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ФОНД ОЦЕНОЧНЫХ СРЕДСТВ

Дисциплины (модуля) **Технический перевод**

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И. о. заведующего кафедрой иностранных языков

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ФИО

1. Критерии и средства оценивания компетенций и индикаторов их достижения, формируемых дисциплиной (модулем)

Код и наименование компетенции	Код и наименование индикатора(ов) достижения компетенции	Результаты обучения по дисциплине (модулю)			Оценочные средства текущего контроля	Оценочные средства промежуточной аттестации
		Знать	*Уметь*	*Владеть*		
ПК-1. Способен выполнять письменный неспециализированный перевод.	ПК-1.1. Способен осуществлять предпереводческий анализ исходного текста, принимая во внимание стилевую и жанровую классификацию текстов, лексико-синтаксические особенности текстов, общую информацию о тексте. ПК-1.2 Способен вырабатывать целостную стратегию перевода текста с учётом его смыслового наполнения, функционально-стилевой характеристики, жанровой принадлежности, а также с учетом цели, адресата перевода и других экстралингвистических факторов ПК-1.3. Демонстрирует способность осуществлять послепереводческое саморедактирование и контрольное	Способы компрессии и смыслового развёртывания текста; - современные отечественные и зарубежные лексикографические ресурсы, особенно экономической направленности; - типологию переводных соответствий; - основные способы достижения эквивалентности в переводе; - основные модели перевода и переводческие трансформации.	Готовиться к выполнению перевода, включая поиск информации в справочной, специальной литературе; - работать с электронными словарями и другими лингвистическими ресурсами; - применять основные приемы перевода с соблюдением переводческих норм; - использовать основные модели перевода и переводческие трансформации при анализе процесса перевода и его результатов; - профессионально грамотно выбирать общую стратегию перевода с учётом прагматической установки и типа текста оригинала; - грамотно употреблять и адекватно (с	Методикой подготовки к выполнению перевода, включая поиск информации в печатных и электронных источниках; - широким словарным запасом из разных областей знания, входящим как в пассивный, так и активный словарь; - навыками перевода с соблюдением норм лексической эквивалентности, соблюдением грамматических, синтаксических и стилистических норм; - навыками работы с лингвистическим программным обеспечением для обработки текста: электронными словарями, орфокорректорами, поисковыми системами, системами машинного перевода,	Комплект заданий в рамках лабораторных занятий	Контрольное задание

	редактирование текста перевода для наибольшей эффективности		учётом функционального стиля и контекста) переводить лексические и фразеологические единицы английского языка; - находить адекватные соответствия в переводном языке; - осуществлять грамотный перевод грамматических форм и синтаксических конструкций, используемых в англоязычных текстах	системами автоматизированного перевода, в т.ч. программами управления памятью переводов, системами распознавания символов OCR, системами анализа и синтеза речи, системами распознавания и синтеза голосового перевода и т.д		
ПК-2. Способен выполнять письменный профессионально ориентированный перевод (в том числе с использованием специализированных инструментальных средств)	ПК-2.1 Находит, анализирует и классифицирует информационные источники в соответствии с переводческим заданием ПК-2.2 Осуществляет качественный письменный перевод на основе комплексного учета смысловой структуры оригинала и с соблюдением существующих в переводящем языке норм построения грамотного и связного текста ПК-2.3 Проверяет качество перевода и его соответствие	Способы компрессии и смыслового развёртывания текста; - современные отечественные и зарубежные лексикографические ресурсы, особенно экономической направленности; - типологию переводных соответствий; - основные способы достижения эквивалентности в переводе; - основные модели перевода и	Готовиться к выполнению перевода, включая поиск информации в справочной, специальной литературе; - работать с электронными словарями и другими лингвистическими ресурсами; - применять основные приемы перевода с соблюдением переводческих норм; - использовать основные модели	Методикой подготовки к выполнению перевода, включая поиск информации в печатных и электронных источниках; - широким словарным запасом из разных областей знания, входящим как в пассивный, так и активный словарь; - навыками перевода с соблюдением норм лексической эквивалентности, соблюдением		

	переводческому заданию, оформляет его в письменном редакторе	переводческие трансформации.	перевода и переводческие трансформации при анализе процесса перевода и его результатов; - профессионально грамотно выбирать общую стратегию перевода с учётом прагматической установки и типа текста оригинала; - грамотно употреблять и адекватно (с учётом функционального стиля и контекста) переводить лексические и фразеологические единицы английского языка; - находить адекватные соответствия в переводном языке; - осуществлять грамотный перевод грамматических форм и синтаксических конструкций, используемых в англоязычных текстах	грамматических, синтаксических и стилистических норм; - навыками работы с лингвистическим программным обеспечением для обработки текста: электронными словарями, орфокорректорами, поисковыми системами, системами машинного перевода, системами автоматизированного перевода, в т.ч. программами управления памятью переводов, системами распознавания символов OCR, системами анализа и синтеза речи, системами распознавания и синтеза голосового перевода и т.д.		

2. Оценка уровня сформированности компетенций (индикаторов их достижения)

<table>
<tr><th rowspan="2">Показатели оценивания компетенций (индикаторов их достижения)</th><th colspan="4">Шкала и критерии оценки уровня сформированности компетенций (индикаторов их достижения)</th></tr>
<tr><th>Ниже порогового
(«неудовлетворительно»)</th><th>Пороговый
(«удовлетворительно»)</th><th>Продвинутый
(«хорошо»)</th><th>Высокий
(«отлично»)</th></tr>
<tr><td>Полнота знаний</td><td>Уровень знаний ниже минимальных требований.
Имели место грубые ошибки.</td><td>Минимально допустимый уровень знаний.
Допущены не грубые ошибки.</td><td>Уровень знаний в объёме, соответствующем программе подготовки.
Допущены некоторые погрешности.</td><td>Уровень знаний в объёме, соответствующем программе подготовки.</td></tr>
<tr><td>Наличие умений</td><td>При выполнении стандартных заданий не продемонстрированы основные умения.
Имели место грубые ошибки.</td><td>Продемонстрированы основные умения.
Выполнены типовые задания с не грубыми ошибками.
Выполнены все задания, но не в полном объеме (отсутствуют пояснения, неполные выводы)</td><td>Продемонстрированы все основные умения.
Выполнены все основные задания с некоторыми погрешностями.
Выполнены все задания в полном объёме, но некоторые с недочетами.</td><td>Продемонстрированы все основные умения.
Выполнены все основные и дополнительные задания без ошибок и погрешностей.
Задания выполнены в полном объеме без недочетов.</td></tr>
<tr><td>Наличие навыков (владение опытом)</td><td>При выполнении стандартных заданий не продемонстрированы базовые навыки.
Имели место грубые ошибки.</td><td>Имеется минимальный набор навыков для выполнения стандартных заданий с некоторыми недочетами.</td><td>Продемонстрированы базовые навыки при выполнении стандартных заданий с некоторыми недочетами.</td><td>Продемонстрированы все основные умения.
Выполнены все основные и дополнительные задания без ошибок и погрешностей.
Продемонстрирован творческий подход к решению нестандартных задач.</td></tr>
<tr><td>Характеристика сформированности компетенции</td><td>Компетенции фактически не сформированы.
Имеющихся знаний, умений, навыков недостаточно для решения практических (профессиональных) задач.

ИЛИ
Зачетное количество баллов не набрано согласно установленному диапазону</td><td>Сформированность компетенций соответствует минимальным требованиям.
Имеющихся знаний, умений, навыков в целом достаточно для решения практических (профессиональных) задач.

ИЛИ
Набрано зачетное количество баллов согласно установленному диапазону</td><td>Сформированность компетенций в целом соответствует требованиям.
Имеющихся знаний, умений, навыков достаточно для решения стандартных профессиональных задач.

ИЛИ
Набрано зачетное количество баллов согласно установленному диапазону</td><td>Сформированность компетенций полностью соответствует требованиям.
Имеющихся знаний, умений, навыков в полной мере достаточно для решения сложных, в том числе нестандартных, профессиональных задач.
ИЛИ
Набрано зачетное количество баллов согласно установленному диапазону</td></tr>
</table>

3. Критерии и шкала оценивания заданий текущего контроля

3.1 Критерии и шкала оценивания лабораторных работ

Перечень лабораторных работ, описание порядка выполнения и защиты работы, требования к результатам работы, структуре и содержанию отчета и т.п. представлены в методических материалах по освоению дисциплины (модуля) и в электронном курсе в ЭИОС МАУ.

Оценка/баллы	Критерии оценивания
Отлично	Содержание переводимого текста передано полностью и правильно, соблюдены стиль и нормы переводящего языка, отсутствуют технологические ошибки, правила оформления текста перевода не нарушены, допускается одна полная ошибка (за исключением грубой смысловой ошибки)
Хорошо	Содержание переводимого текста передано полностью и правильно, соблюдены стиль и нормы переводящего языка, правила оформления текста перевода не нарушены, допускаются две-три полные ошибки (в том числе смысловая неточность)
Удовлетворительно	Содержание переводимого текста передано полностью, соблюдены стиль и нормы переводящего языка, правила оформления текста перевода нарушены, допускаются три-четыре полные ошибки (в том числе 2 грубые смысловые ошибки)
Неудовлетворительно	Содержание переводимого текста передано полностью или неточно, стиль передан с нарушениями, нормы переводящего языка соблюдены, правила оформления текста перевода нарушены, допускаются пять-шесть полных ошибок (в том числе более двух грубых смысловых ошибок) ИЛИ Задание не выполнено.

3.2 Критерии и шкала оценивания глоссария

Требования к структуре, содержанию и оформлению глоссария представлены в методических материалах по освоению дисциплины (модуля) и в электронном курсе в ЭИОС МАУ.

Оценка/баллы	Критерии оценки
10	Содержание разработанного студентом глоссария соответствует заявленной отрасли промышленности или научно-технического знания. Содержит не менее 100 терминов. К глоссарию прилагается список источников, на основе которого данный глоссарий был составлен.
8	Содержание разработанного студентом глоссария соответствует заявленной отрасли промышленности или научно-технического знания. Содержит не менее 80 терминов. К глоссарию прилагается список источников, на основе которого данный глоссарий был составлен.
6	Содержание разработанного студентом глоссария соответствует заявленной отрасли промышленности или научно-технического знания. Содержит не менее 60 терминов. К глоссарию прилагается список источников, на основе которого данный глоссарий был составлен.
4	Содержание разработанного студентом глоссария соответствует заявленной отрасли промышленности или научно-технического знания. Содержит не менее 40 терминов. К глоссарию прилагается список источников, на основе которого данный глоссарий был составлен.
2	Содержание разработанного студентом глоссария соответствует заявленной отрасли промышленности или научно-технического знания. Содержит не менее 20 терминов. К глоссарию не прилагается список

	источников, на основе которого данный глоссарий был составлен.

4. Критерии и шкала оценивания результатов обучения по дисциплине (модулю) при проведении промежуточной аттестации (зачет)

Если обучающийся набрал зачетное количество баллов согласно установленному диапазону по дисциплине (модулю), то он считается аттестованным.

Оценка	Баллы	Критерии оценивания
Зачтено	60 - 100	Набрано зачетное количество баллов согласно установленному диапазону
Незачтено	менее 60	Зачетное количество согласно установленному диапазону баллов не набрано

5. Задания диагностической работы для оценки результатов обучения по дисциплине (модулю) в рамках внутренней и внешней независимой оценки качества образования

ФОС содержит задания для оценивания знаний, умений и навыков, демонстрирующих уровень сформированности компетенций и индикаторов их достижения в процессе освоения дисциплины (модуля).

Комплект заданий разработан таким образом, чтобы осуществить процедуру оценки каждой компетенции, формируемых дисциплиной (модулем), у обучающегося в письменной форме.

Содержание комплекта заданий включает практико-ориентированные задания. Каждое задание представляет собой письменный перевод технического текста с английского на русский язык.

Комплект заданий диагностической работы

Компетенция ПК-1	
1	Письменный перевод текста с английского языка на русский: **HAND TOOLS** In all professions and trades, the fitter’s including, the beginner must first acquaint himself with the various tools he will meet, and must also learn their different forms and uses. The working place of the fitter is usually at his stout work bench. It is a specially designed table with vice and drawing boxes to keep his tools. The vice is secured to the table and is used to hold an object in position whilst work is performed upon it. It consists essentially of two jaws, one fixed and one movable. The movable jaw being operated by a screw by means of which clamping action is secured. Vices may be of leg-type, parallel sliding jaw-type, etc. To the tools and appliances that are usually found at the fitter’s working place belong hammers, chisels, pliers, files, spanners, screw drivers, various marking and measuring tools, etc. A **hammer** is the tool used for striking blows in metalworking, driving nails, etc. Hammers are classed as hand hammers, sledge hammers and special hammers, e.g. those used for riveting work. The hammer consists of a head which is fitted to a wooden shaft or handle. The length of the shaft depends on the weight of the hammer. **Screw driver**: A bar or rod of steel with handle at one end and flatted at the other to fit the slot

	in screwheads. **Cold chisels** are used for work on metals which are in a cold state. The cold chisel is used for chipping off or cutting away, small pieces of metal and also for cutting out workpieces from sheet metal, etc. A chisel with a narrow blade for cutting keyways or grooves for keys and similar work in metal is called the cape chisel. **Pliers** are used for gripping or holding small objects by manual operation. The most common type is the plain or straight-jaw type pliers. Among other types of pliers there are round-nosed pliers, gas pliers, pincer pliers. The pincer pliers is the tool with two long handles and a pair of grasping jaws for holding an object. **Files**. A hard steel tool, made in various shapes and sizes, for smoothing wood or metal. Many kinds of files are made for special purposes and are known by the name of purpose for which they are intended. In general files are named for the manner in which they cut, as rasp or rough cut, bastard cut, smooth cut, dead smooth cut. As to their shape files may be flat, round, half-round, square, three cornered, etc. Files used for delicate or very light classes of work are called needle files. **Spanners (Wrenches)**. These are used for tightening up or unscrewing of nuts and bolts. Their jaws should fit comfortably over the flat faces of the nut without any undue slackness. There are many types of spanners. Among other hand tools used in craftsman's work there are hand shears, hack saws, drift punches, hand drills, grind stones, etc. Specific operations performed in a mechanical workshop may require the application of thread-screwing tools, drilling tools, forging tools, riveting tools, soldering tools, etc. Each kind includes a whole set of specific tools, e.g. thread screwing tools comprise, chiefly, two forms: those which are used for internal thread cutting (screw taps with tap wrenches) and those used for external threads formation (stock and die, screw plate).
2	Письменный перевод текста с английского языка на русский: **ENGINEERING COMPONENTS** **FASTENERS** One of the most common forms of components is perhaps the bolt. It is used for fastening together any two or more parts of a machine which may require dismantling quickly in any emergency, such as in repair work. The body of a bolt is called the shank, one end of which has a head, while the opposite end is screw-threaded to accommodate nut. A bolt is often fitted with a plain round washer, which forms a sort of cushion between the nut and the workpiece which it secures. By their shapes bolts may be divided into square-headed, cup-headed, countersunk head, etc. Bolt nuts are known as hexagonal, square, wing-nuts, and others. To prevent nuts from working loose there are lock nuts, split pin, etc. To fix together some articles permanently rivets or welding may be used. Another kind of component used to locate and secure an object in position is a key. Usually the key is inserted between a shaft and a wheel in order to retain the latter in a fixed position on the shaft. A shaft is intended to mount pulleys, gear wheels, etc. by forming an axle upon which they can rotate. It is usually of solid cylindrical shape, but may also be of hollow construction. Among the shafts the most typical are crankshafts, splined shafts, drive or propeller shafts, and so on. A propeller shaft is a mechanical component for transmitting torque and rotation, usually used to connect other components of a drive train that cannot be connected directly because of distance or the need to allow for relative movement between them. To allow for variations in the alignment and distance between the driving and driven components, drive shafts frequently incorporate one or more universal joints. A drive shaft connects the gearbox to a rear axle. A shaft assembly consists of a propeller shaft and one or more universal joints. Where the engine and axles are separated from each other, as on four-wheel drive and rear-wheel drive vehicles, it is the propeller shaft that serves to transmit the drive force generated by the engine to the axles.

	Components on which shafts are supported, or mounted, in order that they may rotate freely are called bearings, journals, or pedestals. There are many types of bearings, varying from plain cast iron to those of the ball or roller-race pattern. A typical ball bearing consists of the outer race, inner race, balls and ball cage. **POWER TRANSMISSION SYSTEMS** A mechanical drive is a mechanism intended to transmit power from the prime mover to the machine. Belts and pulleys, sprockets and chains, gears, and other drive components used to transmit power. By the mode of transmitting motion from the prime mover mechanical drives fall into the following types: a) transmission by friction: with direct contact (friction drives) or a flexible connection (belt drives). Belt drives are widely used for transmitting rotational mechanical power from one rotating shaft to another. They are light, inexpensive, quiet and capable of transmitting reasonably large amounts of power. b) transmission by mesh: with direct contact (toothed and worm gears) or with a flexible connection (chain drives). A drive may be formed by a series of two or more toothed wheels, or gears which are meshed together to make a gearing or gearbox. **Components of almost all machines used to transmit power both to and within a machine and connect shafts are called couplings and clutches.** A coupling is a mechanical element used to connect collinear shafts directly to one another with the purpose of transmitting torque and/or revolution angles. Couplings may be divided into: those of the fixed or rigid class, and those of the flexible type. Rigid coupling. Used when shafts are virtually collinear and should remain in a fixed angular relation with respect to each other. Disadvantages includes: true alignment of shafts is difficult to achieve and difficult to maintain; most successful when used at low speeds and with flexible shafts; susceptible to fatigue failure and overheating of bearings. Flexible coupling. Used to take care of inevitable shaft misalignment; absorbs shock and vibration that may appear on one shaft. Clutch is a mechanical device used to gradually stop or start the transmission of power, speed, or torque from a prime mover to a load. It may be connected or disconnected at will. The most typical clutches are disc-type or cone-type friction clutches. To prevent any serious damage of a machine due to overloading safety clutches are used.
3	Письменный перевод текста с английского языка на русский: **INTERNAL COMBUSTION ENGINE** There are three modes of travel such as by land, water and air. During centuries man has been dreaming about fast means of transport: magic carpet, high speed boots and so on. But it is only in fairly recent years that man has been able to build really reliable machines to transport him efficiently and safely in all environments. Motor cars travel on solid ground and have only to be propelled along. Boats and ships are supported by the water and will remain afloat under all normal conditions. An aircraft is heaver than the air in which it has to fly, yet it must be got off the ground, made to stay in the air and finally brought back to earth gently without damage. But in design all these means of transport have one common element — the internal combustion engine. The internal combustion engine bums fuel within the cylinders and converts the expanding force of the combustion or «explosion» into rotary force used to propel the vehicle. There are several types of internal combustion engines: two and four cycle reciprocating piston engines, gas turbines and rotary combustion engines. The four cycle reciprocating engine has been refined to such a degree that it has almost complete dominance in the automotive field. The engine is the heart of the automobile. It converts fuel into the energy that powers the automobile. To operate,

	it requires clean air for the fuel, liquid for cooling, electricity (which it generates) for igniting the fuel, and oil for lubrication. A battery and electric starter get it going. Each «cylinder» of the typical car engine has a «piston» which moves back and forth within the cylinder (this is called «reciprocating»). Each piston is connected to the «crankshaft» by means of a link known as a «connecting rod». In 1876, a German engineer named Dr. Otto produced an engine that worked using the four-stroke cycle. «Four-stroke» refers to the number of piston strokes required to complete a cycle (a cycle being a sequence of constantly repeated operations). It takes two complete revolutions of the crankshaft to complete the cycle. The first stroke is the intake stroke. The piston moves down the cylinder and creates a partial vacuum in the cylinder. A mixture of air and fuel is forced through the inlet valve into the cylinder by atmospheric pressure, now greater than the pressure in the cylinder. During this stroke, the exhaust valve stays closed. The second stroke is the compression stroke. The piston moves up in the cylinder with both valves closed. The air and fuel mixture is compressed and the pressure rises. The third stroke is the power stroke. Near the end of the compression stroke, the air and fuel mixture is ignited by an electric spark from the spark plug. The combustion that occurs causes a rise in temperature and enough pressure to force the piston down again. Finally, on the fourth stroke, or exhaust stroke, the piston moves up again and forces the burned gases out of the cylinder and into the exhaust system. This cycle repeats itself the entire time the engine is running. The combustion chamber is where the air-fuel mixture is burned. The location of the combustion chamber is the area between the top of the piston at what is known as TDC (top dead center) and the cylinder head. TDC is the piston's position when it has reached the top of the cylinder, and the center line of the connecting rod is parallel to the cylinder walls. The two most commonly used types of combustion chamber are the hemispherical and the wedge shape combustion chambers. The hemispherical type is so named because it resembles a hemisphere. It is compact and allows high compression with a minimum of detonation. The valves are placed on two planes, enabling the use of larger valves. This improves «breathing» in the combustion chamber. This type of chamber loses a little less heat than other types. Because the hemispherical combustion chamber is so efficient, it is often used, even though it costs more to produce. The wedge type combustion chamber resembles a wedge in shape. It is part of the cylinder head. It is also very efficient, and more easily and cheaply produced than the hemispherical type.
4	Письменный перевод текста с английского языка на русский: **CAR BODY** The body shell is a fairly complex assortment of large steel sections. These sections have been stamped into specific shapes which make up the body of your car. These parts are designed to do many jobs at once; protect the occupants from the elements and in collisions, provide solid mounts for all other systems, and to slice through the air with minimal resistance. The body also has one other job which is usually important to the owner... it has to look good! Although the zillions of parts that make up a car are all very important, it is also important that the car's body be able to make riding in a car bearable for you. Early cars were so uncomfortable to ride in. The body and the suspension system now give us a smooth ride, and cushion us from the jarring of the road. The idea is that the body of the car should go forward with as little up-and-down and side-to-side movement as possible. Frame (Chassis) The frame provides a firm structure for the body, as well a good anchor point for the suspension system. There are two types of frames; integral frames or unibody and conventional frames. A conventional frame is basically a «one-piece» frame, or two «one-piece» frames fastened together. The frame is extremely rigid in order to keep all the other parts of the car in perfect alignment. The manufacturer takes this type of frame and attaches all the other parts of the car to it, like the way a sculptor starts with a wire frame to build his sculpture on and give it shape. To keep things smooth, rubber insulator blocks, or «pads» are placed between the frame and the other car parts. Because the conventional frame is so important to the structure of your car, (without it, your car would be a pile of doors, hoses, seats, wires and metal) it is usually constructed of heavy steel and welded or cold riveted together. Cold riveting keeps the rivets from shrinking. The integral, or unibody, frame is just the opposite. With this type of frame, the body parts are used to structurally strengthen the entire car, and all of the sections are welded into one piece. Sometimes the parts

	of the body and the suspension system are attached and reinforced. Also, some unibody frames have partial front and rear frames for attaching the engine and suspension members. Hood. The car's hood is another type of door. It also consists of an inner and an outer panel. The inner panel provides strength. The outer panel is just a metal cover, or «skin». The underside of the hood is often covered with a sound-absorbing material. Some high performance cars have openings in the hood to allow the engine to «breathe» easier. «Hood scoops» are used to channel outside air directly to the air filter, which gives improved performance and efficiency. Trunk Lid. The trunk lid is another type of door. It consists of an inner and an outer panel. The inner panel provides strength. The outer panel is just a metal cover, or «skin». Rocker Panels. A rocker panel is a three or four inch piece of metal that runs along the bottom of the car body underneath the doors. Rocker panels are usually coated with a rock proof protectant which rubberizes the exterior surface before the car is painted. If you have mud flaps behind your wheels, this protects your rocker panels, as well as your fenders and your doors. Rocker panels are often made of chrome plating, and enhance the car. Wheel Well. The wheel well is either plastic or metal. Metal wheel wells are usually part of the body shell. Metal wheel wells strengthen the structure of the car because of their shape, and because they are strongly welded to the body shell. Most rear wheel wells are made of metal. Wheel wells are coated with a rock-proof, rubberized coating underneath, in order to prevent the rocks kicked up by the wheels from damaging the metal and making a lot of noise when they hit. Often the front wheel wells are made of plastic. This is because it is harder to mount the engine with the front wheel wells in place. Plastic wheel wells can be removed, and make it easier to mount the engine during the manufacturing of the car.
5	Письменный перевод текста с английского языка на русский: **CAR BODY** Front Quarter Panel. The front quarter panel is composed of the body skin, or sheet metal, that runs from the front comer of the hood to the front of the door. It is usually a separate piece that is welded on in a few places. This makes it easy to replace if you get in a «fender bender.» Front quarter panels can usually be replaced relatively inexpensively. Some newer vehicles use a rubber-like plastic for the fenders, which allows small impacts to be absorbed without damage. Windshield. In the 1930s many cars had hinged windshields that could be folded on the hood of the car or opened up. Today, most windshields are stationary. They are fixed in place with a weather-strip made of rubber. The strip has a groove on the inside and a groove on the outside. The inside groove holds the glass; the outside groove holds the metal rim of the windshield opening in place. The glass «floats» in a plastic sealant that is spread out between the edge of the glass and the frame of the windshield. Windshields are made of laminated safety plate glass, which is a sandwich of glass and clear plastic. The plastic acts as a soft, protective barrier, keeping the glass in place, if it is struck during a collision. The glass sticks to the plastic to eliminate glass from flying around the interior and injuring someone. Safety glass for windscreens was one of the first passive safety devices introduced into cars, but its use remains a controversial question. North America and Scandinavia favor a laminated glass, which consists of two sheets of annealed glass, separated by a layer of transparent plastic. In recent years, laminated glass has been improved by changes in the properties of the plastic interlayer. Research has demonstrated that this new laminated glass is about 4 times safer than toughened glass, but because it is more expensive, controversy continues as to whether or not toughened glass windscreens should be banned by legislative action and replaced by laminated glass. Recent developments have combined the benefits of both laminated and toughened material in that a laminated construction is used, but the sheet next to the inside of the car is made of toughened glass. Seats. There are basically two types of seats: bench seats or bucket seats. A bucket seat is a low, separate seat for one person. Bench seats are a continuous cushion and backrest across the width of the car (although some vans might have them running along the length of the van). Bucket seats are single units with a separation between the left and right seats. Usually vinyl leather and fabric are used for upholstery. «Flat springs» are used for comfort. A flat spring is a piece of wire that is bent into a zigzag pattern. Both ends of the wire are attached to the seat frame, with additional lengths added every six inches. Foam padding is used to cover the flat springs. The front seats ride on rails that are bolted to the floor. This arrangement allows the seats to

	move backwards and forwards to suit the driver or passenger. The seat adjustment lever is attached to a latch that fits into teeth along the rail. Moving the lever releases the seat, and allows the seat to move. At any point of the seat's movement, releasing the lever engages the latch with one of the teeth. Usually there is also a pull-spring; this draws the seat forward when the latch is released. The rear seat usually doesn't move, because it is secured to the floor of the car. Its backrest is attached to the partition between the passenger compartment and trunk. Having an air bag and wearing an effective seat belt offers the best protection of all. Not only are you protected from frontal crashes by the air bag — you are also protected by the seat belt in all other types of crashes. The benefits of the three-point seat belts have been firmly established: over 50% of fatal and serious injuries to car occupants would be avoided if all occupants wore their seat belts. Most states now have a law that both passengers and driver must have seat belts buckled while in motion. Those states which do not enforce a seat belt law for all passengers have an effective law for children under five years of age to be strapped in.
6	Письменный перевод текста с английского языка на русский: **GENERATING ELECTRIC CURRENTS** We saw that a change in the magnetic flux passing through a transformer's secondary coil causes current to flow in that coil. Since the magnetic flux through the secondary coil changes whenever the current through the primary coil changes, an alternating current in the transformer's primary coil induces an alternating current in its secondary coil. But there's another way to change the magnetic flux passing through a coil of wire: move the magnetic flux. That's how a generator works. Whenever a magnet moves past a coil of wire or a coil of wire moves past a magnet, the flux through the coil changes and current flows in the coil and its circuit. Most generators use rotary motion to produce electricity. The generator has a permanent magnet that spins between two fixed coils of wire. As the magnet spins, its magnetic flux lines sweep through the two coils and drive a current through them. This current experiences a voltage rise as it passes through the coils and a voltage drop as it passes through the light bulb, so it transfers power from the generator to the bulb. The iron core inside each coil extends the magnet's flux lines so that they are sure to sweep through the coil each time a pole of the magnet passes by. These cores are temporarily magnetized by the nearby magnet and effectively increase its length. Without the iron cores, most of the rotating magnet's flux lines would bend around before passing through the entire coil and the generator would be less effective at producing electricity. In the above diagram, you can see two magnets in the motor: The armature (or rotor) is an electromagnet, while the field magnet is a permanent magnet (the field magnet could be an electromagnet as well, but in most small motors it isn't in order to save power). The principle design of the motor is identical to the generator. A generator produces an alternating current in the circuit it powers. This current flows in one direction as the magnet's north pole approaches a coil and in the opposite direction as the south pole approaches it. To generate the 60 Hz alternating current used in the United States, the generator must turn 60 times each second so that the current completes one full cycle of reversals every l/60th of a second. In Europe, the generator must turn 50 times each second to supply 50 Hz alternating current. The generators throughout the continent-wide power distribution networks all turn together in perfect synchronization. That way, power can be redirected within each network so that any generator can provide the power consumed by any user. Some devices require direct current electric power. A car is a good example. It generates DC electric power to charge its battery and to run its headlights, ignition system, and other electric components. While this power is actually produced by an AC generator or alternator, the car uses special electronic switches to send current from the alternator one way through its electric system. While the current in the alternator's coils reverses, the current through the car's electric system always travels in one direction. Because large permanent magnets are extremely expensive, most industrial generators actually use iron-core electromagnets instead. These rotating electromagnets drive currents through generator coils just as effectively as permanent magnets would. Although these electromagnets consume some electric power, they are much more cost effective than real permanent magnets.
7	Письменный перевод текста с английского языка на русский: **GENERATING ELECTRIC CURRENTS** An alternating current (AC) is an electrical current whose magnitude and direction vary cyclically, as opposed to direct current, whose direction remains constant. The usual waveform

	of an AC power circuit is a sine wave, as this result in the most efficient transmission of energy. However in certain applications different waveforms are used, such as triangular or square waves.Used generically, AC refers to the form in which electricity is delivered to businesses and residences. However, audio and radio signals carried on electrical wire are also examples of alternating current. In these applications, an important goal is often the recovery of information encoded (or modulated) onto the AC signal. Electricity distribution AC voltage can be stepped up or down by a transformer to a different voltage. High-voltage, direct current electric power transmission systems contrast with the more common alternating-current systems as a means for the bulk transmission of electrical power. However, these tend to be more expensive and less efficient than transformers. Use of a higher voltage leads to more efficient transmission of power. The power losses in a conductor are a product of the square of the current and the resistance of the conductor, described by the formula P = I2R. This means that when transmitting a fixed power on a given wire, if the current is doubled, the power loss will be four times greater. Since the power transmitted is equal to the product of the current, the voltage and the cosine of the phase difference ϕ (P = IVcoscp), the same amount of power can be transmitted with a lower current by increasing the voltage. Therefore it is advantageous when transmitting large amounts of power to distribute the power with extremely high voltages (sometimes as high as hundreds of kilovolts). However, high voltages also have disadvantages, the main ones being the increased danger to anyone who comes into contact with them, the extra insulation required, and generally increased difficulty in their safe handling. In the power plant the voltage is generated on three phase low voltage, with a frequency of either 50 or 60 hertz, and stepped up to a high voltage for distribution and stepped down, with a neutral, to a relatively low level for the consumer, generally around 200 V to 500 V between phases and 100 V to 250 V between each phase and the neutral. Three-phase electrical generation is very common and is a more efficient use of commercial generators. Electrical energy is generated by rotating a coil inside a magnetic field, in large generators with a high capital cost. However, it is relatively simple and cost effective to include three separate coils in the generator stator (instead of one). These sets of coils are physically separated and at an angle of 120° to each other. Three current waveforms are produced that are 120° out of phase with each other, but of equal magnitude. Three-phase systems are designed so that they are balanced at the load; if a load is correctly balanced no current will flow in the neutral point. Also, even in the worst-case unbalanced (linear) load, the neutral current will not exceed the highest of the phase currents. For three-phase at low (normal mains) voltages a four-wire system like this is normally used, reducing the cable requirements by one third over using a separate neutral per phase. When stepping down three-phase, a transformer with a Delta primary and a Star secondary is often used so there is no need for a neutral on the supply side.
8	Письменный перевод текста с английского языка на русский: **INTRODUCTION TO NUCLEAR POWER** To provide the power for a dynamo-electric machine, or electric generator, nuclear power plants rely on the process of nuclear fission. In this process, the nucleus of a heavy element, such as uranium, splits when bombarded by a free neutron in a nuclear reactor. (1) The fission process for uranium atoms yields two smaller atoms, one to three free neutrons, plus an amount of energy. Because more free neutrons are released from a uranium fission event than are required to initiate the event, the reaction can become self-sustaining - a chain reaction-under controlled conditions, thus producing a tremendous amount of energy. In the vast majority of the world’s nuclear power plants, heat energy generated by burning uranium fuel is collected in ordinary water and is carried away from the reactor’s core either as steam in boiling water reactors or as superheated water in pres- surized-water reactors. In a pressurized-water reactor, the superheated water in the primary cooling loop is used to transfer heat energy to a secondary loop for the creation of steam. In either a boiling-water or pressurized-water installation, steam under high pressure is the medium used to transfer the nuclear reactor’s heat energy to a turbine that mechanically turns a dynamo- electric machine, or electric generator. Boiling-water and pressurized-water reactors are called light-water reactors, because they utilize ordinary water to transfer the heat energy from reactor to turbine in the electricity generation process. In other reactor designs, the heat energy is transferred by pressurized heavy water, gas, or another cooling substance. Because the water used to remove heat from the core in a light-water reactor absorbs some of the free neutrons normally generated during operation of the reactor, the concentration

	of the naturally fissionable 23 5U isotope in uranium used to fuel light-water reactors must be increased above the level of natural uranium to assist in sustaining the nuclear chain reaction in the reactor core: the remainder of the uranium in the fuel is 238U. Increasing the concentration of 235U in nuclear fuel uranium above the level that occurs in natural uranium is accomplished through the process of enrichment, which is explained below. The fuel core for a light-water nuclear power reactor can have up to 3,000 fuel assemblies. An assembly consists of a group of sealed fuel rods, each filled with U02 pellets, held in place by end plates and supported by metal spacer-grids to brace the rods and maintain the proper distances between them. The fuel core can be thought of as a reservoir from which heat energy can be extracted through the nuclear chain reaction process. During the operation of the reactor, the concentration of 235U in the fuel is decreased as those atoms undergo nuclear fission to create heat energy. Some 23 8U atoms are converted to atoms of fissile 239Pu, some of which will, in turn, undergo fission and produce energy. The products created by the nuclear fission reactions are retained within the fuel pellets and these become neutron-absorbing products (called "poisons") that act to slow the rate of nuclear fission and heat production. As the reactor operation is continued, a point is reached at which the declining concentration of fissile nuclei in the fuel and the increasing concentration of poisons result in lower than optimal heat energy generation, and the reactor must be shut down temporarily and refueled. The amount of energy in the reservoir of nuclear fuel is frequently expressed in terms of "full-power days," which is the number of 24-hour periods (days) a reactor is scheduled, for operation at full power output for the generation of heat energy. The number of full power days in a reactor's operating cycle (between refueling outage times) is related to the amount of fissile 23 5U contained in the fuel assemblies at the beginning of the cycle. A higher percentage of 235U in the core at the beginning of a cycle will permit the reactor to be run for a greater number of full power days. At the end of the operating cycle, the fuel in some of the assemblies is "spent," and it is discharged and replaced with new (fresh) fuel assemblies. The fraction of the reactor's fuel core replaced during refueling is typically one-fourth for a boiling-water reactor and one-third for a pressurized-water reactor. The amount of energy extracted from nuclear fuel is called its "bum up," which is expressed in terms of the heat energy produced per initial unit of fuel weight. Bum up is commonly expressed as megawatt days thermal per metric ton of initial heavy metal.
9	Письменный перевод текста с английского языка на русский: **The Nuclear Fuel Cycle** The nuclear fuel cycle for typical light-water reactors is illustrated in Figure Al. The cycle consists of "front end" steps that lead to the preparation of uranium for use as fuel for reactor operation and "back end" steps that are necessary to safely manage, prepare, and dispose of the highly radioactive spent nuclear fuel. Chemical processing of the spent fuel material to recover the remaining fractions of fissionable products, 235U and 239Pu, for use in fresh fuel assemblies is technically feasible. Reprocessing of spent commercial-reactor nuclear fuel is not permitted in the United States. The front end of the nuclear fuel cycle commonly is separated into the following steps. Exploration. A deposit of uranium, discovered by geophysical techniques, is evaluated and sampled to determine the amounts of uranium materials that are extractable at specified costs from the deposit. Uranium reserves are the amounts of ore that are estimated to be recoverable at stated costs. Mining. Uranium ore can be extracted through conventional mining in open pit and underground methods similar to those used for mining other metals. In situ leach mining methods also are used to mine uranium in the United States. In this technology, uranium is leached from the in-place ore through an array of regularly spaced wells and is then recovered from the leach solution at a surface plant. Uranium ores in the United States typically range from about 0.05 to 0.3 percent uranium oxide (U30g). Some uranium deposits developed in other countries are of higher grade and are also larger than deposits mined in the United States. Uranium is also present in very low grade amounts (50 to 200 parts per million) in some domestic phosphate-bearing deposits of marine origin.

	Because very large quantities of phosphate-bearing rock are mined for the production of wet-process phosphoric acid used in high analysis fertilizers and other phosphate chemicals, at some phosphate processing plants the uranium, although present in very low concentrations, can be economically recovered from the process stream.
10	Письменный перевод текста с английского языка на русский: **NUCLEAR FISSION REACTORS** Weapons weren't the only possibilities open to nuclear scientists and engineers at the end of the 1930's. While nuclear fission chain reactions and thermonuclear fusion were clearly ways to unleash phenomenal destructive energy, they could also provide virtually limitless sources of useful energy. By controlling the same nuclear reactions that occur in nuclear weapons, people have since managed to extract nuclear energy for constructive uses. In the half-century since their conception, nuclear fission reactors have developed into a fairly mature technology and have become one of our major sources of energy. Nuclear fusion power remains an elusive goal, but efforts continue to harness this form of nuclear energy as well. Assembling a critical mass of uranium doesn't always cause a nuclear explosion. In fact, it's rather hard to cause a big explosion. The designers of the atomic bomb had to assemble not just a critical mass but a supercritical mass and they had to do it in much less than a millionth of a second. That's not something that happens easily or by accident. It's much easier to reach a critical mass slowly, in which case the uranium will simply become very hot. It may ultimately explode from overheating, but it will not vaporize everything in sight. Fig.2 Chain reaction and moderation of neutrons. This slow assembly of a critical mass is the basis for nuclear fission reactors. Their principal product is heat, which is often used to generate electricity. Fission reactors are much simpler to build and operate than fission bombs because they don't require such purified fissionable materials. In fact, with the help of some clever tricks, nuclear reactors can even be made to operate with natural uranium. Let's begin by showing that a fission chain reaction doesn't always lead to an explosion. What's important is just how fast the fission rate increases. In an atomic bomb, it increases breathtakingly quickly. At detonation, the fissionable material is far above the critical mass so the average fission induces not just one, but perhaps two, subsequent fissions. With only about 10 ns (10 nanoseconds) between one fission and the two it induces, the fission rate may double every 10 ns. In less than a millionth of a second, most of the nuclei in the material undergo fission, releasing their energy before the material has time to blow apart. But things aren't so dramatic right at critical mass, where the average fission induces just one subsequent fission. Since each generation of fissions simply reproduces itself, the fission rate remains essentially constant. Only spontaneous fissions cause it to rise at all. The fissionable material steadily releases thermal energy and that energy can be used to power an electric generator. A nuclear reactor contains a core of fissionable material. Because of the way in which this core is assembled, it's very close to a critical mass. Several neutron-absorbing rods, called control rods, which are inserted into the reactor's core, determine whether it's above or below critical mass. Pulling the control rods out of the core increases the chance that each neutron will induce a fission and moves the core toward supercriticality. Dropping the control rods into the core increases the chance that each neutron will be absorbed before it can induce a fission and moves the core toward subcriticality. A nuclear reactor uses feedback to maintain the fission rate at the desired level.
Компетенция ПК-2	
1	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** Introduction Wind power has always given the necessary propulsive force to sailing ships and has been also used to run windmills. Then, this type of energy has fallen into disuse due to the spreading of electric power and thanks to the availability of low cost machines supplied by fossil fuel. However, the recent attention paid to climate changes, the demand to increase the amount of green energy and fear of a decrease of oil fuel in the future have promoted a renewed interest in the production of electrical energy from renewable sources and also from the wind power. This type of energy, with respect to other renewable energies, requires lower investments and uses a natural energy source usually available everywhere and particularly usable in the

	temperate zones, that is where most of the industrialized countries are. During the last decade of the Twentieth century, different models of wind turbines have been built and tested: with vertical and horizontal axis, with variable number of blades, with the rotor positioned upstream or down stream of the tower, etc. The horizontal axis wind turbine (HAWT) with upstream three-blade rotor has resulted to be the most suitable typology and consequently has found a remarkable development, characterized both by a quick grow in size and power, as well as by a wide spread. This Technical Application Paper is intended to define the basic concepts which characterize this application and to analyze the problems met when designing a wind power plant. Starting from a general description of the modalities for the exploitation of the wind energy through wind power plants, the technical characteristics of a wind turbine as a whole are described and the methods of protection against overload, earth faults and overvoltage's are presented with the purpose of helping to choose the most suitable switching and protection devices for the different components of the plant. In particular, in the first general Part, the operating principle of wind power plants is described, together with their typology, the main components, the installation methods and the different configurations. Besides, the power output of a plant and how it can vary as a function of determined quantities are analyzed. The second Part, after an overview of the main protection techniques against overcurrents, earth faults and overvoltages, analyzes the effects of wind turbines on the grid to which they are connected. Finally, the third Part presents the solutions offered by ABB for wind power applications. To complete this Technical Application Paper there are four annexes. The first three annexes refer to the Italian context and Standards and to the resolutions and decrees in force at the moment of draft. Particular attention is paid to an analysis of the economic incentives and the valorization of the produced energy; moreover there are information about the connection to medium and high voltage grid and about the measure of the energy and some hints at the general dimensioning of the earthing arrangement for a wind turbine connected to a MV grid. The last annex instead offers a comparison between drag type and lift type turbines.
2	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** Main components of a wind turbine To exploit the kinetic energy of the wind, by converting it into electrical energy available to be fed into the network or to supply loads in parallel, a wind turbine uses different components both mechanical as well as electrical. In particular, the rotor (blades and hub) extracts energy from the wind turning it into mechanical rotation energy and constitutes the "first motor" of the wind turbine, whereas conversion of mechanical energy into electrical energy is carried out by an electric generator according to suitable configurations to be illustrated in the following chapters. To summarize, the main components constituting horizontal axis wind turbines are (see Figure 2.1): 1. blade 2. blade support 3. Pitch angle actuator 4. hub 5. spinner 6. main support 7. main shaft 8. aircraft warning lights 9. gearbox 10. mechanical brakes 11. hydraulic cooling devices 12. generator 13. power converter and electrical control, protection and disconnection devices 14. anemometers 15. transformer 16. frame of the nacelle 17. supporting tower 18. yaw driving device

	The converter and the transformer can be installed directly in the nacelle as Figure 2.1 shows, or positioned at the base of the tower. The installation of the transformer inside the nacelle allows balancing of the rotor weight, while positioning at the base allows a reduction in dimensions and weight of the nacelle.
3	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** 2.1 Rotor 2.1.1 Blades The blades are the components which interact with the wind and are designed with such an airfoil to maximize the aerodynamic efficiency. Figure 2.3 shows the typical form of a blade and its transversal sections; the blade winds up and the total angle between the root and the tip is about 25°. Since the aerodynamic forces are proportional to the square of the relative speed, they increase rapidly with the distance from the hub; therefore it is important to design the part of the blade near the root so that there is a good lift and a low aerodynamic resistance. The cross sectional area of the blade is quite large to get the high stiffness necessary to withstand the variable mechanical loads present under normal operation which contribute to determine the wear and tear of the blade. In fact, the wind exerts an unsteady force, both for the fluctuations due to the turbulence, as well as for the higher speed as a function of altitude. Besides, during rotation, a blade when in the high position is subject to a stronger wind in comparison with the wind intensity when it is in the low position, with the consequent load fluctuations which recur at each rotation. Finally, the centrifugal force due to rotation exerts traction on the different sections of the blade and the weight of the blade itself creates a bending moment on the root which alternates at each rotation. Blades are made from light materials, such as fiber reinforced plastic materials, which have good properties of resistance to wear and tear. Fibers are generally made of glass or aluminum for the blades of small and medium size wind turbines, whereas for larger blades carbon fibers are used in the parts subject to more critical loads. The fibers are incorporated in a matrix of polyester, epoxy resin or vinyl ester constituting two shells kept together and reinforced by an internal matrix. The external surface of the blade is covered with a layer of colored gel to prevent ageing of composite material due to ultraviolet radiation. According to the technology used by the manufacturer, blades can be equipped with additional elements, such as stall controllers to stabilize the air flux, vortex genera tors to increase lift or wingtip devices to reduce the lift loss and the noise. Since the main cause of failure is represented by lightning, a protective measure is taken by installing conductors, both on the surface as well as inside the blade (see Chapter 8). The blades and the central hub (which together constitute the rotor) are mounted on the nacelle through suitable flange bearings.
4	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** 2.7 Tower There are two main types of towers commonly used horizontal axis wind turbines: • free-standing lattice (truss) • tubular The first wind turbines were on free-standing lattice towers, commonly used until the mid-1980s. Nowadays wind turbines are mostly of tubular type since they offer a number of advantages in comparison with the truss one. In particular, tubular towers do not require many bolted connections which need to be periodically checked; they provide a protected area to access the turbine and climbing to the nacelle is made safer and easier thanks to internal stairway or lift in case of larger turbines. Furthermore, they are aesthetically more acceptable in comparison with truss towers. There is a third type of tower, guyed lattice tower (Figure 2.9), but they are little used for medium and large size power plants. The tower height depends on the wind regime at the installation site. In onshore plants the nacelle is usually at a height equal to 1 or 1.2 times the rotor diameter, whereas in offshore plants the height is equal to 0.8 times the rotor diameter. Tubular towers are usually made of rolled steel, although sometimes reinforced concrete is used. They are cone-shaped, with the base diameter longer than that on the top where the nacelle is positioned. The different sections are joined and fixed together by bolted flanges. These types of towers generate a remarkable downwind wake; that is why in most cases the rotor is positioned

	upwind. Moreover, they are very visible structures and therefore they must not show signs of corrosion over many years: to this purpose, adequate coating must be chosen. The towers are set into the ground through foundations generally consisting in reinforced concrete plinths placed at a certain depth. 2.8 Control and protection/disconnection systems These systems are the “brain” of the wind turbine and provide the control logic to command start up and shut down procedures of the turbine and to guarantee turbine functioning in a defined range of operation parameters, by protecting the rotor, in particular, against overspeed, and the different parts of the electric circuit against overcurrents and overvoltages. The logic of control is usually programmed in a PLC. In particular, the protection/disconnection systems disconnect the turbine from the grid in case of malfunctioning, thus allowing proper operation of the other wind turbines in the wind power plant.
5	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** 2.1.2 Hub The hub of the wind turbine is the component that connects the blades to the main shaft, transmitting to it the power extracted from the wind; it includes pitching systems. Hubs are generally made of steel or spheroidal graphite iron and is protected externally by an oval enclosure called spinner. There are three main types of hub (Figure 2.4): • rigid • teetering • hinged A rigid hub is designed to keep all major parts in a fixed position relative to the main shaft. The blade Pitch can be varied, but no other blade motion is allowed. It is the type mostly used for rotors with three or more blades. A rigid hub must be strong enough to withstand all the loads that can arise from any aerodynamic load on the blades as well as those due to yawing. Teetering hubs are used on nearly all two-bladed wind turbines and are designed to reduce the aerodynamic imbalances transmitted to the shaft and typical of two bladed rotors; thus the rotor is free to oscillate some degrees with respect to the direction perpendicular to the rotation axis of the main shaft. Teetering hubs have been mainly coupled with turbines with fixed Pitch angle, but they can be used on variable pitched turbines as well. Also design of the pitching system is more complex since the relevant mechanisms and the switching/protection switchboards are located on the moving part with respect to the main shaft. A hinged hub is, in some ways, a cross between a rigid hub and a teetering hub and it is basically a rigid hub with hinges for the blades. It is used by downwind turbines to reduce excessive loads in case of strong winds. 2.2 Gearbox Most drivetrains include a one- or more-stage gearbox between the rotor, which extracts kinetic energy from the wind and converts it into mechanical rotation energy, and the electric generator, which converts the available mechanical energy into electrical energy. The gearbox has the purpose of increasing the rotor speed to adapt it to the values required by conventional generators (in some turbines the ratio of the gearbox may exceed 1:100). The gearbox consists of one or more gears of epicycloidal or parallel axis type (Figure 2.5). In the last few years, the development of alternators with interposed converter has made it possible the construction of some models of wind turbines without gearbox. In fact, the gearbox is a source of noise and one of the elements requiring more maintenance; furthermore it may cause efficiency losses of the wind turbine. Therefore the lack of the gearbox implies a simplification of the mechanical part and thus allowing a reduction in the size and mass of the nacelle.
6	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** 5.1 Turbine mechanical model A typical wind turbine can be simply modeled as a rotating mass with a large inertia, representing the rotor, and a rotating mass representing the generator, both connected to the rotation shaft (Figure 5.1). To this mechanical model, the aerodynamic torques acting on the rotor apply: the electromagnetic torque acting on the generator and the possible torque applied to the shaft by mechanical brakes. Below the rated wind speed, the control systems act to maximize

	the aerodynamic torque (and therefore the power output), whereas above the rated wind speed, the control systems modulate such torque to keep the rotation speed within acceptable limits. In the turbines designed to operate at nearly constant speed, the generator torque is a function of the aerodynamic torque and the only way to control the generator torque (and consequently the power output) is by regulating the aerodynamic torque. In variable-speed turbines instead, the generator torque and the aerodynamic torque can be independently changed, and consequently the rotor speed can be controlled both acting on the aerodynamic torque as well as on the generator torque thus affecting the acceleration or deceleration of the rotor. Changes of the generator torque are carried out by interposing an electronic power converter (see Chapter 6) regulating phase and frequency of the current flowing through the generator windings. 5.2 Aerodynamic torque control The aerodynamic torque can be controlled by acting on the rotor geometry, which modifies the lift and drag values and consequently the values of the aerodynamic torque. The rotor geometry can be changed by regulating the Pitch over the length of the blade or by changing the geometry of a part of the blade only. As explained later, full span Pitch control can be carried out both to reduce as well as to increase the angle of attack towards stall. Pitch control can be carried out either individually, when the Pitch angle of each blade is regulated independently from all the others, or collectively, when all the blades are moved to the same Pitch angle – cyclic Pitch control – in which the Pitch of each blade is the same as the others at the same rotor Azimuth angle.
7	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** 6.1 Fixed speed wind turbines In these types of turbines induction electrical machines (also known as asynchronous machines), generally used as motors for many industrial applications, are used for the conversion of the mechanical energy extracted from the wind into electrical energy. In the wind turbines, on the other hand, these electrical machines are used as generators, above all because of their constructional simplicity and toughness, their relative cost-effectiveness and for the simplicity of connection and disconnection from the grid (Figure 6.1). The stator of an induction machine consists of copper windings for each phase, as the stator of synchronous machines. On the contrary, the rotor in squirrel-cage motors has no windings, but consists of a series of copper bars set into the grooves of the laminated magnetic core. Some induction machines can have windings also on the rotor and in this case they are called wound rotor machines. They are expensive and less sturdy than the previous type and are used in variable-speed wind turbines, as better explained in the following paragraphs. Induction machines require a given quantity of reactive power to function. This power shall be either drawn from the grid or delivered locally through a capacitor bank, which shall be properly sized so that self-excitement of the synchronous generator can be avoided in case of grid disconnection due to failure. Besides, these machines need an external source at constant frequency to generate the rotating magnetic field and consequently they are connected to grids with high short-circuit power able to support frequency. When working as a generator, the asynchronous machine is speeded up by the wind rotor up to the synchronous speed and then connected to the grid, or it is at first connected to the grid and started as a motor up to the steady state speed. If the first starting method is used, the turbine clearly is self-starting and therefore the Pitch control must be present, whereas the second method is used for passive stall-regulated turbines. In this case the control system stores the wind speed and defines the speed range within which the generator is to be started. Once the synchronous speed has been achieved, the wind power extracted makes the rotor run in hypersynchronous operation with negative slip, thus supplying active power to the grid. As a matter of fact, since the slip has values in the order of 2%, the deviation from the rated speed is very limited and that's why the use of these machines makes the wind turbine run at constant speed. To reduce the starting current, a soft starter is usually interposed between the asynchronous machine and the grid.
8	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** 8 Protection against overvoltages

	8.1 Generalities Wind power plants, being installed outdoor, may be subject to direct and indirect overvoltages of atmospheric origin, besides being subject to switching over voltages. Lightning protection allows risks for people (mainly the personnel in charge) and maintenance operations due to damages on structure and on the internal components to be reduced and measures against economical losses because of drop of energy production due to the plant failure to be taken. If the wind turbine is installed on a building (Figure 8.1) and significantly modifies the outline of the same, a new assessment of the lightning risk is necessary to verify whether installation of an LPS (Lightning Protection System) or modification of that already present are needed. If the wind turbine is installed on the ground, stand-alone or in a wind power plant, due to its height and being often the highest structure in the surrounding area, it represents an “ideal target” for atmospheric discharges (Figure 8.2). In particular, the height of the wind towers (especially for those ones exceeding 100m) facilitates the formation of upward atmospheric discharges from the structure to the cloud. If not otherwise indicated by the risk assessment, the components of a wind turbine must be protected according to a Lightning Protection Level (LPL-I). Such level takes into account the highest lightning parameters. A more accurate risk assessment could let us think favorable from an economic point of view making a difference in the protection levels: for example the blades shall be protected by the highest LPL, whereas other parts, which can be repaired or replaced at a lower cost, shall be protected by a lower LPL. 8.2 Protection of blades Blades are the most exposed part of the whole structure and the lightning protection system must guarantee that the damages caused by an atmospheric discharge is tolerated till the next inspection and scheduled maintenance. The experience has shown that the points where lightning attaches are near the tip of the blades (IEC 61400-24 Annex C). The phenomenon responsible for the severe structural damage to wind turbine blades is the formation of a pressure shock wave around internal arcs caused by the path of lightning across the blade and due to the presence of air-filled cavities or arcs between the different layers of composite material. Damage may range from surface cracking to complete disintegration of the blade. Minor damage may occur when a lightning arc is formed on the outside surface of the blade or when the lightning current is conducted by metallic components with insufficient cross section. As a consequence, the purpose of the blade protection against lightning is conducting the lightning current from the attachment point to the hub, in such a way that the formation of a lightning arc inside the blade is avoided. This can be achieved by diverting the lightning current using metallic conductors of appropriate cross-section either fixed to the blade surface4 or inside the blade, or by adding a metal mesh inside the blade surface.
9	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** 9 Wind power in electric power systems 9.1 Wind power plants As mentioned in the first chapter, wind turbines can operate as power generation plants connected to the grid, to isolated electric systems or also individually to supply a specific load. In particular, the integration process of wind installations into power systems includes first of all the correct choice of the installation site and then, once the construction and the connection to the grid have been carried out, the subsequent management of the injected power taking into account the power demand of the network loads and the randomness and variability of the wind source. In fact, the connection of the turbines to the electrical power systems can have local effects on the network in terms of power-quality and, if the fraction of the wind energy injected into the electrical system becomes not negligible, its effects can involve all the network. Wind turbines can be installed as individual units or grouped in wind power stations, also known as “wind power plants”. As regards the choice of the installation site, usually the main target is maximizing the economic payback of the investment trying to minimize those effects such as noise pollution and visual-environmental impact. Once the site has been chosen, the exact position and direction of the individual turbine or the disposition of the different wind turbines in the wind power plants are generally defined by computer simulation programmes aimed at maximizing the extraction of energy from the wind, always keeping in mind the previous limits and the morphological configuration of the installation site. In particular, when installing wind

	turbines in wind power plants, one of the main technical problem is how much space has to be left between the single turbines to keep within acceptable limits the mutual aerodynamic interference. In fact, the extraction of wind energy from the windward turbines causes a reduction in the speed of the wind available for the leeward turbines and a possible increase in turbulence. The consequence is not only a reduction in the total energy produced by the wind power plant1, but also a remarkable fluctuation of the electric power injected into the grid. Besides reducing the wind energy captured, a high turbulence increases the speeds of the wind gusts with the consequence that the control systems intervene more frequently to stop the turbine, by reducing further the energy production. Moreover, turbulence increases the fatigue stress of the materials constituting the leeward turbines thus reducing their expected life. When the incoming wind into the wind power plant reaches the cut-in speed, the first line of turbines starts to generate electric power. Such extraction of energy from the wind outgoing from the first line reduces the speed of the wind itself and consequently the turbines at the back cannot work. By increasing the speed of the incoming wind, the number of the lines of turbines working till all the turbines generate power rise, even if the turbines in the first line produce more power per unit. Moreover, when the incoming wind reaches the speed at which the first line of turbines generates the rated electric power, the other lines produce less power. This means that, in order to make all the turbines produce the rated power, the speed of the incoming wind should be the higher, the bigger the number of turbine lines of turbines. Thus, not only the total energy generated by a wind power plant is lower than the sum of the energy produced by the single turbines installed separately, but also the total power curve of a wind power plant as a function of the wind speed is different from that of a turbine considered separately.
10	Письменный перевод текста с английского языка на русский: **Technical Application Papers No.13** **Wind power plants** 9.2 Effects of wind turbines on the network In the study of wind turbines injecting power into the grid, the last is often considered ideally with infinite short circuit power; therefore it cannot be influenced by the connection of additional loads or generators. As a matter of fact, each deviation of the generated power from the absorbed one causes a variation of the network voltage frequency and, through the impedance of the different lines, it causes also a variation of the voltage with respect to the rated value. As a consequence, the higher the ratio between the rated power of the wind plant and the fault level of the system at the connection point, the more the network is influenced by the connection of the wind turbines. By schematizing and by simplifying, a power grid can be divided into four main sections: generation, transmission and primary and secondary distribution (Figure 9.2). Power generation is historically carried out by large synchronous generators installed in big power stations supplied by “traditional3” energy sources. These generators can meet also load variations, keeping constant the network frequency and adjusting, if necessary, the supply voltage. The electric energy in these large power plants is produced in medium voltage and then transformed in high voltage and very high voltage to be injected into the grid. Energy transmission is carried out through big overhead lines or in cable at a high voltage so that the power losses are reduced. MV primary distribution and LV secondary distribution are used respectively for the supply of loads (multi- or single user) of decreasing power. The distribution networks are often near the delivery points of electric energy and far from the generation power plants, have a fault level which progressively decreases and therefore are more influenced by the low or fast load fluctuations. Wind power generation plants are usually inserted in the electric power system by connection to the primary distribution section or, in case of small plants, to the secondary distribution section. Onshore and offshore large-size wind power plants are usually connected to high voltage or very high voltage grids. Figure 9.3 shows a typical connection scheme to a high voltage grid for a wind power plant onshore, whereas Figure 9.4 shows the scheme of connection to the electric grid of a wind power plant offshore through a HVDC electric cable.