بسم الله الرحمن الرحيم

Minoufia University		4 Th year
Faculty of Engineering	10/6/2014	Time: 3 hours
Elect. Eng. Department	Control of power system	max. 70 marks.

1-A. Define the Blondel currents and explain their physical significance. Show how you can use the Blondel transformation to reduce the 3-phase synchronous machine voltage equations to the d-q-o system equations. (Comment on the simplicity obtained by using this transformations)

B . A generator having a synchronous reactance of 0.9 p.u. based on its own rating is connected via a transmission line to a remote bus, the voltage at which we may assume is kept constant at a value of 100 percent. The line has an impedance of J 0.15 p.u. per phase, based upon the mega volt-amperes. The internal e.m.f. E, of the machine is kept at a constant amplitude of 135 percent.

i- Compute the pullout power of the machine (operated as a generator)

ii- At the moment of pullout, determine magnitude and direction of both the generator terminal and the remote bus reactive power.

iii- At the moment of pullout, what is the terminal voltage?

iv- Is the machine current overloaded at pullout?

[20 Marks]

2- A. Mention the excitation types for synchronous generating units. Draw a schematic diagram for the brushless excitation system , then derive its model equations and draw the block diagram.

B. For the above excitation system, if:

$K_A = 100$, $T_A = 0.05$sec. , $K_E = 1.0$, $T_E = 0.5$ sec.

$K_F = 1$, $T_F = 3$ sec.

1- Construct a carefully drawn root locus plot for:

i- The system without stabilizing loop.

ii- The system equipped with a stabilizing transformer across the regulator and has a transfer function of : (1+ 0.5 s)

2- Calculate ζ and ω_n for the upper two cases and comment on the results.

3- If the generator load increased resulting in a decrease in the effective field inductance so the field time constant decreases from 3 s to 1 sec, is the system stability changes.

4- Prove that the static accuracy requirements conflicts with the requirements for stability

[20 Marks]

3- A. Draw a schematic diagram of the speed governing system for a synchronous generating unit and describe its function. Then derive its model equations and draw the block diagram.

B. Discuss briefly the turbine function and draw its block diagram

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C. If the machine is represented by a simple transfer function $G_P(s)$, to complete the closed loop (ALFC) and the system has the following data:

(f = 50 hz)

Total rated capacity P_r =2000 MW
Total operating load P_D = 1000 MW

Inertia constant H = 5 sec.
Regulation R = 2 Hz/P.u. MW.

i-Determine the primary ALFC loop parameters.
ii- If the load demand increased by 20 MW, Find the static frequency drop for the two following cases:
1- governor operate 2- governor opened
iii- Explain how we can eliminate the accumulator frequency error.
iv- If the frequency kept constant how we make the generator increase its turbine power by the increased load demand.

[20 Marks]

4-A. What is meant by:
Free governor action - Regulation due to governor action
Synchronous generator stiffness - Power frequency dependency
Isochronous control

B. Two synchronous generators operate in parallel and supply a total load of 300 MW. The capacities of the machines are 150 MW and 200 MW . Assuming free governor action, we found that machine one take 128.6 MW and machine two take the remainder of the load and the difference between the no load speed and the common speed at this setting is 0.034 p.u. Calculate the speed droop characteristics from no-load to full-load.

[10 Marks]

Good luck... *Prof Dr/ Gamal A. Morsy*