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МЕТОДИЧНІ ВКАЗІВКИ З ДИСЦИПЛІНИ «ІНОЗЕМНА МОВА ПРОФЕСІЙНОГО СПРЯМУВАННЯ» ДЛЯ СТУДЕНТІВ СПЕЦІАЛЬНОСТЕЙ 7.092203/8.092203 «ЕЛЕКТРОМЕХАНІЧНІ СИСТЕМИ АВТОМАТИЗАЦІЇ ТА ЕЛЕКТРОПРИВОД», 7.092204/8.092204 «ЕЛЕКТРОМЕХАНІЧНЕ ОБЛАДНАННЯ ЕНЕРГОЄМНИХ ВИРОБНИЦТВ» ФАКУЛЬТЕТУ ІЕЕ

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ПЕРЕДМОВА

Методичні вказівки укладено відповідно до програми і спрямовано на розвиток навичок читання і перекладу науково-технічних текстів.

Цю роботу належіть використовувати як перехідну ланку від стабільного підручника з англійської мови до читання оригінальної літератури за фахом.

Видання складається з І0 основних текстів з вправами та 7 додаткових. Система вправ відповідно до конкретних учбових цілей має на меті як розвиток навичок точного і загального розуміння, так і розвиток навичок з усної мови. Пропонуються також вправи, що мають професійну спрямованість. Виконання студентами методичних вказівок сприяє інтенсифікації процесу навчання іноземній мові і створює умови для правильного і найбільш доцільного тренування, яке забезпечує тривалі навички розуміння структури науково-технічного тексту.

ЗМІСТ

TEXT 1. HISTORY OF AUTOMATION.

Automation is the system of manufacture performing certain tasks, previously done by people, by machines only. The sequences of operations are controlled automatically. The most familiar example of a highly automated system is an assembly plant for automobiles or other complex products. The term automation is also used to describe non-manufacturing systems in which automatic devices can operate independently of human control. Such devices as automatic pilots, automatic telephone equipment and automated control systems are used to perform various operations much faster and better than could be done by people. Automated manufacturing had several steps in its development. Mechanization was the first step necessary in the development of automation. The simplification of work made it possible to design and build machines that resembled the motions of the worker. These specialized machines were motorized and they had better production efficiency. Industrial robots, originally designed only to perform simple tasks in environments dangerous to human workers, are now widely used to transfer, manipulate, and position both light and heavy work pieces performing all the functions of a transfer machine.

In the 1920s the automobile industry for the first time used an integrated system of production. This method of production was adopted by most car manufacturers and became known as Detroit automation.

The feedback principle is used in all automatic-control mechanisms when machines have ability to correct themselves. The feedback principle has been used for centuries. An outstanding early example is the flyball governor, invented in 1788 by James Watt to control the speed of the steam engine. The common household thermostat is another example of a feedback device.

Using feedback devices, machines can start, stop, speed up, slow down, count, inspect, test, compare, and measure. These operations are commonly applied to a wide variety of production operations.

Computers have greatly facilitated the use of feedback in manufacturing processes. Computers gave rise to the development of numerically controlled machines. The motions of these machines are controlled by punched paper or magnetic tapes. In numerically controlled machining centers machine tools can perform several different machining operations.

More recently, the introduction of microprocessors and computers have made possible the development of computer-aided design and computer-aided manufacture (CAD and CAM) technologies. When using these systems a designer draws a part and indicates its dimensions with the help of a mouse, light pen, or other input device. After the drawing has been completed the computer automatically gives the instructions that direct a machining centre to machine the part.

Another developments using automation are the flexible manufacturing systems (FMS). A computer in FMS can be used to monitor and control the operation of the whole factory.

Automation has also had an influence on the areas of the economy other than manufacturing. Small computers are used in systems called word processors, which are rapidly becoming a standard part of the modern office. They are used to edit texts, to type letters and so on.

Automation in Industry. Many industries are highly automated or use automation technology in some part of their operation. In communications and especially in the telephone industry dialing and transmission are all done automatically. Railways are also controlled by automatic signaling devices, which have sensors that detect carriages passing a particular point. In this way the movement and location of trains can be monitored.

Not all industries require the same degree of automation. Sales, agriculture, and some service industries are difficult to automate, though agriculture industry may become more mechanized, especially in the processing and packaging of foods.

The automation technology in manufacturing and assembly is widely used in car and other consumer product industries.

Nevertheless, each industry has its own concept of automation that answers its particular production needs.

Exercise 1. Answer the following questions:

1. How is the term automation defined in the text?
2. What is the most “familiar example” of automation given in the text?
3. What was the first step in the development of automaton?
4. What were the first robots originally designed for?
5. What was the first industry to adopt the new integrated system of production?
6. What do we call a feedback principle?
7. What do the abbreviations CAM and CAD stand for?
8. What is FMS?
9. What industries use automation technologies?

Exercise 2. Find the following words and word combinations in the text:

1. автоматичні прилади
2. автоматизоване виробництво
3. виконувати прості завдання
4. як легкі, так і важкі деталі
5. інтегрована система виробництва
6. принцип зворотного зв’язку
7. механізм може розганятись і гальмувати
8. комп’ютер автоматично посилає команди
9. високоавтоматизована система
10. невиробнича система

Exercise 3. Translate the following words into Ukrainian: non-manufacturing,
independently
simplification
environment
resemble
efficiency
punch
feedback
dimension
packaging
assembly
consumer
nevertheless
particular.

Exercise 4. Ask different types of questions:

1. Computers have greatly facilitated the use of feedback in manufacturing processes.
2. The automation technology in manufacturing and assembly is widely used in car and other consumer product industries.
3. Automation is the system of manufacture performing certain tasks, previously done by people, by machines only.

Exercise 5. Form derivatives from the following words and translate them into Ukrainian:

perform
influence
design
human
system

use

light

local

machine

edit

consume

draw.

Exercise 6. Complete the following sentences:

1. The sequences of operations are controlled … .
2. Such devices as … are used to perform various operations much faster and better than could be done by people.
3. In the … the automobile industry for the first time used an integrated system of production.
4. Small computers are used in systems called word processors, which … of the modern office.
5. A computer in … can be used to monitor and control the operation of the whole factory.
6. The term … is also used to describe … in which … can operate independently of human control.

Exercise 7. Write down the synonyms to the following words: serve, modern, operate, at first, speed, control, own, products, familiar, device.

Exercise 8. Make up a dialogue discussing all stages of automation development.

TEXT 2. ADVANTAGES OF AUTOMATION.

Automation plays an increasingly important role in the global economy and in daily experience. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities.

Automation is important for any company that has a repetitive task for the assembly of products. Most companies know how to make their product and understand the important parameters. However, the expertise to design and build production worthy equipment to implement this knowledge may not be available. It is at this stage that Mechanical Design Specialists can help define a machine that is appropriate to the companies' requirements, budget, and schedule. The questions that then need to be considered are the following. At what production rate does the machine need to operate? What types of inspections should be made at what steps to verify a good product? What level of operator interaction is acceptable? What should happen to rejected, bad, or out of spec parts?

These issues lead to the next most important thing: a company must consider the cost. In general, the faster the machine and the more sophisticated the inspections, the greater the cost. It is a balance that Mechanical Design Specialists can help with by drawing upon years of experience in automation to design the machine to fit each unique situation. By automating a task, an employer can expect the following: to improve productivity, to reduce work-related injuries, to improve quality, to lower costs.

These benefits come from shifting the responsibilities of assembly personnel from actually doing the work to tending to the machines that do the work for them. This means that the same person who used to put parts together can now tend the machine that does the same job at a faster rate and with a higher degree of precision. In fact, some tasks are beyond the capability of a person due to the level of precision required or the ergonomics of the task.

Automation does not have to be complex or expensive for rewards to be achieved. While a high-end vision guided robot may make sense for some applications, a manual assist assembly tool may be better for others. Or, it may be more cost effective to upgrade existing equipment rather than replace it. The decision of what level of automation is right for your application should be based on the level of risk to your operators and the amount of time before you can recover the up front costs for a return on investment (ROI). Since miss-steps can cost time and money, let Mechanical Design Specialists help find your balance.

Using the latest CAD programs such as Solidworks and AutoCAD designs are created to meet the customers' needs. Recent designs have included the following successful projects:

Needle Machine. The needle machine used UV to bond a new type of medical safety needle to its mounting. This machine was designed as a four position rotary dial that had to incorporate the process knowledge gained by the customer during product development.

Pick and Place Machine. The pick and place machine stacked three layers of plastic films between two metal disks. All of the components in the stack were of different sizes and thicknesses. Parts were taken 16 at a time from trays to a conveyor-mounted array of receiving tubes. Component placement accuracy, machine flexibility, and cycle time were the major considerations for this design.

Different types of automation tools exists:

- ANN - Artificial neural network
- DCS - Distributed Control System
- HMI - Human Machine Interface

- LIMS - Laboratory Information Management System
- MES - Manufacturing Execution System
- PAC - Programmable automation controller
- PLC - Programmable Logic Controller
- SCADA - Supervisory Control and Data Acquisition

Specialized computers, referred to as programmable logic controllers (PLCs), are frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events. This leads to precisely controlled actions that permit a tight control of almost any industrial process.

Exercise 1. Translate the following words and word combinations from English into Ukrainian:

physical sensors
types of automation
degree of precision
put parts together
rapidly expanding range of applications
mechanical design specialists
a tight control of ...

Exercise 2. Translate the following words and word combinations from Ukrainian into English:

автоматизоване проектування
ультрафіолетовій
ступінь точності
застосування

відповідний

програмувальний логічний контролер

розмір

товщина.

Exercise 3. Put 10 questions to the text.

Exercise 4. Answer the following questions:

1. What is automation?
2. What can an employer expect by automating a task?
3. Is automation expensive?
4. What are the types of automation tools?
5. What is a programmable logic controller?
6. Name two successful projects of recent designs.

Exercise 5. Explain what the following abbreviations mean:

CAD, UV, ANN, PLC, PAC, SCADA, DCS, HMI, LIMS, MES

Exercise 6. Match the words and word expressions with their definitions.

1. Automation a) the process of putting the parts of something together.

2. machine b) the use of computers and machines instead of people to do a job.

3. controller — c) practical purpose for which a machine, idea etc can be used or a situation when this is used.

4. quality — d) someone who is in charge of a particular system, organization, or part of an organization.

5. application — e) a piece of equipment with moving parts that uses power, such as electricity to do a particular job.

6. assembly — f) how good or bad something is.

Exercise 7. Refer to the text and complete the sentences below:

1. Automation plays an increasingly important role…
2. Automation is for any company that …
3. In fact, some tasks are beyond the capability of a person …
4. Automation does not have to be complex …
5. Component placement accuracy …

Exercise 8. Discuss the process of automation in pairs.

TEXT 3. APPLICATIONS OF AUTOMATION AND ROBOTICS IN INDUSTRY.

Manufacturing is one of the most important application areas for automation technology. There are several types of automation in manufacturing. The examples of automated systems used in manufacturing are described below.

1. Fixed automation, sometimes called "hard automation" refers to automated machines in which the equipment configuration allows the fixed sequence of processing operations. These machines are programmed by their design to make only certain processing operations. They are not easily changed over from one product style to another. This form of automation needs high initial investments and high production rates. That is why it is suitable for products that are made in large volumes. The examples of fixed automation are machining transfer lines found in the automobile industry, automatic assembly machines and certain chemical processes.
2. Programmable automation is a form of automation for producing products in large quantities, ranging from several dozen to several thousand units at a time. For each new product the production equipment must be reprogrammed and changed over. This reprogramming and changeover take a period of non-productive time. Production rates in programmable automation are generally lower than in fixed automation, because the equipment is designed to facilitate product changeover rather than for product specialization. A numerical-control machine-tool is a good example of programmable automation. The program is coded in computer memory for each different product style and the machine-tool is controlled by the computer program.
3. Flexible automation is a kind of programmable automation. Programmable automation requires time to re-program and change over the production equipment for each series of new product. This is lost production time, which is expensive. In flexible automation the number of products is limited so that the changeover of the equipment can be done very quickly and automatically. The reprogramming of the equipment in flexible automation is done at a computer terminal without using the

production equipment itself. Flexible automation allows a mixture of different products to be produced one right after another. Today most robots are used in manufacturing operations. The applications of robots can be divided into three categories: 1.material handling, 2.processing operations, 3. assembly and inspection.

Material-handling is the transfer of material and loading and unloading of machines. Material-transfer applications require the robot to move materials or work parts from one to another. Many of these tasks are relatively simple: robots pick up parts from one conveyor and place them on another. Other transfer operations are more complex, such as placing parts in an arrangement that can be calculated by the robot. Machine loading and unloading operations utilize a robot to load and unload parts. This requires the robot to be equipped with a grip-per that can grasp parts. Usually the gripper must be designed specifically for the particular part geometry.

In robotic processing operations, the robot manipulates a tool to perform a process on the work part. Examples of such applications include spot welding, continuous arc welding and spray painting. Spot welding of automobile bodies is one of the most common applications of industrial robots. The robot positions a spot welder against the automobile panels and frames to join them. Arc welding is a continuous process in which robot moves the welding rod along the welding seam. Spray painting is the manipulation of a spray-painting gun over the surface of the object to be coated. Other operations in this category include grinding and polishing in which a rotating spindle serves as the robot's tool. The third application area of industrial robots is assembly and inspection. The use of robots in assembly is expected to increase because of the high cost of manual labor. But the design of the product is an important aspect of robotic assembly. Assembly methods that are satisfactory for humans are not always suitable for robots. Screws and nuts are widely used for fastening in manual assembly, but the same operations are extremely difficult for a one-armed robot.

Inspection is another area of factory operations in which the utilization of robots is growing. In a typical inspection job, the robot positions a sensor with respect to the work part and determines whether the part answers the quality specifications. In nearly all industrial robotic applications, the robot provides a substitute for human labor. There are certain characteristics of industrial jobs performed by humans that can be done by robots:

1. the operation is repetitive, involving the same basic work motions every cycle;
2. the operation is hazardous or uncomfortable for the human worker (for example: spray painting, spot welding, arc welding, and certain machine loading and unloading tasks);
3. the work piece or tool are too heavy and difficult to handle;
4. the operation allows the robot to be used on two or three shifts.

Exercise 1. Translate the following words from English into Ukrainian:

equipment sequence, initial, investment, to facilitate, rate, assembly machines, quantity, non-productive, changeover, handling, transfer, location, pick up, arrangement, to utilize, gripper, to grasp, spot welding, are welding, spray painting, frame, spray- painting gun, grinding, polishing, spindle, manual, labor, hazardous, shift.

Exercise 2. Answer the following questions:

1. What is the most important application of automation?
2. What are the types of automation used in manufacturing?
3. What is fixed automation?
4. What are the limitations of hard automation?
5. What is the best example of programmable automation?
6. What are the limitations of programmable automation?
7. What are the advantages of flexible automation?
8. Is it possible to produce different products one after another using automation technology?
9. How are robots used in manufacturing?

10. What is the material handling?
11. What does a robot need to be equipped with for performing loading and unloading operations?
12. What is the most common application of robots in automobile manufacturing?
13. What operations could be done by the robot in car manufacturing industry?
14. What are the main reasons to use robots in production?
15. How can robots inspect the quality of production?
16. What operations could be done by robots in hazardous or uncomfortable for the human workers conditions?

Exercise 3. Translate the following sentences from Ukrainian into English:

1. Існує декілька різних сфер використання автоматизації у виробництві.
2. Для виконання жорсткої автоматизації необхідні великі інвестиції.
3. Жорстка автоматизація широко використовується в хімічній промисловості.
4. Станки з числовим програмним управлінням – хороший приклад програмованої автоматизації.
5. Гнучка автоматизація робить можливим перепрограмування оснащення.
6. Час простою оснащення обертається великими збитками.
7. Використання гнучкої автоматизації робить можливим виробництво різноманітної продукції.

Exercise 4. Find the English equivalents to the following word combinations in the text:

1. сфера застосування
2. фіксована послідовність операцій
3. автоматичні збірні машини
4. визначені хімічні процеси
5. станок з числовим програмним управління
6. втрачений виробничий час

7. різноманітна продукція

Exercise 5. Explain in English the meaning of the following word combinations:

1. automation technology
2. fixed automation
3. assembly machines
4. non-productive time
5. programmable automation
6. computer terminal
7. numerical-control machine-tool

Exercise 6. Form derivatives from the following words and translate them into Ukrainian:

satisfy, apply, transfer, require, object, rotate, initial, respect, quality, serve.

Exercise 7. Complete the following sentences:

1. Assembly methods that are satisfactory for humans are not always suitable for … .
2. Machine loading and … operations utilize a robot to … and …parts.
3. … of automobile bodies is one of the most common applications of industrial robots.
4. The applications of robots can be divided into three categories: … .
5. …is a form of automation for producing products in large quantities, ranging from several dozen to several thousand units at a time.
6. …is a kind of programmable automation.
7. In … operations, the robot manipulates a tool to perform a process on the work part.
8. The third application area of industrial robots is… .

TEXT 4. TRANSFORMERS.

A **transformer** is a device that transfers electrical energy from one circuit to another through inductively coupled electrical conductors. A changing current in the first circuit (*the primary*) creates a changing magnetic field; in turn, this magnetic field induces a changing voltage in the second circuit (*the secondary*). By adding a load to the secondary circuit, one can make current flow in the transformer, thus transferring energy from one circuit to the other.

A key application of transformers is to reduce the current before transmitting electrical energy over long distances through wires. Most wires have resistance and so dissipate electrical energy at a rate proportional to the square of the current through the wire. By transforming electrical power to a high-voltage (and therefore low-current) form for transmission and back again afterwards, transformers enable economic transmission of power over long distances. Consequently, transformers have shaped the electricity supply industry, permitting generation to be located remotely from points of demand. All but a fraction of the world's electrical power has passed through a series of transformers by the time it reaches the consumer. Transformers are used extensively in consumer electronic products to step down the supply voltage to a level suitable for the low voltage circuits they contain. In these kinds of applications the transformer may also act as a key safety component that electrically isolates the end user from direct contact with the potentially lethal supply voltage.

Transformers are some of the most efficient electrical 'machines', with some large units able to transfer 99.75% of their input power to their output. Transformers come in a range of sizes from a thumbnail-sized coupling transformer hidden inside a stage microphone to huge units weighing hundreds of tons used to interconnect portions of national power grids. All operate with the same basic principles, though a variety of designs exist to perform specialized roles throughout home and industry.

The transformer is based on two principles: firstly, that an electric current can produce a magnetic field (electromagnetism) and, secondly, that a changing magnetic field within a coil of wire induces a voltage across the ends of the coil (electromagnetic induction). By changing the current in the primary coil, it changes the strength of its magnetic field; since the changing magnetic field extends into the secondary coil, a voltage is induced across the secondary.

Types of transformers:

- 1 Autotransformer
- 2 Polyphase transformers
- 3 Resonant transformers
- 4 Leakage transformers
- 5 Instrument transformers

A variety of specialized transformer designs has been created to fulfill certain engineering applications, though they share several commonalities. Several of the more important transformer types include:

Autotransformer.

An autotransformer has only a single winding with two end terminals, plus a third at an intermediate tap point. The primary voltage is applied across two of the terminals, and the secondary voltage taken from one of these and the third terminal. The primary and secondary circuits, therefore, have a number of windings turns in common. Since the volts-per-turn is the same in both windings, each develops a voltage in proportion to its number of turns. By exposing part of the winding coils and making the secondary connection through a sliding brush, an autotransformer with a near-continuously variable turns ratio is obtained, allowing for very fine control of voltage.

Polyphase transformers**.**

For three-phase supplies, a bank of three individual single-phase transformers can be used, or all three phases can be incorporated as a single three-phase transformer. In this case, the magnetic circuits are connected together, the core thus containing a three-phase flow of flux. A number of winding configurations are possible, giving rise to different attributes and phase shifts. One particular polyphase configuration is the zigzag transformer, used for grounding and in the suppression of harmonic currents.

Exercise 1. Translate the following words and word combinations from English into Ukrainian:

inductively coupled	specialized transformer
electrical conductors	autotransformer
induce	electricity supply industry
resistance	zigzag transformer
transmitting electrical energy	circuit

Exercise 2. Translate the following words and word combinations from Ukrainian into English:

індуктивно зв'язаний, синусоїдальний (гармонійний) струм, багатофазний трансформатор, клема, магнітне поле, напруга, фазове зрушення, схема.

Exercise 3. Read and translate the text.

Exercise 4. Answer the following questions:

1. What is a transformer?
2. What is the application of a transformer?
3. Where is it used?
4. Why may it also act as a key safety?
5. What are the basic principles of the transformer?
6. What are the types of the transformer?
7. What is an autotransformer?
8. What is a polyphase transformer?

Exercise 5. Find the prepositions which usually follow these verbs:

1. to transfer smth … smth … smth
2. to add … smth
3. to be used …
4. to act …
5. to be based …

Exercise 6. Match the words and word expressions with their definitions.

1. transformer   a) a flow of electricity through a wire

2. voltage   b) the ability of a substance to stop the flow of an electric current through it

3. resistance   c) a piece of equipment for changing electricity from one voltage to another

4. current   d) one of the points at which you can connect wires in

an electrical circuit

5. magnetic field e) electrical force measured in volts

6. terminal f) an area around an object that has magnetic power

Exercise 7. Refer to the text and complete the sentences below:

1. A transformer is a device that …
2. A key application of transformers is …
3. By transforming electrical power to a high-voltage …
4. In these kind of applications the transformer may also act as …
5. Transformers are some of the most efficient …
6. The transformer is based on …
7. An autotransformer has only a single

Exercise 8. Make dialogues. Discuss kinds of transformers and their types in pairs.

TEXT 5. CONSTRUCTION OF A TRANSFORMER. (PART I.)

- Cores
- Windings
- Coolant
- Terminals

Cores

Laminated steel cores

Transformers for use at power or audio frequencies typically have cores made of high permeability silicon steel. The steel has a permeability many times that of free space, and the core thus serves to greatly reduce the magnetizing current, and confine the flux to a path which closely couples the windings. Early transformer developers soon realized that cores constructed from solid iron resulted in prohibitive eddy-current losses, and their designs mitigated this effect with cores consisting of bundles of insulated iron wires. Later designs constructed the core by stacking layers of thin steel laminations, a principle that has remained in use. Each lamination is insulated from its neighbors by a thin non-conducting layer of insulation. The universal transformer equation indicates a minimum cross-sectional area for the core to avoid saturation.

The effect of laminations is to confine eddy currents to highly elliptical paths that enclose little flux, and so reduce their magnitude. Thinner laminations reduce losses, but are more laborious and expensive to construct. Thin laminations are generally used on high frequency transformers, with some types of very thin steel laminations able to operate up to 10 kHz.

A steel core's remanence means that it retains a static magnetic field when power is removed. When power is then reapplied, the residual field will cause a high inrush current until the effect of the remanent magnetism is reduced, usually after a few cycles of the applied alternating current.

Distribution transformers can achieve low no-load losses by using cores made with low-loss high-permeability silicon steel or amorphous (non-crystalline) metal alloy. The higher initial cost of the core material is offset over the life of the transformer by its lower losses at light load.

Solid cores

Powdered iron cores are used in circuits (such as switch-mode power supplies) that operate above main frequencies and up to a few tens of kilohertz. These materials combine high magnetic permeability with high bulk electrical resistivity. For frequencies extending beyond the VHF band, cores made from non-conductive magnetic ceramic materials called ferrites are common. Some radio-frequency transformers also have moveable cores (sometimes called 'slugs') which allow adjustment of the coupling coefficient (and bandwidth) of tuned radio-frequency circuits.

Toroidal cores

Toroidal transformers are built around a ring-shaped core, which, depending on operating frequency, is made from a long strip of silicon steel or permalloy wound into a coil, powdered iron, or ferrite. A strip construction ensures that the grain boundaries are optimally aligned, improving the transformer's efficiency by reducing the core's reluctance.

Toroidal transformers are more efficient than the cheaper laminated E-I types for a similar power level. Other advantages compared to E-I types, include smaller size (about half), lower weight (about half), less mechanical hum (making them superior in audio amplifiers), lower exterior magnetic field (about one tenth), low off-load losses (making them more efficient in standby circuits), single-bolt mounting, and greater choice of shapes. The main disadvantages are higher cost and limited rating.

Air cores

A physical core is not an absolute requisite and a functioning transformer can be produced simply by placing the windings in close proximity to each other, an arrangement termed an "air-core" transformer. The air which comprises the magnetic circuit is essentially lossless, and so an air-core transformer eliminates loss due to hysteresis in the core material. The leakage inductance is inevitably high, resulting in very poor regulation, and so such designs are unsuitable for use in power distribution. They have however very high bandwidth, and are frequently employed in radio-frequency applications, for which a satisfactory coupling coefficient is maintained by carefully overlapping the primary and secondary windings.

Exercise 1. Translate the following words and word combinations from English into Ukrainian:

laminated
bandwidth
silicon steel
permalloy
saturation
inrush current
powdered iron core
reluctance
electrical resistivity
flux.

Exercise 2. Translate the following words and word combinations from Ukrainian into English: Повітряний сердечник

залишкова індукція

охолоджувач

досягати

індуктивність розсіювання

залізо

магнітний потік

клема

звукові частоти.

Exercise 3. Read and translate the text.

Exercise 4. By reference to the text, answer these questions:

1. What is the construction of a transformer?
2. What are the types of the transformer cores?
3. What material are the laminated steel cores made of?
4. What is the effect of laminations?
5. What does “a steel core's remanence” mean?
6. What are characteristics of a solid core?
7. What are advantages and disadvantages of toroidal core?
8. What is the air core?

Exercise 5. Match the words and word expressions with their definitions.

1. Core	a) the process of making something using many parts
2. Steel	b) able to conduct electricity, heat etc.
3. Solid	c) how big or small something is
4. Air	d) the part inside an object that is the nearest to its center

5. Conductive — e) strong metal that can be shaped easily, consisting of iron and carbon
6. Size — f) hard or firm, with a fixed shape, and not a liquid or gas
7. Construction — g) the mixture of gases around the Earth

Exercise 6. Refer to the text and complete the sentences below:

1. Later designs constructed the core …
2. The effect of laminations is …
3. A steel core's remanence means …
4. Powdered iron cores are used in …
5. Toroidal transformers are built around …
6. The air which comprises the magnetic circuit is …

Exercise 7. Discuss the construction of a transformer in pairs.

TEXT 6. CONSTRUCTION OF A TRANSFORMER. (PART 2.)

- *Cores*
- *Windings*
- *Coolant*
- *Terminals*

Windings

The conducting material used for the windings depends upon the application, but in all cases the individual turns must be electrically insulated from each other to ensure that the current travels throughout every turn. For small power and signal transformers, in which currents are low and the potential difference between adjacent turns is small, the coils are often wound from enamelled magnet wire, such as Formvar wire. Larger power transformers operating at high voltages may be wound with copper rectangular strip conductors insulated by oil-impregnated paper and blocks of pressboard.

High-frequency transformers operating in the tens to hundreds of kilohertz often have windings made of braided litz wire to minimize the skin-effect and proximity effect losses. Large power transformers use multiple-stranded conductors as well, since even at low power frequencies non-uniform distribution of current would otherwise exist in high-current windings. Each strand is individually insulated, and the strands are arranged so that at certain points in the winding, or throughout the whole winding, each portion occupies different relative positions in the complete conductor. The transposition equalizes the current flowing in each strand of the conductor, and reduces eddy current losses in the winding itself. The stranded conductor is also more flexible than a solid conductor of similar size, aiding manufacture.

For signal transformers, the windings may be arranged in a way to minimize leakage inductance and stray capacitance to improve high-frequency response. This can be done by splitting up each coil into sections, and those sections placed in layers between the sections of the other winding. This is known as a stacked type or interleaved winding.

Both the primary and secondary windings on power transformers may have external connections, called taps, to intermediate points on the winding to allow selection of the voltage ratio. Audio-frequency transformers, used for the distribution of audio to public address loudspeakers, have taps to allow adjustment of impedance to each speaker. A center-tapped transformer is often used in the output stage of an audio power amplifier in a push-pull circuit. Modulation transformers in AM transmitters are very similar.

Coolant

Extended operation at high temperatures is particularly damaging to transformer insulation. Small signal transformers do not generate significant heat and need little consideration given to their thermal management. Specific provision must be made for cooling high-power transformers, the larger physical size requiring careful design to transport heat from the interior. Some power transformers are immersed in specialized transformer oil that acts both as a cooling medium, thereby extending the lifetime of the insulation, and helps to reduce corona discharge. The oil is a highly refined mineral oil that remains stable at high temperatures so that internal arcing will not cause breakdown or fire; transformers to be used indoors must use a non-flammable liquid.

The oil-filled tank often has radiators through which the oil circulates by natural convection; large transformers employ forced circulation of the oil by electric pumps, aided by external fans or water-cooled heat exchangers. Oil-filled transformers undergo prolonged drying processes to ensure that the transformer is completely free of water vapor before the cooling oil is introduced. This helps prevent electrical breakdown under load.

Terminals

Very small transformers will have wire leads connected directly to the ends of the coils, and brought out to the base of the unit for circuit connections. Larger transformers may have heavy bolted terminals, bus bars or high-voltage insulated bushings made of polymers or porcelain. A large bushing can be a complex structure since it must provide careful control of the electric field gradient without letting the transformer leak oil.

Exercise 1. Translate the following words and word combinations from English into Ukrainian:

conducting material
pressboard
depends upon
insulated
oil-impregnated paper
minimize leakage inductance
stray capacitance
current losses
audio-frequency transformers

Exercise 2. Translate the following words and word combinations from Ukrainian into English:

Суміжний
природна (вільна) конвекція
обмотувальний провід електромагніта
амплітудна модуляція
коронний розряд
виток

Exercise 3. By reference to the text, answer these questions:

1. What is the construction of a transformer?
2. What can you say about winding?
3. Why does the transformer need the coolant?
4. What is the transformer oil?
5. What helps prevent electrical breakdown under load?
6. What are the characteristics of the terminal?

Exercise 4. Find the prepositions which usually follow these verbs:

to act …

to depend …

to be insulated …

to be used …

be made …

to lead …

Exercise 5. Match the words and word expressions with their definitions.

1. depend; 2. ensure; 3. conductor; 4. amplifier; 5. rectangular;

a) having the shape of a rectangle;

b) used to say that you cannot give a definite answer to something because your answer will be affected by something else;

c) a piece of electrical equipment that makes sound louder

d) to make certain that something will happen properly

e) something that allows electricity or heat to travel along it or through it.

Exercise 6. Refer to the text and complete the sentences below:

1. The conducting material used for …
2. Larger power transformers operating at high voltages may be …
3. High-frequency transformers operating in the tens to hundreds …
4. The stranded conductor is also more …
5. Both the primary and secondary windings on power transformers may …
6. Modulation transformers in AM transmitters are very …
7. Some power transformers are immersed in specialized transformer oil that …
8. Oil-filled transformers undergo prolonged drying processes …

Exercise 7. Discuss the construction of transformer in pairs.

Exercise 8. Put 10 questions to the text.

TEXT 7. TURBINE.

Steam turbine

The purpose of a steam turbine is to convert heat energy contained in high pressure and high temperature steam into mechanical energy. The source of the high pressure and high temperature steam is a boiler, usually in a power station. Fossil fuel (i.e. coal) or nuclear energy is consumed to provide the heat energy in the boiler.

A steam turbine is a mechanical device that extracts thermal energy from pressurized steam, and converts it into useful mechanical work. It has almost completely replaced the reciprocating piston steam engine, primarily because of its greater thermal efficiency and higher power-to-weight ratio. Also, because the turbine generates rotary motion, rather than requiring a linkage mechanism to convert reciprocating to rotary motion, it is particularly suited for use driving an electrical generator — about 86% of the world's electricity is generated using steam turbines. The steam turbine is a form of heat engine that derives much of its improvement in thermodynamic efficiency from the use of multiple stages in the expansion of the steam, rather than a single stage.

Gas turbine

The purpose of a gas turbine is to convert chemical energy contained in paraffin or diesel into mechanical energy.

Energy is released when compressed air is mixed with fuel and ignited in the combustor. The resulting gases are directed over the turbine's blades, spinning the turbine, and mechanically powering the compressor. Finally, the gases are passed through a nozzle, generating additional thrust by accelerating the hot exhaust gases by expansion back to atmospheric pressure.

The essential mechanical components of a gas turbine are compressor, combustion chamber and turbine.

Compressor

The air compressor, as the name suggests, compresses the incoming air to about 5 or 6 times atmospheric pressure. Generally in larger turbines, axial compressors are used, as opposed to redial or centrifugal compressor. In axial compressor the air passes through the compressor blades in an axial fashion. This is in contrast to the radial or centrifugal compressor where the air enters the centre of the rotating impeller and thrown outward by centrifugal force and pressured.

The air is compressed as the combustion of compressed air and fuel is more efficient than the combustion of uncompressed air and fuel.

Combustion Chamber

Again, as the name suggests, this is the region where the fuel is combusted with the pressurized air from the compressor. The schematic represents the combustion chamber as rectangular object. The combustion chambers are sometimes called “cans”, because they are really just that – hollow metal boxes! The fuel is injected into the chamber at high pressure and the combustor is shaped so as to optimally mix the pressured air and fuel for complete combustion.

What about the combustion chamber metal walls, don’t they melt? The approximate metal skin temperature of the modern combustors may reach 1100 degrees Celsius, which require special alloy steels.

Turbine

What is a turbine? Turbine is an engine or a machine that uses the pressure of liquid or gas on a wheel to get power. The simplest turbines have one moving part, a rotor assembly, which is a shaft with blades attached. Moving fluid acts on the blades, or the blades react to the flow, so that they rotate and impart energy to the rotor.

Impulse turbines

These turbines change the direction of flow of a high velocity fluid jet. The resulting impulse spins the turbine and leaves the fluid flow with diminished kinetic energy. There is no pressure change of the fluid in the turbine rotor blades. Impulse turbines do not require a pressure casement around the runner since the fluid jet is prepared by a nozzle prior to reaching turbine.

Reaction turbines

These turbines develop torque by reacting to the fluid's pressure or weight. The pressure of the fluid changes as it passes through the turbine rotor blades. A pressure casement is needed to contain the working fluid as it acts on the turbine stage(s) or the turbine must be fully immersed in the fluid flow (wind turbines).

Exercise 1. Translate the following words and word combinations from English into Ukrainian:

turbine	combustion chamber
convert	axial
power station	components
fossil fuel	blade
nuclear energy	radial
heat energy,	centrifugal
steam,	impeller
rectangular	shaft
alloy steel	boiler
coal	paraffin
nozzle	thrust.

Exercise 2. Translate the following words and word combinations from Ukrainian into English:

Відцентровий компресор	парова турбіна
Теплова енергія	радіальный компресор

камера згорання	вістовий компресор
легована сталь	котел
керосин	вал

Exercise 3. Answer the following questions:

1. What is the purpose of a steam turbine?
2. Where is a steam turbine used/applied?
3. What is consumed in order to provide the heat energy in the boiler?
4. What is the purpose of a gas turbine?
5. What are the basic components of a gas turbine engine?
6. What is the name of the unit that compresses the incoming air?
7. Why is the air compressed?
8. What is a combustion chamber?

Exercise 4. Refer to the text and complete the sentences below:

1. The essential mechanical components of a gas turbine are …..
2. The air is compressed as ….
3. The approximate metal skin temperature of the modern combustors may reach ……

Exercise 5. Answer the following questions.

1. What word means “to convert”?
2. What word means “one of different parts that a machine or piece of equipment consists of”?
3. How could you explain the term “combustion chamber”?
4. Give the definition to the word “turbine”?

Exercise 6. Match the words and word expressions with their definitions.

1. Gas turbine; 2. Steam engine; 3. Compressor;
4. Gas; 5. Steam.

a) An engine that works by steam power
b) A machine or a part of machine that compresses air or gas
c) A substance such air, which is not solid or liquid, and usually cannot be seen
d) The hot mist that water produces when it is boiled
e) An engine in which a wheel of special blades is driven round at high speed by hot gases, producing a lot of power.

Exercise 7. Discuss the types of turbines in pairs.

Exercise 8. Put 10 questions to the text.

TEXT 8. ELECTRIC FURNACE.

Electric Furnace, electrically heated device used industrially for melting metals or firing ceramics. It is also known as an electrochemical furnace.

The simplest type of electric furnace is the resistance furnace, in which heat is generated by passing a current through a resistance element surrounding the furnace or by utilizing the resistance of the material being heated. The heating element in an externally heated furnace may take the form of a coil of metal wire wound around a tube of refractory material or it may be a tube of metal or other resistive material such as carborundum. Resistance furnaces are particularly useful in applications in which a small furnace, with precisely controlled temperatures, is needed. Small resistance furnaces are widely used in laboratories and in shops for the heat treatment of tools. Larger furnaces are used for firing ceramics and melting metals. The highest temperature at which resistance furnaces are operated, for example, in the manufacture of graphite, is in the neighborhood of 4100° C (7366° F).

The electric-arc furnace is the most widely used type of electric furnace for the production of quality alloy steels and range in capacity from 227 kg (500 lb) to 181 metric tons.

In these furnaces the heat is generated by an arc struck between the metal being heated and one or more electrodes suspended above the metal. A typical form of arc furnace has three electrodes, fed by a three-phase power supply, giving three heating arcs. The electrodes are made either of graphite or of carbon.

A more recently developed type of electric furnace is the induction furnace, consisting of a crucible in which a metallic charge is heated by eddy currents induced magnetically. Around the crucible is wound a coil through which high-frequency alternating currents are passed. The magnetic field of this coil sets up eddy currents in the metal in the crucible. Induction furnaces have a number of advantages, chief among them being the speed at which metal can be melted. At comparatively low frequencies the induced eddy currents exert a stirring action on the molten metal.

Because the higher frequencies are the most effective for heating, some induction furnaces have two coils, one for high-frequency current and one for low-frequency. The earlier types of induction furnaces operated at frequencies between 60 and 60,000 cycles per second, but some modern furnaces are designed to use frequencies of 1 million cycles or more per second.

A special type of furnace, called an electrolytic furnace, is used in the production of aluminum, magnesium, and sodium. In the electrolytic furnace, a salt is fused by the heat generated by the passage of a large electric current and is at the same time electrolyzed so that the pure metal is deposited at one electrode.

Exercise1. Choose the correct answer:

1) What frequencies were used in the operation of earlier types of induction furnaces?

a) 60-60,000 cycles per second

b) 70-70,000 cycles per second

c) 80-80,000 cycles per second

d) 90-90,000 cycles per second

2) What does pronoun “it” mean in the third line?

a) metal

b) ceramics

c) device

d) electric furnace

Exercise 2. Answer the following questions.

1. What types of furnaces do you know?
2. Which type of furnaces is the simplest? What is the principle of its operation?
3. Where can the resistance furnaces be applied?
4. How many electrodes does a typical arc furnace have?
5. What are the components of the induction furnace?

6. What frequencies are more effective for heating?
7. What are the advantages of induction furnaces?
8. What is an electric furnace?
9. What are the differences between earlier types of induction furnaces and some modern ones?
10. How many coils do the inductive furnaces have?

Exercise 3. Translate the following word combinations from English into Ukrainian:

1) electrically heated device
2) element surrounding the furnace
3) resistive material
4) heat treatment of tools
5) in the neighborhood of
6) production of quality alloy steels
7) to be the most widely used
8) range in capacity
9) alternating current
10) high-frequency

Exercise 4. Translate the following words and word combinations from Ukrainian into English:

1) елемент, що нагрівається
2) точно скерована температура
3) піч електричної дуги
4) метрична тонна
5) електроживлення

6) піч індукції
7) низькі частоти
8) магнітне поле
9) арки, що нагріваються
10) труба металу

Exercise 5. Define whether the following statement is true or false.

1) The simplest type of electric furnace is the induction furnace.
2) Resistance furnaces are particularly useful in applications in which a large furnace is needed.
3) A more recently developed type of electric furnace is the induction furnace.
4) At comparatively low frequencies the induced eddy currents exert a stirring action on the molten metal.
5) Electric Furnace is electrically heated device used for heat treatment of tools.

Exercise 6. Choose the most appropriate word for each sentence from the list below and fill in the gaps.

type metals designed wire

coil element form furnace operated

1) An electric furnace is an electrically heated device used industrially for melting ________ or firing ceramics.

2) Resistance furnaces are particularly useful in applications in which a small ________, with precisely controlled temperatures, is needed.

3) The earlier types of induction furnaces ___________at frequencies between 60

and 60,000 cycles per second, but some modern furnaces are _____________to use frequencies of 1 million cycles or more per second.

4) The magnetic field of this __________sets up eddy currents in the metal in the crucible.

5) The electric-arc furnace is the most widely used___________ of electric furnace.

6) The heating___________ in an externally heated furnace may take the___________ of a coil of metal ______wound around a tube of refractory material or it may be a tube of metal or other resistive material such as carborundum.

Exercise 7. Choose one type of the furnace. Discuss with your partner its characteristics, operational principle, advantages and disadvantages.

Exercise 8. Summarize the text.

TEXT 9. DISTRIBUTED CONTROL SYSTEM.

A distributed control system (DCS) refers to a control system usually of a manufacturing system, process or any kind of dynamic system, in which the controller elements are not central in location (like the brain) but are distributed throughout the system with each component sub-system controlled by one or more controllers. The entire system of controllers is connected by networks for communication and monitoring.

DCS is a very broad term used in a variety of industries, to monitor and control distributed equipment (electrical power grids and electrical generation plants, environmental control systems, traffic signals, water management systems, oil refining plants, chemical plants, pharmaceutical manufacturing, sensor networks, dry cargo and bulk oil carrier, elements).

A DCS typically uses custom designed processors as controllers and uses both proprietary interconnections and protocols for communication. Let's study the input and output modules form component parts of the DCS. The processor receives information from input modules and sends information to output modules. The input modules receive information from input instruments in the process (a.k.a. field) and output modules transmit instructions to the output instruments in the field. Computer buses or electrical buses connect the processor and modules through multiplexers/demultiplexers. Buses also connect the distributed controllers with the central controller and finally to the Human-Machine Interface (HMI) or control consoles. See Process Automation System. Elements of a distributed control system may directly connect to physical equipment such as switches, pumps and valves or may work through an intermediate system such as a SCADA system.

Applications: Distributed Control Systems (DCSs) are dedicated systems used to control manufacturing processes that are continuous or batch-oriented, such as oil refining, petrochemicals, central station power generation, pharmaceuticals, food & beverage manufacturing, cement production, steelmaking, and papermaking. DCSs are connected to sensors and actuators and use setpoint control to control the flow of material through the plant. The most common example is a setpoint control loop consisting of a pressure sensor, controller, and control valve. Pressure or flow measurements are transmitted to the controller, usually through the aid of a signal conditioning Input/Output (I/O) device. When the measured variable reaches a certain point, the controller instructs a valve or actuation device to open or close until the fluidic flow process reaches the desired setpoint. Large oil refineries have many thousands of I/O points and employ very large DCSs. Processes are not limited to fluidic flow through pipes, however, and can also include things like paper machines and their associated variable speed drives and motor control centers, cement kilns, mining operations, ore processing facilities, and many others. A typical DCS consists of functionally and/or geographically distributed digital controllers capable of executing from 1 to 256 or more regulatory control loops in one control box. The input/output devices (I/O) can be integral with the controller or located remotely via a field network. Today's controllers have extensive computational capabilities and, in addition to proportional, integral, and derivative (PID) control, can generally perform logic and sequential control. DCSs may employ one or several workstations and can be configured at the workstation or by an off-line personal computer. Local communication is handled by a control network with transmission over twisted pair, coaxial, or fiber optic cable. A server and/or applications processor may be included in the system for extra computational, data collection, and reporting capability.

History: Early minicomputers were used in the control of industrial processes since the beginning of the 1960's. The IBM 1800, for example, was an early computer that had input/output hardware to gather process signals in a plant for conversion from field contact levels (for digital points) and analog signals to the digital domain. The DCS was introduced in 1975. Both Honeywell and Japanese electrical engineering firm Yokogawa introduced their own independently produced DCSs at roughly the same time, with the TDC 2000 and CENTUM[1] systems, respectively. US-based Bristol also introduced their UCS 3000 universal controller in 1975. In 1980, Bailey (now part of ABB[2]) introduced the NETWORK 90 system. Also in 1980, Fischer & Porter Company (now also part of ABB[3]) introduced DCI-4000 (DCI stands for Distributed Control Instrumentation). The DCS largely came about due to the increased availability of microcomputers and the proliferation of microprocessors in the world of process control. Computers had already been applied to process automation for some time in the form of both Direct Digital Control (DDC) and Set Point Control. In the early 1970's Taylor Instrument Company, (now part of ABB) developed the 1010 system, Foxboro the FOX1 system and Bailey Controls the 1055 systems. All of these were DDC applications implemented within mini-computers (DEC PDP 11, Varian Data Machines, MODCOMP etc) and connected to proprietary Input/Output hardware. Sophisticated (for the time) continuous as well as batch control was implemented in this way. A more conservative approach was Set Point Control , where process computers supervised clusters of analog process controllers. A CRT-based workstation provided visibility into the process using text and crude character graphics. Availability of a fully functional graphical user interface was a way away.

Central to the DCS model was the inclusion of control function blocks. Function blocks evolved from early, more primitive DDC concepts of "Table Driven" software. One of the first embodiments of object-oriented software, function blocks were self contained "blocks" of code that emulated analog hardware control components and performed tasks that were essential to process control, such as execution of PID algorithms. Function blocks continue to endure as the predominant method of control for DCS suppliers, and are supported by key technologies such as Foundation Fieldbus[4] today.

Digital communication between distributed controllers, workstations and other computing elements (peer to peer access) was one of the primary advantages of the DCS. Attention was duly focused on the networks, which provided the all-important lines of communication that, for process applications, had to incorporate specific functions such as determinism and redundancy. As a result, many suppliers embraced the IEEE 802.4 networking standard. This decision set the stage for the wave of migrations necessary when information technology moved into process automation and IEEE 802.3 rather than IEEE 802.4 prevailed as the control LAN.

Exercise 1. Answer the following questions:

1. What does a distributed control system (DCS) refer to?
2. Where can we use Distributed Control Systems?
3. What can you say about its history?

Exercise 2. Complete the following sentences:

1. The entire system of controllers is connected by… .
2. DCS is a very broad term used in … .
3. The processor receives information from input modules and … .
4. … processors as controllers and uses both proprietary interconnections and protocols for communication.
5. Elements of a distributed control system may directly connect to … such as switches, pumps and valves or may work through an intermediate system such as … system.
6. The most common example is a setpoint control loop consisting of … .
7. Early minicomputers were used in … .

Exercise 3. Write down the synonyms to the following words:

production
specific
essential
throughout
for example
transmit

power

provide

continue

universal.

Exercise 4. Write down the derivatives from the following words and translate them:

to measure	to know	to divide	to receive
unit	to consider	to require	net
equal	to produce	excess	

manufacture

number	to supply	to develop	direct

media

Exercise 5. Put the questions to the following sentences:

1. Local communication is handled by a control network with transmission over twisted pair, coaxial, or fiber optic cable.
2. The processor receives information from input modules and sends information to output modules.
3. DCS is a very broad term used in a variety of industries, to monitor and control distributed equipment.

Exercise 6. Write down the advantages of distributed control systems.

TEXT 10. OVERVIEW OF COMPUTERIZED ENERGY MANAGEMENT.

Today’s buildings and their potential for enhanced energy management.

The evolution of automatic building control began in the 1880s. The first innovation was a bimetal-based thermostat controlled space temperature by adjusting a draft damper on a coal-fired furnace or boiler. In 1890, the first pneumatic-powered control became available.

Today automated energy control has become standard practice. Virtually all nonresidential buildings have automatic controllers with a computer as the central processor. These systems are called Energy Management Systems (EMS), Energy Management Control Systems (EMCS), or Building Automation Systems (BAS). Today’s building owners and facility managers must regularly address the issue of computerized energy management—assessing existing systems, specifying and commissioning new systems, or optimizing EMS operations.

Controls technology is evolving at a rapid pace. Even for recently installed EMS, there are numerous possibilities for system replacements or upgrades: more powerful computers; more zone-level control; more accurate sensors; more complex control programs; better service; and other enhancements. Continuously advancing technology, combined with the dynamic nature of today’s buildings, makes decisions more complicated for building owners.

Many of the advanced features of EMS are under-utilized. For example, the trending and monitoring capabilities of EMS are powerful tools for improving heating, ventilation, air-conditioning (HVAC) and lighting and for reducing energy use, but most facility managers and system operators simply do not have the time to fully investigate these resources. Those responsible for EMS upgrade or purchase are not always able to study their facility’s exact energy management needs themselves; they may rely on vendors to provide specifications—and they may not receive the optimal system for their building. Furthermore, the commissioning process, which can be critical to the success of an EMS, is relatively unknown to most facility staff.

Basic EMS Capabilities

Before trying to optimize a system, it is important to understand basic EMS capabilities. Features may vary widely from model to model, but some basic capabilities are almost universal. This section will discuss several of the standard EMS capabilities:

- Scheduling
- Setpoints
- Alarms
- Safeties
- Basic monitoring and trending

With each of these features, there are opportunities to move beyond minimal utilization without significant effort or complexity.

Alarms

In addition to basic alarm functionality, an EMS provides options in specifying how alarms are monitored, reported, routed, and ultimately dealt with. For any monitored or controlled point, most systems' basic alarm functions can be set up to register and display the following:

- Equipment failures
- Sensor failures
- High parameter value (temperature, pressure, etc.)
- Low parameter value (temperature, pressure, etc.)
- Invalid temperatures
- Manual override of machinery at remote locations

• Communications problems

Alarm Features. Alarms are fundamental and critically important, so most systems will need little or no extra configuration to provide basic alarm functionality. However, building managers benefit from alarm-handling features that assist in formulating a quick and accurate response. Alarm messaging provides extra information on the source of the alarm, such as the state of the equipment when the alarm was generated. Additional messages can sometimes be attached to alarms as well. Alarm routing is a feature that gives flexibility in delivering messages to a prescribed series of outputs (e.g. computer screens, printers, or remote monitoring sites via modem).

Often there is a distinction between an "alarm" and a "warning." A point may generate a warning if it is slightly out of range but an alarm if it is significantly out of range.

Exercise 1. Translate the following words and word combinations from English into Ukrainian:

bimetal-based
a draft damper
coal-fired furnace
pneumatic-power
central processor
Energy Management Systems
computerized
assess
evolve
accurate sensors
optimize
remote
provide

sensor

enhanced

Exercise 2. Translate the following words and word combinations from Ukrainian into English:

система управління споживанням енергії

пристрій

сигналізація

розвиватися

постачати

основні характеристики

датчик

Exercise 3. Read and translate the text

Exercise 4. Answer the following questions:

1. What was the first innovation?
2. How is controls technology evolving? And why?
3. Why are many of the advanced features of EMS under-utilized?
4. What are the basic EMS capabilities?
5. What are the basic alarm functions?
6. What is the difference between an “alarm” and a “warning?
7. What is the Energy Management System?

Exercise 5. Find the synonyms to the following words in the text:

1. improved 5. complicated

2. fixed 6. best

3. start 7. features

4. active 8. difference

Exercise 6. Match the words and word expressions with their definitions.

1. bimetal
2. utilize
3. optimize
4. evolve
5. equipment
6. alarm
7. thermostat
8. Sensor

a) a device for regulating the temperature of a system so that the system's temperature is maintained near a *setpoint* temperature

b) the tools, machines, or other things that you need for a particular purpose

c) refers to an object that is composed of two separate metals joined together

d) a piece of equipment that reacts to physical changes

e) to gradually change and develop over a period of time

f) to use something

g) to make a method or process as good and effective as possible

h) a piece of equipment that makes a loud noise to warn you of danger

Exercise 7. Refer to the text and complete the sentences below:

1. Virtually all nonresidential buildings have automatic controllers…
2. Controls technology is…

3. Features may vary widely from model to model…
4. Today’s building owners and facility managers must regularly address the issue of computerized energy management…

Exercise 8. Discuss the Energy Management Systems in pairs.

SUPPLEMENTARY TEXTS

TEXT 1

Translate from Ukrainian into English:

Автоматиза́ція — один з напрямів науково-технічного прогресу, спрямований на застосування саморегульованих технічних засобів, економіко-математичних методів і систем керування, що звільняють людину від участі в процесах отримання, перетворення, передачі і використання енергії, матеріалів чи інформації, істотно зменшують міру цієї участі чи трудомісткість виконуваних операцій. Разом з терміном автоматичний, використовується поняття автоматизований, що підкреслює відносно великий ступінь участі людини в процесі.

Автоматизація, окрім об'єкта керування вимагає додаткового застосування давачів (сенсорів), керуючих пристроїв (контролерів із засобами вводу-виводу), виконавчих механізмів та у переважній більшості базується на основі використання електронної техніки та методів обчислень, що іноді копіюють нервові і розумові функції людини.

Автоматизуються:

- виробничі (технологічні) процеси;
- проектування;
- організація, планування та управління;
- наукові дослідження.
- бізнес-процеси.

TEXT 2

Translate from Ukrainian into English:

Мета автоматизації — підвищення продуктивності праці, поліпшення якості продукції, оптимізація управління, усунення людини від виробництв, небезпечних для здоров'я.

Автоматизація, за винятком простих випадків, вимагає комплексного, системного підходу до рішення задачі, тому конкретні вирішення завдань засобами автоматизації, зазвичай називаються системами, наприклад:

- система автоматичного керування (САК);
- автоматизована система управління (АСУ);
- система автоматизації проектних робіт (САПР);
- автоматизована система управління технологічним процесом (АСУ ТП).

Система автоматизації — інформаційно об'єднана сукупність програмованих пристроїв автоматизованого та автоматичного контролю, регулювання та управління.

Галузі, де автоматизація є актуальною: виробництво сталі, гірнича справа, машинобудування, хімічне виробництво, харчова промисловість, енергетика, керування автомобільним, залізничним і повітряним транспортом.

Складовими елементами системи автоматизації є підсистеми:

1. Технологічної та аварійної сигналізації.
2. Автоматичного блокування і технологічного захисту.
3. Аварійного керування.
4. Реєстрації стану керованого процесу і дій оператора.
5. Комунікації даних між пристроями системи та із зовнішніми інформаційними системами.

TEXT 3

Translate from Ukrainian into English:

Автома́тика (грец. *Αὐτόματος* — самодіючий) — галузь науки і техніки, яка розробляє технічні засоби і методи для здійснення технологічних процесів без безпосередньої участі людини. Формування автоматики як наукової дисципліни відноситься до порівняно недавнього часу.

Спочатку вона розвивалась на базі наукових досягнень суміжних галузей, і окремі теоретичні питання її розроблялися ін. науковими дисциплінами. Проте бурхливий розвиток автоматики за останні роки привів до сформування її в окрему наукову дисципліну. Істотний вклад у розвиток автоматики внесли радянські вчені, завоювавши на деякий час пріоритет радянської науки в розв'язанні багатьох важливих проблем автоматики.

Нині автоматизація широко застосовується в різних галузях народного господарства (у промисловості, зв'язку, на транспорті, в комунальному господарстві тощо), а також у військовій справі.

В ряді галузей промислового виробництва створюються повністю автоматизовані цехи і заводи, наприклад автоматизовані бетонні заводи, автоматизовані млини, хлібозаводи тощо. Втіленням ідей автоматизації у машинобудуванні є автоматичний завод по виготовленню деталей машин.

Задачами автоматизації виробництва є автоматичний контроль (включаючи автоматичну сигналізацію і автоматичний захист устаткування), автоматичне регулювання і автоматичне керування.

Ці задачі вирішуються шляхом створення систем автоматизації як інформаційно об'єднаної сукупності програмованих пристроїв автоматизованого та автоматичного контролю, регулювання та керування. Системи автоматизації будуються на основі пристроїв промислової автоматики.

Сприяючи ліквідації істотних відмінностей між фізичною і розумовою працею і забезпечуючи небувалий розвиток продуктивних сил, автоматика є одним з основних елементів технічного суспільства. Прогрес суспільства, науково-технічна революція можливі тільки на основі широкого впровадження нової техніки, комплексної механізації і автоматизації виробничих процесів в усіх галузях господарства.

Автомати́чна систе́ма керува́ння — це сукупність керованого об'єкта й автоматичних вимірювальних та керуючих пристроїв.

На відміну від автоматизованої системи керування, ця система самодіюча і реалізує встановлені функції процеси автоматично, без участі людини (крім етапів пуску та налагодження системи). На практиці часто послуговуються терміном-аналогом *система автоматичного керування* (САК).

Автоматичним регулюванням називають підтримку на заданому рівні певної фізичної (хімічної) величини, що характеризує процес, або зміну її згідно із заданим законом.

Автоматичне керування — більш широке поняття, в цьому випадку здійснюється сукупність впливів на процес, вибраних з певної множини можливих.

TEXT 4

Translate from Ukrainian into English:

Автоматизо́вана систе́ма керува́ння (АСК), Автоматизована система управління (АСУ) — автоматизована система, що ґрунтується на комплексному використанні технічних, математичних, інформаційних та організаційних засобів для управління складними технічними й економічними об'єктами. АСК - це сукупність керованого об’єкта й автоматичних вимірювальних та керуючих пристроїв, у якій частину функцій виконує людина.

АСУ являє собою систему управління, яка орієнтована на широке й комплексне використання технічних засобів і економіко-математичних методів для розв'язування інформаційних завдань управління.

Створені за тридцятилітню історію впровадження ЕОМ у сферу управлінської діяльності численні АСУ різняться призначенням, проблемною орієнтацією, місцем застосування, автоматизованими функціями і т. ін. З метою підвищення ефективності витрат на розвиток діючих систем та проектування нових, усунення паралелізму і дублювання в проведенні наукових досліджень і проектно-конструкторських робіт, створення типових проектних рішень і типових АСУ зроблено їх класифікацію.

Призначена для автоматизації процесів збирання та пересилання інформації про об'єкт керування, її перероблення та видавання керівних дій на об'єкт керування; сукупність економіко-математичних методів, технічних засобів (ЕОМ, пристроїв відображення інформації, засобів зв'язку та інші) і організаційної структури, що забезпечують раціональне керування складними об'єктами і процесами.

TEXT 5

Translate from Ukrainian into English:

АСК дає змогу розв'язувати задачі перспективного та оперативного планування виробництва, оперативного розподілу завантаження обладнання, оптимального розподілу обладнання та використання ресурсів і інше. АСК належить до класулюдино-машинних систем і складається з функціональної і забезпечувальної частин.

Функціональна частина АСК включає систему моделей планово-економічних і управлінських задач, забезпечувальна частина — інформаційну і технічну бази, математичне забезпечення, економіко-організаційну базу та інше.

Інформаційна база АСК — це розміщена на машинних носіях інформації сукупність всіх масивів даних, необхідних для автоматизації керування об'єктом або процесом.

Технічна база — комплекс технічних засобів збору, передачі, обробки, накопичення і видачі даних, а також пристроїв, що безпосередньо впливають на об'єкти управління.

Математичне (програмне) забезпечення АСК поділяється на системне і спеціальне. Перше включає операційні системи (ОС), призначені для управління роботою пристроїв обчислювальних машини, організації черговості виконання обчислених робіт, контролю й управління процесом обробки даних, а також для автоматизації роботи програмістів. За допомогою операційних систем здійснюється також звернення до ЕОМ з віддалених абонентських пунктів.

TEXT 6

Translate from Ukrainian into English:

Найвищою класифікаційною ознакою АСУ є предметна сфера її застосування: економіко-організаційна, технологічна і проектно-конструкторська. Згідно з цим безліч АСУ поділяється на три класи:

- економіко-організаційні (АСУП),
- управління технологічними процесами (АСУ ТП),
- проектно-конструкторські (САПР).

Економіко-організаційні АСУ містять міжгалузеві АСУ (автоматизована система планових розрахунків, автоматизована система фінансових розрахунків, автоматизована система державної статистики, автоматизована інформаційно-пошукова система науково-технічної інформації, автоматизована інформаційно-управляюча система Держкомітету зі стандартів і т. ін.), виробничі АСУ (галузеві автоматизовані системи управління, АСУ акціонерних товариств і концернів, автоматизовані системи управління підприємствами та організаціями (АСУП), територіально-адміністративні АСУ (територіальні АСУ областей, АСУ міського господарства, адміністративних районів, територіально-виробничих комплексів).

До складу автоматизованих систем управління виробничими процесами належать системи, які призначені для управління безперервним виробництвом, автоматизованими потоковими лініями, комплексними лініями агрегатів і верстатів, верстатами з числовим програмним управлінням (ЧПУ). Останнім часом верстати з ЧПУ об'єднуються в оброблювані модулі і разом з транспортно-нагромаджувальними системами створюють гнучкі виробничі системи (ГВС).

TEXT 7

Translate from Ukrainian into English:

Системи автоматизованого проектування використовуються для проектування деталей і вузлів машин, елементної бази, виробничого і технологічного проектування.

Нагромаджений досвід упровадження і використання автоматизованих систем довів порівняно високу ефективність багатьох із них. Економічний ефект від експлуатації передових галузевих АСУ протягом 1988-1989 pp. становив 10-20 млн. крб.

Крім прямого економічного ефекту впровадження галузевих АСУ мало великий вплив на зміну характеру діяльності управлінського персоналу міністерств і відомств. У результаті автоматизації процесів інформаційного обслуговування підвищилась інформованість управлінського персоналу.

Досить ефективні інші автоматизовані системи управління (АСУП, АСУ ТП, САПР).

Розрізняють також такі типии АСК:

- системи організаційного (або адміністративного) керування (АСОК)
- керування технологічними процесами (АСК ТП).

До АСОК входять автоматизовані системи керування підприємством (АСКП), галузеві автоматизовані системи керування (ГАСК) і спеціалізовані автоматизовані системи керування функціональних органів управління господарством.

До останніх належать автоматизовані системи планових розрахунків (АСПР), державної статистики (АСДС), керування матеріальнотехнічним постачанням (АСК МТП), керування науково-технічним процесом (АСК НТП) та інші.

Відомі АСУ об'єктів гірничої промисловості, наприклад, збагачувальних фабрик, шахт, кар’єрів, АСК-Нафта, АСК виробничо-господарською діяльністю виробничо-господарчою діяльністю дочірніх підприємств (газотранспортних, газовидобувних і т. д.), АСК-газ (автоматизована система керування газовою промисловістю), АСК газодобувним підприємством (газовидобувного підприємства з координованого контролю та керування роботою свердловин, устаткувань підготовки газу, ділянок комунікацій та подавання газу в магістральний газопровід з урахуванням оптимальних режимів роботи всього промислу у цілому, визначення раціональних місць буріння та у підсумку одержання товарного газу за мінімізацією витрат на його підготовку), АСК газотранспортним підприємством, АСК ТП головних споруд (під керуванням та контролем якої забезпечується остаточна підготовка газу та подавання його до магістрального газопроводу), АСК ТП компресорного цеху, АСК ТП компресорної станції (що забезпечує керування та контроль за ходом технологічного процесу в межах станції та суміжних лінійних ділянок магістрального газопроводу (ЛДМГ), за роботою компресорних цехів (за допомогою АСК ТП КЦ), допоміжних загальностанційних об'єктів та об'єктів електропостачання, технологічних об'єктів на суміжних ЛДМГ, а також здійснює формування завдань для регулювання та стабілізації режимів роботи компресорних цехів; працює під керуванням та за завданням АСКТП газотранспортним підприємством), АСК ТП станції підземного зберігання газу, АСК ТП устаткування комплексної підготовки газу, АСК ТП устатковання попередньої обробки газу.

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