V - 2059

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, 2006-07

## 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 **four** parts of the following : **5×4**

(a) Explain the per unit (p.u.) system of analyzing power system problems. Discuss the advantages of this method over the absolute method of analysis.

(b) What are current limiting reactors? Discuss its application and locational aspects.

(c) The one line diagram of a three phase power system is shown in fig. 1 (c). Using per unit method of analysis calculate the 3-phase short circuit MVA at fault point F.

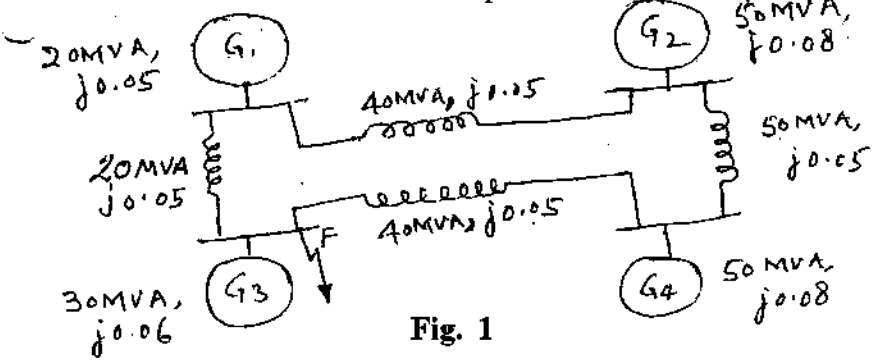


**Fig. 1**

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(d) What do you understand by symmetrical components of unbalanced phasors? Deduce the expressions for symmetrical components.

(e) Write short note on the reactances of an alternator when sudden 3-phase short circuit occurs on its terminals.

(f) A single phase load of 100 kVA connected across lines b-c of 3-phase supply of 3.3 kV. Determine the symmetrical components of current.

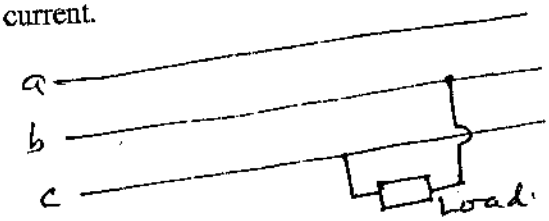


**Fig. 2**

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

(a) Show that the zero sequence impedance of a generator with neutral grounded through an impedance if $Z_n$ in $(Z_s + 3Z_n)$, where $Z_s$ is the synchronous impedance of the generator.

An 11 kV, 25 MVA alternator has positive, negative and zero sequence reactances of 0.12, 0.12 and 0.08 per unit respectively. The generator neutral is grounded through a reactance of 0.03 per unit. Determine the fault current when a single line to ground fault occurs at generator terminal. Also calculate the line to line fault voltage. Assume generator was unloaded before the fault.

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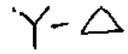
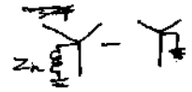
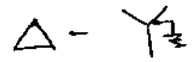
(b) Draw the zero sequence networks for the transformers shown below :

(i) 

(ii) 

(iii) 

Determine the fault current when (i) L-L-G, (ii) L-L fault occurs at point F in the figure 2 (b). The per unit reactances, all referred to the same base, are given in the following table :

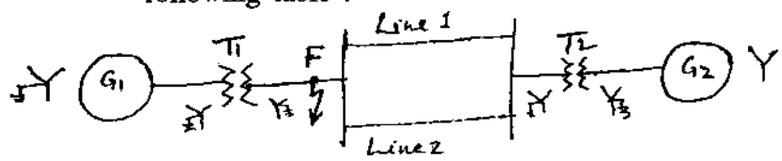



**Fig. 3**

Table :

| | $X_0$ | $X_1$ | $X_2$ |
|---|---|---|---|
| $G_1$ | 0.05 | 0.30 | 0.20 |
| $G_2$ | 0.03 | 0.25 | 0.15 |
| Line 1 | 0.70 | 0.30 | 0.30 |
| Line 2 | 0.70 | 0.30 | 0.30 |
| Trans $T_1$ | 0.12 | 0.12 | 0.12 |
| Trans $T_2$ | 0.10 | 0.10 | 0.10 |

Both generators are generating at 1.0 p.u. voltage.

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(c) (i) Discuss the assumptions made for short circuit analysis of a power system.

(ii) Deduce the expression for system impedance matrix in bus frame of reference ($Z_{BUS}$) using singular transformation.

(iii) Discuss the representation of a 3-phase power system for (taking the assumptions into account) short circuit studies.

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

(a) Discuss the purpose of load flow studies of a power system. Also classify the buses for the same. **6**

(b) Formulate the mathematical model for load flow analysis of a power system using Gauss-Siedal method. Also give detailed steps for implementing it considering also the voltage controlled buses. **6**

(c) Develop the mathematical model of a phase – shifting transformer to be represented in the formation of $[Y_{BUS}]$ for the load flow analysis. **6**

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(d) Discuss the decoupled and fast decoupled method of load flow analysis. 7

(e) Discuss the algorithm for load flow analysis using Newton – Raphson method. 7

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

(a) (i) Show that the steady state power which could be transmitted over a transmission line will be maximum when $X = \sqrt{3}\ R$, where $X$ and $R$ have their usual meanings.

(ii) An alternator with negligible damping is connected to an infinite bus bar. Write the swing equation in usual form and define the inertia constant (H) here. Deduce equal area criterion condition for stability analysis.

(b) For the system given below in figure 4, the numerical values for different components are E = 1.2 p.u., V = 1.0 p.u., X'd = 0.2 p.u., $X_1 = X_2 = 0.4$ p.u. Initially the generator was delivering power of 1.5 p.u. If one of the double circuit lines is tripped out, using equal area criterion determine whether the system would be able to maintain its stability. If stability is maintained, determine the maximum swing $(\delta)$ attained by generator.

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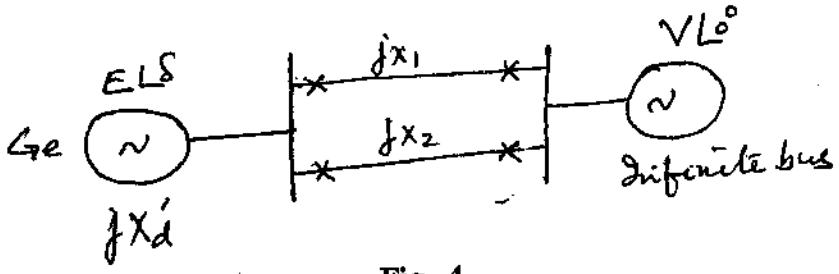


**Fig. 4**

(c) (i) Discuss point – by – point method for solving swing equation for transient stability analysis of a power system.

(ii) Define the terms-steady state and transient stabilities. Explain the various techniques for improving transient stability.

5 Attempt any **three** parts of the following :

(a) Starting from first principles show that surges behave as travelling waves. 7

(b) Discuss the behaviour of a travelling wave when it reaches (i) short circuited (ii) open circuited transmission lines and (iii) line terminated by an impedance equal to surge impendence (Z).

(c) Why the indoor transformers are usually connected to the overhead lines through short length of cables? Discuss. 6

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(d) Explain the procedure for drawing Bewley's lattice diagram with the help of a suitable example. 6

(e) Deduce the general expression for reflection and refraction of travelling waves. 6



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