1. Like the example presented in Lecture 19, assume a two bus, two generator system in which the generators are connected by a single transmission line with per unit reactance of 0.1 (100 MVA base, used for the generators as well). Assume generator 1 has per unit values of $H = 4$, $D = 0$, $R_s=0$, $X'_d=0.08$, and generator 2 has per unit values of $H = 5$, $D = 0$, $R_s=0$, $X'_d=0.04$. If the initial power flow solution is $V_1=1.050\angle5.47^\circ$ and $V_2=1.0\angle0^\circ$. Calculate the initial 8 by 8 implicit Trapezoidal Jacobian matrix with a time step $\Delta t$ of 0.01 second, and variables $\delta_1$, $\Delta\omega_1$, $\delta_2$, $\Delta\omega_2$, $V_{D1}$, $V_{Q1}$, $V_{D2}$, $V_{Q2}$.

2. Book Problem 7.1 using PowerWorld except varying the real power load at bus 8 in 20 MW increments starting at 0 MW until you reach maximum loadability. Plot the voltage at bus 8. Case is saved as Prob_7_1a using a constant power load. Note, when increasing the real power load the reactive load is fixed at 35 Mvar.

3. Book Problem 7.2 using PowerWorld except with the load change again at bus 8 and equal participation factors for each of the generators. Start with the Prob7-2a case.

4. Assume a 60 Hz, single cage induction motor with per unit $H=1.0$, $R_s=0$, $X_s=0.07$, $X_m=4.0$, $R_r=0.02$, $X_r=0.06$ is operating with a terminal voltage of 0.95 and a slip of 0.05. Calculate the per unit real and reactive power consumption of the machine.

5. For the induction motor from problem 4 assume it is operating in the power flow with a terminal voltage of 0.95, and per unit power consumption of 3.0+j1.0. Determine the initial slip and induction motor reactive power consumption. Show your work.

6. PowerWorld case Problem 6-6 models the nine bus WSCC case with 100% induction motor load at each of the load buses. For a fault midway down the line between buses 4 and 6, cleared by opening the line, determine the critical clearing time before the motors stall. The fault is assumed to occur at $t=1.0$. Repeat your analysis with the motor $H$ changed from 1.0 to 0.5 and then again with the value changed from 1.0 to 2.0.

7. Assume the motor in problem 4 is supplied by an infinite bus with unity voltage from a transmission line with $X=0.1$ per unit. If the motor is initially open and then energized at time $t=0$, use Euler’s method to determine the motor state variables for the first 3 timesteps. Pick a reasonable time step.