

# KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

## ELECTRICAL ENGINEERING DEPARTMENT

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EE-463 - 161

### Key Solutions

Quiz 2

ser#:

I.D.:

Name:

#### Problem # 1

A synchronous generator is connected a load through a transmission line. The generator is connected to bus 1 which is considered as a slack bus with  $V_1 = 1.0 + j 0.0$  per unit. The load is connected to bus 2 with  $290 \text{ MW} + j120 \text{ MVAR}$ . The line is connected between the two busses. The line impedance is  $0.02 + j0.04$  per-unit. A capacitor bank is connected to bus one with admittance of  $j0.10$  per-unit. The system base is 100 MVA. After several iterations, the voltage at bus 2 converges to  $0.90 - j 0.10$  per-unit.

Q.1) The line flow from bus 1 to bus 2 is equal to

(2 points)

- a)  $310 \text{ MW} + j150 \text{ MVAR}$
- b)  $310 \text{ MW} + j160 \text{ MVAR}$**
- c)  $290 \text{ MW} + j120 \text{ MVAR}$
- d)  $290 \text{ MW} + j160 \text{ MVAR}$

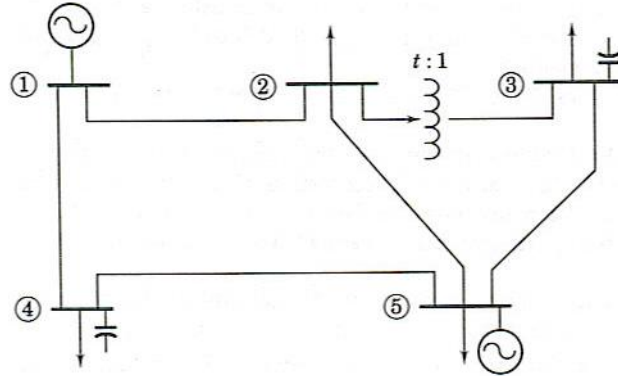
Q.2) The slack bus power is equal to

(2 points)

- a)  $310 \text{ MW} + j150 \text{ MVAR}$**
- b)  $310 \text{ MW} + j160 \text{ MVAR}$
- c)  $290 \text{ MW} + j120 \text{ MVAR}$
- d)  $290 \text{ MW} + j160 \text{ MVAR}$

### Problem # 2

Write down the equations of the 7<sup>th</sup> iteration, using Gauss-Seidel Iterative method with acceleration factor for busses 1, 3 and 5. Consider that bus1 as a PV bus; busses 2, 3, and 4 as PQ busses; bus 5 as a slack bus. (6 points)



### Solution:

For Bus-1

$$Q_{1cal} = -\text{Im}\left[V_{1corr}^{6*} \left( Y_{11}V_{1corr}^6 + Y_{12}V_{2acc}^6 + Y_{14}V_{4acc}^6 \right)\right]$$

$$V_1^7 = \frac{1}{Y_{11}} \left[ \frac{P_1 - jQ_{1cal}}{V_{1corr}^{6*}} - \left( Y_{12}V_{2acc}^6 + Y_{14}V_{4acc}^6 \right) \right]$$

$$\Delta V_1^7 = V_1^7 - V_{1corr}^6$$

$$V_{1acc}^7 = V_{1corr}^6 + \alpha \Delta V_1^7$$

$$V_{1corr}^7 = |V_1| \angle \theta_{1acc}^7$$

For Bus-2

$$V_3^7 = \frac{1}{Y_{33}} \left[ \frac{P_3 - jQ_3}{V_{3acc}^{6*}} - \left( Y_{32}V_{2acc}^7 + Y_{35}V_5 \right) \right]$$

$$\Delta V_3^7 = V_3^7 - V_{3acc}^6$$

$$V_{3acc}^7 = V_{3acc}^6 + \alpha \Delta V_3^7$$

For Bus-5

$$V_5 = V_5 \quad (\text{because it is the slack bus})$$