ECE 470 POWER SYSTEMS I

Test # 1 - Fall 2002

NAME _____

BOX # _____

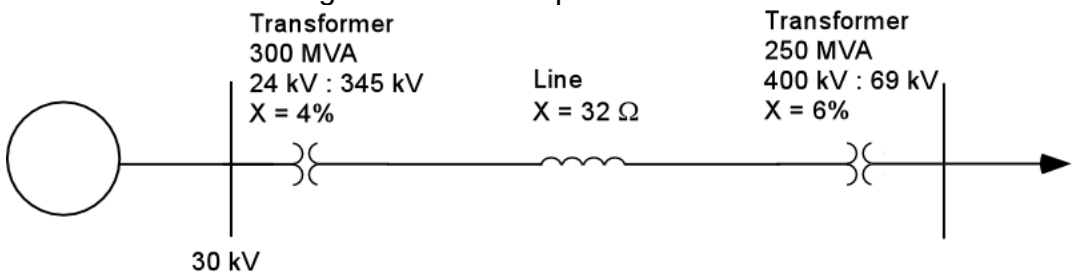
Attempt all four questions.
NO PARTIAL CREDIT will be given for incorrect answers without a full explanation of the solution procedure followed.
Textbooks permitted.
Time allowed - two periods.

Question #	Possible Points	Awarded Points
1	**25**	
2	**25**	
3	**25**	
4	**25**	
Total	**100**	

1.

In the system shown below, the **generator** bus is to be held at 30 kV. The current in the line is metered at 866 A, 0.9 lagging. Working on bases of 500 MVA and 69 kV in the load circuit:

a) draw the pu reactance diagram,
b) determine the resulting load terminal voltage (kV), and
c) determine the resulting load MVA and power factor.



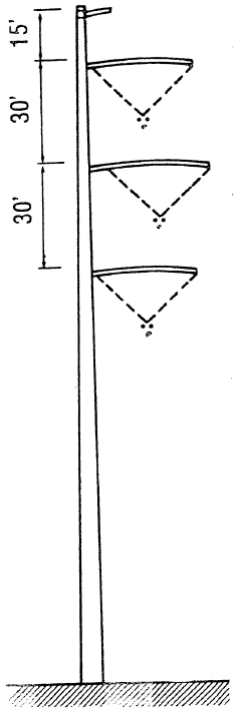
b) 67.7 kV
c) 588.8 MVA, 0.989 lag

2.

A 500 kV overhead transmission line consists of Pheasant ACSR on vertical poles as shown. The inter-phase spacing is 30', while the intra-phase conductor spacing is 18" with three conductors/bundle. The line is 150 miles long and operates at 110 °C.

a) Determine the pi equivalent circuit in terms of: R, X_L, X_C.

b) Determine the nominal charging current.



a) R = 4.8 Ω, X_L = 79.8 Ω, X_C = 850 Ω

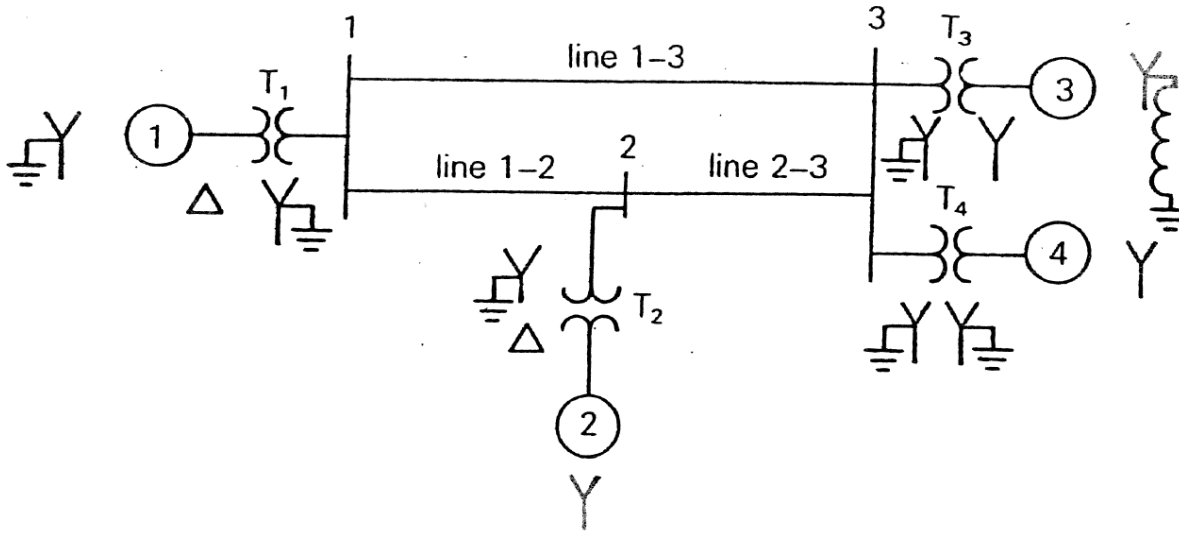
b) I_{CHG} = 339.6 A

3.

The single-line diagram of a 3ϕ power system is shown below. The system data, on equipment rating bases are:

G1	13.8 kV	20 MVA	X = 0.2	
G2	18kV	30 MVA	X = 0.2	
G3	20kV	30 MVA	X = 0.165	
G4	20kV	25 MVA	X = 0.165	
T1	13.8/220kV	25 MVA	X = 10%	
T2	18/127kV	10 MVA	X = 10%	**3 x 1ϕ units**
T3	22/220 kV	35 MVA	X = 10%	
T4	22/220 kV	35 MVA	X = 10%	
L1-2	220 kV		X = 80 Ω	
L1-3	220 kV		X = 100 Ω	
L2-3	220 kV		X = 80 Ω	

Draw the impedance diagram using 100 MVA, 220 kV base in the zone of each line.



4. A 288 MVA, 24 kV, 60 Hz, two-pole, Y-connected, **cylindrical-rotor,** synchronous machine has a rated field current of 1200 A, the synchronous reactance is 2.5 Ω. The excitation voltage (E_f) at the rated speed is 28 kV (line) when the field current is 800 A.

a) Determine the Armature Current rating of the machine.
b) Construct the capability curve for rated generator operation.
c) Determine the power factor and the load angle for rated conditions.
d) Determine the driving torque if the Rotational Losses are 10 MW.

a) 6928 A
c) 0.98 lag and 44.4^0
d) 775 kNm