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 1

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

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O. M. Beketov NUUE
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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 CLASSICAL MECHANICS

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 Greeks, and Aristotle in particular, were the first to propose that there are abstract principles governing nature.

One of the first scientists who suggested abstract laws was Galileo Galilei who may have performed the famous experiment of dropping two cannon balls from the tower of Pisa. (The theory and the practice showed that they both hit the ground at the same time.) Though the reality of this experiment is disputed, he did carry out quantitative experiments by rolling balls on an inclined plane: his correct theory of accelerated motion was apparently derived from the results of the experiments.

Sir Isaac Newton was the first to propose the three laws of motion (the law of inertia, his second law of acceleration, and the law of action and reaction), and to prove that these laws govern both everyday objects and celestial objects.

Newton's third law of motion states that an object experiences a force because it is interacting with some other object. The force that object 1 exerts on object 2 must be of the same magnitude but in the opposite direction as the force that object 2 exerts on object I. If, for example, a large adult gently shoves away a child on a skating rink, in addition to the force the adult imparts on the child, the child imparts an equal but oppositely directed force on the adult. Because the mass of the adult is larger, however, the acceleration of the adult will be smaller.

Newton's third law also requires the conservation of momentum, or the product of mass and velocity. For an isolated system, with no external forces acting on it, the momentum must remain constant. In the example of the adult and child on the skating rink, their initial velocities are zero, and thus the initial momentum of the system is zero. During the interaction, internal forces are at work between adult and child, but net external forces equal zero. Therefore, the momentum of the system must remain zero. After the adult pushes the child away, the product of the large mass and small velocity of the adult must equal the product of the small mass and large velocity of the child. The momenta are equal in magnitude but opposite in direction thus adding to zero.

Newton also developed the calculus which is necessary to perform the mathematical calculations involved in classical mechanics. However, it was Gottfried Leibniz who developed the notation of the derivative and integral which are used to this day. After Newton the field became more mathematical and more abstract.

In physics Classical mechanics is one of the two major sub-fields of study in the science of mechanics, which is concerned with the motions of bodies, and the forces that cause them. The other sub-field is quantum mechanics. Roughly speaking, classical mechanics was developed in the 400 years since the groundbreaking works of Brahe. Kepler, and Galilei, while quantum mechanics developed within the last 100 years, starting with similarly decisive discoveries by Planck, Einstein, and Bohr. The notion of "classical" may be somewhat confusing, insofar as this term usually refers to the era of classical antiquity in European history. While many discoveries within the mathematics of that period remain in full force today, and of the greatest use, the same cannot be said about its "science". This in no way belittles the many important developments, especially within technology, which took place in antiquity and during the Middle Ages in Europe and elsewhere.

However, the emergence of classical mechanics was a decisive stage in the development of science, in the modern sense of the term. What characterizes it, above all, is its insistence on mathematics (rather than speculation), and its reliance on experiment (rather than observation). With classical mechanics it was established how to formulate quantitative predictions in theory and how to test them by carefully designed measurement. The emerging globally cooperative endeavor increasingly provided for much closer scrutiny and testing, both of theory and experiment. This was, and remains, a key factor in establishing certain knowledge, and in bringing it to the service of society. History shows how closely the health and wealth of a society depends on nurturing this investigative and critical approach.

The initial stage in the development of classical mechanics is often referred to as Newtonian mechanics, and is characterized by the mathematical methods invented by Newton himself, in parallel with Leibniz, and others. This is further described in the following sections. More abstract, and general methods include Lagrangean mechanics and Hamiltonian mechanics.

Classical mechanics produces very accurate results within the domain of everyday experience. It is enhanced by special relativity for objects moving with large velocity, near the speed of light Classical mechanics is used to describe the motion of human-sized objects, from projectiles to parts of machinery, as well as astronomical objects, such as spacecraft, planets, stars, and galaxies, and even microscopic objects such as large molecules. Besides this, many specialties exist, dealing with gases, liquids, and solids, and so on. It is one of the largest subjects in science and technology.

2 Abstracting

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

Unit 2 THE INSTITUTION OF MECHANICAL ENGINEERS

1 Introduction

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

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The Institution of Mechanical Engineers (IMechE) is an independent engineering society, headquartered in central London that represents mechanical engineers. With over 111,000 members in 140 countries, working across industries such as railway, automotive, aerospace, manufacturing, energy, biomedical and construction, the Institution is licensed by the Engineering Council (EngC) to assess candidates for inclusion on its Register of Chartered Engineers. It operated from premises in Birmingham until 1877 when it moved to London, taking up its present headquarters on Birdcage Walk in 1899.

The Institution was founded at the Queen's Hotel, Birmingham, in 1847 following an informal meeting at Charles Beyer's house in Cecil Street, Manchester. Charles Frederick Beyer (1813—1876) was a celebrated German-British locomotive designer and builder, and co-founder of the Institution of Mechanical Engineers. He proposed that George Stephenson become the Institution's first President (followed by his son, Robert Stephenson, in 1849). Beyer became Vice President and was one of the first to present papers to the Institution.

George Stephenson (1781–1848) was an English civil and mechanical engineer who built the first public inter-city railway line in the world to use steam locomotives, the Liverpool and Manchester Railway which was opened in 1830. His rail gauge of 4 feet 8 1⁄2 (eight and a half) inches, sometimes called "Stephenson gauge", is the standard gauge by name and by convention for most of the world's railways.

Throughout the 19th and 20th Centuries some of Britain's most notable engineers held the position of President, including Joseph Whitworth, Carl Wilhelm Siemens and Sir Harry Ricardo.

Sir Joseph Whitworth (1803 – 1887) was an English engineer, entrepreneur, inventor and philanthropist in 1841, he devised the British Standard Whitworth system, which created an accepted standard for screw threads. Whitworth also created the Whitworth rifle, often called the 'sharpshooter' because of its accuracy and considered one of the earliest examples of a sniper rifle. Whitworth received many awards for the excellence of his designs and was financially very successful. He was conferred with Honorary Membership of the Institution of Engineers and Shipbuilders in Scotland in 1859. He was elected a Fellow of the Royal Society (FRS) in 1857. In 1868, he founded the Whitworth Scholarship for the advancement of mechanical engineering.

Sir Harry Ricardo (1885 – 1974) was one of the foremost engine designers and researchers in the early years of the development of the internal combustion engine. Among his many other works, he improved the engines that were used in the first tanks, oversaw the research into the physics of internal combustion that led to the use of octane ratings, was instrumental in development of the sleeve valve engine design, and invented the Diesel "Comet" Swirl chamber that made high-speed diesel engines economically feasible.

During 1941–1945 Ricardo was a member of the War Cabinet engineering advisory committee. Ricardo also assisted in the design of the combustion chambers and fuel control system of Sir Frank Whittle's jet engine. In 1944 Ricardo was elected president of the Institution of Mechanical Engineers. In 1948 Ricardo was knighted in recognition for his work in the field of internal combustion engineering.

The first woman to be elected to the Institution was Verena Holmes in 1924. She (1889–1964) was an English mechanical engineer and inventor, and a strong supporter of women in engineering. Holmes gained employment building wooden propellers at the Integral Propeller Company, Hendon, after graduation from Oxford High School for Girls. Her technical specialties included marine and locomotive engines, diesel and internal combustion engines.

She was employed by Research Engineers Ltd. from 1932-39, during which time she developed and patented many inventions, including the Holmes and Wingfield pneumo-thorax apparatus for treating patients with tuberculosis, a surgeon's headlamp, a poppet valve for steam locomotives, and rotary valves for internal combustion engines. She held patents for 12 inventions for medical devices as well as engine components.

Pamela Liversidge in 1997–98 was the first female president. She was born 23 December 1949 and graduated with a BSc in Mechanical Engineering from Aston University. After graduating she worked for GKN, then moved first into forging, then the electricity supply industry, becoming Divisional Director of East Midlands Electricity. In 1993 she set up her own business to manufacture metal powders, notably for medical engineering, and from 1999 was Managing Director of Quest Investments, a holding company for several engineering enterprises. In 1997 she became the first female president of the Institution of Mechanical Engineers and in 1999 was awarded the OBE (Order of the British Empire), rewarding contributions to the arts and sciences, work with charitable and welfare organizations and public service outside the Civil Service. On 7 February 2014 a new building at the University of Sheffield was named the Pam Liversidge Building in her honour.

Today One Birdcage Walk hosts events, lectures, seminars and meetings in 17 conference and meeting rooms named after notable former members of the Institution, such as Frank Whittle, George Stephenson and Charles Parsons.

2 Abstracting

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

Unit 3 SCOPE OF STRENGTH OF MATERIALS

1 Introduction

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

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Strength of Materials is that portion of the science of Mechanics which deals with the relationships existing among the change in shape (deformation), the magnitude and distribution of the internal resisting forces, and the external forces or loads when an elastic or partially elastic body is required to perform some function. The problems of Strength of Materials can generally be classified under one of two types:

a) investigation of the elements or parts of machines or structures, to determine whether they are capable of withstanding certain loads, without failure of the element due to excessive deformation or the development of excessive internal resisting forces (stresses);

b) the determination of the dimensions and form of an element which will successfully withstand a known system of external loads, without developing excessive internal forces (stresses) or deformations of the elements.

It is evident that the solution of each of these problems is dependent on a mathematical analysis of the forces or loads acting (usually found by applying the principles of Statics) and certain experimentally determined physical properties and constants which vary with various types of materials of construction which are employed and the manner in which the loads are applied.

In each of these basic problems stress or deformation may be the governing criterion. In any given case the nature of the function to be performed by the given member or structure determines whether stress or deformation is the limiting factor. For the vast majority of engineering structures and parts of structures stress is the criterion used. For such structures, if the stress developed does not exceed a certain limiting value, the design is considered satisfactory from the point of view of strength. There are, however, certain forms of constructions such as engines, machine tools, and other structures involving moving parts or performing certain specialized functions where the deformations must be confined to narrow limits. For such cases the deformation may be the limiting factor.

Classification of Loads. Loads are classified both according to the method of application and functionally. Method of application: a) concentrated, b) distributed, c) uniform, d) non-uniform. A load whose area of contact with the member on which it acts may be considered as approaching a point or line is generally called a concentrated load. A distributed load is one whose area of contact has appreciable magnitude. The load may be uniformly distributed (a given number of pounds per unit area) or its distribution may be non-uniform. Functional classification: a) static, b) impact, c) bending, d) torsional, e) repeated. A static load is one which is gradually increased from zero to its maximum value and then remains constant throughout the life of the structure, or the load may be removed or partially removed and reapplied at infrequent intervals. Static loads may be caused by the weight of the members themselves and any other non-moving material, which is supported by the structure.

An impact load is the load caused by a moving object coming into contact with some member which resists the motion of the moving object. A bending load is a load applied in such a manner that it causes flexural stress. Beams and columns carry bending loads. Torsional loads cause torsional shear stress. The propeller shaft of a boat carries a torsional load. Loads which are rapidly applied, removed, and reapplied a large number of times are called repeated loads. The kind of stress developed is determined by the manner in which the loads are applied.

Elasticity. All materials in engineering are assumed to consist of small articles or molecules which are held together by certain attractive forces. When a body of such material is acted upon by an external force system, the molecules are displaced or rearranged until the external and internal force systems are brought into a state of equilibrium. This displacement of the molecules causes a deformation of the body. The body is then considered to be strained or to be in a state of strain. The action is similar to that which takes place when a piece of rubber is stretched by the application of external forces. These forces act upon the rubber, deforming or straining it. This work is transformed into potential elastic or strain energy.

Resilience. When an elastic material is stressed below the elastic limit, potential elastic energy is stored up which can be recovered with the removal of stress. This potential elastic energy is called resilience. The amount of elastic energy, which can be stored in one cubic inch of any elastic material when the material is stressed to the elastic limit, is known as the modulus of resilience. The modulus of resilience is therefore a measure of the ability of any given material to store up elastic potential energy.

Plasticity. Plasticity is the direct opposite of elasticity. It is the property of a material which permits the formation of a permanent deformation. The material which is perfectly plastic will therefore have no elastic recovery and thus can store up no resilience. All ordinary materials used in engineering construction are partially plastic and partially elastic when stressed beyond the elastic limit.

Ductility. Ductility is the property of a material which permits plastic flow to take place. It is an especially important property in materials which are to be subjected to mechanical deformation processes.

2 Abstracting

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

Unit 4 CONVEYORS

1 Introduction

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

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Material handling plays an important part in industrial economy. Great steam plants would not be possible without coal-handling equipment, nor could steel, paper, chemical, cement, and manufacturing plants function without conveyors. Mass production in industry depends on the conveying system, and expansions in mass production invariably follow improvements in methods of handling the materials involved.

Screw conveyors. The screw conveyor usually consists of a long-pitch plate-steel helix mounted on a shaft or spindle carried in bearings within a U-shaped trough. As the element rotates, the material fed to it is moved forward by the thrust of the lower part of the helix and is discharged through openings in the trough bottom or at the end. This conveyor does not always find favor with engineers, but properly applied it does a good job and often its cost will be about one-half that for any other type of conveyor. It is a simple machine to maintain, replacements are inexpensive, and it is readily made dust tight. For many functions it is the best type of conveyor.

Inclined Conveyors. - Screw conveyors can be operated with the path inclined upward, but the capacity decreases, rapidly as the inclination increases. A standard pitch screw inclined at 15° with the horizontal has 70 per cent of its horizontal capacity; if it is inclined 25° the capacity is reduced to 40 per cent; if it is inclined 45° the material will move along the floor of the trough but at a greatly reduced rate. For steep inclines the helix may have a short pitch, and the trough may be made tubular; then the capacity loss is less. Thus, with a jam feed and 45° incline such a conveyor has a capacity about 50 per cent of its capacity when horizontal.

The bearing hangers of inclined conveyors should be of T design to reduce the interference with the flow of the material. It may be desirable to use a few turns of double helix each side of the bearing hangers. With suitable forced feed a screw conveyor in a vertical position will lift material if the rotating speed is high and there are no intermediate bearings. Such a conveyor is not self-clearing and should not be used for material, which will sour or spoil.

The Flight Conveyor. The Flight Conveyor has an endless chain or twin chains passing around sprockets at the head and foot ends, with spaced transverse scrapers or "flights" which push the material along a trough. Flight conveyors may be several hundred feet in length, but as the material is scraped along a trough they are not suited to abrasives like ashes or sand. A modified type called the drag-chain conveyor is specifically adapted for ashes. Flight conveyors will operate on an upward slope o 40° to 45° but at a greatly reduced capacity.

The Apron Conveyor almost invariably has twin chains on which overlapping pans are mounted to carry the material instead of scraping-it. An apron conveyor used for controlling the rate of feed, as from a track hopper, is called an "apron feeder".

An apron conveyor can handle abrasive materials that cannot be scraped along a trough, and as the loading is readily controlled it may be used as a feeder. As an alternative to a rubber belt, it can handle materials at a temperature higher than 300° F. that cannot be handled on rubber. The apron conveyor consists of overlapping beaded steel pans supported between, or mounted upon, two strands of roller chain, and with the usual head and foot assembly. The speed usually is less than 100 ft. per min., and if the conveyor is to serve as a picking table the speed must be quite slow.

Overhead Conveyors. Overhead conveyors or trolley conveyors, consist of a power-propelled chain travelling at moderate speed, suspended by trolleys from a suitable track, and provided with attachments of various forms adapted to the work to be done. The loads are not concentrated as in the tram-rail system, and so the track is much lighter. The motor is usually connected by roller chain or V-belt to a vertical-type worm gear or through a variable-speed drive, which permits adjustment to suit varying operating conditions.

Pneumatic Conveyors. The pneumatic conveyor differs altogether from other machines for transporting materials. It depends on a high-velocity air stream to move material in about the same manner as does the wind. If the velocity is too low, the material drags and builds up. If the velocity is sufficiently high, the material is carried in suspension, causing little erosion in the duct except at the bends and short tangents beyond, where eddies occur. The pneumatic conveyor takes far more power per ton per hour-moved than any mechanical conveyor. If the material is lumpy and heavy, the efficiency drops sharply. If it is caky or packed, as with bulk cement, it must be loosened up before it can feed into a nozzle. If it is a material, which tends to build up a static charge, sulphur for example, there is a possibility of a dust explosion. The good features are that it can solve problems that no mechanical conveyor can attempt; that having no moving parts it eliminates danger to men working around it; and that its "vacuum-cleaner" action provides dustless operation, as when unloading pulverized material from a boxcar. The hydraulic conveyor requires less power than a pneumatic conveyor because the conveying medium is dense.

2 Abstracting

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Unit 5 CRANES

1 Introduction

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

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Cranes which lift and swing the load are pillar cranes, jib cranes in various forms, derricks, rotary bridge cranes, locomotive cranes. Cranes which lift the load and travel with it comprise many forms of bridge and gantry cranes.

Locomotive Cranes usually consist of a lower frame fitted with 4 or 8 wheels for use on track, and a rotating upper frame carrying the power plant and operating machinery. A boom, hinged to the upper frame, can be raised or lowered to handle loads at various radii. The crane will act as a portable hoisting engine, a swinging derrick, a grab bucket unloader, or a switching engine. It will handle a lifting magnet, scoop shovel, dragline scraper, or pile driver. Locomotive cranes with usually 8 wheels find widest application around industrial plants served by tracks. Besides lifting loads by hook block, they handle pig iron and scrap with a magnet, and shift cars.

Steam-operated Cranes require a boiler, fuel tank, and water tank. Usually, a licensed engineer is required to run the boiler. Many later cranes have gasoline or diesel engines, which require less space, can be started or shut down instantly, and have lower stand-by expense.

Crawler Cranes, instead of having wheels, have a pair of treads made of steel plates linked together and driven by sprocket wheels. The weight is carried by a row of rollers on the lower frame. The width of tread plates and length of assembly make the unit bearing pressure so low that the crane can travel on soft, rough, or uneven ground, and it requires no track or mats. Crawler cranes are fitted with digging shovels, dragline buckets, trench hoes, skimmer buckets, etc., and can be converted easily from one to the other.

The Power Shovel is for general excavating, digging from the bank, handling blasted rock, and for grading, including shallow cuts below grade. Its particular field is making cuts into and through banks, loading blasted rock on cars or trucks, where the machine stands in the hole or at base of the excavation. It can be used on loose piled materials, but if reach is long or lift high a grab bucket often works better.

The Dragline Crawler is for removing overburden, digging under water, cutting wide or deep trenches, and where it is necessary to work above material handled. Dragline excavators work outside the hole, and when fitted with long booms can cover a large area, pile material high, and load cars some distance away. The dragline bucket is not so well suited to side cutting as the trench hoe.

The Trench Hoe is used to dig trenches up to 12 ft. wide and 20 ft. deep in types of earth that can be cut and that will not cave in. It is faster than the dragline, can be more accurately controlled, and will cut a greater length of trench in a given time.

The Skimmer Bucket is a form of shovel comprising an open-end box with teeth. It travels back and forth on the underside of the crane boom and is used for grading, leveling, tearing up old pavements.

Guy Derricks have a mast, with a step and vertical pivot pin, at the base, a boom hinged to the foot of the mast, whose inclination can be varied by rope tackle joining tops of boom and mast A pivot pin on top of the mast fits a cap to which guy ropes are attached. For hand operation, a double-drum winch is mounted at the base of the mast for hoisting and luffing respectively. If angle of boom is not often changed, a single-drum winch will suffice, luffing being by a hand line hitched to the mast. A guy derrick is used in quarries, in bridge and building construction. It is operated by steam or power hoist with two hoisting drums for load and luffing, and a pair of swinging drums. Ropes from the latter lead to opposite sides of a bull wheel, on the foot of the mast, to swing mast and boom.

The luffing rope runs to foot of mast, to mast-head, thence to tackle between masthead and top of boom. The hoisting rope follows a similar path, and runs through sheaves on the boom to the suspended load. Stress in boomhoist tackle increases as boom is lowered. Hoisting-rope is generally 6 by 19 steel wire rope; boom hoist line is the same, but with more parts in the tackle. Stresses in guy lines can be calculated from their arrangement around the mast with respect to the position of the load and also with respect to the angle they make with the horizontal. Derricks often are made of steel for safety, and in sections for ease in handling.

Tower Derricks consist of a square tower of wood or steel with footings for booms on one or more corner posts. They are used in building construction, booms being shifted higher on the posts as the building goes up.

Electric Tower Crane. All motions of this crane are electrically operated and controlled from the cabin. Four electric motors, one for each operation of the crane, are fitted. Electromagnetic brakes are fitted to hoist, derrick and travel motions. The hoist is also fitted with an electromechanical brake operated by a solenoid. Mechanically operated limit switches are fitted to the luffing and hoisting motions. When the luff or hoist limit switches have been tripped, the limited motion can, by means of the controller, be operated only in the reverse direction until the limit switch has been cleared. Main circuit breaker trips may be fitted on the track to prevent the crane overrunning the rails. An improved type of safe load indicator is fitted, giving visible and audible warning of an overload at any position of jib.

2 Abstracting

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

Unit 6 HISTORY OF WELDING

1 Introduction

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The history of joining metals goes back several millennia, with the earliest examples of welding from the Bronze Age and the Iron Age in Europe and the Middle East. Welding was used in the construction of the Iron pillar in Delhi, India, erected about 310 and weighing 5.4 metric tons. The Middle Ages brought advances in forge welding, in which blacksmiths pounded heated metal repeatedly until bonding occurred. In 1540, Vannoccio Biringuccio published *De la pirotechnia,* which includes descriptions of the forging operation. Renaissance craftsmen were skilled in the process, and the industry continued to grow during the following centuries. Welding, however, was transformed during the 19th century—in 1800, Sir Humphry Davy discovered the electric arc, and advances in arc welding continued with the inventions of metal electrodes by a Russian, Nikolai Slavyanov, and an American, C. L. Coffin in the late 1800s, even as carbon arc welding, which used a carbon electrode, gained popularity. Around 1900, A. P. Strohmenger released a coated metal electrode in Britain, which gave a more stable arc, and in 1919, alternating current welding was invented by C. J. Holslag, but did not become popular for another decade.

Resistance welding was also developed during the final decades of the 19th century, with the first patents going to Elihu Thomson in 1885, who produced further advances over the next 15 years. Thermite welding was invented in 1893, and around that time, another process, oxyfuel welding, became well established. Acetylene was discovered in 1836 by Edmund Davy, but its use was not practical in welding until about 1900, when a suitable blowtorch was developed. At first, oxyfuel welding was one of the more popular welding methods due to its portability and relatively low cost. As the 20th century progressed, however, it fell out of favor for industrial applications. It was largely replaced with arc welding, as metal coverings known as flux for the electrode that stabilize the arc and shield the base' material from impurities continued to be developed.

World War I caused a major surge in the use of welding processes, with the various military powers attempting to determine which of the several new welding processes would be best. The British primarily used arc welding, even constructing a ship, the *Fulagar,* with an entirely welded hull. The Americans were more hesitant, but began to recognize the benefits of arc welding when the process allowed them to repair their ships quickly after German attacks in the New York Harbor at the beginning of the war. Arc welding was first applied to aircraft during the war as well, as some German airplane fuselages were constructed using the process.

During the 1920s, major advances were made in welding technology, including the introduction of automatic welding in 1920, in which electrode wire was fed continuously. Shielding gas became a subject receiving much attention, as scientists attempted to protect welds from the effects of oxygen and nitrogen in the atmosphere. Porosity and brittleness were the primary problems, and the solutions that developed included the use of hydrogen, argon, and helium as welding atmospheres. During the following decade, further advances allowed for the welding of reactive metals like aluminum and magnesium. This, in conjunction with developments in automatic welding, alternating current, and fluxes fed a major expansion of arc welding during the 1930s and then during World War *II*

During the middle of the century, many new welding methods were invented. 1930 saw the release of stud welding, which soon became popular in shipbuilding and construction. Submerged arc welding was invented the same year, and continues to be popular today. Gas tungsten arc welding, after decades of development, was finally perfected in 1941, and gas metal arc welding followed in 1948, allowing for fast welding of non-ferrous materials but requiring expensive shielding gases. Shielded metal arc welding was developed during the 1950s, using a flux coated consumable electrode, and it quickly became the most popular metal arc welding process. In 1957, the flux-cored arc welding process debuted, in which the self-shielded wire electrode could be used with automatic equipment, resulting in greatly increased welding speeds, and that same year, plasma arc welding was invented. Electroslag welding was introduced in 1958, and it was followed by its cousin, electrogas welding, in 1961.

Other developments in welding include the 1958 breakthrough of electron beam welding, making deep and narrow welding possible through the concentrated heat source. Following the invention of the laser in 1960, laser beam welding debuted several decades later, and has proved to be especially useful in highspeed, automated welding. Both of these processes, however, continue to bequite expensive due the high cost of the necessary equipment, and this has limited their applications.

2 Abstracting

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

Unit 7 WELDING PROCESSES

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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Arc welding These processes use a welding power supply to create and maintain an electric arc between an electrode and the base material to melt metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is sometimes protected by some type of inert or semi-inert gas, known as a shielding gas, and filler material is sometimes used as well.

Power supplies. To supply the electrical energy necessary for arc welding processes, a number of different power supplies can be used. The most common classification is constant current power supplies and constant voltage power supplies. In arc welding, the length of the arc is directly related to the voltage, and the amount of heat input is related to the current. Constant current power supplies are most often used for manual welding processes such as gas tungsten arc welding and shielded metal arc welding, because they maintain a relatively constant current even as the voltage varies. This is important because in manual welding, it can be difficult to hold the electrode perfectly steady, and as a result, the arc length and thus voltage tend to fluctuate. Constant t voltage power supplies hold the voltage constant and vary the current, and as a result, are most often used for automated welding processes such as gas metal arc welding, flux cored arc welding, and submerged arc welding. In these processes, arc length is kept constant, since any fluctuation in the distance between the wire and the base material is quickly rectified by a large change in current. For example, if the wire and the base material get too close, the current will rapidly increase, which in turn causes the heat to increase and the tip of the wire to melt, returning it to its original separation distance.

The type of current used in arc welding also plays an important role in welding. Consumable electrode processes such as shielded metal arc welding and gas metal arc welding generally use direct current, but the electrode can be charged either positively or negatively. In welding, the positively charged anode will have a greater heat concentration, and as a result, changing the polarity of the electrode has an impact on weld properties. If the electrode is positively charged, the base metal will be hotter, increasing weld penetration and welding speed. Alternatively, a negatively charged electrode results in more shallow welds. Nonconsumable electrode processes, such as gas tungsten arc welding, can use either type of direct current, as well as alternating current. However, with direct current, because the electrode only creates the arc and does not provide filler material, a positively charged electrode causes shallow welds, while a negatively charged electrode makes deeper welds. Alternating current rapidly moves between these two, resulting in medium-penetration welds. One disadvantage of AC, the fact that the arc must be re-ignited after every zero crossing, has been addressed with the invention of special power units that produce a square wave pattern instead of the normal sine wave, making rapid zero crossings possible and minimizing the effects of the problem

Processes. One of the most common types of arc welding is shielded metal arc welding (SMAW), which is also known as manual metal arc welding (MMA) or stick welding. Electric current is used to strike an arc between the base material and consumable electrode rod, which is made of steel and is covered with a flux that protects the weld area from oxidation and contamination by producing CO2 gas during the welding process. The electrode core itself acts as filler material, making a separate filler unnecessary.

The process is versatile and can be performed with relatively inexpensive equipment, making it well suited to shop jobs and field work. An operator can become reasonably proficient with a modest amount of training and can achieve mastery with experience. Weld times are rather slow, since the consumable after welding. Furthermore, the process is generally limited to welding ferrous materials, though speciality electrodes have made possible the welding of cast iron, nickel, aluminium, copper, and other metals. Inexperienced operators may find it difficult to make good out-of-position welds with this process.

Gas metal arc welding (GMAW), also known as metal inert gas or MIG welding, is a semi-automatic or automatic process that uses a continuous wire feed as an electrode and an inert or semi-inert gas mixture to protect the weld from contamination. As with SMAW, reasonable operator proficiency can be achieved with modest training. Since the electrode is continuous, welding speeds are greater for GMAW than for SMAW. Also, the smaller arc size compared to the shielded metal arc welding process makes it easier to make out-of-position welds (e.g., overhead joints, as would be welded underneath a structure).

The equipment required to perform the GMAW process is more complex and expensive than that required for SMAW, and requires a more complex setup procedure. Therefore, GMAW is less portable and versatile, and due to the use of a separate shielding gas, is not particularly suitable for outdoor work. However, owing to the higher average rate at which welds can be completed, GMAW is well suited to production welding. The process can be applied to a wide variety of metals, both ferrous and non-ferrous. A related process, flux-cored arc welding (FCAW), uses similar equipment but uses wire consisting of a steel electrode surrounding a powder fill material. This cored wire is more expensive than the standard solid wire and can generate fumes and/or slag, but it permits even higher welding speed and greater metal penetration.

2 Abstracting

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

Unit 8 TYPES OF WELDING

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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Gas tungsten arc welding (GTAW), or tungsten inert gas (TIG) welding (also sometimes erroneously-referred to as heliarc welding), is a manual welding process that uses a nonconsumable tungsten electrode, an inert or semi-inert gas mixture, and a separate filler material. Especially useful for welding thin materials, this method is characterized by a stable arc and high-quality welds, but it requires significant operator skill and can only be accomplished at relatively low speeds.

GTAW can be used on nearly all weldable metals, though it is most often applied to stainless steel and light metals. It is often used when quality welds are extremely important, such as in bicycle, aircraft and naval applications. A related process, plasma arc welding, also uses a tungsten electrode but uses plasma gas to make the arc. The arc is more concentrated than the GTAW arc, making transverse control more critical and thus generally restricting the technique to a mechanized process. Because of its stable current, the method can be used on a wider range of material thicknesses than can the GTAW process, and furthermore, it is much faster. It can be applied to all of the same materials as GTAW except magnesium, and automated welding of stainless steel is one important application of the process. A variation of the process is plasma cutting, an efficient steel cutting process.

Submerged arc welding (SAW) is a high-productivity welding method in which the arc is struck beneath a covering layer of flux. This increases arc quality, since contaminants in the atmosphere are blocked by the flux. The slag that forms on the weld generally comes off by itself, and combined with the use of a continuous wire feed, the weld deposition rate is high. Working conditions are much improved over other arc welding processes, since the flux hides the arc and almost no smoke is produced. The process is commonly used in industry, especially for large products and in the manufacture of welded pressure vessels. Other arc welding processes include atomic hydrogen welding, carbon arc welding, electroslag welding, electrogas welding, and stud arc welding.

Gas welding. The most common gas welding process is oxyfuel welding, also known as oxyacetylene welding. It is one of the oldest and most versatile welding processes, but in recent years it has become less popular in industrial applications. It is still widely used for welding pipes and tubes, as well repair work. The equipment is relatively inexpensive and simple, generally employing the combustion of acetylene in oxygen to produce a welding flame temperature of about 3100 °C. The flame, since it is less concentrated than an electric arc, causes slower weld cooling, which can lead to greater residual stresses and weld distortion, though it eases the welding of high alloy steels. A similar process, generally called oxyfuel cutting, is used to cut metals.

Resistance welding. Resistance welding involves the generation of heat by passing current through the resistance caused by the contact between two or more metal surfaces. Small pools of molten metal are formed at the weld area as high current

(1000-100,000 A) is passed through the metal. In general, resistance welding methods are efficient and cause little pollution, but their applications are somewhat limited and the equipment cost can be high.

Spot welding is a popular resistance welding method used to join overlapping metal sheets of up to 3 mm thick. Two electrodes are simultaneously used to clamp the metal sheets together and to pass current through the sheets. The advantages of the method include efficient energy use, limited workpiece deformation, high production rates, easy automation, and no required filler materials. Weld strength is significantly lower than with other welding methods, making the process suitable for only certain applications. It is used extensively in the automotive industry-ordinary cars can have several thousand spot welds made by industrial robots. A specialized process, called spot welding, can be used to spot weld stainless steel.

Like spot welding, seam welding relies on two electrodes to apply pressure and current to join metal sheets. However, instead of pointed electrodes, wheel-shaped electrodes roll along and often feed the workpiece, making it possible to make long continuous welds. In the past, this process was used in the manufacture of beverage cans, but now its uses are more limited. Other resistance welding methods include flash welding, projection welding, and upset welding.

Energy beam welding. Energy beam welding methods, namely laser beam welding and electron beam welding, are relatively new processes that have become quite popular in high production applications. The two processes are quite similar, differing most notably in their source of power. Laser beam welding employs a highly focused laser beam, while electron beam welding is done in a vacuum and uses an electron beam. Both have a very high energy density, making deep weld penetration possible and minimizing the size of the weld area.

2 Abstracting

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

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до проведення практичних занять та організації самостійної роботи
з навчальної дисципліни

« ІНОЗЕМНА МОВА ЗА ПРОФЕСІЙНИМ СПРЯМУВАННЯМ»
Частина 1

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

(Англ. мовою)

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