類組：電機類　科目：電力系統(3008)　　共二頁 第一頁

※請在答案卷內作答

一、 For the given wind generating system shown in Fig. 1, the synchronous generator (SG) is adopted, answer the following questions: (30%)

(一)、(簡答題) Describe the differences in synchronous reactance between a salient-pole and a non-salient pole synchronous generators. (5%)

(二)、(計算題) If the three-phase load currents are balanced with $i_a(t) = \sqrt{2}\,10\sin(377t) + \sqrt{2}\,5\sin(3\times 377t)$ (A): (8%)

1. Find the rms value of $i_a(t)$; (4%)
2. Find $i_a(t)+i_b(t)+i_c(t)$. (4%)

(三)、(計算題) If the wind generator output rms line voltage at a specific speed is $V_{LL} = 200\text{V}$, the AC-DC converter is chosen to be the diode rectifier, and all components are ideal, find the DC-link average voltage of v_d. (6%)

(四)、(計算題) For a single-phase transformer rated as 220V/60Hz, if the frequency is changed to 50Hz, find the voltage to maintain the rated frequency in the transformer core; (6%)

(五)、(簡答題) Draw the equivalent circuit of a practical single-phase transformer. (5%)

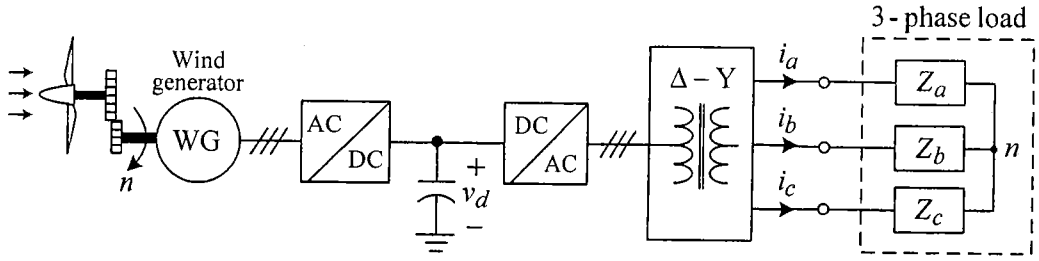

Fig. 1

二、 (計算題) A salient-pole generator without dampers is rated 20 MVA, 13.8 kV and has a direct-axis subtransient reactance of 0.25 per unit. The negative- and zero-sequence reactances are, respectively, 0.35 and 0.10 per unit. The neutral of the generator is solidly grounded. With the generator operating unloaded at rated voltage with $E_{an} = 1.0\angle 0^\circ$ per unit, a single line-to-ground fault occurs at the machine terminals, which then have per-unit voltages to ground,

$$V_a = 0,\ V_b = 1.013\angle -102.25^\circ,\ V_c = 1.013\angle 102.25^\circ$$

Determine the subtransient current in the generator and the line-to-line voltages for subtransient conditions due to the fault. (14%)

三、 (計算題) In the single-phase interface for a bidirectional power flow shown in Fig. 2, v_s=240 V (rms) at 60 Hz and L_s= 2.5 mH. Neglect all losses and assume that the switch-mode converter is pulse-width modulated in its linear range. The converter is controlled such that it is either in phase or out of phase with v_s. Calculate the minimum value of the DC bus voltage V_d if the power flow through the converter is 2 kW (16%)

(一)、 from the grid to the DC side; and (8%)

(二)、 from the DC to the grid. (8%)

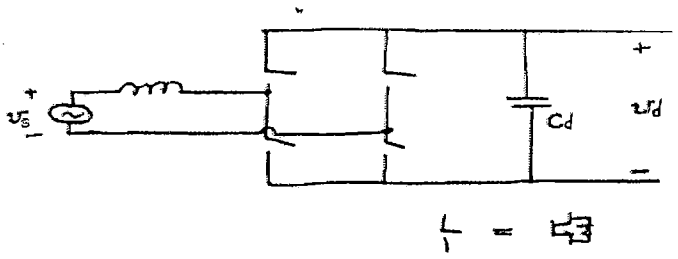

Fig. 2

四、 Consider the one-line diagram shown in Fig. 3. The voltage phasor at Bus I is V_i, The complex power generated from Generator i and the complex power consumed at bus i are S_{Gi} and S_{Di} respectively. The admittance between Bus i and Bus $i+1$ is $y_{i,i+1}=j0.1$ $i=1, 2$. (15%)

(一)、(計算題) Find the Admittance matrix Y. (6%)

(二)、(簡答題)Write down the algorithm for Newton's method for solving power flow equations if $S_{G2}=S_{G3}=0$. Specify known and unknown variables. (9%)

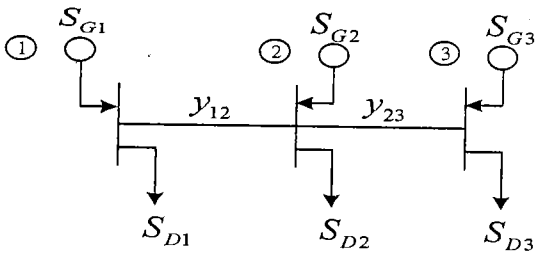

Fig. 3

五、(計算題) The fuel-cost curves of two generators are given as follows: $F_1(P_{G1})=900+45P_{G1}+0.01P_{G1}^2$; $F_2(P_{G2})=2500+40\ P_{G2}+0.003P_{G2}^2$. The total load to be supplies is 750MW. Use the optimal dispatch rule to find the output of each generator if line losses are neglected. (10%)

六、 Assume a round-rotor synchronous generator with the terminal voltage magnitude V_a and the synchronous reactance X_s delivering power to an infinite bus through a transmission line with reactance X_L. The voltage of the infinite bus is $1.0\angle 0^0$. The power angle δ during transients is described by the so-called swing equation: (15%)

$$M\frac{d^2}{dt^2}\delta + D\delta + P_G(\delta) = P_M$$

where M is the machine inertia, $P_G(\delta)$ is the electrical power output, D is damping, and P_M is the mechanical power output.

(一)、(計算題) Express $P_G(\delta)$ in terms of V_a, X_s, and X_L. (5%)

(二)、(簡答題) Does this system have multiple equilibrium points? How to identify their stability. (5%)

(三)、(簡答題) Illustrate how to the phase trajectory from the potential energy curve to derive the equal-area stability criterion for determining the critical clearing time (CCT) under some fault conditions. (5%)