Name:……………….
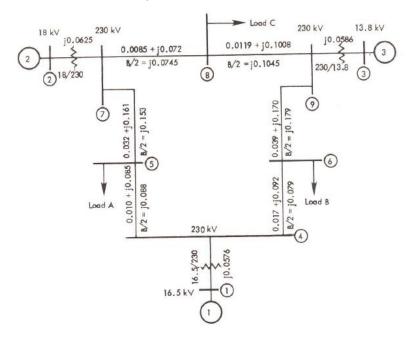
Consider the power system below with 3 generators, 9 buses, 3 load centers, 3 transformers, 6 transmission lines. The data and pre-conditions are also given below.

1) Verify the power flow displayed in the last figure – use bus 1 as a reference.
2) Suppose a 3-phase fault occurs near bus 7 of the transmission line 5-7. The fault lasts for 5 cycles, then it is cleared by removing the faulted line. Will the system remain stable? Plot the 3 power angles for a period of 2 seconds.
3) Repeat 2) if the fault lasts for 10 cycles before it is cleared.

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