國立臺灣科技大學
九十四學年度碩士班招生考試試題
系所組別：電機工程系碩士班甲組
科　　目：電力系統

總分 100 分

1. The annually load in MW on a power system varies as tabulated below. Assume the installation capacity of the system is of 1650 MW. Determine
❶the annually load factor. (5%)
❷the utilization factor. (5%)
❸ system spinning reserve. (5%)

Month	1	2	3	4	5	6	7	8	9	10	11	12
Load	1000	800	600	520	900	1200	1600	1400	1000	800	700	1000

2.A single phase, 60 Hz power line (a,b) runs in parallel with a telephone line (c,d) as shown in Fig. p2. The power line carries a rms current of 226 A. Assume that zero current flows in the ungrounded telephone line. Find the peak value of voltage per kilometer induced in the telephone line. (10%)

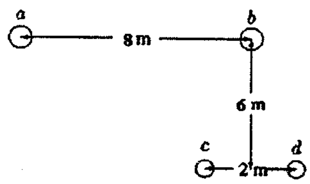

Fig. p2

3.There is a three-phase, 500 kV lossless transmission line with ABCD constant parameters as follows: $A = D = 0.86 + j0$, $B = 0 + j130.2$, $C = j0.002$. When the line delivers 1000 MVA, power factor of 0.8 lagging at the receiving end voltage of 500 kV, determine
❶ the sending end voltage. (7%)
❷ the voltage regulation. (3%)

4. Bus a and bus b of a power system are connected by two parallel transmission lines as shown in Fig. p4. A regulating transformer with negligible impedance is in series with line 1. The transmission line reactances are respectively X_1=0.12pu and X_2=0.08pu. As the tap setting of regulating transformer is $t_s=1\angle 0^\circ$pu, the bus voltages are $V_a=1.05\angle 10^\circ$pu and $V_b=1.0\angle 0^\circ$pu. Assume that V_b and load power are remained unchanged. If the power flow is altered such that the active power flow through line 2 is remained unchanged and the reactive power flow through line 2 is zero, determine the needed tap setting of regulating transformer t_s. (15%)

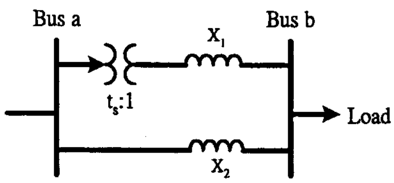

Fig. p4

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5. Consider the system shown in Fig. P5. Slack bus is bus 2. $\overline{V}_2 = 1.0\angle 0^\circ$. All data is in per unit.

❶ Formulate Y_{bus} with entries in rectangular form. (3%)

❷ Reformulate Y_{bus} with entries in polar form. (3%)

❸ Write out simplified expressions for the net real and reactive power entering the network at the bus 1, i.e. P_1 and Q_1. The V_1 and δ_1 are variables. (4%)

The following parts ❹~❼ step through the essence of the Newton-Raphson solution to the power flow problem.

❹ Formulate the 2x2 Jacobian **J**. The V_1 and δ_1 are variables. (4%)

❺ Using starting values V_1=1.0 and δ_1=0, evaluate **J** as constructed in ❹. (3%) Calculate $\mathbf{J}^{-1}$ (3%)

❻ Calculate the bus mismatch ΔP_1 and ΔQ_1. (3%)

❼ Calculate ΔV_1 and $\Delta\delta_1$, and upgrade the bus 1 phase angle and voltage, V_1 and δ_1. (2%)

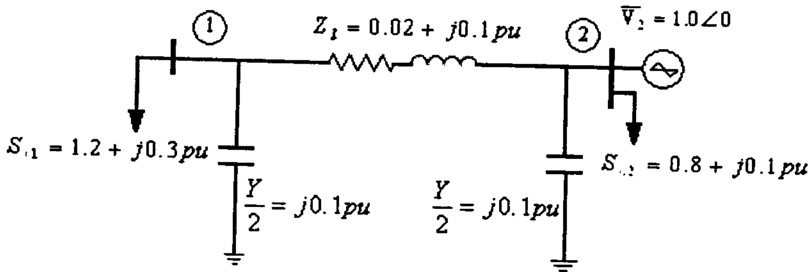

Fig. P5

6. A 60Hz synchronous generator having inertia constant H=5MJ/MVA and a direct axis transient reactance $X_d' = 0.3$ pu is connected to an infinite bus through a purely reactive circuit as shown in Fig. P6. Reactances are marked on the diagram on a common system base. The generator is delivering real power P_e=0.8 pu and Q=0.074 pu to the infinite bus at a voltage of V=1.0 pu. Assume that a temporary three-phase fault occurs at the sending end of the line at point F. When the fault is cleared, both lines are intact. Please determine

❶ The critical clearing angle (Hint : Applying equal-area criterion) (10%)

❷ The critical fault clearing time (Hint : Applying swing equation and let P_e=0) (5%)

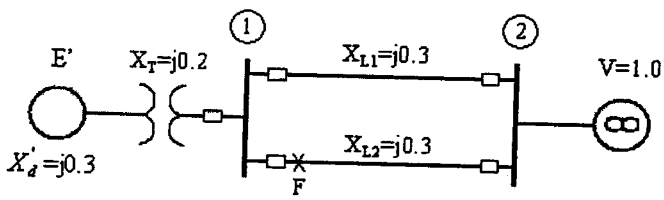

Fig. P6

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7. The system shown in Fig. P7 shows an existing plant consisting of a generator of 100MVA, 30kV, with 20% subtransient reactance and a generator of 50MVA, 30kV with 15% subtransient reactance, connected in parallel to a 30kV bus bar. The 30kV bus bar feeds a transmission line via the circuit braker C which is rated at 1250MVA. A grid supply is connected to the station bus bar through a 500MVA, 400/30kV transformer with 20% reactance. Determine the reactance of a current limiting reactor in ohm to be connected between the grid system and the existing bus bar such that the short-circuit MVA of the circuit braker C does not exceed. (10%)

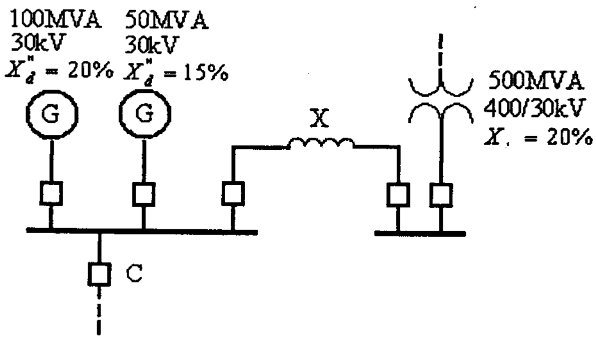

Fig. P7