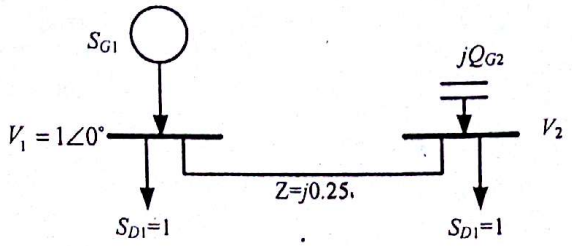
ELL/EEL303 Power Engineering

Minor III | **May 4, 2016** | **Maximum Marks: 25**

One A-4 size "cheat-sheet" is allowed in the exam, with anything written on it. No one is allowed to share anything, including calculators. Anybody found using unfair means will be expelled from the exam.

1. Why is the LG fault more severe than the LLLG fault, when it occurs at the terminals of a generator? 2

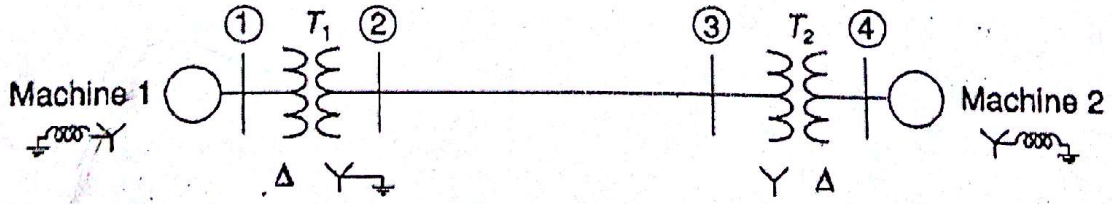
2. For the system below, $Q_{G2} = 0$. Find the resultant voltage on bus 2 using the circle diagram technique. 3



3. Two transformers connected in parallel have the following reactances on a 100MVA base: $X_1 = 0.10$ *pu* and $X_2 = 0.14$ *pu*. The second transformer (T_2) is equipped with a tap changer. It is required to adjust the tap on T_2 so that the flow through T_2 is reduced by 12 MVAr, which is picked up by T_1. Find the tap position for T_2 needed to obtain the desired flow. 6

4. Compare the time taken to accelerate a 86 MVA hydro unit with $W_k = 233$ *MJ* and a 76.8 MVA nuclear unit with $W_k = 281.7$ *MJ* from zero to rated shaft speed under application of rated prime-mover torque with stator open. [W_k: kinetic energy of turbine + generator at rated shaft speed] 2

5. Machines 1 and 2: 90 MVA, 18.5 *k*V, X_1=X_2=0.2, X_0=0.4, X_n=0.05. Transformers T_1 and T_2: 112 MVA, 20Δ/345Y *k*V, X_1=X_2=X_0=0.08. Transmission line between buses 2 and 3 has X_1=X_2=0.12 pu, X_0=0.4 *pu* on a 100MVA, 345 *k*V base. 8
For a L-L fault occurring on bus 2, calculate the post-fault line currents (all phases, in amperes) in the two machines, ignoring pre-fault loading conditions.
[Assume the transformers produce a phase shift of 90° between the LT and HT side of the transformers such that the LT side quantities lead (lag) the HT side in the positive (negative) sequence.]



6. Consider a single machine connected to an infinite bus, via a double circuit transmission line. A temporary LLLG fault occurs on one circuit close to the generator terminals, and the line is tripped by the circuit breaker. An *auto-recloser* may attempt to restore the line soon afterwards. If the fault is self-clearing, the line stays connected, else the recloser again trips the line. 4
Using the Equal Area Criteria, discuss how the system stability is improved by the recloser action by indicating the effect of recloser on the accelerating and decelerating areas.