ДОНСКОЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

УПРАВЛЕНИЕ ДИСТАНЦИОННОГО ОБУЧЕНИЯ И ПОВЫШЕНИЯ КВАЛИФИКАЦИИ

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Аннотация

Методические указания к чтению англоязычных текстов по направлению 140400 «Электроэнергетика и электротехника».

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Оглавление

Text 1. Power Engineering

Task 1. Read the following words and try to remember them:

power engineering - энергетика; **generation** - генерирование, создание; **transmission** - передача; **distribution** - распределение; **power** - сила, мощность, энергия; **utilities –** коммунальные службы**; fuel** - топливо, горючее; **fossil** - ископаемое; **a loop of wire** - виток проволоки; **storage** - хранение; **recovery** - восстановление, регенерация, добыча; **to carry out** -выполнять; **power station** - электростанция; **voltage** - напряжение; **to connect** - связывать; **current** - электрический ток; **power grid** - энергетическая система, энергетическая сеть электропередач; **to drive** - приводить в движение.

Task 2. Read the text and get ready to answer the questions:

1. What does power engineering deal with? 2. What is generation of electric power? 3. What sources of power do you know? 4. What does transmission include? 5. What role do transformers play? 6. What does distribution involve? 7. Why do most grids adopt three-phase electric power with alternating current?

Power Engineering deals with the generation, transmission and distribution of electricity as well as the design of a range of related devices. These include transformers, electric generators, electric motors and power electronics.

Generation is converting other forms of power into electrical power. The sources of power include fossil fuels such as coal and natural gas, hydropower, nuclear power, solar power, wind power and other forms.

For electric utilities, it is the first process in the delivery of electricity to consumers. The other processes, electricity transmission, distribution and electrical power storage and recovery are normally carried out by the electric power industry.

Electricity is most often generated at a power station by electromechanical generators, primarily driven by heat engines fueled by chemical combustion or nuclear fission but also by other means such as the kinetic energy of flowing water and wind. Other energy sources include solar photovoltaic and geothermal power.

Transmission includes moving power over somewhat long distances, from a power station to near place where it is used. Transmission involves high voltages, almost always higher than voltage at which the power is either generated or used. Transmission also includes connecting together power systems owned by various companies and perhaps in different states or countries. Transmission includes long, medium and short lines.

Transformers play an important role in power transmission because they allow power to be converted to and from higher voltages. This is important because higher voltages suffer less power loss during transmission.

Distribution involves taking power from the transmission system to end users, converting it to voltages at which it is ultimately required.

In many regions of the world, governments maintain an electrical network that connects a variety of electric generators together with users of their power. This network is called a power grid. Power engineers may work on the design and maintenance of the power grid as well as the power systems that connect to it. Such systems are called on-grid power systems and may supply the grid with additional power, draw power from the grid or do both.

Today, most grids adopt three-phase electric power with an alternating current This type of power can be easily generated, transformed and used. Often the power is split before it reaches residential customers whose low-power appliances rely upon single-phase electric power. However, many larger industries and organizations still prefer to receive the three-phase power directly because it can be used to drive highly efficient electric motors such as three-phase induction motors.

Task 3. Find Russian equivalents for the following English words and expressions:

delivery of electricity to consumers; combustion; nuclear fission; energy sources; photovoltaic; geothermal power; to convert power; to suffer less power loss; end users.

горение, конечные пользователи, нести меньшие потери энергии, преобразовывать энергию, источники энергии, деление ядра, доставка электричества потребителям, фотоэлектрический, геотермическая энергия.

Text 2. Methods of generating electricity

Task 1. Read the following words and remember them:

charge - заряд, зарядка; **triboelectric effect** - трибоэлектрический эффект(связан с трением); **lightning** - молния; **alternator** - генератор переменного тока; **loop** - контур, петля, виток; **solar cell** - солнечный фотоэлемент; **thermocouple** - термопара, термоэлемент**;** **thermopile** - термоэлектрическая батарея, термоэлемент; **thermionic converter** - термоэлектронный преобразователь; **strain** - усилие, напряжение; **decay** - распад, разрушение, уменьшение; **steam turbine** - паровая турбина.

Task 2. Read the text and try to understand it.

There are seven fundamental methods of directly transforming other forms of energy into electrical energy:

- *static electricity* from the physical separation and transport of charge (examples: triboelectric effect and lightning);
- *electromagnetic induction*, where an electrical generator, dynamo or alternator transforms kinetic energy (energy of motion) into electricity. This is the most used form for generating electricity and is based on Faraday's law. It can be experimented by simply rotating a magnet within closed loops of a conducting material (e.g. copper wire);
- *electrochemistry* (the direct transformation of chemical energy into electricity, as in a battery);
- *photoelectric effect* (the transformation of light into electrical energy, as in solar cells);
- *thermoelectric effect* (the direct conversion of temperature differences to electricity, as in thermocouples, thermopiles, and thermionic converters);
- *piezoelectric effect* (from the mechanical strain of electrically anisotropic molecules or crystals);
- *nuclear transformation* (the creation and acceleration of charged particles).

Static electricity was the first form discovered and investigated, and the electrostatic generator is still used even in modern devices. Charge carriers are separated and physically transported to a position of increased electric potential.

Almost all commercial electrical generation is done using electromagnetic induction, in which mechanical energy forces an electrical generator to rotate. There are many different methods of developing the mechanical energy, including heat engines, hydro, wind and tidal power.

The direct conversion of nuclear potential energy to electricity by beta decay is used only on a small scale. In a full-size nuclear power plant, the heat of a nuclear reaction is used to run a heat engine. This drives a generator, which converts mechanical energy into electricity by magnetic induction.

Most electric generation is driven by heat engines. The combustion of fossil fuels supplies most of the heat to these engines, with a significant fraction from nuclear fission and some from renewable sources. The modern steam turbine currently generates about 80% of the electric power in the world using a variety of heat sources.

Task 3. Find English equivalents for the following words and expressions:

проводниковый материал (проводник); медная проволока; создание и ускорение заряженных частиц; вращаться; тепловые машины; энергия прилива и отлива; в малом масштабе; управлять тепловой машиной; значительная доля (часть); возобновляемые источники.

Task 4. Answer the following questions:

1) What are fundamental methods of directly transforming other forms of energy into electrical one? 2) Which method deals with transforming energy of motion into electricity? 3) How do we call the effect of direct conversion of temperature differences to electricity? 4) What form of electricity was discovered and investigated the first? 5) How much electric power does the modern steam turbine generate?

Text 3. Economics of generation and production of electricity

Task 1. Read the following words and remember them:

selection of modes - выбор режимов; **economic viability** - экономическая жизнеспособность; **viable** - жизнеспособный; **to have one's own pros and cons** - иметь свои «за» и «против»; **fluctuation** - колебание, неустойчивость; **demand** - спрос; **density** - плотность; **to withstand** - выдержать; **load** - нагрузка; **consumption** - потребление, расход; **to decrease** - уменьшать; **unit** - секция, блок, узел; **to raise concerns** - вызывать озабоченность; **to harness** - использовать(в качестве источника энергии); **advancement** - продвижение, успех, прогресс; **to provide subsidies** - предоставлять субсидии; **to offset** - возмещать, компенсировать; **feasible** - выполнимый, осуществимый, возможный.

Task 2 Look through the text and find the equivalents for the word combinations below:

атомная электростанция; тепловая электростанция; местные потребности в электроэнергии; населенные районы; недавние бедствия; безопасность атомной энергии; ежегодный производственный цикл; стоимость производства.

The selection of electricity production modes and their economic viability varies in accordance with demand and region. Hydroelectric plants, nuclear power plants, thermal power plants and renewable sources have their own pros and cons, and selection is based upon the local power requirement and the fluctuations in demand.

Thermal energy is economical in areas of high industrial density, as the high demand cannot be met by renewable sources. The effect of pollution is also minimized as industries are usually located away from residential areas. These plants can also withstand variation in load and consumption by adding more units or temporarily decreasing the production of some units.

Nuclear power plants can produce a huge amount of power from a single unit. However, recent disasters in Japan have raised concerns over the safety of nuclear power.

Hydroelectric power plants are located in areas where the potential energy from flowing water can be harnessed for moving turbines and the generation of power. It is not an economically viable source of production where the load varies too much during the annual production cycle and the ability to stop the flow of water is limited.

Renewable sources other than hydroelectricity (solar power, wind energy, tidal power, etc) are currently expensive to produce, though with advancements in technology their cost of production is coming down. Many governments around the world provide subsidies to offset the high cost and make their production economically feasible.

Task 3. Read the text again and answer the questions:
1) What is selection of electricity production mode based upon?
2) Where is thermal energy economical?
3) What are weak points of hydroelectric plants as the source of energy?
4) What are disadvantages of renewable sources?

Text 4. Electric power transmission

Task 1 Write down and try to remember the following words and expressions:

bulk transfer - передача большого количества/объема; **substation** - подстанция; **consumer** - потребитель; **overhead power transmission lines** - воздушные линии электропередач;

colloquially – разговорно (в разговорной речи); **grid** - сетка; **alternating current (AC) -** переменный ток; **direct current (DC) -** постоянный ток; **conductor** - проводник; **insulation** - изоляция, изоляционный материал; **to cover** - покрывать; **alloy** - сплав; **strand** - жила, кабель; **to reinforce** – усиливать, укреплять; **commodity** - предмет потребления, товар; **sub transmission voltage** - напряжение при передаче электричества на небольшие расстояния; **circuit** - эл.цепь.

Task 2 Read the text.

Electric power transmission, a process in the delivery of electricity to consumers, is the bulk transfer of electrical power. Typically, power transmission is between the power plant and a substation near a populated area. Electricity distribution is the delivery from the substation to the consumers. Electric power transmission allows distant energy sources (such as hydroelectric power plants) to be connected to consumers in population centers.

Due to the large amount of power involved, transmission normally takes place at high voltage (110 kV or above). Electricity is usually transmitted over long distance through overhead power transmission lines. Underground power transmission is used only in densely populated areas due to its high cost of installation and maintenance.

A power transmission system is sometimes referred to colloquially as a "grid". AC power transmission is the transmission of electric power by alternating current. Usually transmission lines use three phase AC current. In electric railways, single phase AC current is sometimes used in a railway electrification system. In urban areas, trains may be powered by DC at 600 volts or so.

Overhead conductors are not covered by insulation. The conductor material is nearly always an aluminum alloy, made into several strands and possibly reinforced with steel strands. Conductors are a commodity supplied by several companies worldwide. Improvements in conductor material and shape may allow increased circuit capacity and is occasionally done to modernize a transmission circuit.

Today, transmission-level voltages are usually considered to be 110 kV and above. Lower voltages such as 69 kV and 33 kV are usually considered sub-transmission voltages but are occasionally used on long lines with light loads. Voltages less than 33 kV are usually used for distribution. Voltages above 230 kV are considered extra high voltage and require different designs compared to equipment used at lower voltages.

Task 3. Find English equivalents for the following collocations:

населенный район; большое количество энергии; высокое напряжение; передавать на большое расстояние; подземная электропередача; густонаселенные районы; установка и обслуживание; трехфазный ток; железные дороги; однофазный ток; городские районы; стальные жилы; легкие нагрузки; цепь электропередачи.

Task 4. Find 10-12 international words in the text above and translate them.

Task 5. Answer the questions:
1) What is electric power transmission?
2) What is electricity distribution?
3) What is a grid?
4) What conductor material is usually used?
5) What is the aim of improvements in conductor material?
6) What are transmission-level voltages?

Text 5. Distribution network configurations

Task 1. Read the following words and try to remember them:

supply – снабжение, подача, питание, источник питания; **rural** – сельский; **urban** – городской; **utility** – коммунальная служба, сооружение; **lineman** – линейный монтер; **benefit** – выгода, польза; **fault** – ошибка, неисправность; **failure** – авария, повреждение, разрыв; **pole** – столб; **to be collocated with** – быть расположенным вместе с; **feeder** – питатель, фидер; **to emanate from** – исходить от**; circuit breaker** – выключатель цепи; **fuse** – пробка, плавкий предохранитель; **recloser** – автомат или реле повторного включения**; to segregate** – изолировать, ликвидировать; **damage** – повреждение; **capacitor** – конденсатор; **to experience** – испытывать.

Task 2. Read the text and try to understand it.

Distribution networks are typically of two types, radial or interconnected. A radial network leaves the station and passes through the network area with no normal connection to any other supply. This is typical of long rural lines with isolated load areas. An interconnected network is generally found in more urban areas and will have multiple connections to other points of supply.

These points of connection are normally open but allow various configurations by the operating utility linemen carefully closing and opening switches. The benefit of the interconnected model is that in the event of a fault or required maintenance a small area of network can be isolated and the remainder kept on supply. There are various types of faults. A fault is defined as an abnormal condition or defect at the component, equipment, or sub-system level which may lead to a failure.

Within these networks there may be a mix of overhead line construction utilizing traditional utility poles and wires and, increasingly, underground construction with cables and indoor or cabinet substations. However, underground distribution can cost 11 times as much as overhead construction. In part to reduce this cost, underground power lines are sometimes colocated with other utility lines. Distribution feeders emanating from a substation are generally controlled by a circuit breaker or fuse which will open when a fault is detected. Automatic Circuit Reclosers may be installed to further segregate the feeder thus minimizing the impact of faults. A circuit breaker is an automatically-operated electrical switch which is designed to protect an electrical circuit from damage caused by overload or short circuit.

Long feeders experience voltage drop requiring capacitors or voltage regulators to be installed.

Task 3. Find English equivalents for the following word expressions:

пункты питания; множественные соединения; допускать различные конфигурации; маленький участок сети; привести к аварии; стоить в 11 раз дороже, чем; воздействие ошибок; автоматически управляемый электрический выключатель; защищать электрическую цепь; перегрузка; короткое замыкание; падение напряжения.

Task 4. Answer the questions:

1. What are the main types of distribution networks? 2. What are differences between radial and interconnected networks? 3. What is the benefit of the interconnected model? 4. What faults may lead to a failure? 5. What is cheaper: overhead line construction or underground construction? 6. What devices control distribution feeders? 7. What is the circuit breaker?

Text 6. Substation

Task1. Write down the words and remember them:

generating station – электростанция; **to flow** – течь; **instead of** – вместо (чего-л.); **subsidiaries** – филиалы, вспомогательные компании; **to interrupt** – прерывать; **to occur** – случаться, происходить; **fenced enclosures** – окруженные заборами места; **switchgear** – распределительное устройство, коммутационная аппаратура; **to ground** – заземлять, заземление; **hazard** – угроза; **electrocution** – удар эл. током.

Task 2. Read the text:

A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. Between the generating station and consumer, electric power may flow through several substations at different voltage levels.

Substations may be owned and operated by an electrical utility, or may be owned by a large industrial or commercial customer. A substation may include transformers to change voltage levels between high transmission voltages and lower distribution voltages. The word *substation* comes from the days before the distribution system became a grid. As central generation stations became larger, smaller generating plants were converted to distribution stations, receiving their energy supply from a larger plant instead of using their own generators. The first substations were connected to only one power station, where the generators were housed, and were subsidiaries of that power station.

Substations generally have switching, protection and control equipment, and transformers. In a large substation, circuit breakers are used to interrupt any short circuits or overload currents that may occur on the network. Smaller distribution stations may use recloser circuit breakers or fuses for protection of distribution circuits. Substations themselves do not usually have generators, although a power plant may have a substation nearby. Other devices such as capacitors and voltage regulators may also be located at a substation.

Substations may be on the surface in fenced enclosures, underground, or located in special-purpose buildings. High-rise buildings may have several indoor substations. Indoor substations are usually found in urban areas to reduce the noise from the transformers, for reasons of appearance, or to protect switchgear from extreme climate or pollution conditions.

Where a substation has a metallic fence, it must be properly grounded to protect people from high voltages that may occur during a fault in the network. Earth faults at a substation can cause a ground potential rise. Currents flowing in the Earth's surface during a fault can cause metal objects to have a significantly different voltage than the ground under a person's feet; this *touch potential* presents a hazard of electrocution.

Task 3. Find English equivalents for the following word expressions:

осуществлять несколько важных функций; находиться в собственности кого-либо; менять уровни напряжения; здания специального назначения; высотные здания; внутренние подстанции; уменьшать шум; включающее, защитное и управляющее оборудование; регуляторы напряжения; из-за внешнего вида; условия загрязнения; значительно отличающееся напряжение.

Task 4. Answer the questions:

1. What functions do substations perform? 2. Who owns substations? 3. What is the function of transformers? 4. When did substations appear? 5. What equipment do substations comprise? 6. What equipment protects substations in case of fault? 7. Why must substation's metallic fence be grounded?

Text 7. Electrical Power Generators

Task 1. Read the following words and try to remember them:

inputs – *зд.* ресурсы, затраты; **outputs** – выходная мощность, выход; **to output** – производить, вырабатывать; **power rating** – номинальная мощность; **specifications** – технические характеристики; **customized** – заказной, изготовленный по техническим условиям заказчика; **starting aids** – средство облегчения пуска; **attachment** – дополнительное приспособление, устройство; **option** – дополнение к стандартной комплектации; **enclosure** – корпус, кожух; **silencer** – глушитель; **governor** – регулятор, управляющее устройство; **design** – конструкция; **performance option** – вариант исполнения, **to feature** – характеризоваться; **coil** – *эл.* катушка; **to range** – колебаться в пределах.

Task 2. Read the text and try to guess the meaning of the words in bold.

Electrical power *generators* are devices that *convert mechanical,* chemical, or other forms of *energy* into electrical energy. The most common *type* of electrical power generator uses electromagnetic induction to convert mechanical energy into electrical energy. These simple devices are essentially reversed electric *motors* with a *rotor* that carries one or more coils surrounded by a *magnetic* field, typically supplied by a permanent magnet or *electromagnet*. In other electrical power generators, mechanical energy from steam *turbines* moves the *rotor*, which induces an electric current in the rotor coil. Electrical power generators that provide direct current (DC) typically include a mechanical switch or *commutator* that switches the current every half-rotation so that the rotor remains unidirectional. Large, modern generators or alternators in power stations provide alternating current (AC) for general distribution. *Specialized electrostatic* generators are principally used for *special* applications such as particle accelerators that require high voltages but low current.

Selecting electrical power generators requires an *analysis* of inputs, outputs, and portability. Typically, smaller units are movable while large devices are mounted or fixed in one location. Inputs usually include conventional fuel sources such as gasoline, *diesel*, *propane,* and *natural gas*; however, some electrical power generators use alternative forms of energy such as solar and wind power. In terms of outputs, some electrical power generators provide single phase or three phase AC voltage. Other devices output DC power. For AC electrical power generators, important specifications include AC prime power rating, which is expressed in *voltamperes* (VA). For DC devices, important specifications include DC power, which is expressed in *watts* (W). As a general principle, both AC and DC electrical power generators should not be operated at maximum power output for more than 30 minutes or for *periods* of time exceeding manufacturer *recommendations*.

Electrical power generators can be customized with a wide range of attachments, components, and performance options. These range from simple electromechanical devices to advanced digital microprocessor-based controls, remote communication capabilities, sound-attenuated and weather-protected enclosures, fuel tank bases, silencers, batteries, alternators, governors, air cleaners, starting aids, and cooling options.

Task 3. Find English equivalents for the following word expressions:

преобразовать механическую энергию в электрическую;

электромагнитная индукция; реверсивный электродвигатель; постоянный электромагнит; паровые турбины; магнитное поле; возбуждать электрический ток; электрогенератор; ускорители частиц; выбор электрогенератора требует; эксплуатировать при максимально вырабатываемой мощности; общее правило; солнечная энергия и энергия ветра.

Task 4. Answer the questions:

1. What are electrical power generators designed for? 2. How is mechanical energy converted into electrical energy in the most common type of electrical power generator? 3. Why does a commutator switch the current every half-rotation? 4. What should be analyzed while selecting electrical power generators? 5. What do inputs include? 6. What manufacturer recommendations should be observed? 6. What attachments and options can electrical power generators be customized with?

Additional texts. Transformers

Power transformers convert power-level voltages from one level or phase configuration to another. They can include features for electrical isolation, power distribution, and control and instrumentation applications. Transformers typically rely on the principle of magnetic induction between coils to convert voltage and/or current levels.

Current transformers measure power flow and provide electrical inputs to power transformers and instruments. Current transformers produce either an alternating current or alternating voltage that is proportional to the measured current. There are two basic types of current transformers: wound and toroidal. Wound current transformers consist of an integral primary winding that is inserted in series with the conductor that carries the measured current. Toroidal or donut-shaped current transformers do not contain a primary winding. Instead, the wire that carries the current is threaded through a window in the toroidal transformer.

Current transformers have many performance specifications, including primary current, secondary current, insulation voltage, accuracy, and burden. Primary current, the load of the current transformer, is the measured current. Secondary current is the range of current outputs. Insulation voltage represents the maximum insulation that current transformers provide when connected to a power source. Accuracy is the degree of certainty with which the measured current agrees with the ideal value. Burden is the maximum load that devices can support while operating within their accuracy ratings. Typically, burden is expressed in volt-ampheres (VA), the product of the voltage applied to a circuit and the current.

There are a variety of applications for current transformers. Some devices are used to measure current in electronics equipment or motors. Others are used in street lighting. Current transformers with small footprints mount on printed circuit boards (PCBs) and are used to sense current overloads, detect ground faults, and isolate current feedback signals. Larger devices are used in many three-phase systems to measure current or voltage. Commercial class current transformers that monitor low-power currents are also available. Some current transformers are weatherproof or are rated for outdoor use. Others meet MIL-SPEC, ANSI C-12, or IEC 1036 standards. Generally, ANSI class devices are intended for power monitoring applications where high accuracy and minimum phase angle are required.

Voltage Transformers are devices used to measure voltage in electric circuits. Their main role is to condition (step down) the voltage to be measured to levels suitable to the measuring instrument.

Relays.

A protective relay is an electromechanical apparatus, often with more than one coil, designed to calculate operating conditions on an electrical circuit and trip circuit breakers when a fault is detected. Unlike switching type relays with fixed and usually ill-defined operating voltage thresholds and operating times, protective relays have well-established, selectable, time/current (or other operating parameter) operating characteristics. Protection relays may use arrays of induction disks, shaded-pole magnets, operating and restraint coils, solenoid-type operators, telephone-relay contacts, and phase-shifting networks. Protection relays respond to such conditions as over-current, over-voltage, reverse power flow, over- and under- frequency. Distance relays trip for faults up to a certain distance away from a substation but not beyond that point. An important transmission line or generator unit will have cubicles dedicated to protection, with many individual electromechanical devices.

Electromechanical protective relays at a hydroelectric generating plant. The theory and application of these protective devices is an important part of the education of an electrical engineer who specializes in power systems. In new installations, these devices are nearly entirely replaced with microprocessor-based digital protective relays (numerical relays) that emulate their electromechanical ancestors with great precision and convenience in application. By combining several functions in one case, numerical relays also save capital cost and maintenance cost over electromechanical relays. However, due to their very long life span, tens of thousands of these "silent sentinels" are still protecting transmission lines and electrical apparatus all over the world.

Electric motors.

An electric motor converts electrical energy into mechanical energy. The reverse process of electrical generators, most electric motors operate through interacting magnetic fields and current-carrying conductors to generate rotational force. Motors and generators have many similarities and many types of electric motors can be run as generators, and vice versa. Electric motors are found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives. They may be powered by direct current or by alternating current which leads to the two main classifications: AC motors and DC motors.

AC motor

An AC motor converts alternating current into mechanical energy. It commonly consists of two basic parts, an outside stationary stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft that is given a torque by the rotating field.

The two main types of AC motors are distinguished by the type of rotor used.

- Induction (asynchronous) motor, the rotor magnetic field is created by an induced current. The rotor must turn slightly slower (or faster) than the stator magnetic field to provide the induced current. There are three types of induction motor rotors, which are squirrel-cage rotor, wound rotor and solid core rotor.
- Synchronous motor, it does not rely on induction and so can rotate exactly at the supply frequency or sub-multiple. The magnetic field of the rotor is either generated by direct current delivered through slip rings (exciter) or by a permanent magnet.

DC motor

The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary permanent magnets, and rotating electrical magnets. Brushes and springs carry the electric current from the commutator to the spinning wire windings of the rotor inside the motor. Brushless DC motors use a rotating permanent magnet in the rotor, and stationary electrical magnets on the motor housing. A motor controller converts DC to AC. This design is simpler than that of brushed motors because it eliminates the complication of transferring power from outside the motor to the spinning rotor.An example of a brushless, synchronous DC motor is a stepper motor which can divide a full rotation into a large number of steps. The motor's position can be controlled precisely without any feedback mechanism as long as the motor is carefully sized to the application.