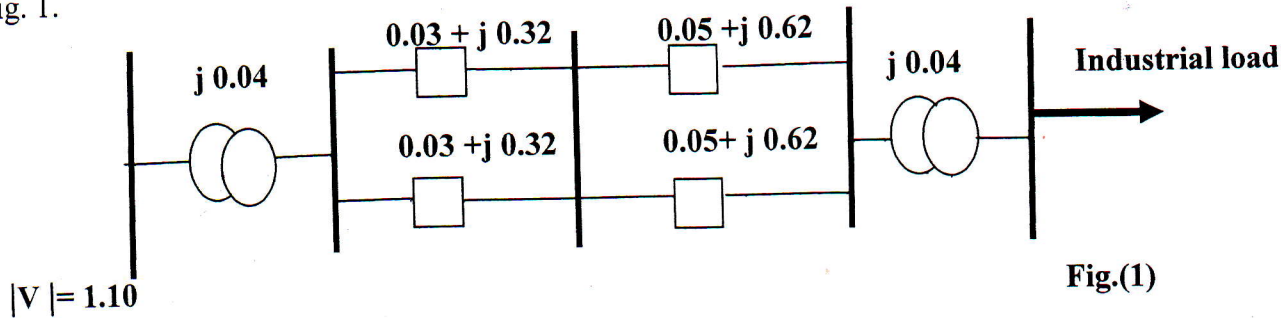


ANSWER THE FOLLOWING QUESTIONS

1- a) For a given power system define each of the following items:

Voltage stability and voltage instability ---- Voltage drop and voltage dip ----- A voltage stability criterion ----- The voltage collapse.

1- b) An industrial load is fed, through a double circuit transmission network, from a constant voltage bus, as shown in Fig. 1.



Assuming the connected load power factor to be **0.85 lag**, plot the $P_L - V_L$ graph (take the power step equals **0.20 pu**).

Then, i- For the load constant impedance $Z_L = 1.0$ pu, find both of its power margin and voltage regulation.

ii- Find the load impedance for which the voltage instability will be occurred.

iii- Assuming the load power factor to be improved to **0.98 lead**, plot the new $P_L - V_L$ graph (take the power step equals **0.30 pu**), and repeat the computations, as given in the last two items, Comment on the results.

Now, let the connected load to be a constant power load $P_L = 0.70$ pu, with power factor **0.75 lag**, plot the $Q - V_L$ characteristic (start with $Q = -0.20$ pu, and take the steps $\Delta Q = \pm 0.10$ pu). Then,

1- Determine the needed injected reactive power when the voltage regulation at the load bus is equal to **5 %**.

2 and the minimum voltage value across the load terminals, and determine the corresponding injected reactive power.

2- a) Discuss, briefly, each of the following items:

- i- Characteristic harmonics, zero-sequence harmonic currents, and inter-harmonics.
- ii- Four sources of harmonics, and five effects of such harmonics.
- iii- Series and shunt harmonic filters.
- iv- Three techniques used for harmonic suppression.
- v- Quality factor, band-pass width, corner frequencies, and sharpness of a given single-tuned filter.

2- b) A series circuit consists of **10 ohms** resistor, **20 mH** inductance, and **135 μ F** capacitor, is connected to an AC supply for which the instantaneous voltage is given as,

$$e(t) = 500 \sin(314t) + 110 \sin(942t + \pi/3) + 45 \sin(1570t + 5\pi/6).$$

Find: 1- The circuit instantaneous current equation.

2- The instantaneous voltage across each of the circuit elements.

3- The circuit active power loss.

4- The circuit voltage and current total harmonic distortion indices.

2- c) A six-pulse converter is connected to a 33-kV, 50 Hz, 3-phase supply. The converter mean active and reactive powers are 50 MW, and 75 MVar, respectively.

i- When the fundamental frequency load power factor is improved to **unity**, find the needed capacitance for the use capacitor bank.

ii- Design the fifth-order tuned filter needed to be connected with the converter.

Take the filter quality factor $Q_f = 40$, and the filter coil quality factor $Q_{coil} = 100$, and find the external resistance needed to be connected with the filter.

3- a) Discuss, briefly, each of the following items:

1- Power system reliability and security

2- The power system telemetry systems

3- The power system network sensitivity factors.

3- b) Consider the three-bus simple power system, shown in Fig.2. When the output power for the generator connected to bus "2" is decreased to 2.0 pu, calculate the factors: $\alpha_{1-2, 2}$, and $\alpha_{1-3, 2}$.

Calculate also each of the factors: $d_{1-2, 2-3}$, and $d_{1-3, 2-3}$.

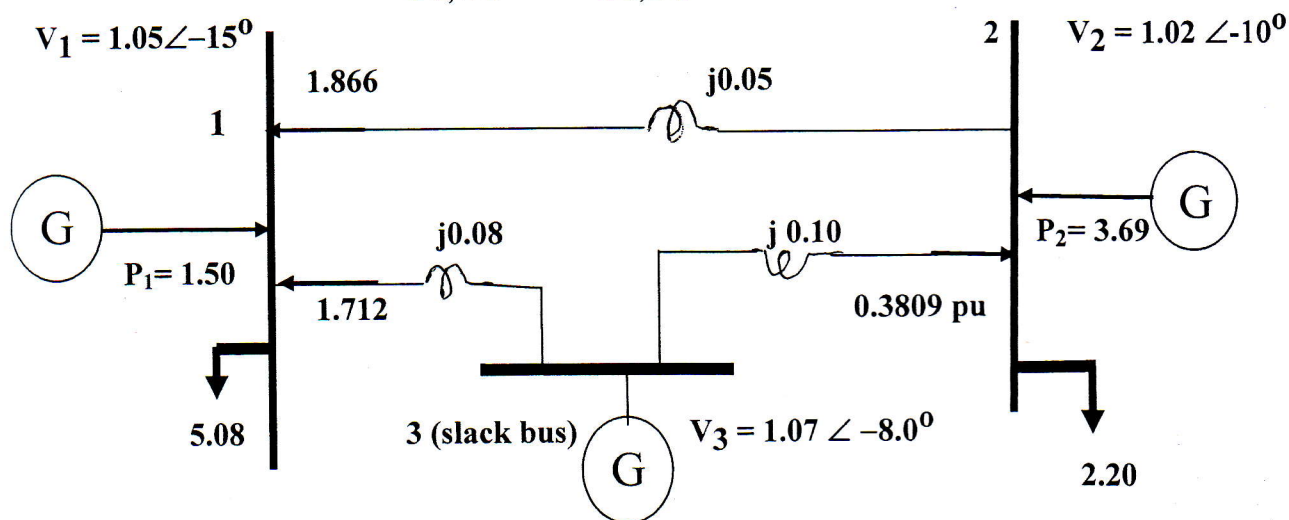


Fig.2

3- c) For a considered 3-machine, 6-bus power system the following data are given:

The generators power limits are: $50 \leq P_{g1} \leq 180$ MW, $60 \leq P_{g2} \leq 200$ MW, and $250 \leq P_{g3} \leq 350$ MW.

The steady-state generators output powers are $P_{g1} = 70$ MW, and $P_{g2} = 90$ MW.

The power on the system line connecting buses "5" and "6", is 40 MW. Show how this power value is decreased to 2 MW, by applying the generators shifts when the following factors are given,

$$\alpha_{5-6, 1} = +0.25, \text{ and } \alpha_{5-6, 2} = -0.10.$$