ECE473 CONTROL OF POWER SYSTEMS

Lab # 6 – Secondary Automatic Load-frequency Control

Repeat lab 5 allowing for secondary ALFC. Save the block diagram from lab 5 and then add the additional AGC feedback loops as shown on the attached figure. You will need to make several runs in order to get appropriate values for K_1 and K_2 (assume they are equal). Vary these constants (qualitatively) and see how they affect the performance of the system.

Note that while K_1 and K_2 are equal on their own system base, their values have to be adjusted to put them on a common 100 GVA base e.g., for K = 1.0 pu:

K_1 = 1.0 pu on a 15 GVA base = $1.0 \times \frac{15}{100} = 0.15$ pu on a 100 GVA base

K_2 = 1.0 pu on a 60 GVA base = $1.0 \times \frac{60}{100} = 0.6$ pu on a 100 GVA base

Refer to the conditions in homework 5 problem 3. The utility in question may be represented by a single unit without re-heat and the following characteristics:

- Governor time constant = 0.2 sec.
- Steam chest time constant = 0.2 sec.
- Angular Momentum, M = 5 pu.

The interconnection may be represented by a single unit without re-heat and the following characteristics:

- Governor time constant = 0.3 sec.
- Steam chest time constant 0.4 sec.
- Angular Momentum, M = 7 pu.
- Tie-line synchronizing power co-efficient, T = 1 pu, 10 pu.

The values of regulation and load damping are given in the homework problem. All pu quantities are on local base and should be converted to 100 GVA base.

Select two appropriate values of T, draw the block transfer function diagram of the interconnected system and determine $\Delta f(t)$ and ΔP_{12} (t) for the loss of the 3 GW station. Using plots of f(t) and $P_{12}(t)$, determine:

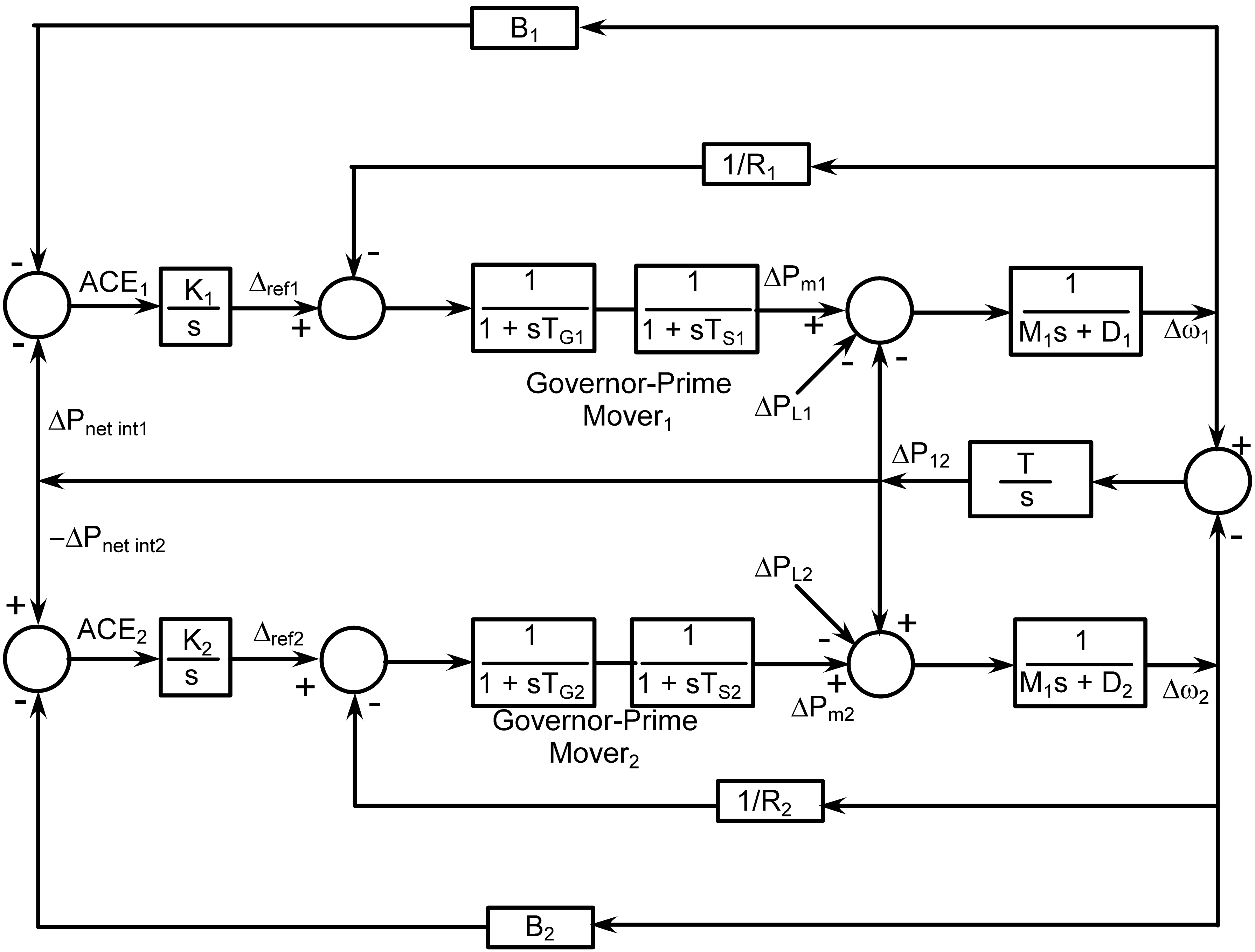
i) the maximum, minimum and steady-state values of f(t) and $P_{12}(t)$,

ii) the approximate value of damping co-efficient, ζ, by assuming that the response is second-order dominated ($\zeta = \alpha/\omega_o$),

iii) the frequency of the tie-line oscillations,

iv) how long it will take for the frequency error to drop below 10 mHz and

v) the amount of load shed (if any) by underfrequency load-shedding relays (compare this with the results of lab 5).


B1
1/R1
ACE1
K1/s
Δref1
1/(1 + sTG1)
1/(1 + sTS1)
ΔPm1
1/(M1s + D1)
Δω1
Governor-Prime Mover1
ΔPL1
ΔPnet int1
ΔP12
T/s
−ΔPnet int2
ΔPL2
ACE2
K2/s
Δref2
1/(1 + sTG2)
1/(1 + sTS2)
1/(M1s + D2)
Δω2
ΔPm2
Governor-Prime Mover2
1/R2
B2