МІНІСТЕРСТВО ОСВІТИ І НАУКИ
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
імені В. Н. КАРАЗІНА

ІНОЗЕМНА МОВА ПРОФЕСІЙНО-ДІЛОВОГО СПІЛКУВАНЯ

Методичні вказівки до проведення
практичної роботи для здобувачів вищої освіти першого (бакалаврського) рівня
спеціальності 015 «Професійна освіта (Зварювання)»

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Рецензенти:

Г. І. Зеленін – доктор педагогічних наук, професор кафедри іншомовної підготовки, європейської інтеграції та міжнародного співробітництва ННІ «УІПА» ХНУ імені В. Н. Каразіна;

А. В. Богдан – кандидат педагогічних наук, доцент, професор кафедри соціально-гуманітарних дисциплін, працівник ЗСУ Військового інституту танкових військ НТУ «ХПІ».

Затверджено до розміщення в мережі Інтернет рішенням Науково-методичної ради Харківського національного університету імені В. Н. Каразіна (протокол № 11 від 25 червня 2025 року)

І 67 **Іноземна** мова професійно-ділового спілкуваня : методичні вказівки до проведення практичної роботи для здобувачів вищої освіти першого (бакалаврського) рівня спеціальності 015 «Професійна освіта (Зварювання)» [Електронний ресурс] / уклад. С. Е. Жигалко. – Харків : ХНУ імені В. Н. Каразіна, 2025. – (PDF 60 с.)

Методичні вказівки до проведення практичних занять розроблено згідно з навчальною програмою з англійської мови для професійного спілкування. Завдання методичних вказівок спрямовані на формування у студентів професійно-орієнтованих компетенцій. У методичні вказівки включені автентичні тексти англійською мовою з основної зварювальної тематики, забезпечені вправами і завданнями до них. Дані методичні вказівки розраховані на підготовку здобувачів освіти освітнього ступеня «бакалавр» 3–4 курсів денної та заочної форми навчання спеціальності «015 Професійна освіта. Зварювання».

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ВСТУП

Дані методичні вказівки до проведення практичних занять розраховані на підготовку студентів вищих навчальних закладів, що навчаються за спеціальністю «Зварювання», з іноземної (англійської) мови для професійного спілкування У навчально-методичний включені автентичні тексти англійською мовою з основної зварювальної тематики, забезпечені вправами і завданнями, спрямованими на розвиток навичок читання, реферування і анотування з літератури за фахом, а також навичок ведення бесіди на спеціальні теми. Робота з матеріалом, представленим у метадичних вказівках, допоможе студентам не тільки опанувати англійськоїю технічною термінологією в області зварювання і зварювальних процесів, а й познайомитися з історією і сучасним станом галузі, заглянути в майбутнє технології. Методичні вказівки включають вправи на відпрацювання граматичних навичок. Усі граматичні вправи розроблені на основі лексичного матеріалу кожної теми.

Методичні вказівки відповідають сучасним методичним вимогам викладання іноземної мови у вищій школі, поєднуючи теоретичний та практичний матеріал. Використання автентичних текстів і професійної лексики дозволяє студентам удосконалювати мовні навички у сфері зварювання, що є важливим для їхньої майбутньої професійної діяльності. Завдяки структурованому підходу та комплексності матеріалу методичні вказівки можуть бути використаний як під час аудиторних занять, так і для самостійної роботи студентів. Він сприяє всебічному розвитку мовної компетентності, що робить його універсальним навчальним ресурсом та рекомендується до використання у навчальному процесі.

ЗМІСТ

Unit 1

What is Engineering?

1. Read and translate the text.

In general, engineering is a science that deals with design, construction and operation of structures, machines, engines and other devices. Engineer is a person who has received technical education and has a basic knowledge of other engineering fields, because most engineering problems are complex and interrelated. The term engineering is difficult to translate into Ukrainian because it has a lot of meaning. Most often it is translated as: інженерна справа, техніка, машинобудування, будівництво.There exist the following main branches of engineering:

Civil Engineering. Civil engineering deals with the design of large buildings, roads, bridges, dams, canals, railway lines, airports, tunnels and other constructions. A civil engineer must have a thorough knowledge of the properties and mechanics of construction materials, the mechanics of structures and soils, and of hydraulics and fluid mechanics. Among the main subdivisions in this field are construction engineering, transport engineering, and hydraulic engineering.

Mechanical Engineering. Engineers in this field design, test, build, and operate machinery of all types. The field is divided into: 1. machine-tools, mechanisms, materials, hydraulics and pneumatics; 2. heat as applied to engines, work and energy, heating, ventilation, and air conditioning. A mechanical engineer must be trained in mechanics and hydraulics, metallurgy and machine design. A mechanical engineer designs not only the machines that makes products but the products themselves.

Electric Power and Machinery. Engineers working in this field design and operate systems for generating, transmitting, and distributing electric power. Several important developments appeared in this field. One of these is the ability to transmit power at extremely high voltages in both the direct current (DC) and alternating current (AC) modes, reducing power losses. Another is the real time control of power generation, transmission and distribution, using computers.

Electronic engineering. Electronic engineering deals with the research, design and application of circuits and devices used in the transmission and processing of information.

The revolution in electronics is the trend towards integrating electronic devices on a single tiny chip of silicon or some other semiconductive material. Much of the research in electronics is directed towards creating even smaller chips, faster switching of components, and three-dimensional integrated circuits.

Computers Engineering. Computers engineering is the most rapidly growing field. Computer engineers design and manufacture memory systems, central processing units and peripheral devices. Major development in this field are microminiaturization (design of Very Large Scale Integration (VLSI) chips) and new computer architectures. Using VLSI, engineers try to play greater numbers of circuit elements onto smaller chips. Another trend is towards increasing the speed of computer operations through the use of parallel processors and superconducting materials.

Chemical Engineering. This branch of engineering is concerned with the design, construction, and management of factories in which the essential processes consist of chemical reactions. The task of the chemical engineer is to select and specify the design that will best meet the particular requirements of production and the most appropriate equipment for the new applications.

Communications and Control. Engineers of this field work on control systems and communication systems that are used widely in aircraft and ships, in rower transmission and distribution, in automated manufactories and robotics.

Major developments in this field are the replacement of analogue systems with digital systems and copper cables with fibre optics (optical fibres). Digital systems lower electrical noise. Fibre optics lower interference, has large carrying capacity, and is extremely light and inexpensive to manufacture.

2. Answer the following questions.

1. Is engineering a science?
2. What do civil engineers deal with?
3. What are the main subdivisions in the field of civil engineering?
4. What do mechanical engineers deal with?
5. What knowledge is necessary for a mechanical engineer?
6. What are four main branches of electrical engineering?
7. What are the major developments in the field of computer engineering?

3. Find the following word combinations in the text.

інженер-металург, інженер- будівельник, інтегральна мікросхема, проектування конструкцій, інженер електротехнік.

4. Fill in the blanks

Complete the sentences by filling in the correct engineering branch.

1. __________ deals with the design of large buildings, roads, bridges, and dams.
2. Engineers working in __________ design and operate systems for generating, transmitting, and distributing electric power.
3. __________ is concerned with the design, construction, and management of factories where chemical reactions take place.
4. __________ focuses on creating smaller and faster chips, and the development of three-dimensional integrated circuits.
5. __________ engineers design and build machines, tools, and mechanisms, as well as work with heat and energy systems.

5. Match the engineering branch to its correct description.

1. Civil Engineering
2. Mechanical Engineering

3. Electronic Engineering
4. Computer Engineering
5. Chemical Engineering

a. Engineers in this field work on creating circuits and devices for transmitting and processing information.

b. This field is focused on the design, construction, and operation of machines and mechanical systems.

c. Engineers in this branch design and manage chemical plants where chemical reactions are essential to production.

d. Engineers working in this field design and construct buildings, roads, bridges, and other large-scale structures.

e. This rapidly growing field involves the design and manufacture of computers, processors, and related devices.

6. Read the statements and determine whether they are true or false based on the information in the text.

1. A civil engineer must only have knowledge of building materials, not hydraulics or soils.
2. The development of microminiaturization in computer engineering has led to larger chips and slower processing speeds.
3. Digital systems in communications and control systems help reduce electrical noise.
4. In mechanical engineering, the focus is primarily on designing machines that make products, not the products themselves.
5. Fibre optics in communication systems provide greater interference resistance and are cheaper to manufacture than traditional copper cables.

Unit 2

1. ***Read and translate the text.***

The History of Engineering

Engineering is one of the most ancient occupations in history. Without the skills included in the broad field of engineering, our present-day civilization never could have evolved. The first toolmakers who chipped arrows and spears from the rock were the forerunners of modern mechanical engineers. The craftsmen who discovered metals in the earth and found ways to refine and use them were the ancestors of mining and metallurgical engineers. And the skilled technicians who devised irrigation systems and erected the marvelous buildings of the ancient world were the civil engineers of their time. Engineering is often defined as making practical application of theoretical sciences such as mathematics. Many of the early branches of engineering were based not on science but on empirical information that depended on observation and experience.

The great engineering works of ancient times were constructed and operated largely by means of slave labor. During the Middle Ages people began to seek devices and methods of work that were more efficient and humane. Wind, water and animals were used to provide energy for some on these new devices. This led to the Industrial Revolution that began in the eighteenth century. First steam engines and then other kinds of machines took over more and more of the work that had previously been done by human beings or by animals. James Watt, one of the key figures in the early development of steam engines, devised the concept of horsepower to make his customers understand the amount of work his machines could perform.

Since the nineteenth century both scientific research and practical application of its results have escalated. The mechanical engineer now has the mathematical ability to calculate the mechanical advantage that results from the complex integration of many different mechanisms. He or she also has new and stronger materials to work with and enormous new sources of power. The Industrial revolution began by putting water and steam to work; since then machines using electricity, gasoline, and other energy sources have become so widespread that they now do a very large proportion of the work of the world.

2. *Answer the following questions*

1. How did the first toolmakers contribute to the development of modern engineering?
2. In what way did ancient civil engineers impact the construction of buildings and irrigation systems?
3. What was the role of slave labor in the great engineering works of ancient times?
4. How did the Industrial Revolution change the way work was performed, and who was a key figure in the development of steam engines?
5. What advancements in materials and energy sources have benefited modern mechanical engineers since the nineteenth century?

3.Complete the sentences by filling in the blanks with the correct words from the passage.

1. The first toolmakers who chipped arrows and spears from rock were the forerunners of modern ___________ engineers.
2. The discovery and use of ___________ led to the development of mining and metallurgical engineering.
3. During the Middle Ages, people began to seek devices and methods of work that were more ___________ and humane.
4. The Industrial Revolution began with the use of ___________ engines and then moved to other kinds of machines.
5. James Watt developed the concept of ___________ to help customers understand the amount of work his machines could perform.

4.Read the statements below and determine if they are true or false.

1. The great engineering works of ancient times were primarily built using modern machinery.
2. Early engineering was based on empirical information rather than scientific theory.

3. The Industrial Revolution began in the twentieth century with the rise of electricity and gasoline-powered machines.
4. Steam engines replaced human and animal labor during the Industrial Revolution.
5. The mechanical engineer of today relies on stronger materials and more advanced power sources than engineers of the past.

Unit 3

1. Read and translate the text.

How Matetials React to External Forces

Materials Science and Technology is the study of materials and how they can be fabricated to meet the needs of modern technology. Using the laboratory techniques and knowledge physics, chemistry, and metallurgy, scientists are finding new ways of using metals, plastics and other materials.

Engineers must know how materials respond to external forces, such as tension, compression, torsion, bending, and shear. All materials respond to these forces by elastic deformation. That is, the materials return their original size and form when the external force disappears. The materials may also permanent deformation or they may fracture. The results of external forces are creep and fatigue.

Compression is a pressure causing a decrease in volume. When a material is subjected to a bending, shearing, or torsion (twisting) force, both tensile and compressive forces are simultaneously at work. When a metal bar in bent, one side of it is stretched and subjected to a tensional force, and the other side is compressed.

Tension is a pulling force; for example, the force in a cable holding a weight. Under tension, a matter usually stretches, returning to its original length if the force does not exceed the material’s elastic limit. Under large tensions, the material does not return completely to its original conditions, and under greater forces the material ruptures.

Fatigue is the growth of cracks under stress. It occurs when a mechanical part is subjected to a repeated or cyclic stress, such as vibration. Even when the maximum stress never exceed the elastic limit, failure of the material can occur even after a short time. No deformation is seen during fatigue, but small localized cracks develop and propagate through the material until the remaining cross-sectional area cannot support the maximum stress of the cyclic force. Knowledge of tensile stress, elastic limits, and the resistance of materials to creep and fatigue are of basic importance in engineering.

Creep is a slow, permanent deformation that results from a steady force acting on a material. Materials at high temperatures usually suffer from this deformation. The gradual loosening of bolts and the deformation of components of machines and engines are all the examples of creep. In many cases the slow deformation eliminates the force causing the creep. Creep extended over a long time finally leads to the rupture of the materials.

2. Answer the following questions.

1. What are the external forces that cause the elastic deformation of materials? Describe those forces that change the form and size of materials.
2. What are the results of external forces?
3. What kinds of deformation are the combinations of tension and compression?
4. What is the result of tension? What happens if the elastic limit of material is exceeded under tension?
5. What do we call fatigue? When does it occur? What are the results of fatigue?
6. What do we call creep? When does this type of permanent deformation take place? What are the results of creep?

*3**. Find the following word combinations in the text.***

відповідати вимогам сучасної технології, використовуючи лабораторні методи, нові засоби використовування металів, розвиток і розповсюдження дрібних тріщин, постійна деформація.

4.Choose the correct answer.

1. What happens when a material is subjected to stress within its elastic limit?

   A. It breaks instantly

   B. It deforms permanently

   C. It returns to its original shape

   D. It becomes harder4.

2. What is **fatigue** in materials?

   A. A sudden break due to one-time stress

   B. A deformation caused by high temperature

   C. Growth of cracks due to repeated stress

   D. Compression of materials under load

3. Which force involves pulling a material apart?

   A. Compression

   B. Shear

   C. Tension

   D. Torsion

4. What is **creep** most commonly associated with?

   A. Repeated impact

   B. Sudden vibration

   C. Constant force and high temperature

   D. High-speed motion

5. ***Complete the sentences by filling in the blanks with the correct words from the passage.***

1.Engineers must know how materials respond to external forces such as ______, compression, torsion, bending, and shear.

2.Under repeated or cyclic stress, materials may develop cracks due to a phenomenon known as ______.

3.Creep is more likely to occur at ______ temperatures.

4.When a metal bar is bent, one side experiences ______, while the other side is compressed.

6. ***Read the statements and determine whether they are true or false based on the information in the text.***

1. Torsion is a twisting force.
2. Fatigue only occurs when the material is subjected to stresses beyond its elastic limit.
3. Elastic deformation means the material changes shape permanently.
4. Creep leads to sudden failure without any visible warning.

Unit 4

1. ***Read and translate the text.***

Fibers

Fibers are probably the oldest engineering materials used by man. Jute, flax, and hemp have been used for "engineered" products such as rope, cordage, nets, water hose, and containers since antiquity. Other plant and animal fibers have been used for felts, paper, brushes, and heavy structural cloth.

The fiber industry is clearly divided between natural fibers (from plant, animal, or mineral sources) and synthetic fibers. Many synthetic fibers have been developed specifically to replace natural fibers, because synthetics often behave more predictably and are usually more uniform in size.

For engineering purposes, glass, metallic, and organically derived synthetic fibers are most significant. Nylon, for example, is used for belting, nets, hose, rope, parachutes, webbing, ballistic cloths, and as reinforcement in tyres. Metal fibers are used in high-strength, high-temperature, lightweight composite materials for aerospace applications. Fiber composites improve the strength-to-weight ratio of base materials such as titanium and aluminium. Metal-fiber composites are used in turbine compressor blades, heavy-duty bearings, pressure vessels and spacecraft re-entry shields. Boron, carbon, graphite, and refractory oxide fibers are common materials used in high-strength fiber composites.

Glass fibers are probably the most common of all synthetic engineering fibers. These fibers are the finest of all fibers, typically 1 to 4 microns in diameter. Glass fibers are used for heat, sound, and electrical insulation; filters; reinforcements for thermoplastics and thermoset resins and for rubber (such as in tyres); fabrics; and fiber optics.

2. Match the fiber type with its primary application. Draw a line between the fiber and its correct usage.

Fiber Types:

1. Glass fibers
2. Nylon fibers
3. Metal fibers
4. Boron fibers
5. Flax fibers

Applications:

a. Used in aerospace materials and turbine blades.
b. Common in ropes, parachutes, and webbing.
c. Used for heat, sound, and electrical insulation.
d. Primarily used in paper, brushes, and containers.
e. Common in high-strength fiber composites, used in military and aerospace.

3. Debate Exercise: Natural and Synthetic Fibers

Instructions: Divide into two groups: one will argue the advantages of natural fibers, and the other will argue for synthetic fibers. Consider factors such as sustainability, cost, strength, and application in modern engineering.

Group 1 (Natural Fibers): Discuss the benefits of using natural fibers, such as biodegradability, renewability, and traditional uses.

Group 2 (Synthetic Fibers): Discuss why synthetic fibers are preferred in modern engineering, focusing on their strength, consistency, and wide range of applications in industries like aerospace.

4. Determine whether the following statements about fibers are true or false.

1. Jute and hemp have been used in engineering applications such as ropes and nets since ancient times.
2. Glass fibers are primarily used for their strength-to-weight ratio in aerospace materials.
3. Nylon fibers are commonly used for insulation in electrical wiring.
4. Synthetic fibers like carbon and graphite are used for heat-resistant applications, such as spacecraft re-entry shields.

Unit 5

1. Read and translate the text.

Properties of Materials

Density (specific weight) is the amount of mass in a unit volume. It is measured in kilograms per cubic metre. The density of water is 1000kg/m3 but most materials have higher density and sink in water. Aluminium alloys, with typical densities around 2800 kg/m3 are considerably less dense than steels, which have typical densities around 7800kg/m3. Density is important in any application where the material must not be heavy.

Stiffness (rigidity) is a measure of the resistance to deformations such as stretching or bending. The Young modulus is a measure of the resistance to simple stretching or compression. It is the ratio of the applied force per unit area (stress) to the fractional elastic deformation (strain). Stiffness is important when a rigid structure is to be made.

Strength is the force per unit area (stress) that a material can support without failing. The units are the same as those of stiffness, MN/m2, but in this case the deformation is irreversible. The yield strength is the stress at which a material first deforms plastically. For a metal the yield strength may be less than the fracture strength, which is the stress at which it breaks. Many materials have a higher strength in compression than in tension.

Ductility is the ability of material to deform without breaking. One of the great advantages of metals is their ability to be formed into the shape that is needed, such as car body parts. Materials that are not ductile are brittle. Ductile materials can absorb energy by deformation but brittle materials cannot.

Toughness is the resistance of material to breaking when there is a crack in it. For a material of given toughness, the stress at which it will fail is inversely proportional to the square root of the size of the largest defect present. Toughness is different from strength: the toughest steel, for example, are different from the ones with highest tensile strength. Brittle materials have low toughness: glass can be broken along a chosen line by first scratching it with a diamond. Composites can be designed to have considerable greater toughness than their constituent materials. The example of a very tough composite is fiberglass that is very flexible and strong.

Creep resistance is the resistance of a gradual permanent change of shape, and it becomes especially important at higher temperatures. A successful research has been made in materials for machine parts that operate at high temperatures and under high tensile forces without gradually extending, for example the parts of plane engines.

2. Answer the following questions.

1. What is the density of the materials?
2. What are the units of density? Where low density is needed?
3. A measure of what properties is stiffness? When stiffness is important?
4. What is strength?
5. What is yield strength? Why fracture strength is always greater than yield strength?
6. What is ductility? Give the examples of ductile materials. Give the examples of brittle materials.
7. What is toughness?
8. Where is aluminium mostly used because of its light weight?

3. Find the following word combinations in the text.

кількість маси в одиниці об’єму, тонна на кубічний метр, поступове змінення форми, підвищення температури, жорстка конструкція.

4 .Choose the correct answer for each question.

1. What is the unit of density?
   a) Newtons per meter squared
   b) Kilograms per cubic meter
   c) Meters per second squared
   d) Joules per cubic meter
2. Which of the following materials is most likely to have a higher density than water?
   a) Wood
   b) Aluminum alloys
   c) Styrofoam
   d) Steel
3. What does the Young modulus measure?
   a) The resistance to deformation under force
   b) The resistance to breaking when stressed
   c) The ability to absorb energy before breaking
   d) The mass of a material
4. What is the difference between yield strength and fracture strength?
   a) Yield strength is when a material fractures, while fracture strength is when it deforms.
   b) Yield strength is the point where plastic deformation starts, while fracture strength is when the material breaks.

c) Yield strength is the strength in compression, while fracture strength is in tension.

d) Yield strength is the maximum force before breaking, while fracture strength is the minimum force.

5. Match the terms to their correct descriptions.

1. Density
2. Stiffness
3. Strength
4. Ductility
5. Toughness
6. Creep Resistance

A. Ability of a material to withstand gradual permanent deformation, especially at high temperatures.

B. The ability of a material to resist breaking under stress, especially when there is a crack.

C. The amount of mass in a given volume of a material.

D. The force per unit area that a material can support without failure.

E. The ability of a material to deform without breaking.

F. The resistance to stretching or bending, and is measured by the Young modulus.

6. Determine if the statements below are true or false based on the text provided.

1. Aluminum alloys have a density of around 7800 kg/m^3.
2. Strength and stiffness are the same concept, as both measure a material's ability to resist deformation.
3. Materials with high ductility are more likely to break under stress compared to brittle materials.
4. Fiberglass is an example of a composite material with high toughness.
5. Creep resistance is only important at low temperatures.

Unit 6

1. Read and translate the text.

Composite Materils

The combinations of two or more different materials are called composite materials. They usually have unique mechanical and physical properties because they combine the best properties of different materials. For example, a fibre-glass reinforced plastic combines the high strength of thin glass fibres with the ductility and chemical resistance of plastic. Nowdays composites are being used for structures such as bridges, boat-building etc.

Composite materials usually consist of synthetic fibres within a matrix, a material that surrounds and is tightly bound to the fibres. The most widely used type of composite material is polymer matrix composites (PMCs). PMCs consist of fibres made of ceramic material such as carbon or glass embedded in a plastic matrix. Usually the fibres make up about 60 per cent by volume. Composites with metal matrices are called metal matrix composites (MMCs) and ceramic matrix composites (CMCs), respectively.

Continuous-fibre composites are generally required for structural applications. The specific strength (strength-to-density ratio) and specific stiffness (elastic modulus-to-density ratio) of continuous carbon fibre PMCs, for example, can be better than metal alloys have. Composites also have other attractive properties, such as high thermal or electrical conductivity and a low coefficient of thermal expansion.

Although composite materials have certain advantages over conventional materials, composites also have some disadvantages. For example, PMCs and other composite materials tend to be highly anisotropic – that is, their strength, stiffness, and other engineering properties are different depending on the orientation of the composite material. For example, if a PMC is fabricated so that all the fibres are lined up parallel to ne another, then the PMC will be very stiff in the direction parallel to the fibres, but not stiff in the perpendicular direction. The designer who uses composite materials in structures subjected to multidirectional forces, must take these anisotropic properties into account. Also, forming strong connections between separate composite material components is difficult.

The advanced composites have high manufacturing costs. Fabricating composite materials is a complex process. However, new manufacturing techniques are developed. It will become possible to produce composite materials at higher volumes and at a low cost than is now possible, accelerating the wider exploitation of these materials.

2. Answer the following questions.

1. What is called “composite materials”?
2. What are the best properties of fiberglass?
3. What do composite materials usually consist of?
4. What is used as matrix in composites?
5. What is used as filler or fibers in composites?
6. How are composite materials with ceramic and metal matrices called?
7. What are advantages and disadvantages of composites?

3. Find the following words and word combinations in the text.

композитні матеріали, полімерні матричні композити, складати 60% об’єму, розширення, специфічна жорсткість.

4. Match each item on the left with its correct description on the right.

Term	**Description**
A. PMC	1. Ceramic fibres in ceramic matrix
B. MMC	2. Plastic matrix with glass/carbon fibres
C. CMC	3. Metal matrix composite

Term	Description
D. Matrix	4. Surrounds and binds the fibres
E. Anisotropic	5. Different properties depending on direction

5. Choose the correct answer for each question.

1. What is a composite material?

A. A pure metal

B. A material made from one element

C. A combination of two or more different materials

D. A type of chemical compound

2. What type of fibres are often used in PMCs?

A. Wooden fibres

B. Glass or carbon fibres

C. Plastic fibres only

D. Wool fibres

3. What is the main disadvantage of composite materials like PMCs?

A. They are too heavy

B. They corrode quickly

C. They are isotropic

D. They are anisotropic

4. In composite materials, what is the matrix?

A. The outer coating

B. The core of the composite

C. The material that surrounds and binds the fibres

D. The leftover material

5. Which of the following is a metal matrix composite?

A. PMC

B. CMC

C. MMC

D. PVC

6. ***Read the statements and determine whether they are true or false based on the information in the text.***

1. Composite materials are always cheaper to produce than traditional materials.
2. Anisotropic materials have properties that vary with direction.
3. Continuous carbon fibre PMCs can have better specific strength than metals.
4. Composite materials are rarely used in construction.
5. Designers must consider fibre orientation when using composites in structures.

Unit 7

1. Read and translate the text.

Metals

Metals are materials most widely used in industry because their properties. The study of the production and properties of metals is known as metallurgy.

The separation between the atoms in metals is small, so most metals are dense. The atoms are arranged regularly and can slide over each other. That is why metals are malleable (can be deformed and bent without fracture0 and ductile (can be drawn into wire). Metals vary greatly in the properties. For a example, lead is soft and can be bent by hand, while iron can only be worked by hammering at red heat.

The regular arrangement of atoms in metals gives them a crystalline structure. Irregular crystals are called grains. The properties of the metals depend on the size, shape, orientation, and composition of these grains. In general, a metal with small grains will be harder and stronger than one with coarse grains.

Heat treatment controls the nature of the grains and their size in the metal. Small amounts of the other metals (less than one per cent) are often added to a pure metal. This is called alloying and it changes the grain structure and properties of metals.

All metals can be formed by drawing, rolling, hammering and extrusion, but some require hot-working. Metals are subjects to metal fatigue and to creep (the slow increase in length under stress) causing deformation and failure. Both effects are taken into account by engineers when designing, for example, airplanes, gas-turbines, and pressure vessels for high temperature chemical processes. Metals can be worked using machine-tools.

The ways of working a metal depend on its properties. Many metals can be melted and cast in moulds, but special conditions are required for metals that react with air.

The most important metal in industry is iron and its alloy – steel. Steel is an alloy of iron and carbon. It is strong but corrodes easily through rusting, although stainless and other special steels resist corrosion. The amount of carbon in steel influences its properties considerably. Steels of low carbon content (mild steels) are quite ductile and are used in the manufacture of sheet iron, wire and pipes. Medium-carbon steels containing from 0.2 to 0.4 per cent carbon are tougher and stronger and are used as structural steels. Both mild and medium-carbon steels are suitable for forging and welding.

The inclusion of other elements affects the properties of the steel. Manganese gives extra strength and toughness. Steel containing 4 per cent silicon is used for transformer cores or electromagnets because it has large grains acting like small magnets. The addition of chromium gives extra strength and corrosion resistance, so we can get rust-proof steels. Heating in the presence of carbon or nitrogen-rich materials is used to form a hard surface on steel (case-hardening). High-speed steels, which are extremely important in machine-tools, contain chromium and tungsten plus smaller amounts of vanadium, molybdenum and other metals.

2. Answer the following questions.

1. What are metals and we called metallurgy?
2. Why are most metals dense?
3. What is malleability?
4. What are grains?

5. What are the properties of metals depend on?
6. What are the main processes of metal forming?
7. What is creeping?
8. What are the main properties of steel?
9. How can we get rust-proof (stainless) steel?

3. Find the following words and word combinations in the text.

відстань між атомами, кристалічна структура, способи обробки металів, гаряча обробка, металургія.

Unit 8

1. Read and translate the text.

Methods of Steel Heat Treatment and Hot Working of Steel

Quenching is a heat treatment when metal at a high temperature is rapidly cooled by immersion in water or oil. Quenching is a heat treatment applied to steel and certain alloys. Hardened steel after quenching from a high temperature is too hard and brittle for many applications and is also brittle. Tempering, that is re-heating to an intermediate temperature and cooling slowly, reduces this hardness and brittleness. Tempering temperatures depend on the composition of the steel but are frequently between 100 and 650 C. Higher temperatures usually give a softer, tougher product. The colour of the oxide film produced on the surface of the heated metal often serves as the indicator of its temperature.

Annealing is a heat treatment in which a material at high temperature is cooled slowly. After cooling the metal again becomes malleable and ductile (capable of being bent many times without cracking).

All these methods of steel heat treatment are used to obtain steels with certain mechanical properties for certain needs.

An important feature of hot working is that it provides the improvement of mechanical properties of metals. Hot-working (hot-rolling or hot-forging) eliminates porosity, directionality, and segregation that are usually present in metals. Hot-worked products have better ductility and toughness than the unworked casting. During the forging of a bar, the grains of the metal become greatly elongated in the direction of flow. As a result, the toughness of the metal is greatly improved in this direction and weakened in directions transverse to the flow. Good forging makes the flow lines in the finished part oriented so as to lie in the direction of maximum stress when the part is places in service.

The ability of metal to resist thinning and fracture during cold-working operations plays an important role in alloy selection. In operations that involve stretching, the best alloys are those which grow stronger with strain (are strain hardening) – for example, the copper-zinc alloy, brass, used for cartridges and the aluminum-magnesium alloys in beverage cans, which exhibit greater strain hardening.

Fracture of the workpiece during forming can result from inner flaws in the metal. These flaws often consist of nonmetallic inclusions such as oxides or sulfides that are trapped in the metal during refining. Such inclusions can be avoided by proper manufacturing procedures.

The ability of different metals to undergo strain varies. The change of the shape after one forming operation is often limited by the tensile ductility of the metal. Metals such as copper and aluminum are more ductile in such operations than other metals.

2. Answer the following questions.

1. What can be done to obtain harder steel?
2. What makes steel more soft and tough?
3. What can serve as the indicator of metal temperature while heating it?
4. What are the methods of steel heat treatment used for?
5. What process improves the mechanical properties of metals?
6. How does the forging of a bar affect the grains of the metal? What is the result of this?

7. How are the flow lines in the forged metal oriented and how does it affect the strength of the forged part?
8. What are the best strain-hardening alloys? Where can we use them?

3. Find the following words and word combinations in the text.

температура нормалізації, швидке охолодження, індикатор температури, важлива особливість гарячої обробки, напрямок максимальної напруги.

Unit 9

1. Read and translate the text.

The History of Bridge Building

An outstanding statesman once said in his speech: "There can be little doubt that in many ways the story of bridge-building is the story of civilization. By it we can readily measure an important pat of a people's progress." Great rivers are important means of communication, for in many parts in the world they have been, and steel are, the chief roads. But they are also barriers to communication, and people have always been concerned with finding ways to cross them.

For hundreds of years men have built bridges over fast-flowing rivers or deep and rocky canyons. Early man probably got the idea of a bridge from a tree fallen across a stream. From this, at a later stage, on a very simple bracket or cantilever principle was evolved. Timber beams were embedded into the banks on each side of the river with their ends extending over the water. These made simple supports for a central beam reaching across from one bracket to the other. Bridges of this type are still used in Japan, and in India. A simple bridge on the suspension principle was made by early man by means of ropes, and is still used in countries such as Tibet. Two parallel ropes suspended from rocks or trees on each bank of the river, with a platform of woven mats laid across them, made a secure crossing. Further ropes as handrails were added. When the Spaniards reached South America, They found that the Incas of Peru used suspension bridges made of six strong cables, four of which supported a platform and two serves as rails.

All these bridges made possible crossing only over narrow rivers. The type of temporary floating bridge, the pontoon bridge, has been used for military purposes; military engineers can constructed a temporary bridge on this principle, able to carry all the heavy equipment of a modern army, in an extremely short time.

The idea of driven wooden piles into the bed of the river in order to support a platform was put into practice 3,500 years ago. This is the basis of the "trestle" or pile bridge which makes it possible to build a wider crossing easier for the transport of animals and goods.

With the coming of railway in the 19^{th} century there was a great demand for a bridges, and the railways had capital for building them. The first railway bridges were built of stone or brick. In many places long lines of viaduct were built to carry railways; for instance, there are miles of brick viaduct supporting railways in London.

The next important development in bridge-building was the use of iron and, later, of steel. The first iron bridge crossed the river Severn in Great Britain.

The idea of a drawbridge, a bridge hinged so that it can be lifted by chains from inside to prevent passage, is an old one. Some St. Petersburg bridges were built on this principle.

A modern bridge probably demands greater skill from designer and builder than any other engineering project. Many things should be taken into consideration, and these may vary widely according to local conditions. In deciding what type of bridge is most suitable the designer has to consider the type of weight of the traffic, and width and depth of the gap to be bridged, the nature of the foundations and the methods of erecting the bridge. The designer has to calculate carefully how the various loads would be distributed and to decide which building materials are more suitable for carrying these loads.

2. Answer the following questions.

1. Where did early man get the idea of a bridge?

2. What kind of bridges do you know?
3. What is cantilever bridge?
4. How can you describe the suspension principle of bridge building?
5. What does a modern bridge demand from designer and builder?

3. Complete the statements choosing to the contents of the text.

1. For hundreds of years men have built bridges:
   a. over the deep lakes;
   b. over the canals;
   c. over the fast-flowing rivers.
2. A cantilever principle bridge consisted of:
   a. the ropes;
   b. the stones;
   c. the timber beams.
3. The second name of the floating bridge is:
   a. the pontoon bridge;
   b. the pile bridge;
   c. the bridge of the suspension principle.
4. The first iron bridge crossed:
   a. the river Danube;
   b. the river Severn;
   c. the river Neva.
5. A modern bridge probably demands greater skill:
   a. from the engineer;
   b. from the researcher;
   c. from the builder.

Unit 10

1. ***Read and translate the text.***

Metal Working

Metals are important in industry because they can be easily deformed into useful shapes. A lot of metalworking processes have been developed for certain applications. They can be divided into five broad groups:

1. rolling,
2. extrusion,
3. drawing,
4. forging,
5. sheet-metal forming.

During the first four processes metal is subjected to large amount of strain (deformation). But if deformation goes at a high temperature, the metal will recrystallize – that is, new strain-free grains will grow instead of deformed grains. For this reason metals are usually rolled, extruded, drawn, or forged above their recrystallization temperature. This is called hot working. Under these conditions there is no limit to the compressive plastic strain to which the metal can be subjected.

Other processes are performed below the recrystallization temperature. These are called cold working. Cold working hardens metal and makes the parts stronger. However, there is a limit to the strain before a cold part cracks.

Rolling

Rolling is the most common metalworking process. More than 90 percent of the aluminum, steel and copper produced are rolled at least once of the course of production. The most common rolled product is sheet. Rolling can be done either hot or cold. If the rolling is finished cold, the surface will be smoother and the product stronger.

Extrusion

Extrusion is pushing the billet to flow through the orifice of a die. Products may have either a simple or a complex cross section. Aluminium window frames are the examples of complex extrusions.

Tubes or other hollow parts can also be extruded. The initial piece is a thick-walled tube, and the extruded part is shaped between a die on the outside of the tube and a mandrel held on the inside.

In back-extrusion the workpiece is placed in the bottom of a hole and a loosely fitting ram is pushed against it. The ram forces the metal to flow back around it, with the gap between the ram and the die determining the wall thickness. The example of this process is the manufacturing of aluminium beer cans.

2. Answer the following questions.

2. Why are metals so important in industry?
3. What are the main metalworking processes?
4. Why are metals worked mostly hot?
5. What properties does cold working give to metals?
6. What is rolling? Where is it used?
7. What is extrusion? What shapes can be obtained after extrusion?
8. What are the types of extrusion?

3. Find the following words and word combinations in the text.

можуть легко деформуватися, потрібні форми, температура перекристаллізації, звичайний процес обробки металів, зерна вільні від деформацфї.

Unit 11

1. Read and translate the text.

The triumph of Human Spirit

The Brooklyn Bridge was built in the year 1883. It is still one of the most popular places of interest in New York.

The plan for the Brooklyn Bridge was made by a man named John Roebling. This was in the year 1867.

Roebling was a German. He emigrated to the United States when he was twenty-five. In 1867 Roebiling was already quite famous. Years before he had invented the steel cable. Using this steel cable he built several bridges, one at Niagara Falls and a second across the Monogahela River at Pittsburgh. He was sure he could build this new bridge.

It was decided to give Roebling a chance. A company was organized. Roebling was head engineer. He began to work making the plans for the bridge. He sent his son Washington to Europe to study some new bridges ther.Some experiments had been made with working in a large box under water.

And then the accident happened. Roebling was working near the river. A boat struck the dock on which he was standing. Two weeks later he died. Before he died he asked that his son Washington should continue his work.

W. Roebling began to work with the same interest and energy as his father. The bridge was begun. There were many problems. According to the plans, there were to be two large towers. One of these towers was to be on the Brooklyn side of the rivewr and the other was to be on the Manhattan side. From the tower hung a system of steel cables. These steel cable were to hold the bridge.

Today engineers know how to do these things. They have had experience. They have special machines. But at that time no one knew exactly how to do this work. The Brooklyn Bridge was the first bridge of its kind in the world. They used the new box that Washington Roebling had studied in Europe. The box was made of wood and was about the size of a house. In this box men could work under water. Air was forced into the box and the water was forced out of it. It was very dangerous. No one understood the problems of this kind of work. Men became sick. There were many accidents. Roebling himself worked with the men in the box. He tried to encourage the men.

One day a worker went down into the box. He felt perfectly well. Within half an hour he began to feel strong pains. Five minutes later he was dead. The same thing happened to other man. One day Roebling himself had a similar attack. He could not talk. He could not hear. He became paralyzed. After a week or two he felt better. He went back again to work in the box. He had a second attack, more serious than the first. He could not work again. In fact he was unable to work again during the rest of his life. He remained a cripple. Yet the work had to continue. And Washington Roebling continued to direct the construction of the bridge. His home was near the bridge. He used the telescope. He watched the work every day. His wife helped him. Each day she went to the bridge. She carried her husband’s orders to the men. At night she returned to her husband. She told him about the work of the day. In this way, year after year, work continued.

In 1876 the first cable was placed from one tower to the other. In 1883 about fifteen years after it was first begun, the bridge was officially opened. Many important people, including the President of the US, took part in the ceremony. Washington Roebling watched the ceremony through his telescope.

The bridge was one of the wonders of the 19^{th} century. It is still today. There is more traffic on it today than ever before. The bridge remains very strong. It also remains the monument to the two men who built it, John Roebling and his son Washington.

2. Answer the following questions.

1. How did John Roebling make his experiments?
2. How did steel cables use?
3. What did people use during the construction of the bridge?

4. When did W. Roebling become a cripple?
5. How did W. Roebling watch the ceremony?

3. Complete the statements choosing the variant corresponding to the contents of the text.

1. When John Roebling came to the United States:
   a. nobody knew him;
   b. he was known for his invention of the steel cable;
   c. only his friends knew him.
2. Washington Roebling:
   a. was only making the plans for the bridge;
   b. was making experiments;
   c. began building the bridge.
3. During the construction of the bridge the people used the box:
   a. which was constructed by John Roebling;
   b. which was used in Europe;
   c. which was invented by Washington Roebling.
4. Washington Roebling became a cripple after:
   a. he had fallen down by bridge;
   b. he had an accident during the construction of the bridge at Niagara Falls;
   c. he had worked in the box.
5. Washington Roebling:
   a. did not live to see the ceremony of the opening the bridge;
   b. could see the ceremony;
   c. was present at the ceremony.

Unit 12

1. Read and translate the text.

Technological Progress

Drawing consists of pulling metal through a die. An example of drawing is wire drawing. The diameter reduction that can be achieved in one die is limited, but several dies in series can be used to get the desired reduction.

Sheet metal forming is widely used when parts of certain shape and size are needed. It includes forging, bending and shearing. One characteristic of sheet metal forming is that the thickness of the sheet changes little in processing. The metal is stretched just beyond its yield point (2 to 4 percent strain) in order to retain the new shape. Bending can be done by pressing between two dies. Shearing is a cutting operation similar to that used for cloth.

Each of these processes may be used along, but often all three are used on one part. For example, to make the roof on the automobile from a flat sheet, the edges are gripped and the piece pulled in tension over a lower die. Next an upper die is pressed over the top, finishing the forming operation, and finally the edges are shearing off to give the final dimensions.

Forging is a shaping of a piece of metal by pushing with open or closed dies. It is usually done hot in order to reduce the required force and increase the metal’s plasticity.

Open die forging is usually done by hammering a part between two flat faces. It is used to make parts that are too big to be formed in a closed die or in cases where only a few parts are to be made. The earliest forging machines lifted a large hammer that was then dropped on the workpiece, but now air or steam hammers are used, since they allow greater control over force and the rate of forming. The part is shaped by moving or turning it between blows.

Closed-die forging is the shaping of hot metal within the walls of two dies that come together to enclose the workpiece on all sides. The process starts with the rod or bar cut to the length needed to fill the die. Since large, complex shapes and large strains are involved, several dies may be used to go from the initial bar to the final shape. With closed dies, parts can be made to close tolerances so that little finish machining is required.

Two closed-die forging operations are given special names. They are upsetting and coining. Coining takes its name from the final stage of forming metal coins, where the desired imprint is formed on a metal disk that is pressed in a closed die. Coining involves small strains and is dine cold. Upsetting involves a flow of the metal back upon itself. An example of this process is the pushing of a shot length of a rod through a hole, clamping the rod, and then hitting the exposed length with a die to form the head of a nail or bolt.

2. Answer the following questions.

1. How can the reduction of diameter in wire drawing be achieved?
2. What is sheet metal forming and where it can be used?
3. What is close-die forging?
4. What are the types of forging?
5. What types of hammers are used now?
6. Where are coining and upsetting used?
7. What process is used in wire production?
8. Describe the process of making the roof of a car.

3. Find the following word combinations in the text.

зменшення діаметру, зменшити необхідне зусилля, збільшити пластичність металу, повітряні або парові молоти, сила та швидкість штампування.

Unit 13

1. Read and translate the text.

Types of Welding

Welding is a fabrication process that joins two or more materials, typically metals or thermoplastics, by using high heat to melt the parts together and then allowing them to cool, creating a strong bond. Welding is a critical process in construction, manufacturing, and repairs, used extensively in industries such as automotive, aerospace, shipbuilding, and infrastructure development. There are several types of welding processes: arc welding uses an electric arc to create heat, melting the metal at the joint. Examples include: MIG (Metal Inert Gas) Welding: Ideal for thicker materials and high-speed welding, TIG (Tungsten Inert Gas) Welding: Offers precision and is suitable for thin materials, Stick Welding: A versatile and simple method often used in construction and repair work.

1. Gas Welding: Employs a flame produced by burning a gas like acetylene with oxygen, commonly used for smaller projects or delicate work.
2. Resistance Welding: Joins materials by applying pressure and passing an electrical current through them.
3. Laser and Plasma Welding: High-energy processes used for precision work in advanced industries like electronics and aerospace.
4. Friction Welding: Generates heat through mechanical friction to join materials, often used for joining dissimilar metals.

Safety in welding involves risks such as high temperatures, intense light, and hazardous fumes. Proper safety measures include: wearing protective gear (e.g., welding helmets, gloves, and flame-resistant clothing), ensuring adequate ventilation or using fume extractors, adhering to workplace safety regulations and standards. Welding is applied in construction. It creates and repairs structures like bridges and buildings. It is also used in manufacturing, in producing vehicles, machinery, and consumer goods. With the help of welding repairs are performed such as fixing equipment, pipelines, and structures. It continues to evolve with advancements in automation, robotics, and material science, playing a vital role in modern engineering and technologyHeat welding is the most common welding process used today.

Nowadays welding is used instead of bolting and riveting in the construction of many types of structures, including bridges, building, and ships. It is also a basic process in the manufacture of machinery and in the motor

and aircraft industries. It is necessary almost in all productions where metals are used.

The welding process depends greatly on the properties of the metals, the purpose of their application and the available equipment. Welding processes are classified according to the sources of heat and pressure used: gas welding, ark welding, and resistance welding. Other joining processes are laser welding, and electron-beam welding.

Gas Welding

Gas welding is a non-pressure process using heat from a gas flame. The flame is applied directly to the metal edges to be joined and simultaneously to a filler metal in the form of wire or rod, which is melted to the joint. Gas welding has the advantage of using equipment that is portable and does not require an electric power source. The surfaces to be welded and the welding rod are coated with flux, a fusible material that shields the material from air, which would result in a defective weld.

Arc Welding

Ark-welding is the most important welding process for joining steels. It requires a continuous supply of either direct or alternative electrical current. This current is used to create an electrical arc, which generates enough heat to melt metal and create a weld.

Ark welding has several advantages over ether welding methods. Ark welding is faster because the concentration of heat is high. Also, fluxes are not necessary in certain methods of ark welding. The most widely used arc-welding processes are shielded metal ark, gas-tungsten arc, gas-metal arc, and submerged arc.

Resistance Welding

In resistance welding, heat is obtained from the resistance of metal to the flow of an electric current. Electrodes are clamped on each side of the parts to be welded, the parts are subjected to great pressure, and a heavy current is applied for the short period of time. The point where the two metals touch creates resistance to the flow of current. This resistance causes heat, which melts the metals and creates the weld. Resistance welding is widely employed in many fields of sheet metal or wire manufacturing and is often used for welds made by automatic or semi-automatic machines especially in automobile industry.

2. Answer the following questions.

1. How can a process of welding be defined?
2. What are the two main groups of processes of welding?
3. How can we join metal parts together?
4. What is welding used for nowadays?
5. Where is welding necessary?
6. What do the welding processes of today include?
7. What are the principles of gas welding?
8. What kinds of welding can be used for joining steels?
9. What does arc welding require?

3. Find the following word combinations in the text.

зварка тиском, теплова зварка, болтове з’єднання, зварочний електрод, безперервна подача електричного струму.

4 .Complete the sentences by filling in the blanks with the correct terms related to welding.

1. ___________ welding uses an electric arc to create heat, melting the metal at the joint.

2. ___________ welding is commonly used for smaller projects or delicate work, employing a flame produced by burning a gas like acetylene with oxygen.
3. ___________ welding generates heat through mechanical friction to join materials, often used for joining dissimilar metals.
4. ___________ welding is used for high-speed welding and is ideal for thicker materials.
5. In ___________ welding, pressure is applied while an electrical current passes through the materials to join them, commonly used in spot welding.

5 . Choose the correct answer for each question.

1. Which welding method is ideal for thin materials and offers precision?

   a) MIG Welding

   b) Stick Welding

   c) TIG Welding

   d) Gas Welding

2. What safety equipment is necessary when performing welding?

   a) Safety goggles

   b) Welding helmet

   c) Hard hat

   d) Safety boots

3. Which welding method uses a high-energy laser or plasma to create precise welds in advanced industries like electronics and aerospace?

   a) Gas Welding

b) Friction Welding

c) Laser and Plasma Welding

d) Arc Welding

4. Which welding technique joins materials by passing an electrical current through them and applying pressure?
   - a) Stick Welding
   - b) Resistance Welding
   - c) TIG Welding
   - d) MIG Welding

6. Match the Welding Process with its Description

Match each welding process to its correct description.

1. MIG Welding
2. Stick Welding
3. Gas Welding
4. Laser and Plasma Welding

a) Uses a flame produced by burning a gas like acetylene with oxygen, commonly for smaller projects.
b) Uses an electric arc to create heat, often for thicker materials.
c) High-energy process that uses laser or plasma to join materials in precision applications.
d) A simple and versatile method often used for construction and repair work.

7. Read and entitle the text.

Experts estimate that in the 21st century we will go by rocket from New York to Tokyo in 30 minutes. We will be able to reach any point on the globe from any other point through tunnels deep in the earth. The prospect is adventurous and exciting.

It's possible, that within the next two or three decades we will be riding in remote-controlled electronic cars.

Trips through metropolitan areas will be made on quit, swift buses traveling on separate express lines of city streets. Helicopters may carry whole buses loaded with passengers from point to point above city traffic. "Flying crane" helicopters soon may help solve the complicated problem of getting passengers from the center to the airport and back again.

Most of the advances in air transportation will materialize within the next few years. The largest airplane ever designed for commercial service, capable of seating nearly 500 passengers, is already being built.

Supersonic transport prototypes now in development are forerunners of a new generation of 1,800 miles per hour passenger jet-liners.

The "ideal" short-haul air transport is a vertical or short take-off and landing aircraft that can fly 30 to 45 passengers right into the heart of a city or its suburbs trips up to 260 miles.

Mankind has entered an age of high speeds, pressures, and temperatures which could be generated and withstood only with the help of new and hitherto unknown materials.

In the 1920s the top speed of an airplane was not more than 200 kilometres per hour, the load per square metre of the wing area was about 50 kilograms. The main construction material was wood. In our day, the speed of aircraft, even passenger planes, is approaching 3,000 kilometres per hour, loads may be as high as 600 kilograms per square metre of wing. The turbine that drives such as aircraft is not miracle of designer, it is also a miracle of materials strength. Its blades, for example, rotate at a tremendous speed and at the temperature greater than 1,000 Centigrade. The given examples are sufficient to indicate the complexity of materials studies today and the extent to which progress in the near or more distant future depends on them.

Of tremendous importance is the creation of new materials. Chemists engaged in polymer research have produced the world's best synthetic materials.

Metallurgists studying a new class of aluminium alloys have produced a very durable alloy which is being used in aircraft and rocking engineering. The alloy helps reduce the weight of apparatus substantially thereby effecting a considerable saving of materials.

Plastics are employed in a number of aircraft engine applications and have successfully displaced metals in yet turbine impellers where the high fatigue resistance of the material is of great importance. If suitable higher temperature plastics were developed, it is quite feasible that turbines will one day be all of plastic construction.

At present a great deal of research and development is being carried out to produce special grades of plastics for space vehicles.

For space travel, resistance to cosmic radiation is an important consideration. Many plastic materials possess this property, and also offer the advantage of light weight. Astronaut couches, space capsules, missile fuel cases are manufactured of plastic materials.

Some ideas of rapid air transportation are on the drawing boards, some may never get off. Some are already under way and operational, while others may not take shape until the next decade. But changes are taking place, and there are more to come.

Unit 14

1. Read and translate the text.

Milling Machine

In a milling machine the cutter is a circular device with a series of cutting edges on its circumference. The workpiece is mounted (fastened) on a table that controls the feed against the cutter. The table has three possible movements:

longitudinal, horizontal and vertical; in some cases can is also rotate. Milling machines are the most versatile of all machine tools. Flat or contoured surfaces may be machined with excellent finish and accuracy. Angles, slots, gear teeth and cuts can be made by using various shapes of cutters.

Drilling and Boring Machines

To drill a hole usually hole-making machine-tools are used. They can drill a hole according to some specification, they can enlarge it, or they can cut threads for a screw or to create a smooth hole.

Drilling machines are different in size and function, from portable drills to radial drilling machines, multispindle units, automatic production machines, and deep-hole-drilling machines.

Boring is a process that enlarges holes previously drilled, usually with the rotating single-point cutter held on a boring bar and fad against a stationary workpiece.

Shapers and Planers

The shaper is used mainly to produce different flat surfaces. The tool slides against the stationary workpiece and cuts on one stroke, returns to its starting position, and then cuts on the next stroke after a slight lateral displacement. In general, the shaper can make any surface having straight-line elements. It uses only one cutting-tool and is relatively slow, because the return stroke is idle. That is why the shaper is seldom found on a mass production line. It is , however, valuable for tool production and for workshops where flexibility is important and relative slowness is unimportant.

The planer is the largest of the reciprocating machine tools. It differs from the shaper, which moves a tool past a fixed workpiece because the planer moves the workpiece to expose a new section to the tool. Like the shaper, the planer is intended to produce vertical, horizontal, and diagonal cuts. It is also possible to mount several tools at one time in any or all tool holders of a planer to execute multiple simultaneous cuts.

Grinders

Grinders remove metal by a rotating abrasive wheel. The wheel is composed of many small grains of abrasive, bonded together, with each grain acting as a miniature cutting tool. The process gives very smooth and accurate finishes. Only a small amount of material is removed at each pass of the wheel, so grinding machines require fine wheel regulation. The pressure of the wheel against the workpiece is usually very light, so that grinding can be carried out of fragile materials that cannot be machined by other conventional devices.

2. Answer the following questions.

1. What is the shape of cutter in a milling machines?
2. What moves in milling machine, a table or a cutter?
3. What possible movements has the table of milling machine?
4. What kind of surfaces and shapes may be machined by a milling machine?
5. What can we use a drilling machine for?
6. What kinds of drilling machines exist?
7. What is rotated while boring, a cutter or a workpiece?
8. Describe the work of shaper (planer).
9. What must be done to execute multiple simultaneous cuts on a planer?
10. Can we obtain a very smooth surface after grinding and why?
11. Can we grind fragile materials and why?

3. Find the following word combinations in the text.

фрезерний верстат, токарний верстат, рух інструменту, шліфувальний верстат, абразивне коло.

4. Read and entitle the article.

One of the earliest attempts to propel a vehicle by mechanical power was suggested by Isaac Newton. But the first self-propelled vehicle was constructed by the French military engineer Cugnot in 1763. He built a steam-driven engine which had three wheels, carried two passengers and ran at maximum speed of four miles. The carriage was a great achievement but it was far from perfect and extremely inefficient. The supply of steam lasted only 15 minutes and the carriage had to stop every 100 yards to make more steam.

In 1825 a steam engine was built in Great Britain. The vehicle carried 18 passengers and covered 8 miles in 45 minutes. However, the progress of motor cars met with great opposition in Great Britain. Further development of motor car lagged because of the restrictions resulting from legislative acts. The most famous of these acts was the Red Flag Act of 1865, according to which the speed of the steam-driven vehicle was limited to 4 miles per hour and a man with a red flag had to walk in front of it.

Motoring really started in the country after the abolition of this act.

In Russia there were cities where motor cars were outlawed altogether. When the editor of local newspaper in the city of Uralsk bought a car, the governor issued these instructions to the police: “When the vehicle appears in the streets, it is to be stopped and escorted to the police station, where its driver is to be prosecuted.”

From 1860 to 1900 was a period of the application of gasoline engines to motor cars in many countries. The first to perfect gasoline engine was N. Otto who introduced the four-stroke cycle of operation. By that tome motor cars got a standard shape and appearance.

In 1896 a procession of motor cars took place from London to Brighton to show how reliable the new vehicle were. In fact, many of the cars broke, for the transmissions were still unreliable and constantly gave trouble.

The cars of that time were very small, two-seated cars with no roof, driven by an engine placed under the seat. Motorists had to carry large cans of fuel and separate spare tyres, for their were no repair or filling stations to serve them.

After World War 1 it became possible to achieve greater reliability of motor cars, brakes became more efficient. Constant efforts were made to standardize common components. Multi-cylinder engines came into use, most commonly used are four-cylinder engines.

Like most other great human achievements, the motor car is not a product of any single inventor. Gradually the development of vehicles driven by internal combustion engine – cars, as they had come to be known, led to the abolition of earlier restrictions. Huge capital began to flow into the automobile industry.

From 1908 to 1924 the number of cars in the world rose from 200 thousand to 20 million; by 1960 it had reached 60 million! No other industry had ever developed at such a rate.

There are about 3,000 Americans who like to collect antique cars. They have several clubs such as Antique Automobile Club and Veteran Motor Car Club, which specialize in rare models. The clubs practise meetings where members can exhibit their cars. Collectors can also advertise in the magazines published by their clubs. Some magazines specialize in single type of car such as glorious Model "T". A number of museums have exhibitions of antique automobile models whose glory rings in automobile history. But practically the best collection – 100 old cars of great rarity – is in possession of William Harrah. He is very influential in his field. The value of his collection is not only historical but also practical: photographs of his cars are used fort films and advertisements.

5. Complete the statements choosing the variant corresponding to the contents of the text.

1. Helicopters may carry:
   a. whole buses loaded with passengers;
   b. whole trains loaded with metals;
   c. whole ships loaded with heavy goods.
2. The largest airplane ever designed for commercial service, capable of seating nearly 500 passengers:
   a. isn't being built;
   b. is building now;
   c. is already being built.

3. In the 1920s the main construction material was:

   a. steel;
   b. iron;
   c. wood.

4. Of tremendous importance is:

   a. the development of new branches in the technology;
   b. the creation of new materials;
   c. the contribution in science.

5. At present a great deal of research and development is being carried out:

   f. to produce special grades of plastic for space vehicles;
   g. to produce space capsules;
   h. to produce powerful turbines.

Unit 15

1. Read and translate the text.

Challenges of Welding in Space

Welding in space is a fascinating and complex process that plays a crucial role in the construction and maintenance of spacecraft and space stations. In the vacuum of space, traditional welding techniques used on Earth don't work the same way due to the absence of atmosphere, gravity, and the unique environmental conditions. However, research and development have made it possible to perform welding tasks in space with modified techniques. Welding in space refers to the welding and joining of materials in the space environment. This technique has been primarily utilized in the maintenance and repair of orbiting spacecrafts, construction of space workstations, and welding fabrication for building permanent experimental bases on other planets. In 1964, the E.O. Paton Electric Welding Institute (PWI) in Ukraine began to put forward a space welding plan. From 1965 to 1990, extensive research had been carried out, and a multifunction electron beam welding device for space welding was developed, which was later carried into space many times for space welding experiments and extravehicular space welding experiments conducted by astronauts. Since the beginning of the twenty-first century, with the development of deep-space exploration and space exploitation, the United States, Japan, Europe, and China have successively carried out research on ground-based simulation of space welding.

On Earth, gravity helps molten metal to flow and form a stable weld pool. In space, there is no gravity to control the molten material, making it difficult to control the welding process. The molten metal can float away, leading to poor welds or contamination.

In space, there is no atmospheric pressure or oxygen, which could make certain welding processes, like oxy-acetylene welding, impossible. However, other techniques, such as Tungsten Inert Gas welding, which uses an inert gas like argon to protect the weld from contamination, work well in space.

Space experiences extreme temperatures, with heat varying drastically from the extreme cold of the vacuum to intense sunlight. These temperature fluctuations pose challenges in controlling the heat during welding processes.

Space is filled with high levels of cosmic radiation and solar radiation, which can affect both the welding materials and the process itself. Protective measures are necessary to shield equipment and welds from radiation.

2. Decide whether the folowing sentences are true or false.

a. In space, gravity helps molten metal to flow and form a stable weld pool.

b. Oxy-acetylene welding is the most common technique used for welding in space due to the lack of atmospheric pressure.

c. Extreme temperature fluctuations in space, from extreme cold to intense sunlight, can affect the stability and quality of a weld.

d. Cosmic and solar radiation in space have no significant effect on welding processes or materials.

e. The United States, Japan, and China have never conducted any research on space welding techniques.

3. Find a suitable variant to the following questions.

1. What is the primary challenge of welding in space due to the absence of gravity**?**

a) Lack of atmospheric pressure

b) Inability to form a stable weld pool

c) Exposure to extreme temperatures

d) Limited access to welding tools

2. Which welding technique is most commonly used in space due to its ability to use inert gas for protection?

a) Oxy-acetylene welding

b) Tungsten Inert Gas (TIG) welding

c) Stick welding

d) Laser welding

3. How do extreme temperature fluctuations in space affect the welding process?

a) They have no impact on welding quality.

b) They make it easier to control the heat.

c) They make it difficult to maintain stable welding conditions.

d) They reduce the need for protective equipment.

4. Which of the following is a major factor that makes welding in space more complex than on Earth?

a) Lack of light

b) Lack of gravity

c) Abundance of oxygen

d) Presence of sea water

5. Which countries have conducted research and development on welding techniques specifically for space environments?

a) United States, Japan, and China

b) France, Italy, and Russia

c) Germany, India, and South Korea

d) Canada, Australia, and Brazil

4. *Read and entitle the article.*

The PC has now become an essential tool in the work of the engineer for not only word processing but also specialized tasks such as in design, simulation and performance assessment. Within the manufacturing industry sector, most engineers have access to a PC and the vast majority can be classed as frequent users. It is not surprising, therefore, that in response to the growing market demand, a wide range of computer programs have been written specifically for the welding engineer. Whilst

PC programs can be considered to be a mature source of welding engineering IT, over the last year the Internet has emerged as a new exciting source of welding related information. As the Internet is already widely used by many welding engineers as a source of IT, guidelines are provided on how the vast amount of information on welding engineering related topics can be accessed. Welding engineering software for the PC The first IT packages written for the welding engineer were for carrying out simple calculations such as the preheat temperature level to avoid hydrogen cracking. However, as the PC became more powerful (faster computing speeds and additional memory), their use was extended to mass storage of information in databases such as for welding procedures and welder qualification. More recently, software has incorporated novel programming techniques, expert systems for knowledge based advisory type software and multimedia systems for advisory and education and training software. The main advantage of expert systems is that they are capable of encapsulating expert knowledge, which may be largely subjective. Thus, operation of an expert system differs from that of a conventional software which progresses in a predetermined, step by step manner until a result is obtained e.g. the preheat temperature or the output of a database.

Interrogation of a problem solving expert system will produce an output, which is usually advice or an opinion as to the likely cause of the problem and the recommendations to avoid the problem in the future. A noteworthy advance in computer hardware in recent years has been the inclusion of a CD ROM player in the PC to provide a multimedia capability. Multimedia combines scanned photographs, graphics, animation, audio and video action with very fast processing and large databases to provide very visual / interactive software. T he CD ROM disk is crucial in that with a capacity of 700MB can store over 250,000 pages of text, or up to 30 mins of video, equivalent to 450 high density 3.5 in floppy disks. Commercially available software for the welding engineer There is now a wide range of powerful software available to the welding engineer which makes best use of the computing, memory, knowledge based and/or *multimedia facilities* of the PC. The IT programs produced as aids for the welding engineer can be conveniently grouped into the following categories:

Repetitive calculations;

Storage of Information;

Interpretation of Standards;

Advisory;

Simulation;

Education and Training.

Many companies have written software for *in-house use* but the examples described here have been restricted to commercially available software.

5. Complete the sentences with the correct word from the list below.

(essential, simulation, multimedia, expert, repetitive, guidelines)

1. The PC has become an ___________ tool for engineers worldwide, allowing them to perform complex calculations and simulations.
2. A ___________ system helps welders diagnose problems by providing expert advice based on accumulated knowledge.
3. The process of welding requires ___________ calculations, such as determining preheat temperatures, to avoid problems like cracking.
4. Welding software can now incorporate ___________ elements such as images, videos, and sounds to provide an interactive experience.
5. To avoid problems in welding, it is important to follow the right ___________, which offer recommendations on the best practices.
6. A ___________ model mimics real-world welding processes, allowing engineers to test different scenarios safely.

6. Read the following sentences and determine whether they are true or false. After that, rewrite the false sentences to make them true.

1. The PC is no longer widely used by welding engineers.
2. Software programs for welding engineers have become more advanced with the introduction of multimedia.

3. The first IT packages for welding engineers were intended for complex calculations.

4. CD ROMs can store very little information compared to floppy disks.

5. Welding engineers have only limited access to computer programs.

7. Choose the correct answer based on the text. Then, explain why the other options are incorrect.

1. What was one of the first types of IT packages developed for welding engineers?

a) Simulation software

b) Expert systems

c) Simple calculation software

d) Multimedia software

2. What is one benefit of expert systems in welding engineering software?

a) They provide detailed instructions for welding procedures.

b) They can encapsulate subjective expert knowledge.

c) They offer interactive training.

d) They calculate preheat temperatures.

3. What is the capacity of a CD ROM mentioned in the text?

a) 700 MB

b) 500 MB

c) 250 MB

d) 1 GB

8. *Rewrite the following sentences in the passive voice. Then, make the sentences more formal or professional, as they might be used in a report or presentation.*

1. Engineers have written software to help in-house operations.

2. Companies are developing new welding programs for the industry.

3. The welding industry has used the PC for decades.

4. Experts will provide the guidelines for safe welding procedures.

9. Summarize the following paragraph in 3-4 sentences. Use some of the vocabulary from the text to make your summary more detailed.

"The first IT packages written for the welding engineer were for carrying out simple calculations such as the preheat temperature level to avoid hydrogen cracking. However, as the PC became more powerful (faster computing speeds and additional memory), their use was extended to mass storage of information in databases such as for welding procedures and welder qualification."

10. Use the words in parentheses to form the correct word to complete the sentence. After forming the correct word, discuss how the word fits into the sentence.

1. The use of expert systems for welding has become more __________ (wide).
2. The company has invested in __________ (advance) software for their welding operations.
3. The welding process is highly __________ (complex) and requires accurate calculations.
4. Engineers must rely on __________ (special) training to handle these new technologies.

Answer the following questions. After writing your answer, discuss it with a partner or a teacher.

1. How has the use of computers and software changed the role of welding engineers in modern industries?
2. In your opinion, how might the use of multimedia software improve welding education and training? What are some examples of how multimedia could be used effectively in training?
3. What are some potential disadvantages of relying on expert systems in the welding industry? How could these challenges be overcome?

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Електронне навчальне видання комбінованого використання
Можна використовувати в локальному та мережному режимі

Жигалко Світлана Едуардівна

ІНОЗЕМНА МОВА ПРОФЕСІЙНО-ДІЛОВОГО СПІЛКУВАНЯ

Методичні вказівки до проведення
практичної роботи для здобувачів вищої освіти першого (бакалаврського) рівня
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