King Saud University
Department of Electrical Engineering
Power Systems Operation and Control (EE 585)

First Semester 1435/1436 | First Midterm Exam | Time Limit: 1.5 hours

الاسم: الرقم:

Question 1:

A) Three generating units have MW ratings and speed-droop characteristics as follows:-

Unit1: 500 MW, speed-droop 4%,

Unit 2: 400 MW, speed-droop 5%

Unit 3: 300 MW, speed-droop 6%

The three units are operating in parallel at their rated MW and 60 Hz to supply the loads as shown in Fig 1. If the 400 MW load is disconnected and at the same instant unit 3 is shut-down, determine the new system frequency and the new power output of each unit.

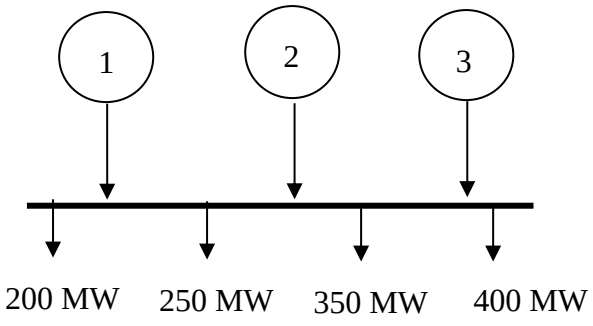

Fig. 1

B) Three thermal units with incremental fuel cost (IFC) as follows:-

$IFC_1 = 0.009\ Pg_1 + 7.0$

$IFC_2 = 0.008\ Pg_2 + 8.0$

$IFC_3 = 0.007\ pg_3 + 9.0$

Determine Pg_1, Pg_2, and Pg_3 for economic operation to supply a total demand of 1200 MW. Neglect system losses.

Question 2:

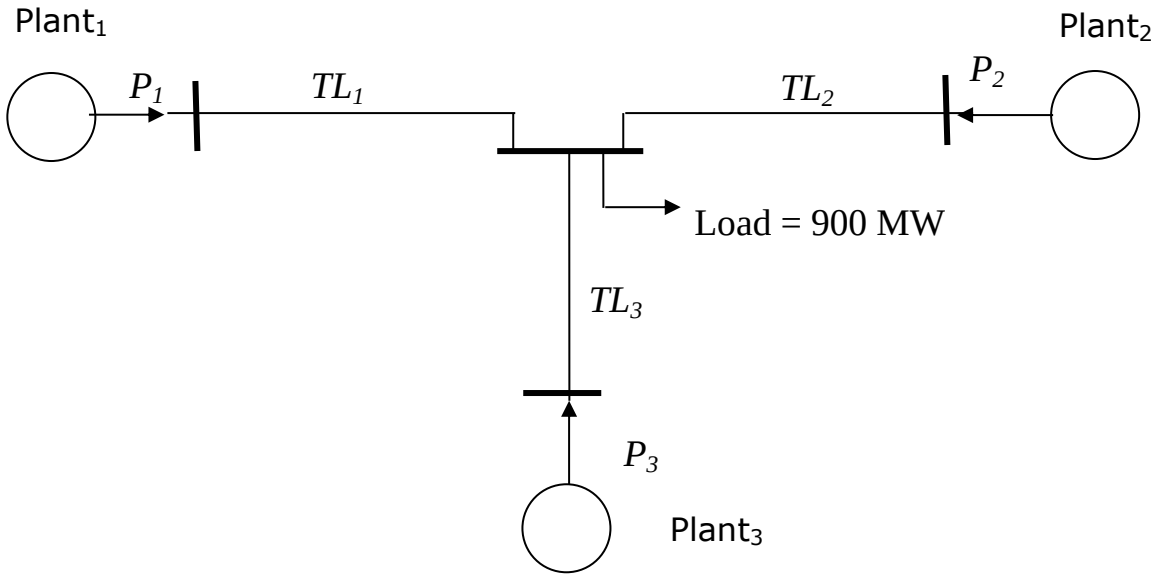

Fig. 2

A power system consists of 3 plants with output power P_1, P_2, and P_3 as shown in Fig. 2, and incremental fuel cost (IFC) as follows:-

IFC of Plant$_1$ = 11 + 0.08 P_1 SR/MW-hour.

IFC of Plant$_2$ = 13 + 0.12 P_2 SR/MW-hour.

IFC of Plant$_3$ = 15 + 0.04 P_3 SR/MW-hour.

Transmission line losses are given by:

Transmission line losses in TL_1 = $6\times10^{-5}\times P_1^2$

Transmission line losses in TL_2 = $8\times10^{-5}\times P_2^2$

Transmission line losses in TL_3 = $4\times10^{-5}\times P_3^2$

Where P_1, P_2, and P_3 are in MW.

For a total system demand of 900 MW, determine P_1, P_2, and P_3 for economic operation.

Question 3:

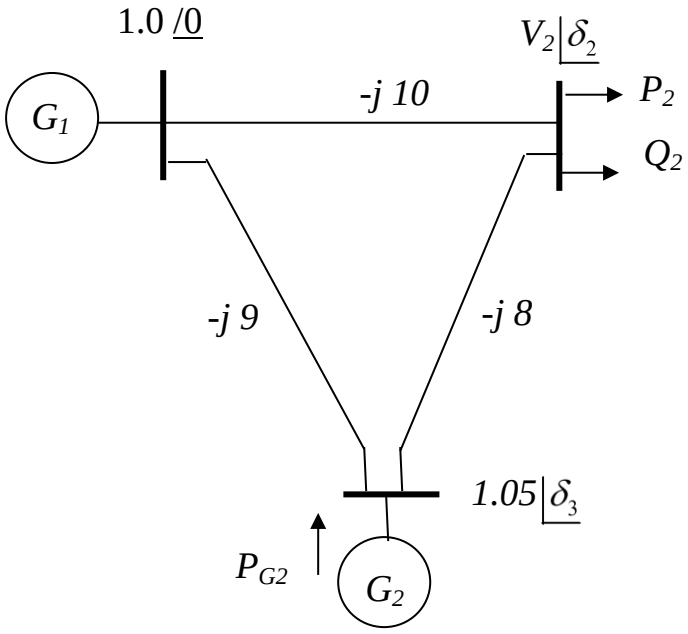

Fig 3.

a) For the system shown in Fig 3, write equations for P_2, P_{G2}, and Q_2 in terms of V_2, δ_2, and δ_3.
b) Assuming $P_{G2} = 1.2$, $P_2 = 2$, and $Q_2 = 1$, all in pu, determine V_2, δ_2 and δ_3