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Printed Pages : 7 **TEE – 601**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2059 **Roll No.** | | | | | | | | | | |

B. Tech.

(SEM. VI) EXAMINATION, 2007-08

POWER SYSTEM ANALYSIS

Time : 3 Hours] *[Total Marks : 100*

Note: *(1) Attempt **all** questions.*

*(2) In case of numerical problems assume **data** wherever not provided.*

(3) Be precise in your answer.

1 Attempt any **three** parts of the following : **20**

(a) Discuss lthe representation of a power system network by reactance diagram.

Show that the per unit impedance of a transformer computed from primary or secondary side is same if the voltage bases on two sides are in the ratio of transformation.

(b) The one line diagram of a 3-phase power system is shown in **figure 1(b).** Select a common base of 100 MVA and 22 kV on the generator side. Draw its impedance diagram with all impedances including the load impedance marked in per-unit.

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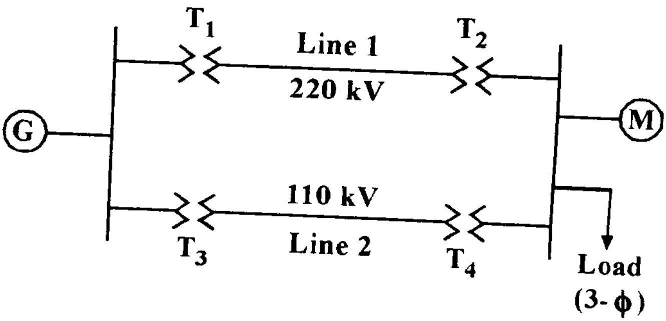
The manufacturer's data for each device are given below:



G: 90MVA, 22 kV, X=18%

T_1: 50MVA, 22/220 kV, X=10%

T_2: 40MVA, 220/11 kV, X=6%

T_3: 40MVA, 22/110 kV, X=6.4%

T_4: 40MVA, 110/11 kV, X=8%

M: 66.5MVA, 10.45 kV, X=18.5%

The 3-phase load absorbs 57 MVA, 0.6 p.f lagging at 10.45 kV. Line 1 and Line 2 have reactances of 48.4 and 65.43 ohms respectively.

(c) Discuss the various strategic locational aspects of reactors for limiting the fault current and their advantages.

(d) A 25 MVA, 11 kV, 3-phase generator has a subtransient reactance of 20%. The generator supplies two motors over a transmission line with transformers at both ends. The motors have rated inputs of 15 and 7.5 MVA, both 10kV with

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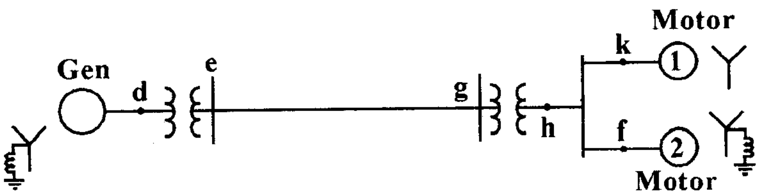
25% subtransient reactance. The 3-phase transformers are both rated 30MVA, 10.8/121 kV, connected in $\Delta - Y$ with leakage reactance of 10% each. The series reactance of the line is 100 ohms. Draw the positive and negative sequence networks of the system with reactances marked in per unit.



(e) Find the subtransient current in the fault if 3-phase fault occurs at the point F in the figure given for problem 1(d).

2 Attempt any **two** parts of the following : **2×10=20**

(a) (i) Show that the sequence impedances of a star-connected with neutral grounded through an impedance Z_n is given as:

$$Z^{0,1,2} = \begin{bmatrix} Z_s + 3^Z n & 0 & 0 \\ & Z_s & 0 \\ 0 & 0 & Z_s \end{bmatrix}$$

Where Z_s in the impedance of the load per phase.

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(ii) For the power system whose line diagram is given in **figure 2(a)**, draw the zero sequence network.

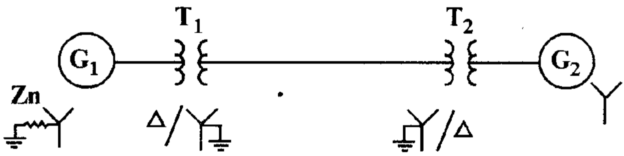

Fig. 2 (a)

(b) A 25 MVA, 13.2 kV alternator with solidly grounded neutral has a subtransient reactance of 0.25 pu. The negative and zero sequence reactances are 0.35 and 0.1 p.u. respectively. Determine the fault current and line to line voltages at the fault when a double line to ground fault occurs at the terminals of the alternator. Deduce also the expression used for calculating fault current.

(c) Find the bus admittance matrix for the network given in **Fig. 2(c)**. Line connected between bus-1 and bus-2 has half line charging of j.05 mho.

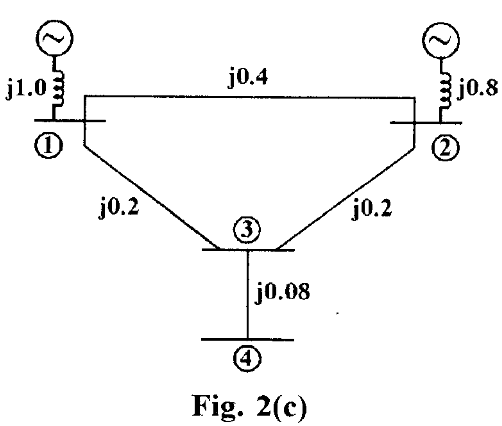

Fig. 2(c)

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3 Attempt any **two** parts of the following : **2×10=20**

(a) Formulate the mathematical model in rectangular form for the load flow analysis of a power system considering the voltage controlled buses into account using Newton-Raphson method. How the line flows and line losses are calculated?

(b) Discuss different types of tap changing transformers. Obtain partial Y_{Bus} of a tap changing transformer. Show that a tap changing transformer can be represented by a π model only if its turns ratio is real.

(c) What are the assumptions made in obtaining fast decoupled load flow equations? Give steps to solve a load flow problem using Newton Raphson load flow method.

4 Attempt any **two** parts of the following : **2×10=20**

(a) (i) Deduce the swing equation of a synchronous machine connected to an infinite bus.

(ii) Describe the Point by Point solution technique of swing equation for the transient stability of a power system.

(b) (i) Using equal area criterion, discuss the concept of transient stability when sudden change in mechanical input of an alternator takes place.

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(ii) Derive expression for critical clearing angle when sudden short circuit on one of two parallel lines, away from the alternator ends, occurs in the system.

(c) Discuss the steady state stability using swing equation of a machine connected with infinite bus.

A 50Hz four pole turbogenerator rated 20MVA, 13.2 kV has an inertia constant of H=9.0 kW-Sec. /kVA. Determine the kinetic energy stored in the rotor at synchronous speed. Also calculate the acceleration if the input less the rotational losses is 25000 HP and the electric power developed is 15000 kW.

5 Attempt any **two** parts of the following : **2×10=20**

(a) Show that the velocity of a travelling wave can be given by

$$v = \frac{1}{\sqrt{LC}}.$$

(b) Derive the expressions for reflection and refraction coefficients of voltage and current waves when a line

(i) terminated through a resistance

(ii) through a cable.

(c) An overhead line with surge impedance 400 ohms is connected to a terminal apparatus through a short length of cable of surge impedance 40 ohms.

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A travelling wave of constant magnitude of 100 kV and infinite duration originates in the overhead line and travels towards the junction with the cable. Calculate the energy transmitted into the cable during a period of 5 μ sec after the arrival of the wave at the junction.

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