New Mexico State University
Klipsch School of ECE
EE 493/543 – Power Systems III
Fall 2009
Project Part - I
Due: Monday, 10/30/2009, 4 PM – will *not* be extended.

Name (print) :_____

ID # :_____

I have neither given nor accepted help on this test

Signature:_____

Parts	Maximum Points	Actual Score
1	10	
2	05	
3	35	
4	10	
5	10	
6	30	
Total	**100**	

You may use MATLAB® or any other programming language of your choice. Any ready EMS software (like Powerworld®) is not permitted.

Note: You will submit your code for me to cross-check your answers. For grading, your answers will be cross-checked with the results from the code that you will submit. The code will consist of ONE file that needs to be run, and all the results should be displayed either on the MATLAB command window, or stored in a file. Any results that are not displayed properly with accompanying legend will NOT be considered for grading.

This is a take-home exam. NO interactions between students are permitted. Please follow the code of ethics very strictly. Any defaults will result in zero-grade and will be formally reported to the department.

Following are the data for a 6-bus power system rated at 115 kV_{L-L}. Take the three-phase power base of 100 MVA for conversion to per unit.

Bus	Load (MVA)	Generation	Capacitors (MVAR)
1 (Slack)	50 + j80	Yes	
2	95 + j50	---	70
3	60 + j110	200 MW	
4	70 + j100	---	80
5	80 + j40	120 MW	
6	40 + j50	---	60

Line		Length (km)
From-Bus	To-Bus	
1	2	70
1	3	90
2	4	80
4	5	100
4	6	50
5	6	85
3	5	60

The impedance of all lines is 0.1 + 0.4 Ω/km. Generators on bus 3 and bus 5 keep the bus voltage magnitude constant at 1.05 per unit. The slack bus voltage is $1.01/\_0^0$ per unit.

Answer the following questions. For parts (1) through (4), assume the capacitors are ***not connected*** to the system.

1) Formulate the bus admittance matrix in per unit. Show it in polar form below:

Y_{BUS}=

2) Identify generator buses and load buses. Enter in the table below the type of each bus, and known/unknown quantities (in per unit) at each bus.

Bus	**Type**	**Known Quantities (specified)**		**Unknown Quantities**	
1	Slack				
2					
3					
4					
5					
6					

3) Obtain load flow solution assuming a flat voltage start using ***Newton-Raphson*** method. Show below the voltages and angles at all buses at the end of every iteration. Consider tolerance of 1×10^{-5} per unit power. Add/delete rows according to the actual number of iterations you have.

Iteration	**Bus#1**		**Bus#2**		**Bus#3**		**Bus#4**		**Bus#5**		**Bus#6**	
	|V|	**δ**	**|V|**	**δ**	**|V|**	**δ**	**|V|**	**δ**	**|V|**	**δ**	**|V|**	**δ**
1												
2												
3												
4												
5												
6												
7												
8												
9												

4) Tabulate the final voltages, loads, generations, and injections at all the buses below.

Bus	**|V|**	**δ**	**Load**		**Generation**		**Injection**	
			MW	**MVAR**	**MW**	**MVAR**	**MW**	**MVAR**
1								
2								
3								
4								
5								
6								

5) Show the final line-flows, and line losses, below. Perform a power-check on your results.

From-Bus	To-Bus	Injected Power		Power Loss	
		MW	MVAR	MW	MVAR
1	2				
1	3				
2	1				
2	4				
3	1				
3	5				
4	2				
4	5				
4	6				
5	3				
5	4				
5	6				
6	4				
6	5				
POWER CHECK					
Total Power Generated		Total Load		Total Loss	
MW	MVAR	MW	MVAR	MW	MVAR

6) Repeat parts (4) and (5) with shunt capacitors connected. Describe how you will formulate the problem. What is the difference in results? Explain the reasons for this difference.

Bus	|V|	δ	Load		Generation		Injection	
			MW	MVAR	MW	MVAR	MW	MVAR
1								
2								
3								
4								
5								
6								

From-Bus	To-Bus	Injected Power		Power Loss	
		MW	MVAR	MW	MVAR
1	2				
1	3				
2	1				
2	4				
3	1				
3	5				
4	2				
4	5				
4	6				
5	3				
5	4				
5	6				
6	4				
6	5				
POWER CHECK					
Total Power Generated		**Total Load**		**Total Loss**	
MW	**MVAR**	**MW**	**MVAR**	**MW**	**MVAR**