\delta = 33.69° \quad \psi = 7.85°}$

$$I_d = 0.8\operatorname{sen}(7.85°)\angle 33.69 - 90° = 0.1093\angle -56.31° \text{ pu}$$

$$I_q = 0.8\cos(7.85°)\angle 33.69° = 0.7925\angle 33.69° \text{ pu}$$

$$\vec{E}_F = V_t + I_d X_d j + I_q X_q j = 0.9414\angle 33.69° \Rightarrow E_F = 11.296K\angle 33.69°$$

b) $I_F = 0 \Rightarrow E_F = 0$

$$P = \frac{V_t E_F \operatorname{sen}\delta}{X_d} + \frac{V_t^2(X_d - X_q)}{2X_d X_q}\operatorname{sen}(2\delta) = \frac{V_t^2(X_d - X_q)\operatorname{sen}(2\delta)}{2X_d X_q} \Rightarrow P = \frac{3\operatorname{sen}(2\delta)}{14}$$

$$\frac{dP}{d\delta} = \frac{6\cos(2\delta)}{14} = 0 \Rightarrow \boxed{2\delta = 90°} \Rightarrow P_{max} = \frac{3}{14}\operatorname{sen}(90°) = 0.2143 \text{ pu}$$

$$FP = \frac{P_{max}}{S} = \frac{0.2143}{1} = 0.2143 \Rightarrow \theta_1 = 77.63°$$

Questão 12) $X_s = 1.2$ pu, $I_{max} = 2.5 I_F$, $I_F \rightarrow V_{F,VZ}$

$E_{f_{max}} = 2.5$ pu; $I_a = \dfrac{V_t - E_F}{jX_s} = \dfrac{1 - 2.5}{j1.2} = 1.25j$ pu

$Q_{max} = V_T I_A = 1 \times 1.25 = \underline{1.25 \text{ pu}}$