Menoufia University
Faculty of Engineering
Shebin El-Kom

Department of Electrical Engineering | **Time Allowed: 3 Hours**
Course Title: Analysis of Electric Power Networks | **Total Marks: 100**
Post-Graduate (M. Sc degree) Examination | **Date: 17 / 8 / 2020**

ANSWER THE FOLLOWING QUESTIONS:

1–a) Discuss, briefly, each of the following items:

i- Power system quality.
ii- Characteristics harmonics, zero-sequence harmonics, and inter-harmonics.

iii- Five sources of power system harmonics.

iv- Four techniques used for harmonic suppression.

v- Six effects of power systems harmonics.

vi- Techniques of harmonics suppression.

vii- Single-tuned and band-pass filters.

viii- Quality factor, corner frequencies and bandwidth for a given single-tuned filter.

1–b) A 10 ohm resistance, a 25 mH inductance, and a 250 μ F capacitor are connected in series and the circuit is connected to an AC supply its voltage equation is given as,

$$e(t)= 1000 \sin(314t) + 220 \sin(942t + \pi/3) + 1570\,t + 5\pi/6).$$

Find :

1- The circuit instantaneous current.

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

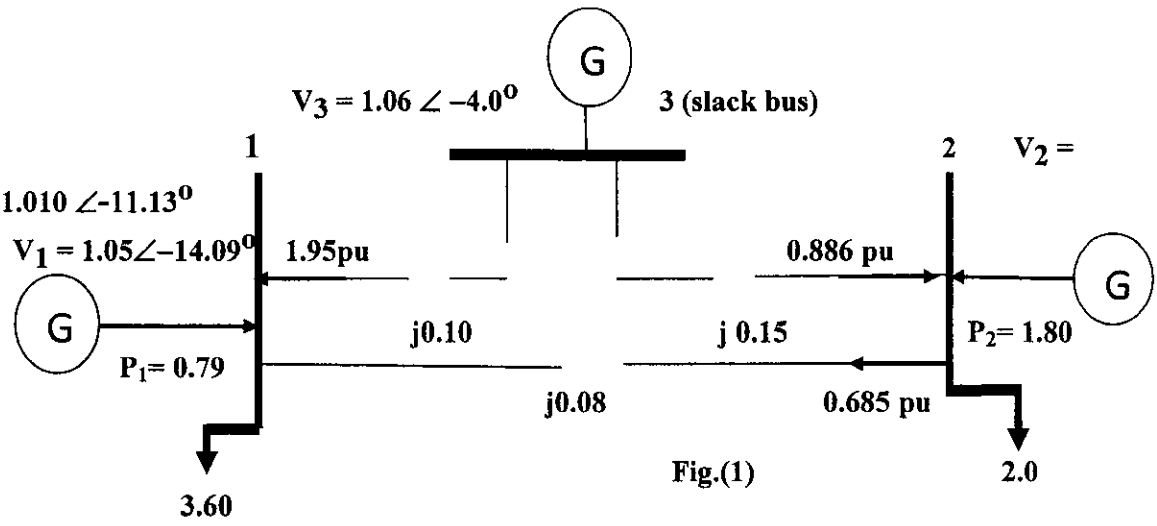
3-The circuit total active power loss.

4- The two total harmonic distortion factors for the circuit current and voltage.

1–c) A **35**MW, with **0.70** lag power factor load is connected to a 3-phase, **33** kV, 50 Hz, supply. Find the capacitive power needed to be connected in shunt with the load to improve its power factor to 0.95 lag.
Now, let the obtained capacitive reactance to be equally divided among 5^{th}, and 7^{th} needed two single tuned filters. Take the filter quality factor Q_f =40 and the coil quality factor Q_c= 100.

2 – a) Power system reliability --- Power system security --- Telemetry systems --- The system network sensitivity factors---- the D.C. load flow

1–b) Consider the three-bus sample power system, shown in Fig.(1). Calculate each of the following factors: $\alpha_{1\text{-}2,\,2}$, $\alpha_{1\text{-}3,\,2}$, $d_{1\text{-}2,\,2\text{-}3}$, and $d_{1\text{-}3,\,2\text{-}3}$.



1–c) A three-generator, and 6-bus power system is considered. Suppose we wished to correct the power flow on the line connecting buses "**2**" and "**3**" of the system from **2.9** MW (the steady-state power flow) to **13** MW. Given the following factors: $\alpha_{2\text{-}3,\,2}$ = **+ 0.05** and $\alpha_{2\text{-}3,\,3}$ = **– 0.34.**

The steady-state generator output powers Pg_2= **50** MW, and P g_3= **60** MW. The upper and lower generation limits are 37.5 MW $\leq Pg_2 \leq$ 150 MW and 45 MW $\leq Pg_3 \leq$180 MW.