

科目：電力系統(500D)

校系所組：清大電機工程學系(甲組)

- 一、(7%) The three-phase power rating of the central processing unit (CPU) on a mainframe digital computer is 22659 W. The three-phase line supplying the computer has a line voltage of 208 V(rms). The line current is 73.8 A(rms). The computer absorbs magnetizing VARs. (1) Calculate the total magnetizing reactive power absorbed by the CPU. (2) Calculate the power factor.
- 二、(8%) Given the following coupling inductors together with an equivalent circuit as shown in Fig. 1 where an ideal transformer with turn ratio n is inserted. Find the unknown parameters, L_x , L_y , and n in terms of the coupling-inductor parameters.

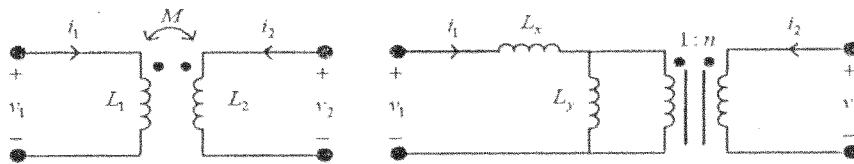


Fig. 1

- 三、(10%) The five transmission lines in the following four-bus power system can be modeled as $Z_{ij} = R_{ij} + jX_{ij}$ as shown in Fig. 2. (1) Find the corresponding Y-bus. (2) Let $S_{Gi} = P_{Gi} + jQ_{Gi}$ and $S_{Di} = P_{Di} + jQ_{Di}$. Derive the corresponding power flow equations.

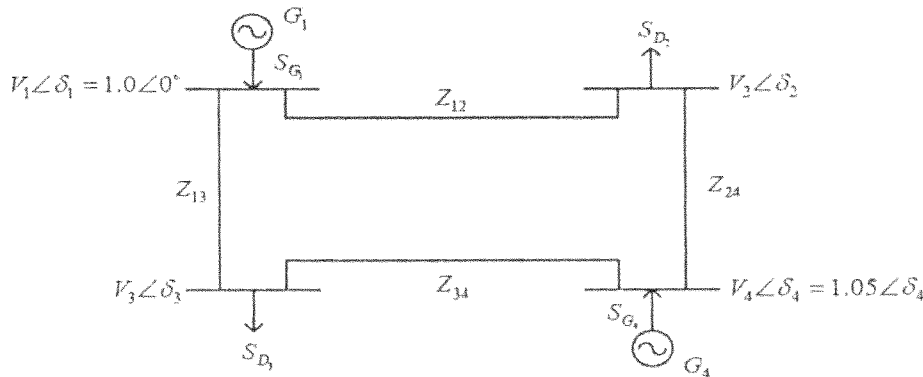


Fig. 2

- 四、(10%) A three-phase Y-connected synchronous generator (30MVA, 18kV, 1800rpm, 60Hz) has the following sequence impedances: $R_1 = 0.5\%$, $X_1 = 15\%$, $R_2 = 3\%$, $X_2 = 10\%$, $R_0 = 1\%$, $X_0 = 5\%$. (1) Give its pole number; (2) If this generator is grounded through an impedance of 100Ω , and the generator voltage is 110% of rated value, determine the positive, negative and zero sequence networks with the impedances being expressed in ohms.

五、(15%)

- (1) (9%) In Fig. 3, the CT ratio is 1000:5, and the line currents are: $I_a = 500 \angle -30^\circ$ A, $I_b = 400 \angle -135^\circ$ A, $I_c = 300 \angle 90^\circ$ A. Find the zero sequence current and the relay current I_r .

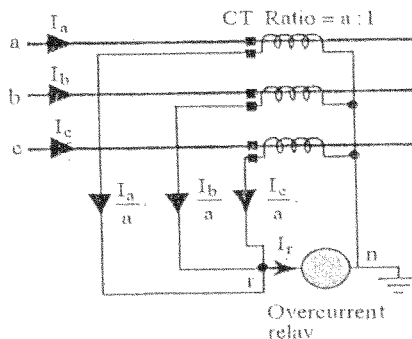


Fig. 3

注意：背面有試題

- (2) (6%) A single-phase transmission line possesses the parameters per-unit length of R' , L' , G' , C' , give the expressions of its characteristic impedance Z_c and surge impedance Z_s , and describe their difference.

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六、(10%) In Fig. 4, a three-phase source of 440V rms (line-to-line) powers a nonlinear load of 120kVA. The current THD of the nonlinear load is 40%, and its displacement power factor is 1. An active filter is installed to compensate the nonlinear load so the power factor is unity looking in from PCC. Please calculate the kVA rating of the active filter.

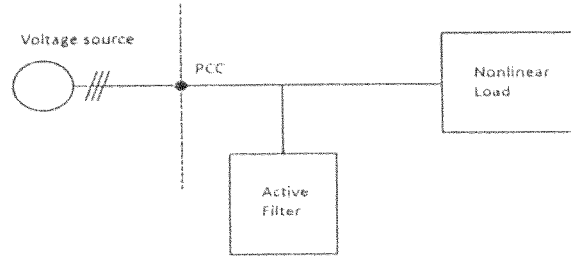


Fig. 4

七、(10%) In Fig. 5, a three-phase source of 440Vrms(line-to-line) powers a nonlinear load of 120kVA. The current THD of the nonlinear load is 40%, and its displacement power factor is 1. An active filter is installed to compensate the nonlinear load so the power factor is unity looking in from PCC. Please calculate the kVA rating of the active filter.

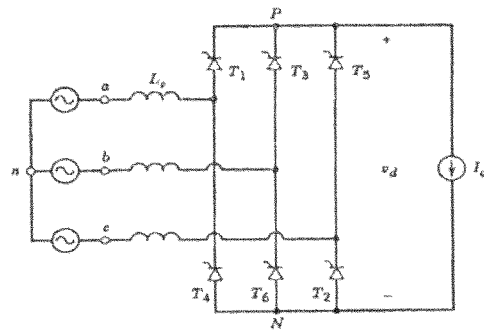


Fig. 5

八、(8%) A 60 Hz synchronous generator is delivering 50% of the power that is capable of delivering through one transmission line to an infinite bus. A fault occurs that increases the reactance between the generator and the infinite bus to 500% of the value before the fault. When the fault is isolated, the maximum power that can be delivered is 75% of the original maximum value. Determine the critical clearing angle for the condition described.

九、(8%) Two turbo-alternators rated for 110 MW and 210 MW have governor drop characteristics of 5% from no load to full load. They are connected in parallel to share a load of 250MW. Determine the load shared by each machine assuming free governor action.

十、(8%) Incremental fuel costs in rupees per MWh for a power plant consisting of two units are: $dF_1/dP_1=0.4P_1+40$, and $dF_2/dP_2=0.5P_2+30$. Assume that both units are operating at all times, and the maximum and minimum loads on each unit are to be 125 and 20 MW, respectively. If the total load is 220 MW, find the incremental fuel cost for the most economic operation without considering losses.

十一、(6%)

(1) (3%) Consider the power system shown in Fig. 6 (a) with generating sources beyond buses 1, 3, and 4. Which circuit breakers will open for fault at P_1 and P_2 ?

(2) (3%) If three circuit breakers are added at the tap point 2 as shown in Fig. 6 (b). Which circuit breakers will open for fault at P_1 and P_2 ?

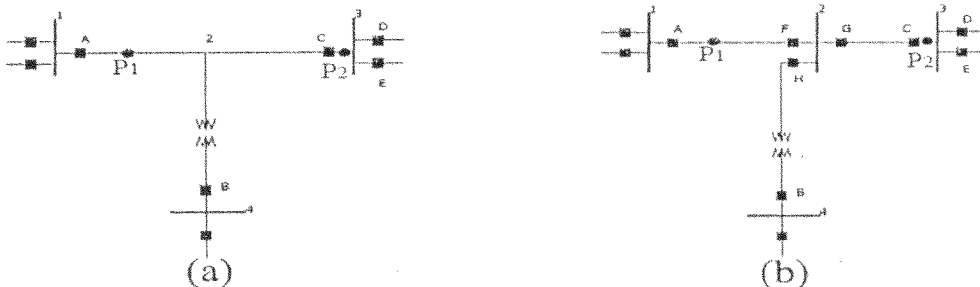


Fig. 6