EE 742 - Fall 2015 – Final Exam (Take Home Portion)

Name:…….

Consider the power system below with 3 generators, 9 buses, 3 load centers, 3 transformers, 6 transmission lines. The data and pre-conditions are also given below. It is desired to conduct a voltage stability study using PowerWorld software. The slides found in the links below are helpful when performing such a study.

1) Derive the P-V curve at unity power factor for busses 5, 6, and 8.
    a. Let the load on the other busses be fixed to the specified values.
    b. Let the specified generator voltages be fixed at the specified values.
    c. Let the power generated by generators 2 and 3 vary in the same proportion as the base case.
2) Derive the P-V curve for the same buses above.
    a. Let the load on the other busses be fixed to the specified values.
    b. Let the real power of the load at the bus under study be fixed at the specified value.
    c. Let the specified generator voltages be fixed at the specified values.

http://www.powerworld.com/files/S06PVCurves.pdf
http://www.powerworld.com/files/S07QVCuvers.pdf

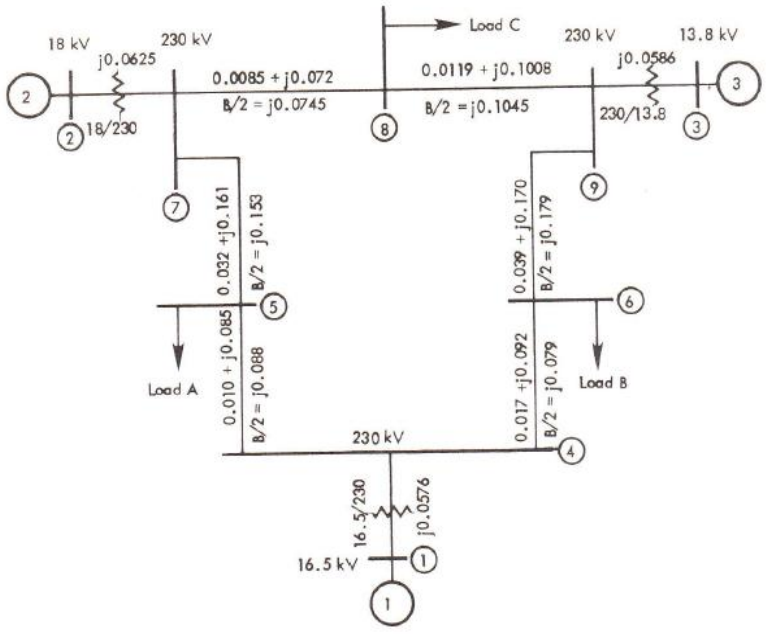

Table 2.2. Prefault Network

	Bus no.	Impedance		Admittance	
		R	*X*	*G*	*B*
Generators*					
No. 1	1-4	0	0.1184	0	−8.4459
No. 2	2-7	0	0.1823	0	−5.4855
No. 3	3-9	0	0.2399	0	−4.1684
Transmission lines					
	4-5	0.0100	0.0850	1.3652	−11.6041
	4-6	0.0170	0.0920	1.9422	−10.5107
	5-7	0.0320	0.1610	1.1876	−5.9751
	6-9	0.0390	0.1700	1.2820	−5.5882
	7-8	0.0085	0.0720	1.6171	−13.6980
	8-9	0.0119	0.1008	1.1551	−9.7843
Shunt admittances†					
Load *A*	5-0			1.2610	−0.2634
Load *B*	6-0			0.8777	−0.0346
Load *C*	8-0			0.9690	−0.1601
	4-0				0.1670
	7-0				0.2275
	9-0				0.2835

*For each generator the transformer reactance is added to the generator x'_d.
†The line shunt susceptances are added to the loads.

Table 2.1. Generator Data

Generator	1	2	3
Rated MVA	247.5	192.0	128.0
kV	16.5	18.0	13.8
Power factor	1.0	0.85	0.85
Type	hydro	steam	steam
Speed	180 r/min	3600 r/min	3600 r/min
x_d	0.1460	0.8958	1.3125
x'_d	0.0608	0.1198	0.1813
x_q	0.0969	0.8645	1.2578
x'_q	0.0969	0.1969	0.25
x_ℓ (leakage)	0.0336	0.0521	0.0742
τ'_{d0}	8.96	6.00	5.89
τ'_{q0}	0	0.535	0.600
Stored energy at rated speed	2364 MW·s	640 MW·s	301 MW·s

Note: Reactance values are in pu on a 100-MVA base. All time constants are in s. (Several quantities