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EE61

# Sixth Semester B.E. Degree Examination, June / July 08
# Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

**Note :** ***Answer any FIVE full questions.***

1 a. Define per unit quantity. Mention the advantages of per unit system. **(06 Marks)**

b. Show that the per unit reactance is same for both HV and LV side of a transformer. **(06 Marks)**

c. Draw the reactance diagram of the power system shown in fig.1(c). Use a base of 100 MVA, 220 kV in line circuit to mark per unit quantities on the reactance diagram.

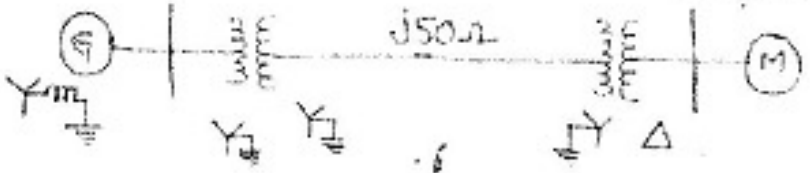


Fig. 1(c)

The ratings are : Generator (G) : 40 MVA, 25kV, X" = 20% ;
Motor (M) : 50MVA, 11kV, X" = 30% ;
Y – Y transformer : 40 MVA, 33/220kV, X = 15% ;
Y - Δ transformer : 30 MVA, 11Δ/220 Y kV, X = 15%. **(08 Marks)**

2 a. Define symmetrical components. Resolve an unbalanced 3-phase voltages of a power system into symmetrical components and also in vice versa. **(10 Marks)**

b. Prove that a balanced three phase voltages of a power system will have only positive sequence components. **(04 Marks)**

c. In a 3-phase, 3 wire system with phase sequence abc, the current in two of the lines are $I_a = 10\angle 30^0$ A, $I_b = 20\angle -60^0$ A. Find the symmetrical components of the three line currents. **(06 Marks)**

3 a. Derive an expression for 3-phase power in terms of symmetrical components. **(10 Marks)**

b. Show that the zero sequence impedance of the neutral impedance ($Z_n$) is equal to thrice the neutral impedance ($3 Z_n$). **(10 Marks)**

4 a. Following data gives the series impedance and line charging admittance in p.u. on a common base for each line of a four bus power system. Obtain $Y_{BUS}$ for the system. **(12 Marks)**

| BUS Code | Line impedance (P.U) | Line charging admittance P.U. |
|---|---|---|
| 1 - 2 | 0.2 + j 0.8 | j 0.02 |
| 2 – 3 | 0.3 + j 0.9 | j 0.03 |
| 2 – 4 | 0.25 + j 1.0 | j 0.04 |
| 3 – 4 | 0.20 + j 0.80 | j 0.02 |
| 1 – 3 | 0.10 + j 0.40 | j 0.01 |

b. Draw the single phase zero sequence equivalent circuits of three phase transformer bank along with connection diagrams and symbols for the following types of corrections.
i) Y Y ii) Y Δ iii) Y Y iv) Y Δ **(08 Marks)**

5 a. A double line to ground fault occurs at the terminals of an unloaded generator. Derive the expression for the fault currents. Draw the connection of sequence network. **(10 Marks)**

b. A salient pole generator without dampers is rated 20MVA, 13.8kV and has a direct – axis sub transient reactance of 0.25 P.U. The negative and zero sequence reactances are 0.35P.U, and 0.10 P.U respectively. The neutral of the generator is solidly grounded. Determine the sub transient current in the generator and the line – to – line voltage for sub transient conditions when a single line to ground fault occurs at the terminals of the generator when operating under no load at rated voltage. Neglect resistance. **(10 Marks)**

6 a. Obtain the interconnection of sequence networks for the following types of open conductor faults on power systems. i) ONE conductor open ii) TWO conductors open. **(08 Marks)**

b. A synchronous motor is receiving 60MW at 0.8p.f . lag at 6kV. A line to ground fault occurs at the mid point "F" of the transmission line through a fault impedance of 0.05Ω as shown in fig.6(b). Determine the fault current. Choose base values of 100MVA and 11kV on generator circuit. **(12 Marks)**

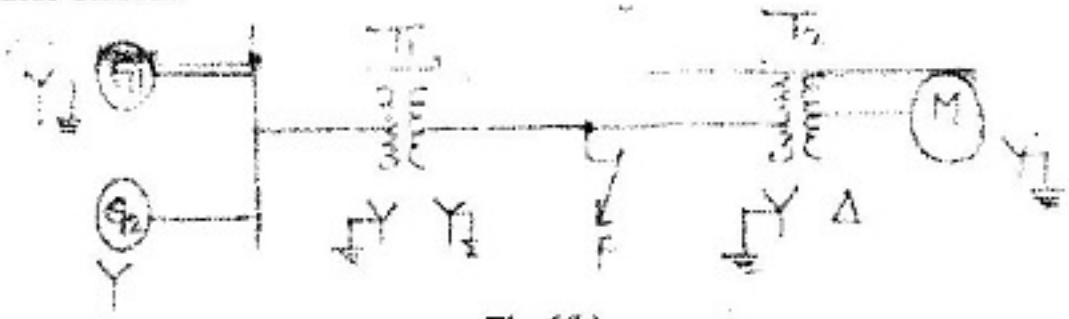


Fig.6(b)

$G_1$, $G_2$ : 100MVA, 11kV, $X_1 = 0.2$ P.U ; $X_2 = 0.1$ P.U ; $X_0 = 0.1$ P.U.
M : 160 MVA, 6.3kV, $X_1 = X_2 = 0.3$ P.U ; $X_0 = 0.1$ P.U.
$T_1$ : 180 MVA, 11.5Y | 115Y, X = 0.1 P.U
$T_2$ : 170 MVA, 110Y | 6.6Δ, X = 0.1 P.U.
Transmission line : $X_1 = X_2 = 30\ \Omega$ ; $X_0 = 60\Omega$.

7 a. Explain the following terms as applicable to a power system. **(08 Marks)**
i) Stability ii) Steady state stability iii) Dynamic stability iv) Transient stability.

b. Derive the swing equation of a synchronous machine with usual notation. Mention the uses of swing equation. **(12 Marks)**

8 Write short notes on any four of the following :
a. Selection of circuit breakers.
b. Methods of improving transient stability.
c. Equal area criterion of transient stability.
d. Formation of $Y_{BUS}$ by inspection method.
e. Inertia constants M and H. **(20 Marks)**