

**FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI**  
**SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY**  
**DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**

2009/10 HARMATTAN SEMMESTER EXAMINATION      MAY, 2010

PSE 413: POWER SYSTEMS ENGINEERING TECHNOLOGY

TIME ALLOWED: 3HRS

INSTRUCTION: Attempt only 5 questions

1. (a) State the rule for the formation of the admittance matrix
- (b) What are the 4 major components of a load-flow problem?
- (c) A typical 5-bus, 2-generator power system has the following parameters.

Table Q1a

BUS	P	Q	V	REMARKS
1	-	-	1.02 $\angle 0^\circ$	Swing bus
2	-0.6	-0.3	1.00 $\angle 0^\circ$	Load bus
3	1.0	-	1.04 $\angle 0^\circ$	Voltage magnitude constant
4	-0.4	-0.1	1.00 $\angle 0^\circ$	Load bus
5	-0.6	-0.2	1.00 $\angle 0^\circ$	Load bus

All values are in per unit.

Table Q1b

Line	G	B
1-2	0.588235	-2.352941
1-4	0.392157	-1.568627
1-5	1.176471	-4.705882
2-3	1.176471	-4.705882
2-4	0.588235	-2.352941
3-5	1.176471	-4.705882

All values are in per unit.

Find the voltage at bus 3 after one iteration. If the voltage at bus 2 has been obtained as  $0.976351 - j0.050965$  pu from the previous iterations. Use polar form or method of rationalization to simplify the necessary.

Q2 (a) Derive the following using first principle expression:

- (i) Line-to-line fault      (ii) Single line-to-ground fault      (iii) Double line-to-ground fault

- Q2b. (i) State at least 5 possible ways a fault in a Power System can originate.  
(ii) Why do we carry out Fault analysis study?  
(iii) Explain Power Systems categories and give examples of each.

Q3

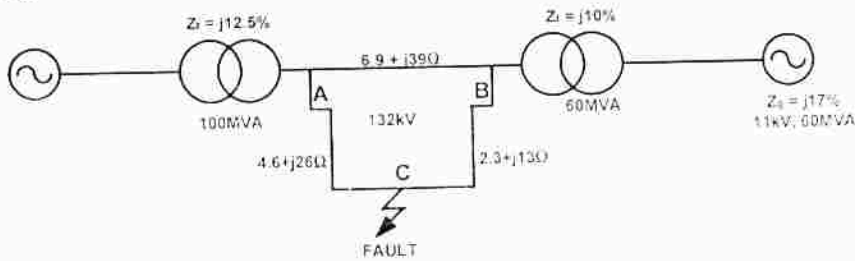


FIG Q3

The Power System shown in Fig Q3 has a 3-phase short circuit on the 132kV busbars at station C. Determine the resulting value of the 3-phase fault current and its distribution in the 132kV system, given that the pre-fault value of the line-to-line voltage at the point of fault is 140kV. The system can be assumed to be operating on no-load prior to the fault. Simplify using delta and star network conversion.

- Q4. (a) State causes of Power factor in a Power system and hence its possible improvements.  
(b) A single-phase motor connected to 400V, 50Hz supply takes 31.7A at a power factor of 0.7 lagging. Compute the capacitance required in parallel with the motor to raise the power factor to 0.9 lagging.  
(c) Draw a typical model of medium line electric transmission line. Hence use  $\pi$  and T model network to prove that  

$$I_s = YV_R (ZY/4 + 1) + (ZY/2 + 1) I_R$$

$$V_s = V_R (ZY/2 + 1) + (ZY/4 + 1) I_R Z.$$

Q5. A single phase transmission 50 miles long delivers 4000kW at a voltage of 38kV at 0.5 pF lagging.

- (i) Find the Sending end Voltage, current and pF at (a) nominal T-method (b) nominal  $\pi$  method.  
The resistance, reactance, and susceptance per mile are  $0.3\Omega$ ,  $0.7\Omega$ , and  $12 \times 10^{-6}S$ . Draw the equivalent circuit for each case, as well as the phasor representation.

Q6. A 50Hz single phase 50km long supplies of 5MW at pF of 0.71 lagging. The line has a resistance of  $0.3345\Omega/km$  for each wire and a loop inductance per km of 1.5mH. The receiving end voltage is 10kV, and a capacitor is connected across the load to raise its pF to 0.9 lagging. Compute the capacitance of the capacitor, the sending end voltage when the capacitor is out of use and the efficiency of the transmission in each case