**FEDERAL UNIVERSITYOF TECHNOLOGY OWERRI**
**DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**
**RAIN SEMESTER 2013/2014 EXAMINATION**
**PSE 312: POWER SYSTEMS AND MACHINES TIME : 3 HOURS**
**INSTRUCTIONS : Answer all questions in section A and any four questions in section B**

## SECTION A

1.State four Nigeria electric energy resources
2. What does the diagonal element $Y_{kk}$ of a $Y_{bus}$ termed. Mutual or Self Admittance.
3. A reactive power 13 KVAR is in a system of 415 V at 50 Hz frequency. Determine the capacitor generating this reactive power.
4. State two types of reactors in general use.
5. State the main advantage of Tie-bar over ring reactors system.
6. Draw a two-bus power system with generator and load connected at each bus and hence show the impedance diagrams.
7. What is an infinite bus bar system?
8. List cause of low power factor in electric power system.
9. State the three components of Nigeria Electric Power System unbundling outcome.
10. With a good and labeled one line diagram show a typical Nigeria Power System

## SECTION B

1a. (i) Briefly explain why a 230V, 5kVA generator operating at 0.63 power factor lagging (PF) may be cheaper to purchase but less efficient and more expensive to operate than a generator of the same ratings, but operating at 0.95PF lagging. (ii) In an inductive circuit, ___ leads ___, while ____lags _____ in a capacitive circuit. b. Outline 3 important facts about the term POWER FACTOR in a power system. State 2 equipment used for its improvement. c. (i) Calculate the reactive power rating of a synchronous condenser used to improve the power factor of a 400V, 3kW generator from 0.8 PF to 0.9 PF. (ii) Hence calculate the improved Real Power rating.

2. The lengths, load currents and applied voltages of a ring main are shown in Fig. B2. Compute the voltagesof each of the load point in each case if reactive per meter of double conductor is 0.0008 Ω.

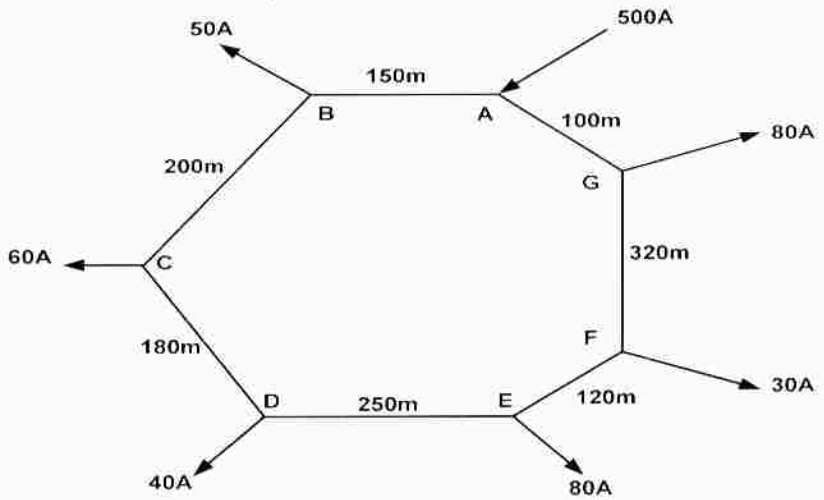


FIG B2

3. (a) Describe the procedures for carrying out open circuit and short circuit tests on transformer; draw the instruments equivalent circuit connections for such tests and list the machine parameters determined in each case. (b) Draw the complete equivalent circuit of a two winding transformer referred to the primary side and to the secondary side respectively; and derive the referred values of the transformer parameters. (c) A single phase, two winding transformer rated 50KVA, 2400/240V, 50Hz yielded the following results on test: open circuit test; input through the primary: 2400V, 0.65A, 80W; Short circuit test: input through the secondary: 90V, 5.5A, 200W. Calculate the approximate equivalent circuit parameters of the transformer.

4. (a) A 60KVA, 240/1200V, 50 Hz two winding transformer is to be connected so as to form a step-down autotransformer in a power distribution system. A primary voltage of 240V is applied to the transformer. Determine (i) the primary voltage of autotransformer (ii) the maximum volt ampere rating in this mode of operation (iii) the apparent power rating advantage over the conventional 240/1200V mode. (b) A Delta-Star distribution transformer rated 50KVA, 14/0.2KV has a resistance of 1% and a reactance of 7% pu. Calculate (i) the phase impedance of the transformer referred to the primary side (ii) the transformer's voltage regulation at full-load and 0.8 P. F. lagging.

5a. List different causes of fault in power system b. What are the procedures for calculating fault current in power system?

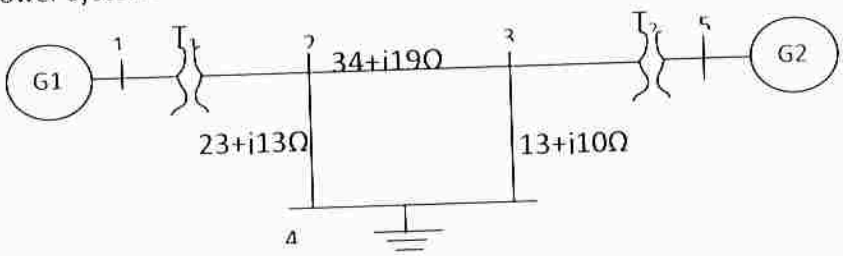


Fig. $Q_5$

Using MVA base of 100, base voltage of 11kV for LT side and 132kV for HT side, find the fault current in Amperes for a fault at bus 4 in the network of Fig. $Q_5$ above. The manufacturer's data are as follows;

$G_1$ = j18%, 11kV, 100MVA; $G_2$ = j15%, 11kV, 80MVA;

$T_1$ = j12%, 11/132kV, 100MVA; $T_2$ = j15%, 11/132kV, 80MVA;

6.

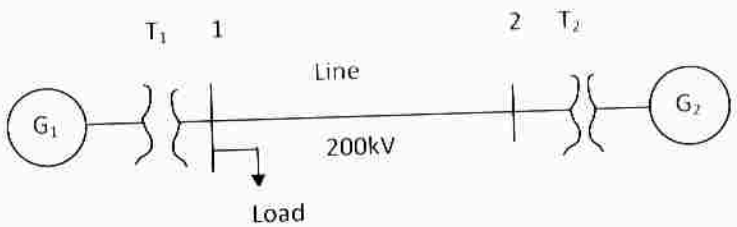


Fig. $Q_6$

Draw an impedance diagram for the electric power system shown in fig. $Q_6$. the three-phase power and line ratings are given below;

$G_1$: X=9%, 90MVA, 20kV; $T_1$: X=16%, 20/200kV, 80MVA; $T_2$: X=20%, 200/20kV, 80MVA; $G_2$: X=9%, 18kV, 90MVA; Line: 120+j200 Ω, 200kV; Load: 80MVA, 0.60 power factor. Show all working.