Homework #3 – ECEN 667 Fall 2025

Do not turn in, but please complete before the first exam.

1. Book 5.2

Answer:

$$I_q = \frac{(X'_d + X_{ep})V_s \sin(\delta - \theta_{vs}) + (R_s + R_e)(E'_q - V_s \cos(\delta - \theta_{vs}))}{(R_s + R_e)^2 + (X_q + X_{ep})(X'_d + X_{ep})}$$

$$I_d = \frac{-(R_s + R_e)V_s \sin(\delta - \theta_{vs}) + (X'_q + X_{ep})(E'_q - V_s \cos(\delta - \theta_{vs}))}{(R_s + R_e)^2 + (X_q + X_{ep})(X'_d + X_{ep})}$$

2. Book 5.5 except changed so $X_d = 1.4$ and $X_q = 1.1$

Answer:

$$\delta = 33.3°;\ \ E'_q = 0.8407;\ \ E'_d = 0.449$$
$$E_{fd} = 0.875;\quad T_m = 0.4323$$
$$E'^0 = 0.954;\quad \delta'^o = -23.096°$$

3. Book 4.1

Answer:

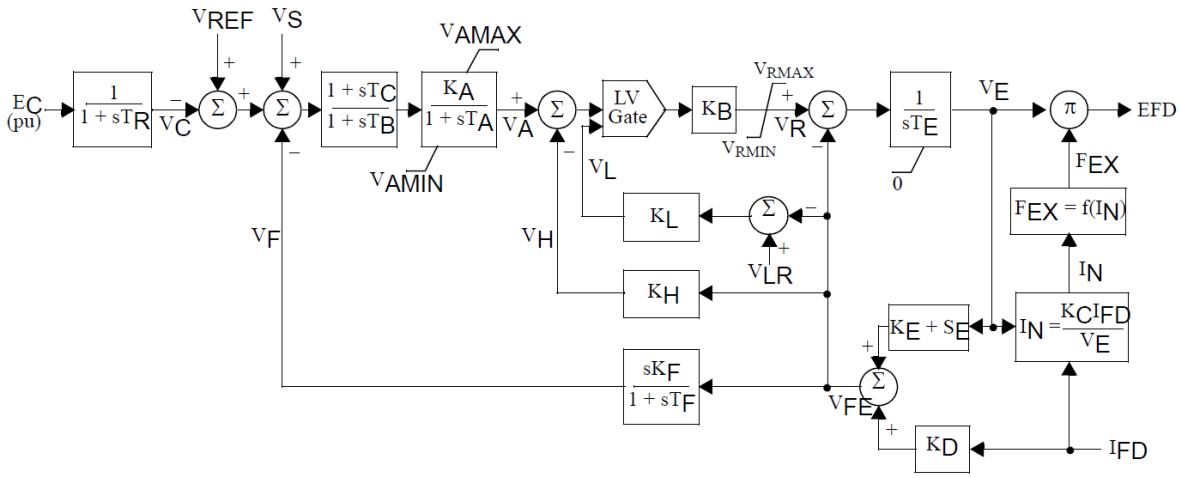
$$E_{fdmax} = 4.211;\ \ A_x = 0.0857;\ \ B_x = 0.5584$$

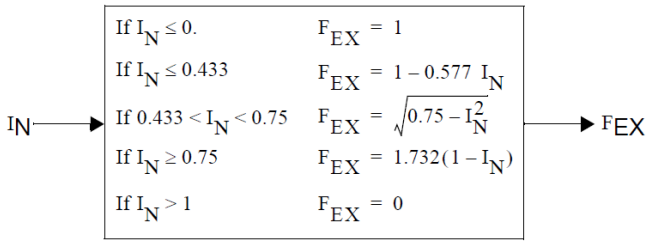
4. Book 4.3

Answer:

$$K_{eself} = -0.132$$

5. The block diagram for an EXAC2 exciter is shown below (reproduced from the PSSE manual). With an initial voltage and field current of 3.1866 and a terminal voltage of 1.0946, manually calculate the initial values of Ve, Va, and Vref
   You may ignore the LV gate. Assume Tr=0.05, Tb=1, Tc=2, Ka=300, Ta=0.02, Vamax=8, Vamin=-8, Kb=20, Vrmax=10, Vrmin=-10, Te=0.8, Kl=10, Kh=0, Kf=0.0, Tf=1, Kc=0.3, Kd=0, Ke=1, VLR=4.4, E1=3.3, SE1=0.3, E2=4.4, SE2=0.08.





V_S = VOTHSG + VUEL + VOEL

Answer:

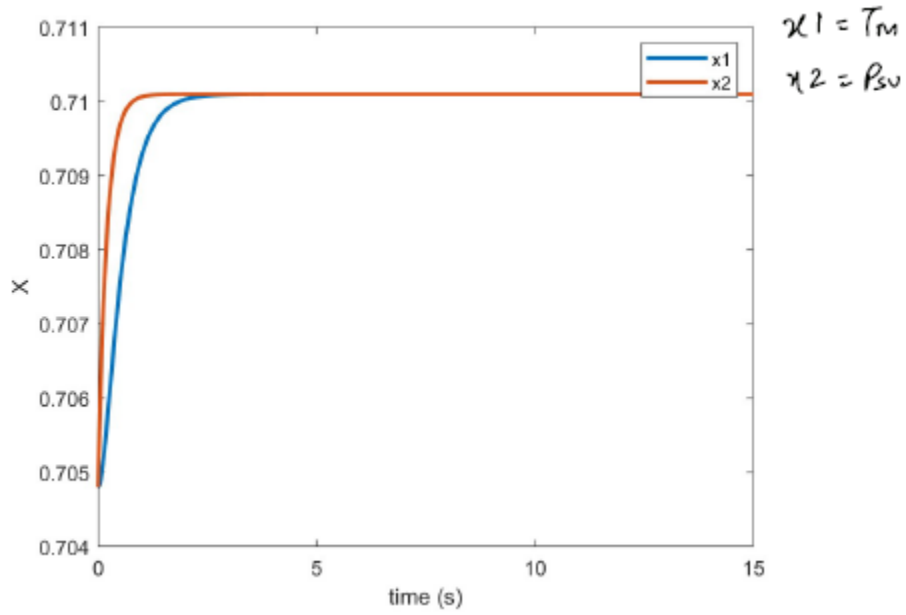
$$V_E = 3.74; V_a = 0.196; V_{ref} = 1.0953$$

6. Book 4.8

Answer:

(a) $P_{SV} = 0.7048; T_M = 0.7049$

(b)



7. For the 37 bus case given on the website AGL37_TS, analytically calculate the expected final frequency if the contingency is the outage of the generator at bus 53 (KYLE138). Note, all generators have TGOV1 models with R=0.05. Then perform the simulation in PowerWorld to verify your result.

Answer:
Expected final frequency: 59.59 Hz