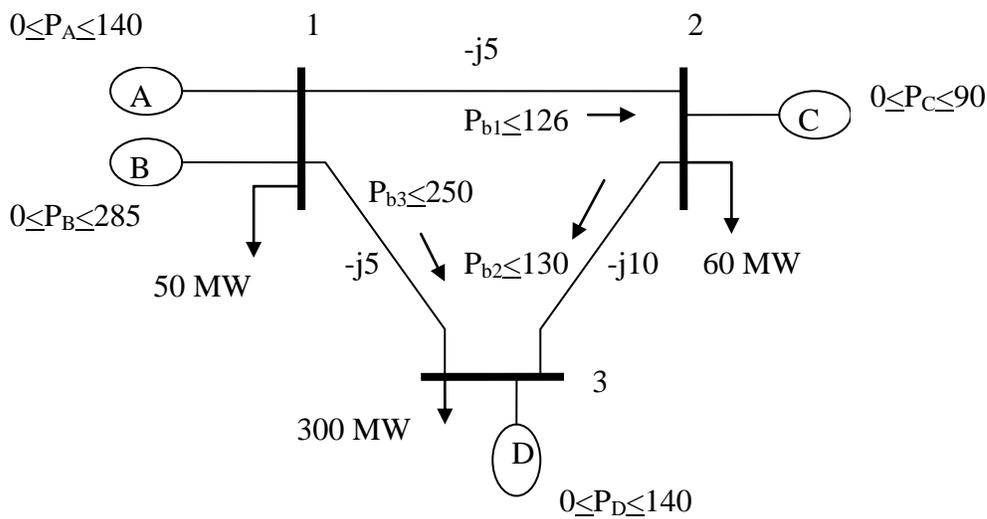


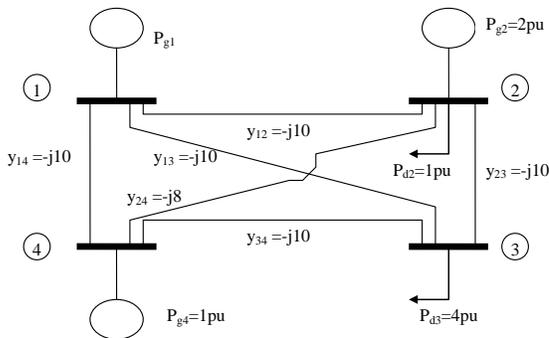
EE 458, Fall 2019: HW 7, Due Tuesday Nov 5

A. Set up a linear program in Matlab or CPLEX to solve the linearized optimal power flow problem for the system and data shown below. There are 4 generators: A, B, C, and D. Line admittances given on the diagram (-j5, -j5, -j10) are in per unit. Provide your Matlab or CPLEX code, the dispatch, flows, total cost, and all Lagrange multipliers.



The offers submitted from owners of units A, B, C, and D are 7.5, 6, 14, and 10, respectively, all in \$/MWhr.

B. You solved the following optimization problem in HW6.



B1. Using this same system, set up the optimal power flow as a linear program assuming the objective function is the same as used

in the example in class when we investigated the case of demand bidding, i.e.,

$Z = 1307P_{g1} + 1211P_{g2} + 1254P_{g4} - 1300P_{d2} - 1200P_{d3}$. Also, assume each generator has a lower limit of 100 MW and an upper limit of 300 MW, which will be (in per unit):

$$1 \leq P_{g1} \leq 3$$

$$1 \leq P_{g2} \leq 3$$

$$1 \leq P_{g3} \leq 3$$

and the loads are constrained as follows:

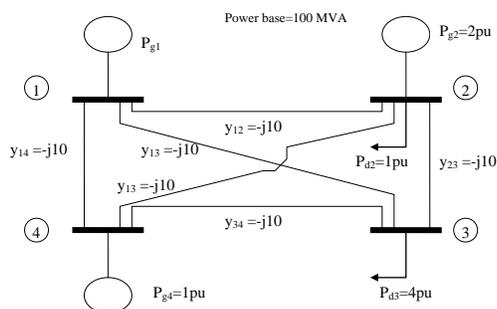
$$1 \leq P_{d2} \leq 2$$

$$2 \leq P_{d3} \leq 3$$

B2: Provide the value of the objective function and values for all primal decision and auxiliary variables and dual variables at the optimal solution. Also identify the settlement, i.e., identify how much each load pays and how much each generator pays.

B3: Now constrain the flow on branch 3 to $P_{b3}=P_{23}=0.45$ pu and resolve. Provide the value of the objective function and values for all solution variables and dual variables at the optimal solution. Also identify the settlement, i.e., identify how much each load pays and how much each generator pays. Finally, compute the congestion charges as the difference between total load payments made and total generator payments received, and also using the dual variable of the constrained branch.

C. Using the system below, compute the \underline{T} matrix of generation shift factors for every branch. Make the computation in two different ways, according to the following instructions.



C1: Assume bus 1 compensates for all changes, i.e., bus 1 is the slack bus.

C2: Assume a distributed slack, with all buses compensating equally.

C3: Use the elements of the appropriate T-matrix above to compute the flows for a change in generation at bus 2 from 2 to 4 per unit, compensated by reduction at bus 1. Perform the calculations for each branch to get the new branch flow using the original branch flow plus the change in branch flow, where the change in branch flow is computed from the appropriate elements of the appropriate \underline{T} matrix. The original branch flows are given by

$$\begin{bmatrix} P_{B1} \\ P_{B2} \\ P_{B3} \\ P_{B4} \\ P_{B5} \\ P_{B6} \end{bmatrix} = \begin{bmatrix} 0.25 \\ 0.25 \\ 1.25 \\ 1.25 \\ 1.5 \\ 0 \end{bmatrix}$$