

# KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

## ELECTRICAL ENGINEERING DEPARTMENT

EE-520 (171)

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### Home Work 3

Q.1) A 4-bus system has the following line and bus data (on the base of 100MVA, 230kV base):

#### Line-Data

Bus-to-Bus	R (per-unit)	X (per-unit)	Y/2 (per-unit)
1-2	0.01008	0.05040	0.05125
1-3	0.00744	0.03720	0.03875
2-4	0.00744	0.03720	0.03875
3-4	0.01272	0.06360	0.06375

#### Bus-Data

Bus	Type	P <sub>G</sub> (MW)	Q <sub>G</sub> (MW)	P <sub>D</sub> (MW)	Q <sub>D</sub> (MW)	V (per-unit)	Q <sub>max</sub> (MVAR)
1	Slack	-	-	50	30.99	1.0	-
2	Load	0	0	170	105.35	-	-
3	Load	0	0	200	123.94	-	-
4	Voltage Controlled	318	-	80	49.58	1.02	125

- Ignoring the reactive power limit of bus 4, use Gauss-Seidel method to calculate the first two iterations bus voltages with acceleration factor  $\alpha = 1.6$ .
- Considering the reactive power limit of bus 4, use Gauss-Seidel method to calculate ONLY the first iteration bus voltages with acceleration factor  $\alpha = 1.6$ .

Q.2) A 3-bus system has the following line and bus data (on the base of 100MVA, 230kV base):

**Line-Data**

Bus-to-Bus	R (per-unit)	X (per-unit)
1-2	0.02	0.04
1-3	0.01	0.03
2-3	0.0125	0.025

**Bus-Data**

Bus	Type	P <sub>G</sub> (MW)	Q <sub>G</sub> (MW)	P <sub>D</sub> (MW)	Q <sub>D</sub> (MW)	V (per-unit)
1	Slack	-	-	0	0	1.05
2	Load	0	0	400	250	-
3	Voltage Controlled	200	-	0	0	1.04

- a) Use Newton-Raphson (Polar-Form) method to calculate P<sub>1</sub>, Q<sub>1</sub>, and Q<sub>3</sub> (considering mismatch voltage tolerance of  $\epsilon = 2.5 \times 10^{-4}$  for both magnitudes and phase-angles, and maximum number of iteration **5**).
- b) Use Newton-Raphson (Rectangular-Form) method to calculate P<sub>1</sub>, Q<sub>1</sub>, and Q<sub>3</sub> (considering mismatch voltage tolerance of  $\epsilon = 2.5 \times 10^{-4}$  for both real and imaginary, and maximum number of iteration **15**).
- c) Use Decoupled method to calculate P<sub>1</sub>, Q<sub>1</sub>, and Q<sub>3</sub> (considering mismatch voltage tolerance of  $\epsilon = 2.5 \times 10^{-4}$  for both magnitudes and phase-angles, and maximum number of iteration **15**).
- d) Use Fast-Decoupled method to calculate P<sub>1</sub>, Q<sub>1</sub>, and Q<sub>3</sub> (considering mismatch voltage tolerance of  $\epsilon = 2.5 \times 10^{-4}$  for both magnitudes and phase-angles, and maximum number of iteration **15**).