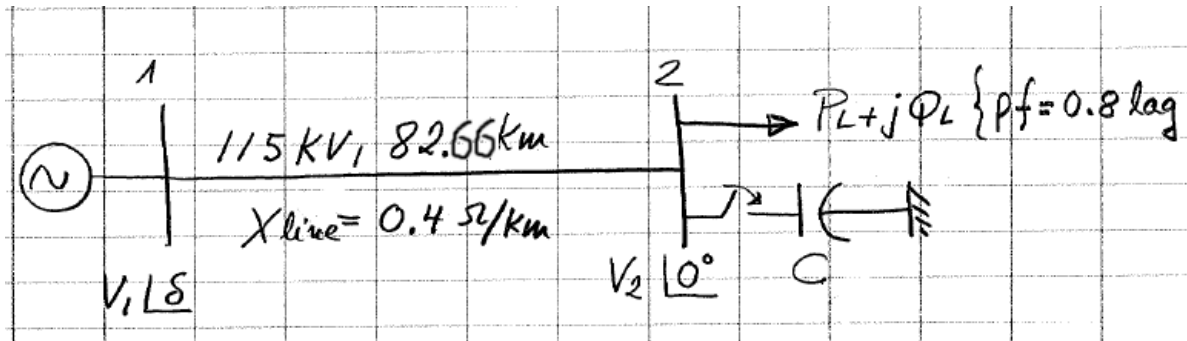


### ASSIGNMENT No. 3

Due Date: Tuesday 7 November  
**POWER CIRCLE DIAGRAM**

Consider the following power transmission system



System Base: 100 MVA, 115 kV at bus 1. Bus 1 is voltage regulated.

Draw a per unit Power Circle Diagram at the receiving-end bus 2 to answer the following questions:

1. With  $V_2 = 1.0$  pu and  $V_1 = 1.05$  pu, determine the maximum active power that can be transmitted without exceeding a transmission angle of  $\delta = 30^\circ$ .
2. Suppose the load  $P_L$  has the value calculated in 1). Taking now into account that  $Q_L$  is related to  $P_L$  by a power factor  $pf = 0.8$  lagging, determine the reactive power  $Q_c$  (in MVAR) that must be provided by a bank of capacitors to satisfy the operating condition of 1), that is:  $V_2 = 1.0$ ,  $V_1 = 1.05$ ,  $\delta = 30^\circ$ ,  $P_L$  as in 1,  $Q_L$  as required by the power factor. Calculate also the value of the capacitors  $C$  in  $\mu F$  assuming they are connected in star.
3. Suppose that in order to save money only half of the  $Q_c$  calculated in 2) is installed. What would now be the needed  $V_1$  and  $\delta$  to maintain  $V_2 = 1.0$ ?
4. Verify all your answers using the power transfer formula:  $P_2 = \frac{V_1 \cdot V_2}{X} \sin \delta$