SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

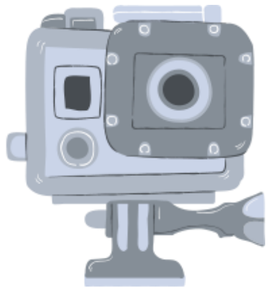
Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

UNIT 1

Per Unit Representation

19EET302 – Power System 1
III year / V Semester



INTRODUCTION

Per Unit

- The per unit value of any quantity is defined as

The ratio of the actual value of the any quantity to the base value of the same quantity as a decimal.

Per Unit : Actual Value / Base Value

Merits of per unit system

(i). The pu value is the same for both 1-phase and & 3-phase systems

(ii). The pu value once expressed on a proper base, will be the same when refereed to either side of the transformer. Thus the presence of transformer is totally eliminated

(iii). The variation of values is in a smaller range 9nearby unity). Hence the errors involved in pu computations are very less.

(iv). Usually the nameplate ratings will be marked in pu on the base of the name plate ratings, etc.

Demerits:

If proper bases are not chosen, then the resulting pu values may be highly absurd (such as 5.8 pu, -18.9 pu, etc.). This may cause confusion to the user. However, this problem can be avoided by selecting the base MVA near the high-rated equipment and a convenient base KV in any section of the system.

PU representation

If Ib is the base current in kilo amperes and Vb, the base voltage in kilo volts, then the base MVA is,

MVAb = (VbIb).

Then the base values of current & impedance are given by

- Base current (kA), Ib = MVAb/KVb
- Base impedance, Zb = (Vb/Ib) = (KVb2/ MVAb)
- Hence the per unit impedance is given by Zpu = Zohms/Zb = Zohms (MVAb/KVb2)

In 3-phase systems, KVb is the line-to-line value & MVAb is the 3-phase MVA. [1-phase MVA = (1/3) 3-phase MVA].

Change of Base

$$Zpu\ new = Zpu\ given\ * \frac{MVAb\ new}{MVAb\ given} * \left(\frac{KVb\ given}{KVb\ new}\right)^2$$

Problem 1

- Two generators rated 10 MVA, 13.2 KV and 15 MVA, 13.2 KV are connected in parallel to a bus bar. They feed supply to 2 motors of inputs 8 MVA and 12 MVA respectively. The operating voltage of motors is 12.5 KV. Assuming the base quantities as 50 MVA, 13.8 KV, draw the per unit reactance diagram. The percentage reactance for generators is 15% and that for motors is 20%.

$$Zpu\ new = Zpu\ given * \frac{MVAb\ new}{MVAb\ given} * \left(\frac{KVb\ given}{KVb\ new}\right)^2$$

Solution

$$Zpu\ new = Zpu\ given\ * \frac{MVAb\ new}{MVAb\ given} * \left(\frac{KVb\ given}{KVb\ new}\right)^2$$

Selection of base quantities: 50 MVA, 13.8 KV

Calculation of pu values:

XG1 = j 0.15 (50/10) (13.2/13.8)2 = j 0.6862 pu.

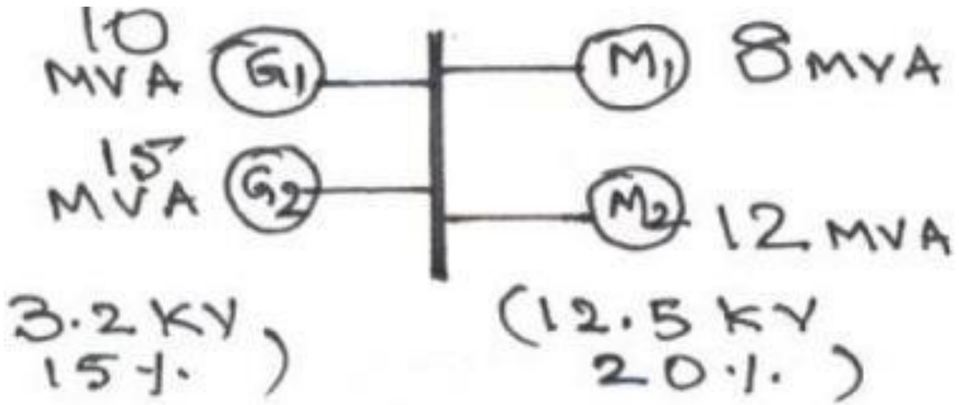
XG2 = j 0.15 (50/15) (13.2/13.8)2 = j 0.4574 pu.

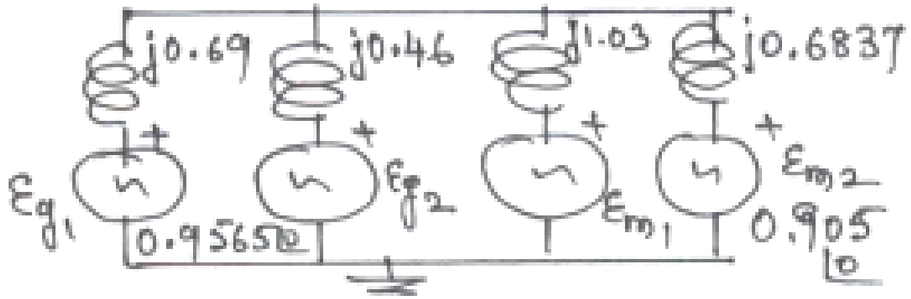
Xm1 = j 0.2 (50/8) (12.5/13.8)2 = j 1.0256 pu.

Xm2 = j 0.2 (50/12) (12.5/13.8)2 = j 0.6837 pu.

Eg1 = Eg2 = (13.2/13.8) = 0.9565 □00 pu

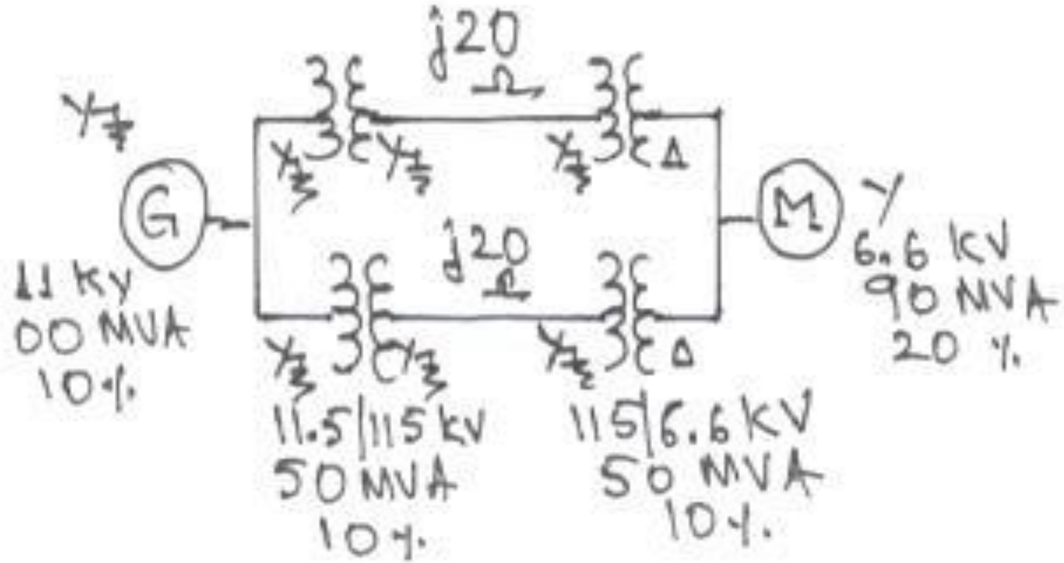
Em1 = Em2 = (12.5/13.8) = 0.9058 □00 pu





Problem 2

Draw the per unit reactance diagram for the system shown in figure below. Choose a base of 11 KV, 100 MVA in the generator circuit.



Impedance Diagram

Solution

Summary

Activity

KEEP
LEARNING..

Thank u

SEE YOU IN NEXT CLASS