EE5200 SC EXERCISES

Due Mon Nov 15th, 9am

Name & ID Number

1) [20 pts] A 4-bus system is described by its positive sequence subtransient impedance and admittance matrices as given below.

$$Z^1_{bus} = j\begin{bmatrix} 0.1488 & 0.0651 & 0.0864 & 0.0978 \\ 0.0651 & 0.1554 & 0.0798 & 0.0967 \\ 0.0864 & 0.0798 & 0.1314 & 0.1058 \\ 0.0978 & 0.0967 & 0.1058 & 0.1566 \end{bmatrix} \qquad Y^1_{bus} = j\begin{bmatrix} -12.33 & 0.0 & 4.0 & 5.0 \\ 0.0 & -10.83 & 2.5 & 5.0 \\ 4.0 & 2.5 & -17.83 & 8.0 \\ 5.0 & 5.0 & 8.0 & -18.0 \end{bmatrix}$$

a) A balanced 3ϕ fault occurs at bus 2. Calculate the fault current.

b) Calculate the phasor voltages that exist during the fault at buses 1, 3 and 4.

c) Calculate the phasor currents I_{12}, I_{23} and I_{42} flowing between the faulted bus and the other system buses.

2) [20 pts] A 400-MVA 23-kV generator has the following parameters, given on the base of the generator:

$X_d = 1.85$	$X_d' = 0.33$	$X_d'' = 0.25$
$T_A = 0.2s$	$T_d' = 0.8s$	$T_d'' = 0.04s$

Assume that the generator is operating at no load and rated voltage when a 3ϕ fault occurs directly on the terminals.

a) Calculate the initial subtransient symmetrical RMS fault current Iac(0) and the steady state fault current $I(\infty)$.

b) Write the expression for the maximum dc offset as a function of time.

c) Calculate the asymmetrical worst-case RMS short circuit current (in amps) that a 2-cycle breaker would have to interrupt.

3) [20 pts] The sequence bus impedance matrices (in per unit) for a 3-bus system are given below. Assume that the system has balanced positive sequence sources and that the prefault value of V_{AN} is 1.05 $\angle$0.0°.

$$Z^0_{bus} = j\begin{bmatrix} 0.15 & 0.08 & 0.0 \\ 0.08 & 0.20 & 0.0 \\ 0.0 & 0.0 & 0.30 \end{bmatrix} \qquad Z^1_{bus} = Z^2_{bus} = j\begin{bmatrix} 0.12 & 0.08 & 0.04 \\ 0.08 & 0.12 & 0.06 \\ 0.04 & 0.06 & 0.08 \end{bmatrix}$$

a) Calculate the phasor values of I_{A1}, I_{A2}, I_{A0}, and I_C flowing in the fault for a L-L-G short circuit at bus 1.

b) Calculate the phasor values of V_{A0}, V_{A1}, V_{A2} and V_A at bus 2 during the fault.

c) Calculate the phasor value of V_A at bus 1 during the fault.

4) [20 pts] Answer **any four of the** of the following short concept/essay questions. Be sure to clearly indicate which one you do not want graded, or the first four will be graded. **Explain in your own words - explanations copied word-for-word from your textbook will not be given full credit.**

a) [5 pts] Explain how you would correct network fault current flows to account for prefault load current for a L-G fault.

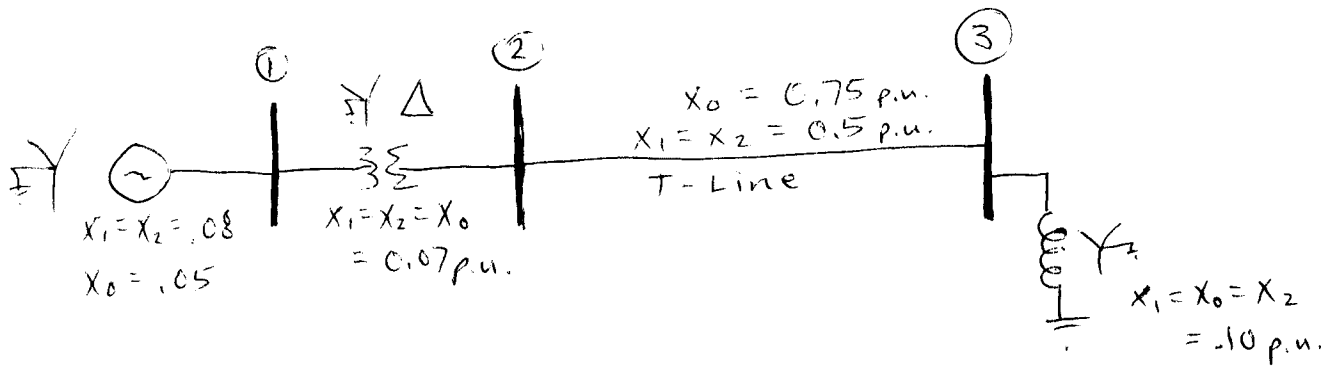
b) [5 pts] How do you incorporate a fault impedance Z_F into the Z_0, Z_1, Z_2 network connections for a L-L-G fault?

c) [5 pts] Dry rocky soils have a higher resistivity than wet silty soils. Explain what effect this has (if any) on the a) positive sequence, b) negative sequence and c) zero sequence impedances of a transmission line.

d) [5 pts] Give at least 3 good reasons/uses for performing fault study calculations.

e) [5 pts] The conductor spacing of transmission lines increases with voltage. What effect does an increase in phase spacing have on the characteristic impedance of the line? Explain.

5) [20 pts] A L-L fault occurs between phases B & C at bus 2 of the network shown. Assume that the prefault voltage at bus 2 is 1.05 per unit. Assume that the voltage at the generator leads corresponding voltages on the transmission line by 30°.



a) Draw the sequence impedance networks and connect for the fault given.
b) Thevenize the sequence networks about bus 2, connect for fault, and label all sequence voltages and currents.
c) Solve for I_{A0}, I_{A1}, I_{A2}, and I_C flowing in the fault.
d) Solve for I_{A0}, I_{A1}, I_{A2}, and I_A, I_B, I_C flowing through bus 1 toward the fault.