科目：電力系統(500C)　　校系所組：清華大學電機工程學系（甲組）

一、(13%) For the following balanced three-phase system shown in Fig. 1, it is known the time domain function of $\bar{V}_a$ is $v_a(t)=200\sqrt{2}\cos 377t$.

(一)、(6%) Draw the corresponding one line impedance diagram with all the parameters expressed in per unit (p.u.), the base of phase voltage is 200V and that of line current is 20A.

(二)、(7%) Find time domain current of $\bar{I}_1$, i.e., $i_1(t)$

二、(12%) Consider the following three-bus power system shown in Fig. 2. Assume the transmission line impedance of Z_T is $j0.5$ p.u. and the power flow S_{23} as shown in the figure is $\sqrt{3}/2+j1.0$ p.u. Find the voltage magnitude and phase of bus 2, i.e., V_2 and δ_2.

三、(15%) A single-phase line possesses the following line constants at 60Hz:

$z = 0.02 + j0.2\ \Omega/\text{km}$, $y = j5\times10^{-6}\text{S/km}$

(一)、(9%) Find the nominal-π circuit and the corresponding $ABCD$ parameters for a medium-length line of 200km.

(二)、(6%) The line is terminated by a resistor ($R = 100\,\Omega$) as shown in Fig. 3: (1) find the line characteristic impedance Z_c; (2) find the line surge impedance Z_S; (3) for the injected voltage surge v_f, find the voltage transmission coefficient and reflection coefficient.

四、(10%) A non-salient pole synchronous generator has a synchronous reactance $X_s = j1.5$ p.u. It is connected to an infinite bus via a feeder of reactance $X_e = j0.5$ p.u. as shown in Fig. 4. The terminal voltage of V_t is maintained at rated value ($|V_t| = 1$ p.u.) for any loading. If the real power sending to the system is $P = 0.8$ p.u., find: (一) (3%) δ_t; (二) (3%) I_a; (三) (4%) E_f.

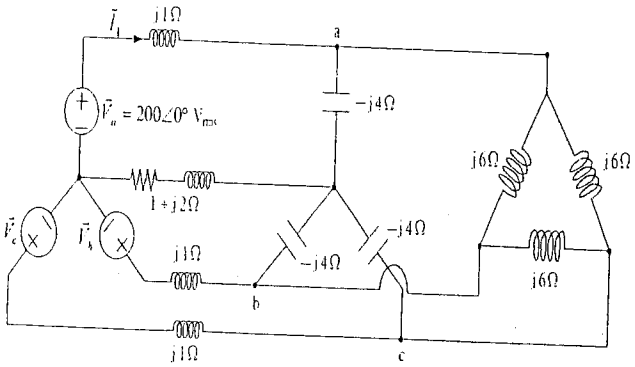

Fig. 1

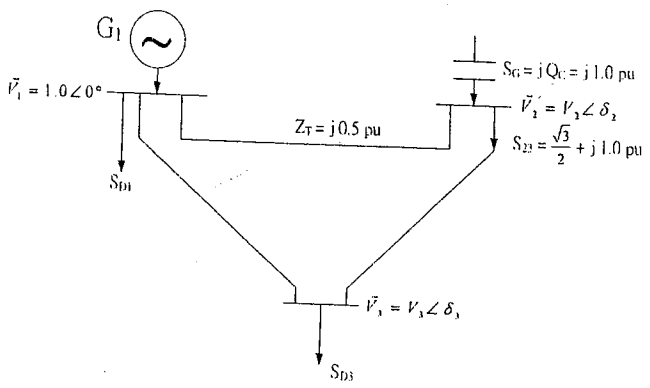

Fig.2

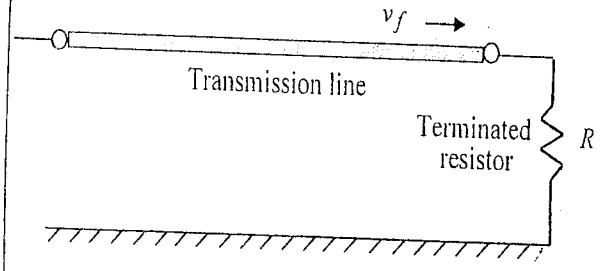

Fig. 3

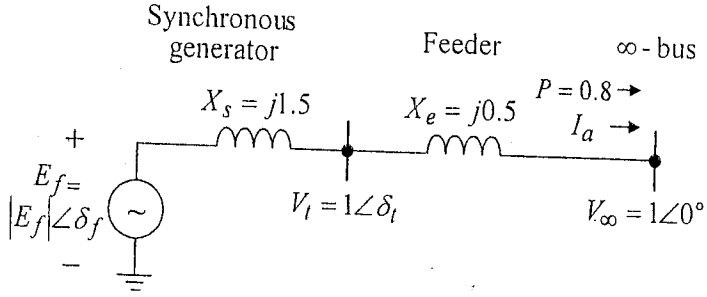

Fig. 4

注意：背面有試題

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五、(10%) A single line-to-earth fault occurs on phase A at the load end of a 66kV transmission line. The line is fed via a transformer by 11kV generators connected to a common busbar. The line side of the transformer is connected in wye with the neutral earthed and the generator side in delta. The positive sequence reactances of the transformer and line are j10.9 Ω and j44 Ω respectively, and the equivalent positive sequence and negative sequence reactances of the generators, referred to the line voltage, are j18 Ω and j14.5 Ω respectively. Measured up to the fault the total effective zero sequence reactance is j150 Ω. Calculate the fault current in the lines if resistances may be neglected. If a two-line-to-earth fault occurs between phase B line and phase C line at the load end, please calculate the current in the phase C.

六、(10%) As shown in Fig. 5, the three-phase rectifier circuit is powered by balanced AC voltages of magnitude V (line-to-line, rms value).

(一)、(3%) Please sketch the AC line current waveforms.

(二)、(3%) Calculate the THD value of the AC line current.

(三)、(4%) Calculate the average power delivered to the DC side. Assume the diodes are ideal.

七、(5%) A 600-MVA, 60-Hz turbine-generator has a regulation constant R=0.05per unit based on its own rating. If the generator frequency increases by 0.03 Hz in steady-state, what is the decrease in turbine mechanical power output?

八、(7%) An area of an interconnected power system has two fossil-fuel units operating on economic dispatch. The fuel-cost curves are given as follows:

$$C_1(P_{G1}) = 900 + 45P_{G1} + 0.01P_{G1}^2 \quad C_2(P_{G2}) = 2500 + 43P_{G2} + 0.003P_{G2}^2$$

The load is specified as P_D=700 MW. Generator limits are given as $50MW \le P_{G1} \le 200MW$, $50MW \le P_{G2} \le 600MW$. Determine the power output of each unit, the incremental operating cost, and the total operating cost.

九、(18%) Consider the power system shown in Fig. 6.

(一)、(5%) The generator is initially operating in the steady-state condition. If the infinite bus receives 1.0 per unit real power at 0.95 power factor (p.f.) lagging, determine (1) (2.5%) the internal voltage of the generator, and (2) (2.5%) the electrical power delivered by the generator versus its power angle.

(二)、(13%) When a temporary three-phase-to-ground short circuit occurs at point F. Three cycle later, circuit breakers B_{13} and B_{22} open after 3 cycles and then reclose when a power angle reaches 35°. Assume that the temporary fault has already self-extinguished when the breakers reclose, use the equal-area criterion to determine the maximum value of the power angle.

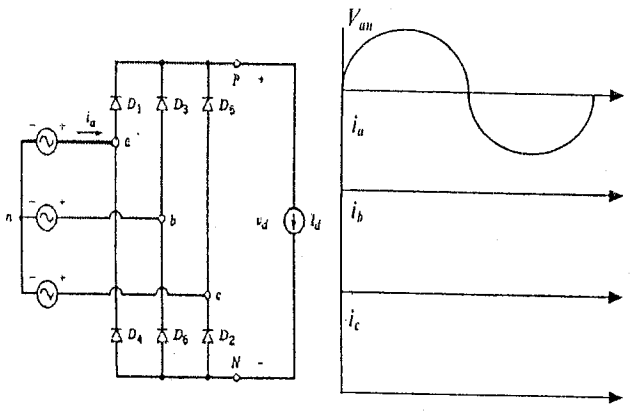

Fig. 5

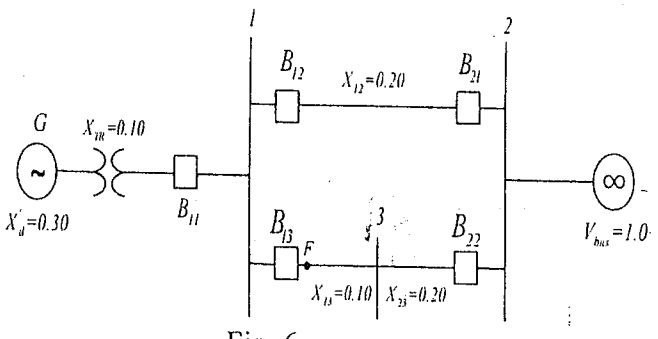

Fig. 6