University of Med Boudiaf M'sila | University Year 2025/2026

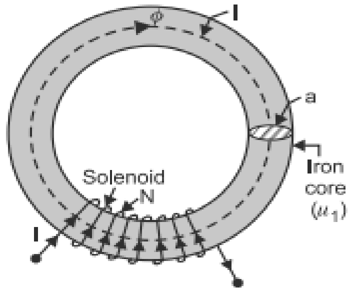
Faculty of Technology | Teacher: BELHAMDI SAAD

Electrical Engineering Department | Module: Fundamental Electrotechnics II

2nd Year Electrotechnics Series n01

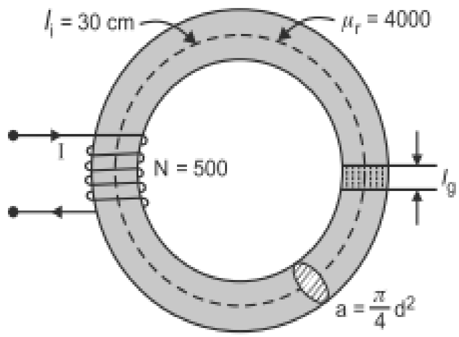
Example 1.1

An iron ring of 400 cm mean is made from round iron of cross-section 20 cm^2. Its permeability is 500. If it is wound with 400 turns, what current would be required to produce a flux of 0·001 Wb?



Example 1. 2

A wrought iron bar 30 cm long and 2 cm in diameter is bent into a circular. It is then wound with 500 turns of wire. Calculate the current required to produce a flux of 0·5 mWb in magnetic circuit with an air gap of 1 mm; ur (iron) = 4000.



Example 1. 3

A rectangular magnetic core shown in Fig. 1. 3 (a). has square cross-section of area 16 cm^2. An air-gap of 2 mm is cut across one of its limbs. Find the current needed in the coil having 1000 turns wound on the core to create an air-gap flux of 4 m Wb. The relative permeability of the core is 2000.

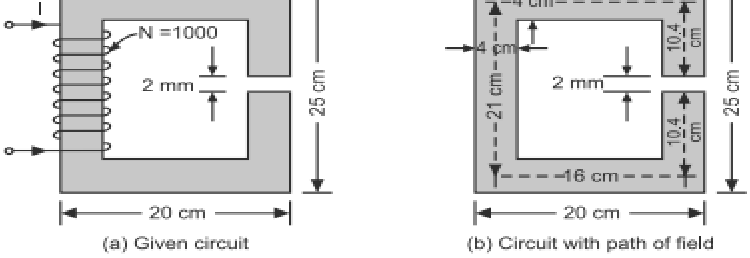


Fig. 1. 3 Magnetic circuit

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2nd Year Electrotechnics Series n02

Example 1

Draw the developed winding diagram of a progressive lap winding for 4 poles, 16 slot showing therein position of poles, direction of motion, direction of emf and position of brushes.

Example 2

Draw a developed winding diagram of a lap winding for a four-pole generator with 16 coils. Also draw the equivalent ring diagram with position of brushes and diagram representing parallel circuits thus formed.

Example 3

Draw a developed winding diagram for a wave wound, six-pole DC armature having 16 slots with 2 coil-sides per slot. Therein position of poles, direction of motion, and direction of induced emf and position of brushes.

Example 4

Draw a developed winding diagram showing position of poles, direction of rotation, polarity and position of brushes of wave winding for a four-pole DC generator with 30 armature conductors.

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2nd Year Electrotechnics Series n 03

Example 1

A 12-pole DC shunt generator has 50 slots on its armature with 12 conductors per slot with wave winding. The armature and field winding resistance is 0.5 ohm and 60 ohm respectively. The generator is supplying a resistive load of 15 ohm at terminal voltage of 300 V when running at a speed of 625 rpm. Find the armature current, the generated emf and the flux per pole.

Example 2

A DC generator is connected to a 220 V DC mains. The current delivered by the generator to the mains is 100 A. The armature resistance is 0.1 ohm. The generator is driven at a speed of 500rpm Calculate (i) the EMF (ii) the electromagnetic torque (iii) the mechanical power input to the armature neglecting iron losses, (iv) Electrical power output from the armature, (v) armature copper loss.

Example 3

A shunt generator supplies 195 A at 220 V. Armature resistance is 0.02 ohm, shunt field resistance is 44 ohm. If the iron losses amount to 1600 watt, find

- **EMF generated;**
- **Copper losses;**
- **Efficiency of generator.**

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2nd Year Electrotechnics Series n04

Example 1

A 6-pole, 440 V DC motor has 936 wave wound armature conductors. The useful flux per pole is 25 m Wb. The torque developed is 446.35Nm. Calculate the following, if armature resistance is 0·5 ohm; (i) Armature current (ii) Speed

Example 2

A 250 V shunt motor takes 4A at no-load and resistance of armature is 0.4: and that of shunt field is 125: calculate: (i) output is kW (ii) Efficiency of motor when motor current is 102A.

Example 3

A 6-pole, 500V, wave connected shunt motor has 1200 armature conductors and useful flux/pole of 20mWb. The armature and field resistances are 0.5Ω and 250Ω respectively. What will be the speed and torque developed by the motor when it draws 20A from the supply mains? If magnetic and mechanical losses amount to 900W, find (i) output in kW (ii) useful torque (Tsh) (iii) efficiency (ηc) at this load

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2nd Year Electrotechnics Series n05

Example 1: A 230/460-V transformer has a primary resistance of 0.2 Ω and reactance of 0.5 Ω and the corresponding values for the secondary are 0.75Ω and 1.8Ω respectively. Find the secondary terminal voltage when supplying 10 A at 0.8 p.f. lagging.

Example 2: A 50-kVA, 4,400/220-V transformer has $R_1 = 3.45$ Ω, $R_2 = 0.009$ Ω. The values of reactances are $X_1 = 5.2$ Ω and $X_2 = 0.015$ Ω. Calculate for the transformer (i) equivalent resistance as referred to secondary (ii) equivalent reactance as referred to both secondary (iii) equivalent impedance as referred to both secondary (iv) total Cu loss, first using individual resistances of the two windings and secondly, using equivalent resistances as referred to each side

Examples 3: **I** Using open secondary winding, the transformer generates a voltage of RMS value U_{20}=100V at the secondary winding, for an applied voltage of RMS value U_{10}=20V with a drawn current intensity of RMS value I_{10}=3.2A and a consumed power P_{10}=8W.

Using short circuited secondray winding , a voltage of RMS value U_{1cc}=0.8V for a total power of P_{1cc}=24W is measured ,causing a current flow of RMS value I_{2cc}=10A through the secondray winding.

Considering a simplified equivalent model of the transformer (resistances and inductances gathered and moved to the secondary winding):

1. Calculate the transformer ratio m;

2. Calculate the resistance R_0 and the magnetizing inductance L_0 , placed at the secondary of the transformer;

3. Compute the values of the resistance R_0 and the reactance X_0 corresponding to the Joule losses and the leakage reactance, placed at the secondary of the transformer.

II Using the transformer connected to a load on the secondary side drawing a current of RMS value I_2=12 A with a power factor cos $\varphi_2 = 0.8$ (the current is lagging the voltage), a RMS voltage of $U_1 = 20$ V is applied to the primary winding.

4. Calculate the RMS voltage U_2 appearing across the secondary winding by using a wise approximation of the voltage dropout ΔU_2 and justify that the approximation is relevant;

5. Deduce the active power P_2 provided to the load;

6. Calculate the RMS current I_1 on the primary side;

7. Compute the transformer efficiency η.

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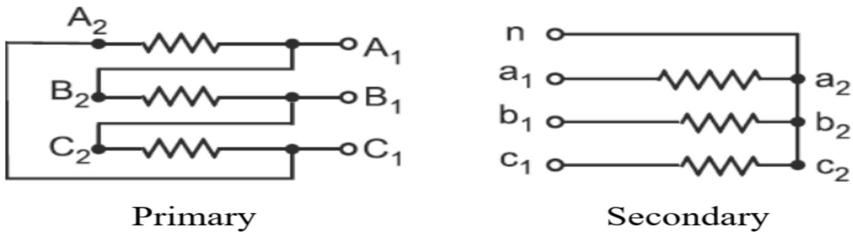
1. The type of connection in figure below is :



a. Star/delta.
b. Delta/star.
c. Delta/delta.
d. Star/star.

2. A three-phase delta-star transformer is connected to an 11 kV supply with N1/N2=11 and draws 6 A current. Determine:
   a. line voltage at the secondary side,
   b. The line current in the secondary coil

3. A 3-phase, 50-Hz transformer has a delta-connected primary and star connected secondary, the line voltages being 22000 V and 400 V respectively. The secondary
   has a star connected balanced load at 0.8 power factor lagging. The line current on the primary side is 5 A. Determine the current in each coil of the primary and in each secondary line. What is the output of the transformer in kW?

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Example1

What is the frequency of the voltage generated by a three-phase alternator having 6 poles and rotating at 1200 RPM?

Example2

The armature of a 4-pole, 3-phase, 50 Hz alternator has 24 slots and 10 conductors per slot. A flux of 0.03 Wb is entering the armature from one pole. Calculate the induced EMF per phase.

Example3

A 3-phase, 11 kV, 3 MVA star-connected alternator has a per phase synchronous reactance of 10 Ω. Its excitation is such that the generated line EMF is 15 kV. When the alternator is connected to infinite busbars. Calculate the maximum output power of the alternator at the given excitation when armature resistance is neglected.