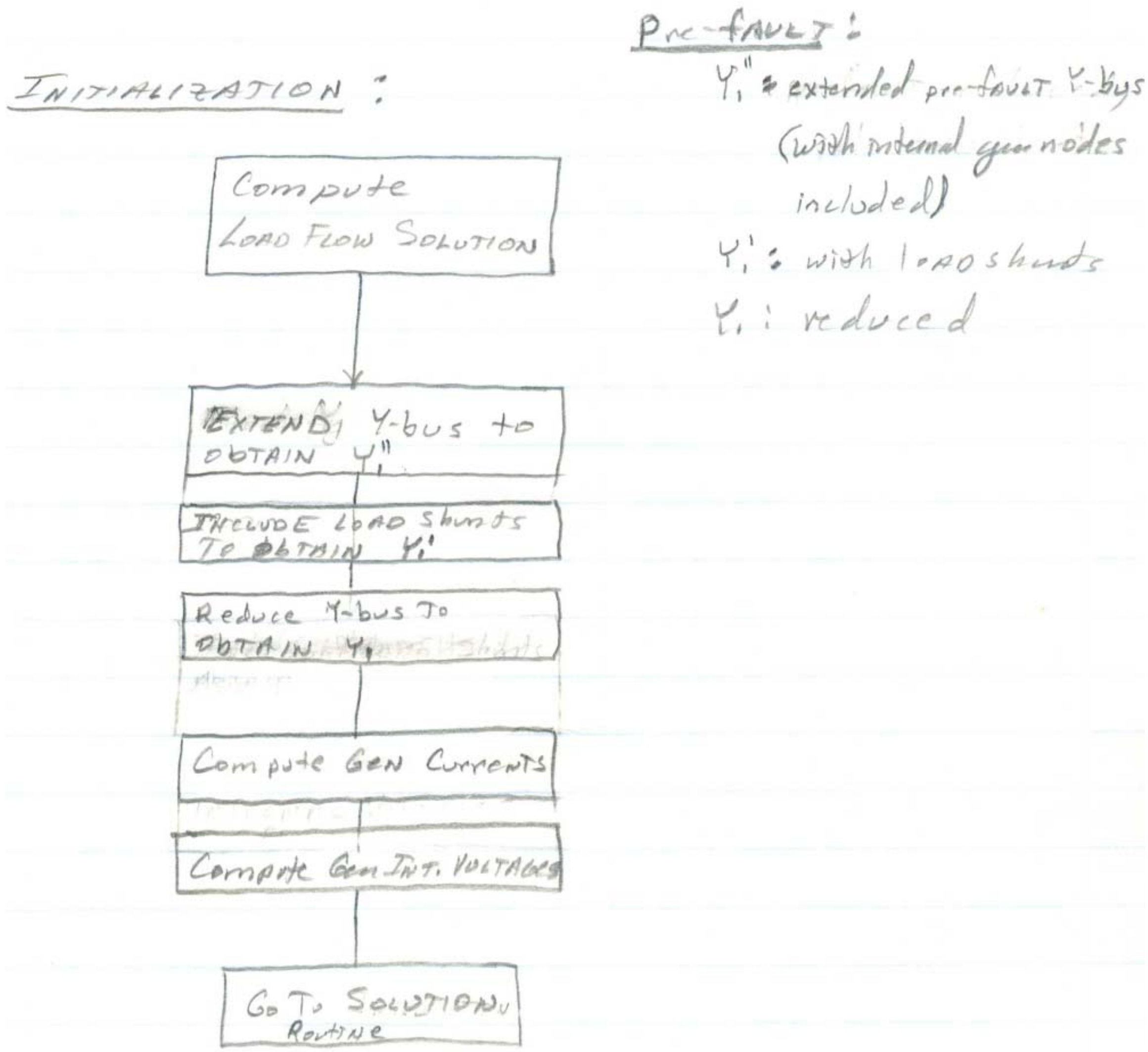
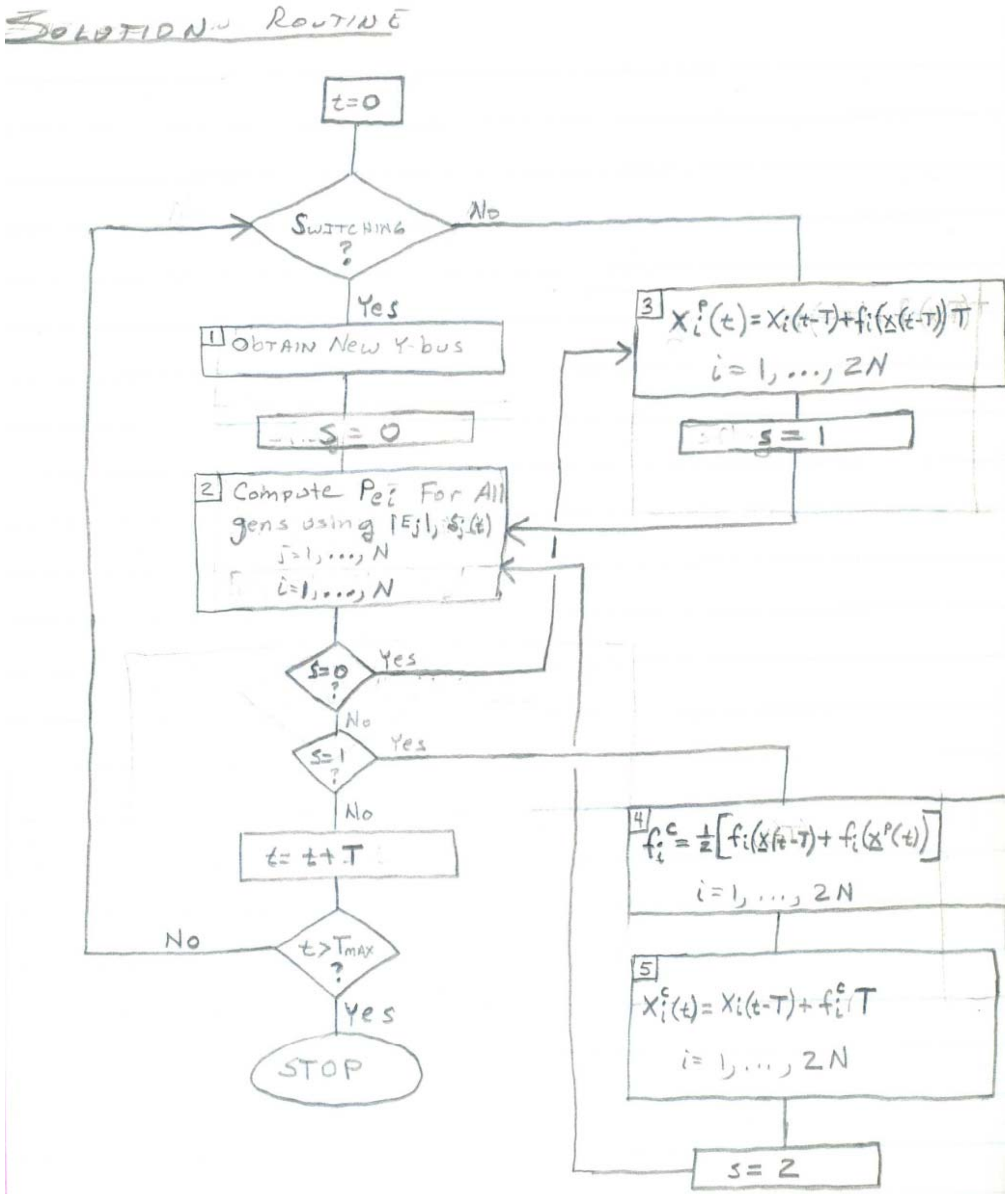
Homework #4, Due Thursday 3/4/09

A. Consider the below two flow-charts.





The numbers in the following questions correspond to the numbers in the blocks of the flow-chart.

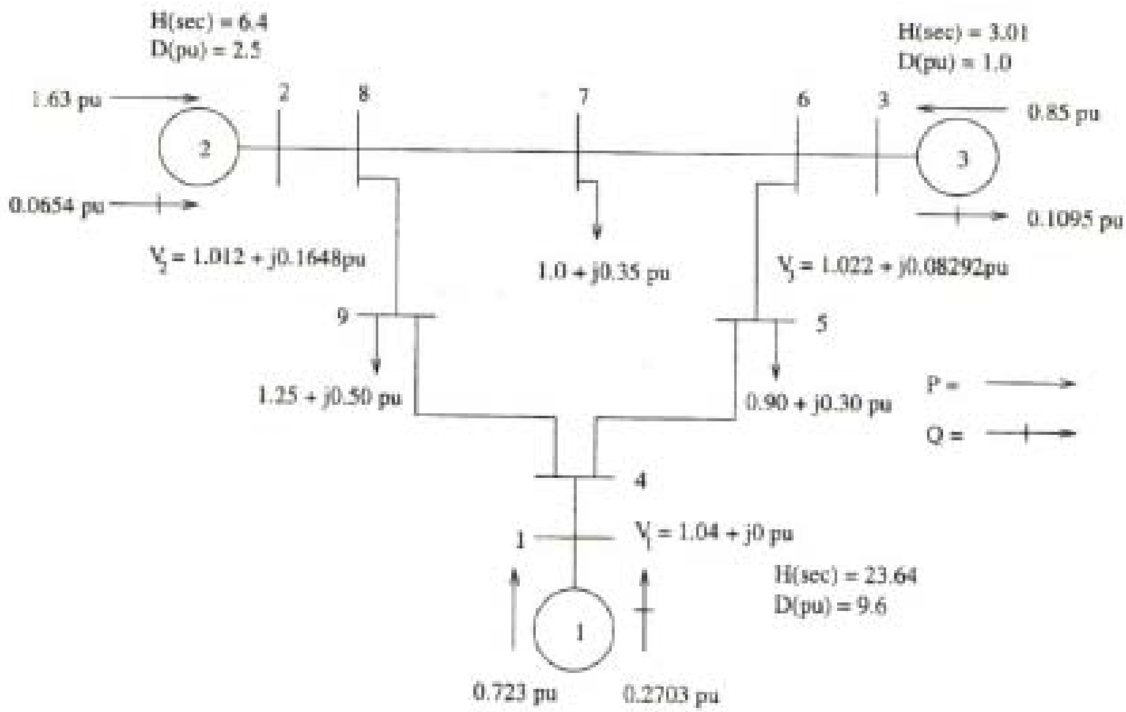
1. In obtaining the new Y-bus,
   a. What are the most typical switching events to consider?
   b. What techniques do you use for these events in modifying the Y-bus?
2. Consider the block where the bus powers are computed.
   a. What is N?
   b. What is the equation used to compute P_{ei} ?

c. When computing P_{ei} **for a particular bus i,** we must obtain voltages at other nodes.
    i. Do we need to obtain the terminal bus voltages? Why or why not?
    ii. What other nodes are there for which we need information? What information?
    iii. How would this step need to be changed if there were constant power and constant current loads represented in the network at the load buses?

3. Consider the integration scheme represented only in this block.
    a. What kind of integration scheme is it?
    b. Why do we recompute P_{ei} before taking another step?
    c. Why is the argument of f_i a vector?
    d. Why are there 2N of these equations?
    e. Give the form of these equations for 1 generator in terms of angles, speeds, P_{mi}, and P_{ei}.

4,5. Consider the steps in blocks 4 and 5.
    a. What kind of integration scheme is used as a result of steps 4 and 5?
    b. Give the form of the equations in steps 4 and 5 in terms of angles, speeds, P_{mi}, and P_{ei}.

B. For the three machine, nine-bus system shown below, a three-phase fault occurs at bus 8 at 0.0 seconds. The fault is cleared by opening line 8-9. Determine whether or not the system will remain stable for a clearing time of 0.12 seconds after application of the fault.



The power flow solution data are given below, where bus voltage angles are given in degrees, and bus voltage magnitudes, P and Q powers, and impedance data are all in per unit. H is given in seconds on the system MVA base.

i	V	θ	P_{gen}	Q_{gen}
1	1.0400	0	0.7164	0.2685
2	1.0253	9.2715	1.6300	0.0669
3	1.0254	4.6587	0.8500	-0.1080
4	1.0259	-2.2165		
5	1.0128	-3.6873		
6	1.0327	1.9625		
7	1.0162	0.7242		
8	1.0261	3.7147		
9	0.9958	-3.9885		

The generator data is:

i	x'_d	H
1	0.0608	23.64
2	0.1198	6.40
3	0.1813	3.01

The branch data is given below:

Bus 1	Bus 2	Admittance (pu)
1	4	-j17.3611
2	8	-j16.0
3	6	-j17.0648
4	5	1.9423-j10.5106
4	9	1.3652-j11.6041
5	6	1.2819-j5.5882
6	7	1.1546-j9.7843
7	8	1.6164-j13.6981
8	9	1.1874-j5.9752

Write a program which provides the following information. Report all of this information in what you turn in.

1. Internal machine voltage magnitudes and angles
2. Unreduced, prefault Y-bus.
3. Reduced prefault Ybus.
4. Reduced fault-on Ybus.
5. Reduced post-fault Ybus.

Develop the algebraic (discrete) equations necessary to solve the problem based on the trapezoidal integration scheme, given some Y-bus matrix.

Develop the linear equations necessary to iteratively solve the above algebraic equations. Express the Jacobian in terms of the necessary derivatives.

Extra credit (worth an additional homework grade): Extend your program to simulate the above system and fault using the trapezoidal integration method.