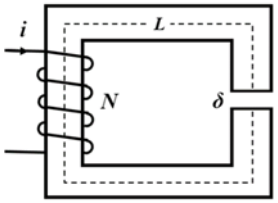
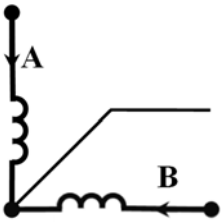
1.The magnetic circuit consists of a core material and an air-gap. The air-gap length is $\boldsymbol{\delta}$, the core length is $\boldsymbol{L}$ and the core cross-sectional area is $\boldsymbol{A}$. The turns of the coil are $\boldsymbol{N}$. Assume that the core is infinite permeability ($\boldsymbol{\mu_{Fe}}=\infty$) and neglect the effects of magnetic leakage and fringing. Calculate: (1) the reluctance of the core $\boldsymbol{R_{Fe}}$ and that of the air-gap $\boldsymbol{R_{\delta}}$, (2) the inductance of coil $\boldsymbol{L_c}$, (3) the current $\boldsymbol{i}$ required to produce an air-gap flux density $\boldsymbol{B_{\delta}}$, (4) the corresponding flux linkage $\boldsymbol{\Psi_c}$ of the coil.



2. Draw the equivalent-T circuit of a transformer. When the primary voltage $\boldsymbol{U_1}$ increases, analyze the changes of main flux $\boldsymbol{\Phi_m}$, core permeability $\boldsymbol{\mu_{Fe}}$, exciting resistance $\boldsymbol{R_m}$, exciting reactance $\boldsymbol{X_m}$ and the secondary voltage $\boldsymbol{U_2}$.

3. What are the synchronous speeds of 2-pole, 4-pole, 6-pole, 8-pole and 10-pole AC machines in China and America respectively?

4. Analyze the fundamental resultant MMFs when the two-phase symmetrical windings flow in two-phase symmetrical currents $i_A=I_m\cos\omega t$ and $i_B=I_m\cos(\omega t-90°)$. (10 points)



5. When the mechanical load of a 3-phase induction motor decreases, analyze the changes of synchronous speed $\boldsymbol{n_s}$, rotor speed $\boldsymbol{n}$, rotor frequency $\boldsymbol{f_2}$, electromagnetic torque $\boldsymbol{T_e}$, rotor current $\boldsymbol{I_2}$, stator current $\boldsymbol{I_1}$, stator power factor $\boldsymbol{\cos\varphi_1}$, input power $\boldsymbol{P_1}$ and efficiency $\boldsymbol{\eta}$.

6. Sketch the phase diagrams for a steam-turbine synchronous generator at (a) unity power factor, (b) lagging power factor, (c) leading power factor.

7. A 13.8kV,10000kVA, 0.8-lagging power factor, 50Hz, two-pole, Y-connected steam-turbine generator has a synchronous reactance X_s of 12Ω per phase and the armature resistance R_a is omitted. The generator is operating in parallel with a large power system (infinite bus). Find:

(a) What is the per unit value of E_0 at rated conditions?

(b) What is the power angle δ of the generator at rated conditions?

8. When the active power of a steam-turbine synchronous generator increases, sketch the phase diagrams change trajectory. The armature resistance R_a is omitted, and the excited current is unchanged.

9. A separately excited dc motor, U_N=220V,P_N= 10kW,η_N=0.88, n_N=1200r/min, R_a=0.44Ω. Calculate the armature electromotive force E_a and electromagnetic power P_e of the rated load. Calculate the electromagnetic torque T_e, output torque T_2 and idle torque T_0 at the rated load.

10. Analyze the conditions of self-excitation generating process in shunt DC generator.

11. A 220V, three-phase, 2-pole, 60Hz induction motor is running at a slip of 5percent. Find:

(1)The speed of the magnetic fields in revolutions per minute.(2)The speed of the rotor in revolutions per minute.(3)The slip speed of the rotor.(4)The rotor frequency in hertz.

12. Sketch the topology of H Bridge for the DC motor.

13. Separately excited dc motor is: P_N=30kW, U_N=220V, I_N=158.5A, n_N= 1000r/min, R_a=0.1Ω. The armature reaction effect is omitted.

(1) Calculate the armature electromotive force E_a and electromagnetic power P_e of the rated load. (2) Calculate the electromagnetic torque T_e, output torque T_2 and idle torque T_0 at the rated load.

(3) T_L= 0.8 T_N, the speed of the motor.

(4) T_L= T_N, the series with the armature circuit of steady speed of 0.3Ω resistance.

(5) T_L=T_N, the steady speed when the voltage is reduced from 220V to 188V.

14. For an iron device，the section area is $9\times10^{-4}m^2$，the average length is 0.3m，the iron permeability is 5000μ_0，the winding turns is N=500.Question: If the flux density is 1T, what is the demanded MMF and the exciting current? $\mu_0=4\pi\times10^{-7}$ H/m.

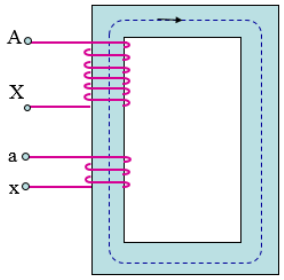
15. What information is learned in a short-circuit test of transformer?

16. There are two identical transformers which are all same except their frequencies are 50Hz and 60Hz respectively, represent A and B. In the case of consideration of saturation, please compare the no-load loss and no-load current.

17.If 220V is applied to the high-voltage side of a U_{1N}/U_{2N}=220V/110V single-phase transformer, the exciting current is 0.3A and the no-load loss is 4W. Calculate the exciting current and the no-load loss if

(1) The terminal X is connected to the terminal a and 330V is applied to the high-voltage side (terminal A and x) of the transformer;

(2) The terminal X is connected to the terminal x and 110V is applied to the high-voltage side (terminal A and a) of the transformer.



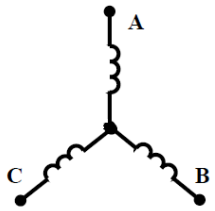
18.For two same single-phase transformers with the voltage ratio of U_{1N}/U_{2N}=220V/110V, any one of them has a no-load current of 0.6A and a no-load loss of 10W if 220V is applied to the primary side at no-load operation. Calculate the total no-load current and the no-load loss if

(1)440V is applied to the primary side with the primary terminals of two transformers are connected in series;

(2)220V is applied to the primary side with the primary terminals of two transformers are connected in parallel.

19.The rated values of a shunt DC generator are known as P_N=107.8kW, U_N=440V, I_{fN}=5A, R_a=0.078Ω, T_1=2250N.m, n_N=500 r/min. When the armature reaction is ignored, find: Ω_N, I_{aN},E_{aN}, P_{eN}, T_{eN}, T_0, P_1 and η_N.

20. When the rotating speed increases 20%, please analyze the changes of no-load voltage of a separate excitation and a shunt excitation DC generator respectively
21. A shunt excitation DC motor operates at the rated speed 1000r/min and the rated input power is 10kW. When the voltage and the load torque keep constant, R_a is increased to decrease the speed to 800r/min. Please find the input power at this time.
22. A shunt excitation DC motor operates at the rated speed 1000r/min and the rated input power is 10kW. When the voltage and the load torque keep constant, R_a is increased to decrease the speed to 800r/min. Please analyze the changes of output power and efficiency.
23. Which is bigger, X_d or X_q? Why?
24. Assume the 3-phase symmetrical windings flow in 3-phase symmetrical currents: $i_A=\cos(\omega t)$, $i_B=\cos(\omega t+120°)$ and $i_C=\cos(\omega t+240°)$. When $\omega t=90°$, determine the rotating direction and the axis position of the rotating MMF.



25. An induction motor connected to 50Hz AC power is on no-load and the rotor speed is 980 r/min. Find: (1) the pole numbers of the motor, (2) the frequency of rotor current, (3) the speed of stator MMF vs rotor, (4) the speed of stator MMF vs stator, and (5) the speed of rotor MMF vs stator MMF.
26. Sketch the power flow diagram of an induction motor.
27. Sketch the power flow diagram of a shunt DC motor.
28. Sketch the power flow diagram of a shunt DC generator.
29. With the increase of output power, analyze the changes of mechanical loss p_Ω, stator core loss p_{Fe1}, rotor core loss p_{Fe2}, stator copper loss p_{Cu1} and rotor copper loss p_{Cu2} of an induction motor.
30. The overload ability of an induction motor is $k_T=1.5$. If the stator voltage decreases 20%, can the motor continue to operate?
31. Draw the Torque-Slip Curve of an induction motor.
32. Describe the structure features of synchronous machines with cylindrical rotor.
33. Describe the structure features of synchronous machines with salient-pole rotor.
34. Give the relational expression about the power angle δ, the power factor angle φ and the inner power factor angle Ψ_0. When $\delta=30°$ and $\varphi=-30°$, please draw the phase diagram and analyze the armature reaction property of a synchronous generator with cylindrical rotor.
35. Please write the voltage equations and power-angle equations of a cylindrical rotor synchronous generator and a salient-pole rotor synchronous generator respectively. And then, analyze their similarities and differences.
36. A steam turbine generator is connected with the infinite bus and $R_a\approx0$.Keep the active power and regulate the reactive power, please sketch the phase diagrams change trajectory.
37. A steam turbine generator is connected with the infinite bus and $R_a\approx0$. Keep the field current constant and increase the active power, please sketch the phase diagrams change trajectory.
38. A steam turbine generator is connected with the infinite bus and $R_a\approx0$.Keep the reactive power and increase the active power with over excitation, please sketch the phase diagrams change trajectory.
39. How can the speed of a separately excited dc motor be controlled? Explain in detail.
40. Sketch the power flow chart of a separately excited dc motor.
41. Describe in detail the operating principle of a three-phase induction motor.
42. Why is the frequency of a synchronous generator locked into its rate of shaft rotation?
43. What information is learned in an open-circuit test of transformer?
44. Why is the efficiency of an induction motor so poor at high slips?
45. A 380V, 1470r/min, 50Hz, Δ-connected wound-rotor induction motor is rated at 7.5kW. The rated power factor is lagging 0.8. The iron losses P_{Fe} is 231W. The stator copper losses p_{cu1} is 474W. The mechanical losses p_Ω is 45W. The additional losses p_Δ is 37W. Find:(a) Electromagnetic power P_e;(b) The motor's efficiency η; (c) The stator line current.
46. What happens in a shunt dc motor if its field circuit opens while it is running?
47. Derive the equation of magnetic Ohm's law.
48. Sketch the transformer equivalent-T circuit and explain every component in the equivalent circuit.
49. Sketch the induction motor equivalent-T circuit and explain every component in the equivalent circuit.
50. A three-phase induction machine, with squirrel cage rotor, has the following ratings: $f_N=50$ Hz, $P_N=28$ kW (mechanical power), $U_N=380$ V, $n_N=950$ r/min and $\cos\varphi=0.88$. The stator winding is in star connection, under the rated load condition, the stator copper loss is 1.4 kW, the core loss is 0.8 kW, mechanical loss is 1.1 kW and the stray loss is 186 W. Find: 1) rated slip; 2) electromagnetic power; 3) input power; 4) efficiency, and 5) stator line current.
51. A single-phase 20 kVA, 20000 V/480 V, 60 Hz transformer is tested with the following results:

Open-circuit (measured from the secondary winding)	Short-circuit test (measured from the primary winding)
U_0 = 480 V	U_k= 1130 V
I_0= 1.60 A	I_k= 1 A
P_0 = 305 W	P_k =260 W

Suppose that $X_{1\sigma}= X'_{2\sigma}$and $R_1=180\Omega$, find the transformer equivalent-T circuit parameters by showing the calculation steps.
52. Explain that the output voltage of a stand-alone steam-turbine generator with purely inductive load will decrease when the load current is increased. The excitation current of the generator is kept constant and the armature resistance can be omitted.

53. A 13.8kV, 70000kVA, 0.85-lagging power factor, 50Hz, two-pole, Y-connected hydro-generator is operating in parallel with a large power system (infinite bus). X_d=2.72Ω, X_q=1.90Ω, the armature resistance R_a is omitted. Calculate:(a) What is the per unit value of E_0 at rated conditions. (b) What is the power angle δ of the generator at rated conditions.
54. The speed of a U_N=220V, I_N=78.5A, R_a=0.26Ω separately excited dc motor running at rated condition is 1000r/m, and the series resistor of armature wound is zero. If the series resistor of armature wound is adjusted to 0.65Ω, what is the speed of the motor at the same torque load condition? The armature reaction effect is omitted.
55. A separately excited dc machine is operated at a constant speed of 3000r/min with a constant field current such that the emf E_a is 125V. The armature resistance R_a is 0.02Ω. Compute the armature current, terminal power and electromagnetic power and torque when the terminal voltage U is 128V.
56. A separately excited dc machine is operated at a constant speed of 3000r/min with a constant field current such that the emf E_a is 125V. The armature resistance R_a is 0.02Ω. Compute the armature current, terminal power and electromagnetic power and torque when the terminal voltage U is 124V.
57. A separately excited dc machine is operated at a constant speed of 3000r/min with a constant field current such that the emf E_a is 125V. The armature resistance R_a is 0.02Ω. The machine is observed to be operating as a motor with a terminal voltage U of 123 V and with an input terminal power of 21.9 kW. Calculate the speed of the motor.
58. A permanent-magnet dc motor without field winding is known to have an armature resistance of 1.03 Ω. When operated at no load from a dc source 50V, it is observed to rotate at a speed of 2100 r/min and to draw a current of 1.25A. Find (a) The $C_e\Phi$ (b) the no-load rotational losses of the motor, and (c) the power output of the motor when it is operating at 1700 r/min from a 48V source.
59. A single-phase transformer with its secondary circuit open and an alternating voltage applied to its primary terminals. The core loss and exciting voltamperes were found to be P_{Fe}=16W S=20VA and the primary voltage was U=194V when the winding had 200 turns.Find the power factor, the core-loss current I_{Fe}, the exciting current I_m, and the magnetizing current I_μ.
60. The voltage regulation of one transformer operator at full load is zero. Find that the power factor is lagging or leading.
61. Describe the theory of deep slot induction motor.