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1. (15%) Please categorize the bus type for power flow computation. Then, for each type of bus, please distinguish what variables are specified and what variables are unknown.

2.

(1) (10%) From the viewpoints of reactive power as well as the comparison with overhead transmission lines, please list and explain the demerits of underground cables installed for electric power transmission and distribution.

(2) (10%) Please list feasible strategies to improve the above drawbacks when underground cables are employed for electric power transmission and distribution.

3. (15%) Please explain the reason why Metal-Oxide-Semiconductor Field Effect Transistors (MOSFETs) are voltage-controlled devices and Bipolar Junction Transistors (BJTs) are current-controlled devices.

4. Please draw the phasor diagrams and answer the questions for the synchronous machine according to the following steady-state operations.

　I.　(5%) motoring with a leading power factor, capacitive or inductive?

　II.　(5%) motoring with a lagging power factor, capacitive or inductive?

　III.　(5%) generating with a leading power factor, capacitive or inductive?

　IV.　(5%) generating with a lagging power factor, capacitive or inductive?

Note:

　　A、　Reactance effect is considered but resistance effect is neglected.

　　B、　You should sketch the vector of **field excitation voltage E_f** in horizontal axis as a reference, then sketch out vectors of terminal **voltage V_a, current I_a,** and **reactance voltage V_x** with appropriate lengths and angles.

　　C、　Please also label **power angle** δ, and phase angle ϕ for the leading condition in counter-clockwise direction or lagging condition in clockwise direction.

5. The one-line diagram of a simple two-bus power system is depicted below. Each generator is represented by an emf behind the sub-transient reactance. The neutral of each generator is grounded through a current limiting reactor of 0.30/3 pu on a 100 MVA base. The zero-, positive-, and negative-sequence bus impedances in per unit for a two-bus power system are shown in the table below. The generators are operated on no load at their rated voltage with their emfs in phase. An unbalanced fault with impedance $Z_f = j0.1$pu occurs at bus 1. Please do the following

　I.　(15%) draw the **Thevenin sequence impedances and label the values** in per unit for the fault at bus 1

（背面仍有題目,請繼續作答）

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II. (5%) compute the **sequence fault currents** (I^0, I^+, I^-) in per unit at bus 1 when a single line to ground fault occurs at bus 1

III. (5%) compute the **sequence fault currents** (I^0, I^+, I^-) in per unit at bus 1 when a line to line fault occurs at bus 1

IV. (5%) compute the **sequence fault currents** (I^0, I^+, I^-) in per unit at bus 1 when a double line to ground fault occurs at bus 1
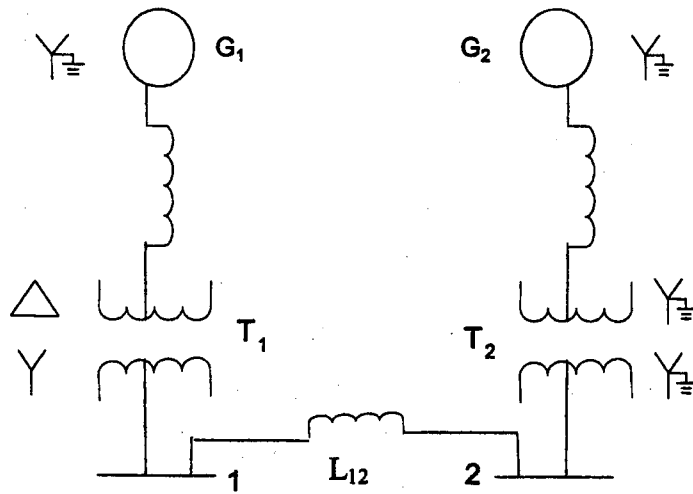
Item	Base MVA	Voltage rating	X^1	X^2	X^0
G_1	100	11 kV	0.10	0.10	0.05
G_2	100	11 kV	0.10	0.10	0.05
T_1	100	11/121 kV	0.20	0.20	0.10
T_2	100	11/121 kV	0.20	0.20	0.10
L_{12}	100	121 kV	0.25	0.25	0.40