MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

O. M. BEKETOV NATIONAL UNIVERSITY
of URBAN ECONOMY in KHARKIV

Methodical recommendations
for practical classes and organizing independent work
on an academic discipline

"FOREIGN LANGUAGE FOR PROFESSIONAL PURPOSES"
Part 2

(for first-year full-time
students second (master's) level of higher education
specialty 133 – Industrial engineering)

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CONTENTS

INTRODUCTION 4
Unit 1 DIESEL ENGINE 5
Unit 2 HOW DIESEL ENGINES ARE USED 9
Unit 3 HOW DIESEL ENGINE DIFFERS FROM GASOLINE ENGINE 13
Unit 4 MATERIAL BUILDING EQUIPMENT 17
Unit 5 NANOTECHNOLOGY IN CIVIL ENGINEERING 21
Unit 6 APPLICATIONS OF NANOTECHNOLOGY IN CONSTRUCTION 25
Unit 7 HYDRAULIC AUTOMATIC TRANSMISSIONS 28
Unit 8 NANOELECTROMECHANICAL REALY TECHNIQUE 32
REFERENCES 37

INTRODUCTION

These Methodical recommendations are developed to provide students of the Master's programme in Industrial Engineering with the necessary tools to learn English effectively in a professional context. The programme involves in-depth mastery of the language specific to the field of mechanical engineering, with an emphasis on developing reading, writing and speaking skills. Working with this material, students will master the following key skills:

Reading and comprehension of texts. Students will learn to find the main information in specialised texts on topics related to mechanical engineering. They will learn how to analyse texts and formulate questions to the text, which helps to develop critical thinking skills.

Vocabulary development. Students will expand their professional vocabulary by learning specific engineering terminology. This will enable them to speak confidently in the work environment, understand technical documentation and conduct professional negotiations in English.

Writing and expressing opinions. By completing essay and summary tasks on given topics, students will improve their writing skills. It will also help them to master the skills of structuring information and arguing their ideas in English.

Working with this course will enable students to broaden and deepen their knowledge of English specific to engineering and prepare them for successful interaction in an international engineering environment. These guidelines are a valuable tool for developing students' language skills necessary for further professional success and active participation in international engineering projects.

Unit 1 DIESEL ENGINE

1 Introduction

1.1 Read the text title and hypothesize what the text is about. Write down your hypothesis.

1.2 Read the text and make the plan of the abstracting in the form of questions.

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1.3 Find in the text 14–16 professional words and expressions you don't know. Write down their translation in the table and explain their meaning.

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The diesel engine is known as a prime mover. A prime mover may be defined as a mechanism that converts heat energy into mechanical power. Most prime movers are heat engines such as steam engines, turbines, gas, gasoline and diesel engines, and gas turbines. Electric motors are not generally considered prime movers.

Diesel fuel burning and expanding in a cylinder provides the diesel engine, as in the case of all heat engines the process is one of converting the chemical energy in the fuel, firstly into heat energy by burning in the cylinder; and secondly, by the mechanical movements of piston, connecting rod and crankshaft, into mechanical power. The crankshaft receiving an impulse from the cylinder converts it into a rotary motion, and this rotary motion is the mechanical power used in this case to turn an electric generator.

The diesel engine is an internal combustion engine. The term "internal combustion engine" is applied to all engines in which the combustion of the fuel occurs in the cylinder. A large variety of engines are included under this heading. Internal combustion engines are subdivided according to the type of fuel used; they may be gas engines, petrol engines, light oil engines, or heavy oil engines. These, in turn, may be again subdivided and classified according to the working cycle used, the method of igniting the fuel, the method of injecting the fuel, and the speed.

The following are the chief characteristics of the internal combustion engine:

1. The fuel used.
2. The working cycle.
3. Method of ignition.
4. Method of fuel injection.
5. Method of governing.
6. Speed.

Every internal combustion engine in common usage has what is known as a cycle of events. A cycle consists of the introduction of fuel and air, the expansion, and the exhausting of the burnt gases. Some engines require four strokes of the piston to complete the cycle and are known as four-cycle engines, while others require only two strokes of the piston to complete the cycle of events and are known as two-cycle engines.

In describing the cycles in both a two-cycle and a four-cycle engine it must be remembered that the cycle is a series of events, beginning with the ignition of one fuel charge in a cylinder of an engine and lasting to, but not including, the ignition of the following fuel charge in the same cylinder. In the four-cycle engine, pure air is drawn into the cylinder through an inlet valve as the piston descends. The inlet valve then closes and the piston ascends, thus compressing the air. Just before completion of this compression stroke, oil is sprayed into the cylinder; the spray mixes with the hot compressed air and ignites almost immediately since the temperature is well above the spontaneous ignition temperature of the oil used. As the fuel burns, the pressure in the cylinder rapidly rises and the piston is forced

down on its working stroke. The exhaust valve opens, and as the piston again ascends, it pushes the waste gases out of the cylinder until top dead centre is reached. The inlet valve then opens, the exhaust valve closes, and the cycle repeats. There is thus one working stroke in every four strokes or two revolutions of the crankshaft. Thus, in the first cycle (suction stroke) the piston travels down; the admission valve opens, the cylinder being filled with pure air.

In the second cycle (compression stroke) the piston travels up; all valves are closed, air in the cylinder being. In the third cycle (power stroke) the piston travels dawn; gases expand. In the fourth stroke (exhaust stroke). The piston travels up; the exhaust valve opens, burnt gases being expelled from the cylinder.

The two-stroke engine can dispense with valves and may control the admission of air and exhaust by inlet and outlet ports in the cylinder walls. These are uncovered by the downward movement of the piston which allows scavenging air, under slight pressure, to enter at one side and expel the spent gases through the outlet ports. The piston, in rising, closes both ports and compression takes place followed by fuel injection as in the four-stroke engine. A two-stroke engine will produce one power stroke for each revolution of the engine crankshaft for each cylinder.

In comparing the two-cycle engine with the four-cycle, if we assume two engines are of identical horsepower, it will be found that the two-cycle engine is about 75 per cent of the weight of the four-cycle engine. It uses a medium or light-weight flywheel, gives a more constant toque on the crankshaft, has fewer valves and a slightly better fuel economy. The four-cycle engine uses less lubricating oil and has better lubricating ability; it does not require a scavenging pump to exhaust the burnt gases on the exhaust stroke; it will produce about 10 per cent more useful work.

2 Abstracting

Write an abstract to the text according to your plan from 1.2 and retell it.

Unit 2 HOW DIESEL ENGINES ARE USED

1 Introduction

1.1 Read the text title and hypothesize what the text is about. Write down your hypothesis.

1.2 Read the text and make the plan of the abstracting in the form of questions.

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Now let's look at the applications in which diesel engines are widely used. The reason why they are preferred in these applications is that their advantages, as a whole, are more important.

Locomotives and Railcars Almost all railroad locomotives now being built are powered with diesel engines, and existing steam locomotives are being rapidly replaced with diesels. Locomotives for pulling trains and for switching service are mostly diesel-electric – that is, the diesel engine drives an electric generator which supplies electric power to electric motors connected to the wheels. You might say it is an electric locomotive which carries its own power plant along with it. Where passenger traffic is light, and only one or two cars are needed, diesel-electric railcars are used. They work like the locomotives, but each car carries its own diesel-electric power plant as well as the electric motors to drive the wheels.

The reason why the railroads have almost universally adopted the diesel engine is to save money. Compared to steam locomotives diesels save money by using much less fuel and by being available for service for much more of the time. Compared to straight electric locomotives, diesels save the heavy investment required for overhead wires or third-rails. Passengers prefer diesel-electric locomotives to steam because trains start more smoothly, travel more comfortably at higher speeds, and give off little smoke.

Construction Machinery and Logging Equipment Diesel engines have come into general use for all these applications. The principal reason is the saving in cost of fuel –the diesel engine uses fewer gallons of less costly fuel than the gasoline engine. True, the diesel costs more to begin with, but if it is used in a class of service which keeps it busy enough, the saving in cost of fuel soon pays back the extra investment. Another advantage of the diesel is its greater pulling or "lugging" power when it slows down under a heavy load. In other words, the diesel loses less power at reduced speed than the gasoline engine.

Stationary Power Plants Diesel engines are employed in a great many kids of stationary power plants. The reasons are many; the chief ones are saving in cost of fuel compared to small steam or gasoline power plants, and lower total cost than that of bought electric power. Additional advantages enter into certain special applications such as isolated service stations, railway water stations, vacation resorts, lumber camps, mine power plants, oil-well drilling, and emergency power plants. Here the following advantages of the diesel are important: independence of water supply, lightness and compactness, freedom from fire hazard, and ability to start quickly.

Marine Uses. Diesels are now widely used in marine service of many kids, such as sea-going vessels (both passenger and freight), motorboats, ferryboats, tugs, naval vessels, and icebreakers. The main reason for these uses of diesels is, again, lower cost of fuel compared to steam. Submarines used to be powered with gasoline engines; now they invariably use diesels, not only because of the greater range of travel due to their consuming less fuel, but also because of the reduced fire hazard. The latter is also an impelling reason for the use of diesels on motorboats.

Mines and Tunnels Diesel locomotives are now preferred to electric locomotives for mine haulage and for tunnel construction because they are less expensive in both first cost and operating cost. Their exhaust gases contain little poisonous monoxide gas which is an important objection to gasoline engines.

Why We Call it a "Diesel" Engine You have learned earlier in this chapter that a diesel engine is one form of internal-combustion engine, the latter being an engine from which work is obtained by the combustion of fuel within the engine cylinders themselves. A diesel engine is that type of internal-combustion engine which injects fuel oil in a finely divided state into a cylinder within which air has been compressed to a high pressure and temperature.

The temperature of the air is high enough to ignite the particles of the injected fuel; no other means are used for ignition. Because of this method of ignition, diesel engines are sometimes called compression-ignition engines. This sets them apart from other internal-combustion engines called spark-ignition engines. These latter engines use gasoline or gas as fuel, and the mixture of fuel and air is ignited by an electric spark.

We call this compression-ignition engine by the name "diesel" simply because a man whose name was Rudolf Diesel originated in Germany and obtained patents in

1892 on a high-compression, self-ignition engine originally intended to burn powdered coal.

2 Abstracting

Write an abstract to the text according to your plan from 1.2 and retell it.

Unit 3 HOW DIESEL ENGINE DIFFERS FROM GASOLINE ENGINE

1 Introduction

1.1 Read the text title and hypothesize what the text is about. Write down your hypothesis.

1.2 Read the text and make the plan of the abstracting in the form of questions.

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If you know something about ordinary gasoline engines, such as those in automobiles, you will have noticed that diesel engines, in many respects, work in the same way. Before we see how they differ, let s see how they are alike.

Both types of engines run on liquid fuels. In certain special cases they even use exactly the same fuel. Gasoline engines have been made to run on kerosene, and so have diesel engines. Gasoline, kerosene, and diesel oil are all produced from natural petroleum (crude oil), and are distinguished mainly by their volatility, that is, the ease with which they can be changed from a liquid to a vapor. Gasoline is quite volatile, that is, it evaporates or vaporizes at a low temperature. Kerosene needs more heat to make it vaporize, while diesel oil requires still more heat.

Both types of are internal-combustion engines, that is, they burn the fuel inside their cylinders. Most gasoline engines and many diesel engines work on the four-stroke cycle, that is, the piston makes a suction stroke (down), a compression stoke (up), a power stoke (down), and an exhaust stoke (up).

What, than, are the main differences between diesel engines and gasoline engines?

F i r s t, a diesel engine has no ignition system - it has no spark plug fed with high-tension electricity from a distributor, spark-oil, timer, and battery, or from a magneto. None of this is needed, on a diesel engine because the fuel is ignited simply by contact with very hot air which has been highly compressed in the cylinder.

S e c o n d, a diesel engine draws into its cylinder air alone, and it compresses this air on its compression stroke before any fuel enters the cylinder. On the other hand, a gasoline engine mixes air with fuel in a carburetor outside the cylinder before it enters the engine through the inlet valve during the suction stroke.

T h i r d, diesel engines use greater compression that gasoline engines. In a gasoline engine, the amount of compression or compression ratio that can be used is strictly limited because fuel, as well as air, is being compressed.. In other words, the mixture will pre-ignite before the piston has completed its compression stroke, and will try to stop the piston. Even a little more compression than the right amount will cause detonation or knocks because some of the mixture burns all at once before the flame from the spark gets to it. A mixture of a certain amount of fuel and air will produce more power the more it has been compressed. Therefore, the efficiency of a gasoline engine, that is, the amount of power produced from a certain amount of fuel, is limited by the permissible compression ratio, which is about 7 to 1 (or a little more if highly leaded premium gasoline is used). The compression in a diesel engine is not limited by the possibility of pre-ignition because a diesel engine compresses air only. Therefore, diesel engines use compression ratios of about 16 to 1, and so achieve greater efficiency in the use of fuel.

F o u r t h, diesel engines use less volatile, heavier liquid fuels than gasoline engines. These heavier fuels are generally cheaper than gasoline. Gasoline engines must use this highly volatile fuel because only a fuel which evaporates at low temperature will form a uniform mixture which the rapid current of air flowing through the carburetor.

F i f t h, diesel engines use fuel pumps and injection nozzles to inject the oil into the cylinder in the form of a fine spray. Gasoline engines, on the other hand, mix the fuel and air in a carburetor.

S i x t h, diesel engines are heavier than gasoline engines of the same size because they work against greater pressures, and consequently their parts must be stronger. The greater strength is obtained (for the same materials) by making the parts thicker and therefore heavier.

Why are diesel engines used so much? Not merely because they can produce power — there are many other ways of producing power. Besides diesel engines, there are gasoline engines, steam engines, steam turbines, and water wheels (also known as hydraulic turbines), to name some though not all such examples. These machines are known as prime movers. Also, you can often buy power in the form of electricity which has come over wires; this is power which first has been produced by a prime mover and then converted into electricity. So it is a fair question — why, with all these different sources of power, are diesel engines often preferred to the others? Sometimes the question is easily answered; sometimes it demands professional engineering study.

It's not the purpose of this chapter to explain the work of professional engineers, so let's just list the main advantages that diesel engines have over other forms of power for certain kinds of uses.

1. Small Consumption of Fuel. The diesel engine is one of the most highly efficient heat-engines; that is, it gets more power out of the fuel it burns than any other ordinary prime mover, except the largest and most efficient steam turbines. Its fuel consumption is much less than that of a gasoline engine. It is an engine of high economy.

2. Cheap Fuel. The diesel engine uses fuels costing less than half as much as gasoline.

2 Abstracting

Write an abstract to the text according to your plan from 1.2 and retell it

Unit 4 MATERIAL BUILDING EQUIPMENT

1 Introduction

1.1 Read the text title and hypothesize what the text is about. Write down your hypothesis.

.2 Read the text and make the plan of the abstracting in the form of questions.

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Everyone knows that every construction project involves some type of material handling function. It's always a challenge to get the materials to where they are needed when they are needed. Construction work demands the movement of materials such as rock, debris, dirt, trees, shrubs, soil, etc. from one place to another. For specific types of material handling activities, there are purpose-built machines such as dozers, cranes, scrapers and excavators for earthmoving, scrap handlers and forestry equipment.

Material handling equipment encompasses a diverse range of tools, vehicles, storage units, appliances and accessories involved in transporting, storing, controlling, enumerating and protecting products at any stage of manufacturing, distribution, consumption or disposal. The four main categories of material handling equipment include: storage, engineered systems, industrial trucks and bulk material handling.

Storage equipment is usually limited to non-automated examples, which are grouped in with engineered systems. Storage equipment is used to hold or buffer materials during "downtimes", or times when they are not being transported. The majority of storage equipment refers to pallets, shelves or racks onto which materials may be stacked in an orderly manner to await transportation or consumption.

A conveyor structure is a common piece of mechanical handling equipment that moves materials from one location to another location. Conveyors are mainly useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries.

Rubber conveyor belts are commonly used to convey items with irregular bottom surfaces, small items that would fall in between rollers or bags of product that would sag between rollers. Belt conveyors are generally fairly similar in construction consisting of a metal frame with rollers at either end of a flat metal bed. The belt is looped around each of the rollers and when one of the rollers is powered (by an electrical motor) the belting slides across the solid metal frame bed, moving the product. In heavy use applications the beds which the belting is pulled over are replaced with rollers. The rollers allow weight to be conveyed as they reduce the amount of friction generated from the heavier loading on the belting.

Belt conveyors are the most commonly used powered conveyors because they are the most versatile and the least expensive. Product is conveyed directly on the belt so both regular and irregular shaped objects, large or small, light and heavy, can be transported successfully. These conveyors should use only the highest quality premium belting products, which reduces belt stretch and results in less maintenance for tension adjustments. Belt conveyors can be used to transport product in a straight line or through changes in elevation or direction. With efficient belt conveyors the transport of the excavated material keeps pace with the tunnelling progress. The transport of excavated material on belt conveyor systems is the most direct and often the most cost-efficient way.

Another challenge is the conveying distance that becomes longer, the further tunnelling progresses, and individual distances of up to 15 kilometers are possible.

If the tunnel portal is located below the jobsite surface, for example in a shaft, vertical belt conveyors or ascending belts transport the excavated material to the surface.

Screw conveyors are volumetric conveying devices. With each revolution of the screw, a fixed volume of material is discharged. The purpose of a screw conveyor is to transfer product from one point to the next. The screw conveyor is one of the most reliable and cost-effective ways for conveying bulk materials. It is a very versatile machine that can handle a wide variety of materials from dry, free-flowing materials such as portland cement to wet, sluggish materials such as dewatered biosolids.

A hoist is a device used for lifting or lowering a load by means of a drum or lift-wheel around which rope or chain wraps. It may be manually operated, electrically or pneumatically driven and may use chain, fiber or wire rope as its lifting medium. The load is attached to the hoist by means of a lifting hook. The lifting medium is either wire rope, wrapped around a drum, or load-chain, raised by a pulley with a special profile to engage the chain. The power can be provided by different means. Common means are hydraulics, electrical and air driven motors.

A forklift (also called a lift truck, a fork truck, or a forklift truck) is a powered industrial truck used to lift and move materials short distances. Trucks can also be manual or powered lift and operation can be walk or ride, requiring a user to manually push them or to ride along on the truck. A stack truck can be used to stack items, while a non-stack truck is typically used for transportation and not for loading.

2 Abstracting

Write an abstract to the text according to your plan from 1.2 and retell it.

Unit 5 NANOTECHNOLOGY IN CIVIL ENGINEERING

1 Introduction

1.1 Read the text title and hypothesize what the text is about. Write down your hypothesis.

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As people involved in construction, we are very familiar with the concept of getting raw materials, bringing them together in an organized way and then putting them together into a recognizable form. The finished product is a passive machine. It works and slowly decays as it is used and abused by the environment and the owners of the project. Construction then is definitely not a new science or technology and yet it has undergone great changes over its history. In the same vein, nanotechnology is not a new science and it is not a new technology either. “Nanotechnology is an enabling technology that allows us to develop materials with improved or totally new properties”. It is rather an extension of the sciences and technologies already developed for many years to examine the nature of our world at an ever-smaller scale. Traditionally, nanotechnology has been concerned with developments in the fields of microelectronics, medicine and materials sciences. However, the potential for application of many of the developments in the nanotechnology field in the area of construction engineering is growing. The evolution of technology and instrumentation as well as its related scientific areas such as physics and chemistry are making the nanotechnology aggressive and evolutional.

Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering. Nano, which comes from the Greek word for dwarf, indicates a billionth. It’s hard to imagine how small nanotechnology is. One nanometer is a billionth of a meter, or 10-9 of a meter.

Nanoscience and nanotechnology involve the ability to see and to control individual atoms and molecules. Everything on Earth is made up of atoms—the food we eat, the clothes we wear, the buildings and houses we live in, and even our own bodies. The microscopes needed to see things at the nanoscale were invented relatively recently—about 30 years ago.

Nanotechnology is one of the most active research areas that include a number of disciplines including civil engineering and construction materials. Nanotechnology encompasses two main approaches:

1. the “top-down” approach, in which larger structures are reduced in size to the nanoscale while maintaining their original properties or deconstructed from larger structures into their smaller, composite parts;

2. the ‘‘bottom-up” approach, also called ‘‘molecular nanotechnology” or ‘‘molecular manufacturing,” in which materials are engineered from atoms or molecular components through a process of assembly or self-assembly.

Civil engineers deal with designing, building and maintaining the various structures that make civilization function. Roads, bridges, canals, tunnels, traffic systems, public transportation and other structures that operate on a large scale are subject to special considerations they require engineers to account for earthquakes, winds, massive public movement and even military strikes. There are many potential areas where nanotechnology can benefit construction engineering like its applications in concrete, structural composites, coating materials and in nanosensors, etc.

Sensors have been developed and used in construction to monitor and/or control the environment condition and the materials/structure performance. One advantage of these sensors is their dimension (10 -9m to 10-5m). These sensors could be embedded into the structure during the construction process. Smart aggregate, a low cost piezoceramic-based multi-functional device, has been applied to monitor early age concrete properties such as moisture, temperature, relative humidity and early age strength development. The sensors can also be used to monitor concrete corrosion and cracking. The disclosed system can monitor internal stresses, cracks and other physical forces in the structures during the structures’ life. It is capable of providing an early indication of the health of the structure before a failure of the structure can occur.

Nanotechnology products can be used for design and construction processes in many areas. The nanotechnology generated products have unique characteristics, and can significantly fix current construction problems, and may change the requirement and organisation of construction process. The recent developments in the study and manipulation of materials and processes at the nano-scale offer the great prospect of producing new macro materials, properties and products. Exploitation of nanotechnology in concrete on a commercial scale remains limited with few results successfully converted into marketable products. The main advances have been in the nanoscience of cementitious materials with an increase in the knowledge and understanding of basic phenomena in cement at the nanoscale.

Today's scientists and engineers are finding a wide variety of ways to make materials at the nanoscale to take advantage of their enhanced properties such as higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity than their larger-scale counterparts.

2 Abstracting

Write an abstract to the text according to your plan from 1.2 and retell it.

Unit 6 APPLICATIONS OF NANOTECHNOLOGY IN CONSTRUCTION

1 Introduction

1.1 Read the text title and hypothesize what the text is about. Write down your hypothesis.

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Current civil engineering education should address the need to provide a broad vision, develop the higher-order skills of future civil engineers, enable them to adopt emerging technologies, and formulate innovative solutions to complex problems.

Nanotechnology in eco-efficient construction is a technical guide for all those involved in the design, production and application of eco-efficient construction materials, including civil engineers, materials scientists, researchers and architects within any field of nanotechnology, eco-efficient materials or the construction industry.

Nanotechnology is the creation and utilization of functional materials and devices at the nanoscale or macromolecular level. Nanotechnology is not new for us, at least for people that are related to engineering but the new applications of this new technology into Civil Engineering are breaking the barriers of safety.

Nanotechnology can be used for design and construction processes in many areas since nanotechnology generated products have many unique characteristics. These characteristics can, again, significantly fix current construction problems, and may change the requirement and organization of construction process. Applications of nanotechnology in civil engineering are numerous.

Concrete. Concrete is one of the most common and widely used construction materials. Addition of nanoscale materials into cement could improve its performance. Use of nano-SiO2 could significantly increase the compressive strength for concrete, containing large volume fly ash, at early age and improve pore size distribution by filling the pores between large fly ash and cement particles at nanoscale. It has also been reported that adding small amount of carbonnanotube (1%) by weight could increase both compressive and flexural strength.

Cracking is a major concern for many structures. When the microcapsules are broken by a crack, the healing agent is released into the crack and contact with the catalyst. The selfhealing polymer could be especially applicable to fix the microcracking in bridge piers and columns. The resulting concrete, already used in projects around the world, has a white colour that retains its whiteness very effectively unlike the stained buildings of the material’s pioneering past.

Steel. Steel is a major construction material. Its properties, such as strength, corrosion resistance, and weld ability, are very important for the design and construction. The new steel was developed with higher corrosion-resistance and weld ability by incorporating copper nanoparticles from at the steel grain boundaries.

Fatigue is a significant issue that can lead to the structural failure of steel. This can happen at stresses significantly lower than the yield stress of the material and lead to a significant shortening of useful life of the structure. The research has shown that the addition of copper nanoparticle reduces the surface unevenness of steel which then limits the number of stress risers and hence fatigue cracking.

Glass. The current state of the art in cladding is an active system which tracks sun, wind and rain in order to control the building environment and contribute to sustainability. Consequently, there is a lot of research being carried out on the application of nanotechnology to glass. For heat protection thin film coatings are being developed which are spectrally sensitive surface applications for window glass and filter out unwanted infrared frequencies of light (which heat up a room) and reduce the heat gain in buildings.

Most of glass in construction is on the exterior surface of buildings and the control of light and heat entering through glazing is a major issue. Titanium dioxide (TiO2) is used in nanoparticle form to coat glazing since it has sterilizing and anti-fouling properties. The particles catalyze powerful reactions which breakdown organic pollutants, volatile organic compounds and bacterial membranes. TiO2 is hydrophilic and this attraction to water forms sheets out of rain drops which then wash off the dirt particles broken down in the previous process. Glass incorporating this self-cleaning technology is available on the market today.

Wood. Wood is also composed of nanotubes or "nanofibrils", lignocelluloses are twice as strong as steel. Nanofibrils would lead to a new paradigm in sustainable construction. Functionality onto lignocelluloses surfaces at the nanoscale could open new opportunities for such things as self-sterilizing surfaces, internal selfrepair, and electronic lignocelluloses devices. Researchers have developed a highly water repellent coating based on the actions of the lotus leaf as a result of the incorporation of silica and alumina nanoparticle and hydrophobic polymers.

Coatings. The coatings incorporating certain nanoparticles or nanolayers have been developed for certain purpose. It is one of the major applications of nanotechnology in construction. Nanotechnology is being applied to paints and insulating properties, produced by the addition of nanosized cells, pores and particles, giving very limited paths for thermal conduction.

2 Abstracting

Write an abstract to the text according to your plan from 1.2 and retell it.

Unit 7 HYDRAULIC AUTOMATIC TRANSMISSIONS

1 Introduction

1.1 Read the text title and hypothesize what the text is about. Write down your hypothesis.

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The predominant automatic transmission is hydraulically operated; using a fluid

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coupling or torque converter, and a set of planetary gear sets to provide a range of gear ratios. A cutaway of an 8-speed ZF 8HP showing the major stages of a hydraulic automatic transmission: the torque converter (left), the planetary gear sets and clutch plates (center), as well as hydraulic and electronic controls (bottom). Hydraulic automatic transmissions consist of three major components.

Torque converter A type of fluid coupling hydraulically connects the engine to the transmission. This takes the place of a friction clutch in a manual transmission. It transmits and decouples the engine power to the planetary gears, allowing the vehicle to come to stop with the engine still running without stalling. A torque converter differs from a fluid coupling, in that it provides a variable amount of torque multiplication at low engine speeds, increasing breakaway acceleration. A fluid coupling works well when both the impeller and turbine are rotating at similar speeds, but it is very inefficient at initial acceleration, where rotational speeds are very different. This torque multiplication is accomplished with a third member in the coupling assembly known as the stator, which acts to modify the fluid flow depending on the relative rotational speeds of the impeller and turbine. The stator itself does not rotate, but its vanes are so shaped that when the impeller is rotating at a high speed and the turbine is spinning at a low speed, the fluid flow hits the vanes of the turbine in a way that multiplies the torque being applied. This causes the turbine to begin spinning faster as the vehicle accelerates and as the relative rotational speeds equalize, the torque multiplication diminishes.

Planetary gears train Consisting of planetary gear sets as well as clutches and bands these are the mechanical systems that provide the various gear ratios, altering the speed of rotation of the output shaft depending on which planetary gears are locked. To effect gear changes, one of two types of clutches or bands are used to hold a particular member of the planetary gearset motionless, while allowing another member to rotate, thereby transmitting torque and producing gear reductions or overdrive ratios. These clutches are actuated by the valve body (see below), their sequence controlled by the transmission's internal programming. Principally, a type of device known as a sprag or roller clutch is used for routine upshifts/downshifts. Operating much as a ratchet, it transmits torque only in one direction, free-wheeling or "overrunning" in the other. The advantage of this type of clutch is that it eliminates the sensitivity of timing a simultaneous clutch release/apply on two planetaries, simply "taking up" the drivetrain load when actuated, and releasing automatically when the next gear's sprag clutch assumes the torque transfer. The bands come into play for manually selected gears, such as low range or reverse, and operate on the planetary drum's circumference.

Hydraulic controls Special transmission fluid is sent under pressure by an oil pump to control various clutches and bands modifying the speed of the output depending on the cars running condition. Not to be confused with the impeller inside the torque converter, the pump is typically a gear pump mounted between the torque converter and the planetary gear set. It draws transmission fluid from a sump and pressurizes it, which is needed for transmission components to operate. The input for the pump is connected to the torque converter housing, which in turn is bolted to the engine's flywheel, so the pump provides pressure whenever the engine is running and there is enough transmission fluid, but the disadvantage is that when the engine is not running, no oil pressure is available to operate the main components of the transmission, and is thus impossible to push-start a vehicle equipped with an automatic transmission.

The governor is connected to the output shaft and regulates the hydraulic pressure depending on the vehicle speed. The engine load is monitored either by a throttle cable or a vacuum modulator. The valve body is the hydraulic control center that receives pressurized fluid from the main pump operated by the fluid coupling/torque converter. The pressure coming from this pump is regulated and used to run a network of spring-loaded valves, check balls and servo pistons. The valves use the pump pressure and the pressure from a centrifugal governor on the output side to control which ratio is selected on the gearset; as the vehicle and engine change speed, the difference between the pressures changes, causing different sets of valves to open and close. The hydraulic pressure controlled by these valves drives the various clutch and brake band actuators, thereby controlling the operation of the planetary gearset to select the optimum gear ratio for the current operating conditions. However, in many modern automatic transmissions, the valves are controlled by electro-mechanical servos which are controlled by the electronic engine control unit (ECU) or a separate transmission control unit (TCU, also known as transmission control module (TCM).

2 Abstracting

Write an abstract to the text according to your plan from 1.2 and retell it.

Unit 8 NANOELECTROMECHANICAL REALY TECHNIQUE

1 Introduction

1.1 Read the text title and hypothesize what the text is about. Write down your hypothesis.

1.2 Read the text and make the plan of the abstracting in the form of questions.

1.3 Find in the text 14–16 professional words and expressions you don't know. Write down their translation in the table and explain their meaning.

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A nanoelectromechanical (NEM) Relay is an electrically actuated switch that is built on the nanometer scale using semiconductor fabrication techniques. They are designed to operate in replacement, or in conjunction, with traditional semiconductor logic. While the mechanical nature of NEM relays makes them switch much slower than solid-state relays, they have many advantageous properties, such as zero current leakage and low power consumption, which make them potentially useful in next generation computing.

Operation A NEM relay can be fabricated in two, three, or four terminal configurations. A three terminal relay is composed of a source (input), drain (output), and a gate (actuation terminal). Attached to the source is a cantilevered beam that can be bent into contact with the drain in order to make an electrical connection. When a significant voltage differential is applied between the beam and gate, and the electrostatic force overcomes the elastic force of the beam enough to bend it into contact with the drain, the device "pulls in" and forms an electrical connection. In the off position, the source and drain are separated by an air gap. This physical separation allows NEM relays to have zero current leakage, and very sharp on/off transitions.

The nonlinear nature of the electric field and adhesion between the beam and drain cause the device to "pull out" and lose connection at a lower voltage than the voltage at which it pulls in. This hysteresis effect means there is a voltage between the pull in voltage, and the pull-out voltage that will not change the state of the relay, no matter what its initial state is.

Fabrication NEM relays are usually fabricated using surface micromachining techniques typical of microelectromechanical systems (MEMS). Laterally actuated relays are constructed by first depositing two or more layers of material on a silicon wafer. The upper structural layer is photo lithographically patterned in order to form isolated blocks of the uppermost material. The layer below is then selectively etched away, leaving thin structures, such as the relay's beam, cantilevered above the wafer, and free to bend laterally. A common set of materials used in this process is polysilicon as the upper structural layer, and silicon dioxide as the sacrificial lower layer.

NEM relays can be fabricated using a back end of line compatible process, allowing them to be built on top of Complimentary Metal-Oxide Semiconductor (CMOS). This property allows NEM relays to be used to significantly reduce the area of certain circuits. For example, a CMOS-NEM relay hybrid inverter occupies 0.03 µm2, one-third the area of a 45 nm CMOS inverter.

Mechanical computing Due to transistor leakage, there is a limit to the theoretical efficiency of CMOS logic. This efficiency barrier ultimately prevents continued increases in computing power in power-constrained applications. While NEM relays have significant switching delays, their small size and fast switching speed when compared to other relays means that mechanical computing utilizing NEM

Relays could prove a viable replacement for typical CMOS based integrated circuits, and break this CMOS efficiency barrier.

A NEM relay switches mechanically about 1000 times slower than a solid-state transistor takes to switch electrically. While this makes using NEM relays for computing a significant challenge, their low resistance would allow many NEM relays to be chained together and switch all at once, performing a single large calculation. On the other hand, transistor logic has to be implemented in small cycles of calculations, because their high resistance does not allow many transistors to be chained together while maintaining signal integrity. Therefore, it would be possible to create a mechanical computer using NEM relays that operates at a much lower clock speed than CMOS logic, but performs larger, more complex calculations during each cycle. This would allow a NEM relay-based logic to perform to standards comparable to current CMOS logic.

There are many applications, such as in the automotive, aerospace, or geothermal exploration businesses, in which it would be beneficial to have a microcontroller that could operate at very high temperatures. However, at high temperatures, semiconductors used in typical microcontrollers begin to fail as the electrical properties of the materials they are made of degrade, and the transistors no longer function. NEM relays do not rely on the electrical properties of materials to actuate, so a mechanical computer utilizing NEM relays would be able to operate in such conditions. NEM relays have been successfully tested at up to 500 °C, but could theoretically withstand much higher temperatures.

Field-programmable gate arrays The zero-leakage current, low energy usage, and ability to be layered on top of CMOS properties of NEM relays make them a promising candidate for usage as routing switches in Field-programmable gate arrays (FPGA). A FPGA utilizing a NEM relay to replace each routing switch and its corresponding static random-access memory block could allow for a significant reduction in programming delay, power leakage, and chip area compared to a typical 22nm CMOS based FPGA. This area reduction mainly comes from the fact that the NEM relay routing layer can be built on top of the CMOS layer of the FPGA.

2 Abstracting

Write an abstract to the text according to your plan from 1.2 and retell it.

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з навчальної дисципліни

«ІНОЗЕМНА МОВА ЗА ПРОФЕСІЙНИМ СПРЯМУВАННЯМ»
Частина 2

(для здобувачів другого (магістерського) рівня вищої освіти денної форми навчання зі спеціальності 133 – Галузеве машинобудування)

(Англ. мовою)

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