Министерство науки и высшего образования Российской Федерации

**Федеральное государственное бюджетное образовательное учреждение высшего образования
Санкт-Петербургский горный университет**

Кафедра иностранных языков

ДЕЛОВОЙ ИНОСТРАННЫЙ ЯЗЫК

АВТОМАТИЗАЦИЯ ТЕХНОЛОГИЧЕСКИХ ПРОЦЕССОВ И ПРОИЗВОДСТВ

Методические указания к практическим занятиям для студентов магистратуры направления 15.04.04

ENGLISH FOR SPECIFIC PURPOSES

INDUSTRIAL AUTOMATION

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ДЕЛОВОЙ ИНОСТРАННЫЙ ЯЗЫК. Автоматизация технологических процессов и производств: Методические указания к практическим занятиям / Санкт-Петербургский горный университет. Сост.: *О.Ю. Гагарина , С.А. Свешникова.* СПб, 2019. 37 с.

На материале аутентичных текстов, в которых освещаются основные аспекты истории и современного развития машиностроения и автоматизации, магистранты смогут овладеть необходимыми навыками для решения коммуникативных задач в научной сфере и будущей профессиональной деятельности.

Методические указания предназначены для студентов магистратуры направления 15.04.04 «Автоматизация технологических процессов и производств» (направленность программы «Системы автоматизированного управления в машиностроении»).

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ПРЕДИСЛОВИЕ

Данные методические указания предназначены для проведения практических занятий по английскому языку со студентами магистратуры направления подготовки 15.04.04 «Автоматизация технологических процессов и производств» (направленность программы «Системы автоматизированного управления в машиностроении»). Методические указания составлены в соответствии с учебной программой по дисциплине «Деловой иностранный язык» для формирования иноязычной профессиональной компетенции будущих магистров.

В методические указания включены аутентичные публицистические и технические тексты, в которых освещаются основные аспекты истории и современного развития машиностроения и автоматизации.

Использование предложенного комплекса упражнений способствует пополнению словарного запаса студентов магистратуры специальной лексикой по теме «Mechanical and Automation Engineering», а также формированию у них навыков перевода технических текстов и совершенствованию стратегий чтения и понимания информации из различных источников на английском языке.

UNIT 1. INTRODUCTION TO MECHANICAL ENGINEERING

Before You Read

I. Do you know what a digraph is?

A **digraph** is when two letter sounds or phonemes combine to make one sound or phoneme. Digraphs differ from blends. Whereas a blend is a group of letters in which each letter represents an individual sound such as the ***b-l*** sound blend in bloom or the ***s-t-r*** sound blend in street, a digraph represents only one single sound. The written form of English is a language of digraphs. For example, the following chart identifies the digraph and an example of the most common consonant digraphs in the English language.

digraph	example
ch	***ch***ur***ch*** |tʃəːtʃ|
ck	ba***ck*** |bæk|
dg	gru***dg***e |grʌdʒ|
gh	cou***gh*** |kɒf|
gh	***gh***ost |gəʊst|
gn	***gn***ome |nəʊm|
kn	***kn***ife |naɪf|
lk	wa***lk*** |wɔːk|
mn	***mn***emonic |nɪˈmɒnɪk|

II. Do you know how to read the digraph ***ch***?

This consonant digraph has three different sounds, the most common of which is the «***ch***» heard in ***ch***eese and mu***ch***. «***ch***» is also presented as ***ch***=***sh***, for example in ***ch***ef, and ***ch***=***k*** in ***Ch***ristmas.

III. Before you practise reading the following words with ***ch***, put them into three columns:

as in ***ch***eese or mu***ch***	as in ***ch***ef	as in ***Ch***ristmas

Anchor, bench, branch, chain, character, chase, cheek, chemistry, chest, Chicago, chicken, chimney, chirp, chord, chorus, chrome, echo, lunch, match, mechanic, Michigan.

IV. Remember the way you should pronounce the following words:

word	transcription	useful links
machine	|məˈ**ʃ**iːn|	https://www.howtopronounce.com/machine/ *or* https://wooordhunt.ru/word/machine
machinery	|məˈ**ʃ**iːnərɪ|	https://www.howtopronounce.com/machinery/ *or* https://wooordhunt.ru/word/machinery
mechanical	|mɪˈ**k**ænɪkl|	https://www.howtopronounce.com/mechanical/ *or* https://wooordhunt.ru/word/mechanical
mechanics	|mɪˈ**k**ænɪks|	https://www.howtopronounce.com/mechanics/ *or* https://wooordhunt.ru/word/mechanics
technical	|ˈte**k**nɪkl|	https://www.howtopronounce.com/technical/ *or* https://wooordhunt.ru/word/technical

While You Read

V. Skim the short paragraph about mechanical engineering. What aspects of this discipline are brought into focus?

Mechanical Engineering is the engineering discipline that involves application of the principles of physics for the analysis, design, manufacture, and maintenance of mechanical systems. It requires a solid understanding of concepts including mechanics, thermodynamics, and engineering design; as well as solid grounding in physics and math. Mechanical engineers use these principles and others in the design and analysis of automobiles, heating and cooling systems, industrial equipment, and more.

VI. Read the passage about the work of mechanical engineers. Pay attention to the words **in bold**. When you don’t know the meaning of a word, look at the words around it to help you. You may be able to guess the meaning of the word from its surrounding context.

The mechanical engineer has been called the general practitioner and **the jack-of-all trades** among engineering professions. This is because the profession requires education and skills that span a broad range of technical, social, environmental, and economic problems. In general, however, the mechanical engineer is concerned with controlling the principles of motion, energy, and force through mechanical **solution**s.

A mechanical engineer **design**s the **tool**s and processes used for satisfying the needs of society through a combination of material, human, and economic resources. He might work on electric generators, internal combustion engines, steam and gas turbines, and other **power-generating machine**s. He might also **develop** machines such as refrigeration and air-conditioning equipment, power tools, and other **power-using machine**s.

The diverse mechanical engineering field can be divided in a variety of ways in terms of job functions. Some of the most common functions relate to these areas of technology, but not all do. Among these fields are:

• Product Design − developing products ranging from biomedical devices to gasoline-powered engines. A mechanical engineer designs anything that uses mechanical motion.

• Research and Development − discovering new solutions to human needs or improving older methods.

• Manufacturing − developing the machines that **process** materials into products. Designing and building machines and systems of machines that **improve operating efficiency** is of prime importance.

• Systems management − overseeing operations of a large system, such as a power plant, as well as supervising the people who work there.

• Energy − planning how energy is generated, stored, and moved. Industries that produce and deliver electrical power, such as natural gas, oil and alternative energy, employ mechanical engineers to develop more **fuel-efficient** cars, motors, and **appliance**s.

• Marketing − determining the need for a new or **modified** product, and calculating product **availability**, market size, cost structure, profitability, **specification**s, and distribution channels.

In most of these fields, the mechanical engineer is concerned with **heat utilization** or **machine design** − in other words, harnessing or creating energy. Heat utilization techniques are applied in boilers, air conditioners, and refrigeration units. Machine design is more focused on hardware, including automobile engines, computers, and washing machines.

Mechanical engineers are constantly being asked to make decisions. The size, shape, and material of every part of every mechanical product created must be decided by a mechanical engineer. They also have to **determine** the best and most efficient ways to manufacture the products.

After You Read

When you hear or read a new word or phrase that is important to you, add it to your ***Vocabulary Notebook***. Try grouping the words and phrases in your notebook by topic. Next to each item, write down a sentence containing the word that will help you remember its meaning.

VII. Look back at the reading passage and find words or expressions that are related to mechanical engineering. Add these to the chart below:

Vocabulary Notebook

English	part of speech	Russian	example
jack-of-all trades	ph	универсал; умелец; мастер на все руки	The mechanical engineer has been called the general practitioner and the jack-of-all trades among engineering professions.
solution	n	решение; разрешение (проблемы и т.п.); объяснение	… the mechanical engineer is concerned with controlling the principles of motion, energy, and force through mechanical solutions.

Critical Thinking

VIII. Why do you think mechanical engineering is vitally important for all fields of science and technology? Discuss the scope of its applications with your partner.

Translation Challenge

IX. Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

Mechanical Engineering Functions

There are four functions of the mechanical engineer, common to all branches of mechanical engineering. The first is the understanding of and dealing with the bases of mechanical science. These include dynamics, concerning the relation between forces and motion, such as in vibration; automatic control; thermodynamics, dealing with the relations among the various forms of heat, energy, and power; fluid flow; heat transfer; lubrication; and properties of materials.

Second is the sequence of research, design, and development. This function attempts to bring about the changes necessary to meet present and future needs. Such work requires a clear understanding of mechanical science, an ability to analyze a complex system into its basic factors, and the originality to synthesize and invent.

Third is production of products and power, which embraces planning, operation, and maintenance. The goal is to produce the maximum value with the minimum investment and cost while maintaining or enhancing longer term viability and reputation of the enterprise or the institution.

Fourth is the coordinating function of the mechanical engineer, including management, consulting, and, in some cases, marketing.

UNIT 2. THE MOTHER OF INVENTION

Before You Read

I. Answer the following questions.

1. What is the greatest invention in engineering ever?
2. Who invented it?
3. When was it invented?
4. Do you remember under what circumstances?

II. Share your ideas with your partner, make together a list of five main inventions and rank them in order of importance.

While You Read

III. Read the passage. Pay attention to the words **in bold**. Copy them down into your ***Vocabulary Notebook***.

The Steam Engine

The Greatest Invention That Changed Human History

The invention of the steam engine was an important **milestone** in the Industrial Revolution. James Watt is often credited with its invention, but Watt only brought about — admittedly game-changing — developments in the original design. The machine became symbolic of the Industrial Revolution. Most of the early **development**s during the period revolved around this vital invention.

In 1698, the most primitive form of the steam engine was **patent**ed by Thomas Savery. It was a simple machine used to pump water out of coal mines; it had no moving parts, and used up huge quantities of coal. Thomas Newcomen made **improvement**s in this machine. He added a movable **piston** in the original design for the steam to displace it and perform the necessary work. The engine, however, was of no significant use even after the improvements made by Newcomen. It was only in 1763 that James Watt drastically improved this machine.

The pistons used in Watt's engine could be **move**d **to-and-fro**. The most important thing about these engines was that a **crankshaft** was used in the conversion of the motion to circular motion. This engine **consume**d 75% less coal than the one made by Newcomen. Circular motion produced by the steam engine lead to the development of locomotives. These locomotives were used by industries for transportation, **hasten**ing the development of the Industrial Revolution.

The mechanism of the steam engine is quite simple. The steam needed to run this engine is produced in a boiler outside the actual engine. The **flow** of steam into the engine is directed through **valve**s. Pistons in the engine move with the help of the pressure generated by the steam. These pistons move in an **oscillatory motion**; a crankshaft is used in the conversion of the oscillatory motion to **rotatory motion**.

The engines developed by Newcomen and Watt didn't make full use of the steam power. Their machines were actually **powered** by vacuum. The vacuum was created by the condensation of steam. The role of steam in functioning of the engine was limited up to the task of compensating for the atmospheric pressure; it helped move the piston back and forth. Richard Trevithick developed engines in which steam was forced under high pressure. The size of this model, too, was reduced to great extent, making it easy to transport the engine itself.

The steam engine brought about a huge change in the industrial scene. The speed of industrial development increased many times over. Therefore, the steam engine is considered as one of the greatest inventions in history.

After You Read

IV. Sum up the main stages in the history of the steam engine and fill in the table using information from the reading passage.

The Invention of the Steam Engine

inventor	contribution	improvement	drawbacks
Thomas Savery (1650 –1715)	patented the most primitive form of the steam engine in 1698	–	- had no moving parts - used up huge quantities of coal
Thomas Newcomen (1664 –1729)			
James Watt (1736– 1819)			

inventor	contribution	improvement	drawbacks
Richard Trevithick (1771 – 1833)			

V. Do you know what a slinky is? Read the story of its invention and complete the gaps with the right form of the verbs in brackets.

Slinky … (be) the invention of Richard James, a mechanical engineer in the United States Navy. In 1943 he … (look) for a way to lessen the vibrations that sensitive equipment … (endure) shipboard in rough waters. An accident during his experiments … (lead) to the creation of a 'walking', tumbling metal spring.

Neighbourhood children … (love) it. James's wife Betty … (name) the toy Slinky after finding the word in a dictionary. The Jameses … (have) 400 Slinkys made by a local machine shop.Then they … (put) Slinky on display at Gimbels Department Store in Philadelphia in November 1945. All 400 units were sold.

VI. Study the way the information is summed up in the following table:

1	invention	Slinky
	inventor	Richard James
	year	1943, large-scale production since 1945
	details	looking for a way to lessen the vibrations of sensitive equipment shipboard in rough waters → an accident → the creation of a 'walking' metal spring

VII. Prepare a short talk about some other invention made by chance.
Say who, where, when and under what circumstances invented it.

VIII. Tell your groupmates about the invention and listen to their stories. While listening continue filling in the table:

2	invention	
	inventor	
	year	
	details	

Critical Thinking

IX. Discuss these questions in a group.

1. Why do you think the development of the steam engine is considered to be "*the greatest invention that changed human history*"?
2. How do people invent things? What do you think an inventor's life is like?
3. What does "*necessity is the mother of invention*" mean? Do you agree with it?
4. Do you think inventions always have some bad side effects?
5. Have you ever thought about inventing anything? What invention would you like to create?

Translation Challenge

X. Read about peculiarities of rendering personal names.

Personal names are divided into two groups depending on their translation: those translated according to tradition and those translated in keeping with the modern tendency. The modern tendency demands retaining in translation the way a proper name sounds, cf. Henry James – Генри Джеймс. The traditional approach did not follow any solid principles and the results of such a translation are often in conflict with the modern demand. The effect of the force of tradition is still felt today in translating two groups of units: 1) names of crowned kings, queens, emperors, monarchs which used to be translated in a special way contrasted to names of common people, cf. Elizabeth – Елизавета и Элизабет, William – Вильгельм и Уильям, James – Яков и Джеймс; 2) biblical and mythological names, e.g. Icarus – Икар, Mary – Мария. This accounts for doublets used to translate names that relate in origin. Those historical names the translation of which has become well-established in translation practice are not revised though it runs contrary to present-day demands as new versions of translation might result in doublets.

Translation of one and the same personal proper name may vary depending on the nationality of its bearer, cf. Hugo – Хьюго (English) and Гюго (French), Richard – Ричард (English) and Рихард (German). The choice of the way of translation can also depend on connotations that words arouse in two languages. The name Шитиков which sounds quite good and acceptable to a Russian will have to undergo some phonetic changes to suppress any negative associations with its transcription in English, Shitikov >Chitikov.

XI. Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

Who invented the Bicycle?

From medieval Italy to the 19th century France, four major inventors contributed to the rise of the bicycle. Some created true innovations, others improved upon earlier models, but only one man is today regarded as the true inventor of the bicycle. Frenchman Pierre Michaux created first pedal based bicycle during early 1860s. That moment started long and successfully history of bicycle that we all know and use today.

Bicycle history started in 1493 when one student of Leonardo da Vinci drew crude designs in one of his documents. First archetype of a bicycle appeared in 1817 Germany. Simple wooden velocipede called ‘draisine’ with no pedals or any other means of mechanical drive was created by the Baron Karl von Drais. That model was soon refined to more usable design, most notably on popular wooden ‘dandy horse’ design of Denis Johnson in London.

True bicycle revolution started in early 1860s with the invention of pedal. Two French carriage makers Pierre Michaux and Pierre Lallement started production of their bike. Still the greatest problem regarding those bikes was wooden wheels that produced very shaky drive. Popular name of their bikes at that time was ‘boneshaker’.

Final great landmark of bicycle history happened in 1885 with the appearance of John Kemp Starley’s ‘safety bicycle’. Equipped with standardized metal frame, rear wheel chain drive and pneumatic wheels, this model became instant success. Everyone was able to drive it, and its use became widespread all across the world.

UNIT 3. MECHANICAL AND AUTOMATION ENGINEERING

Before You Read

When you skim a reading selection, you read it quickly to learn about its content and organization. You don't read every word. Instead, your eyes move very quickly over the selection, trying to find general information (e.g., the topic of a reading).

I. Skim the text. Put the following headings in the correct place.

A. Description
B. Education & Training
C. Preferred Experience
D. Required Experience
E. Responsibilities
F. Skills

While You Read

II. Read the passage again. Pay attention to the words **in bold**. Copy them down into your ***Vocabulary Notebook***.

____________________ 1

We are looking for a gifted and innovative mechanical engineer that has a **thorough** understanding of all principles related to **mechanical design** and a talent for **hands on work**. Experience with automation, **precision mechanism**s, **fluidic system**s, and/or MEMs is desired. We are a growing company with significant potential for advancement and professional development.

____________________ 2

This position will support R&D and process improvement efforts by creating and maintaining process equipment required for the manufacturing of products created with *Microfabrica's* unique MICA Freeform technology. This position will also support new product initiatives by participating in **concept** generation, detailed design & analysis, and **application** testing for components and systems utilizing MICA Freeform manufacturing capabilities.

The candidate filling this position will:

• Develop, design and support machines, **fixture**s and sub-assemblies for production tools and R&D apparatus, often requiring micron level **precision** and **accuracy**

• Participate in concept generation and brainstorming activities in support of new product and process initiatives

• Provide detail mechanical design and analysis for new products

• Apply understanding of principles of **measurement**, **tolerance**s, and material properties to equipment & product development

• Interface with **vendor**s of equipment, components and materials

• Mentor, review, and guide efforts of junior engineers and/or technicians

[3]

• BS or MS in Mechanical Engineering or related field

• 5-10 years relevant work experience

[4]

• Demonstrated ability to design and troubleshoot automation and motion control systems

• 3D CAD proficiency, preferably with SolidWorks

• Understanding and use of mechanical **drawing practice**s for manufacture and GD&T

• Good hands-on skills and ability to perform basic machine **shop practice**s

• Demonstrated ability to design and **procure** mechanical parts and assemblies to meet technical requirements

[5]

• Basic programming and/or database integration for **automated machine operation**s

• Experience with designing highly precise mechanisms (micron level accuracy)

• Familiarity with precision motion systems and components including linear motors, encoders, air bearings

• MEMs or semiconductor equipment experience

• Proficiency with FEA **software** like SolidWorks Simulation or ANSYS

• Experience with **planarization** technologies such as CMP or lapping

6

- Technical problem solving
- Clear analysis & data presentation
- Self-organization & focus
- Proficient with Microsoft Office tools, particularly Excel and Word
- Working knowledge of basic statistics
- Excellent written and verbal communication
- Technical report preparation including collection, analysis and summary of information & data

After You Read

An abbreviation is a shortened form of a word or phrase used to represent the complete form. There are four main kinds of abbreviations: shortenings (e.g. *in* = *inch*, *zoo* = *zoological garden*), contractions (e.g. *Dr.* = *doctor*, *St.* = *saint* or *street*), initialisms (e.g. *CIA / C.I.A., NYC, pm / p.m.*), and acronyms (e.g. *AIDS, laser, scuba, UNESCO*).

III. Fill in the following table using, for example, *https://www.acronymfinder.com*:

abbreviation	**complete form**	**по-русски**
3D	3-dimensional	трёхмерный
ANSYS		
BS		
CAD		
CMP		
FEA		
GD&T		
MEM		
MICA Freeform		
MS		
R&D		

Critical Thinking

IV. Discuss these questions in a group.

1. Who do you think might have written the article?
2. What is the article aimed at?
3. Who is the audience for this article?
4. Would you like to apply for this position? Which of the required skills and qualifications do you have?
5. Why have you chosen to be concerned with Mechanical and Automation Engineering (MAE)?
6. What are you going to do after you finish your master's degree at the Saint-Petersburg Mining University?

Translation Challenge

V. Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

MICA Freeform

MICA Freeform is a unique mass production additive manufacturing (AM) technology for microscale metal parts. As with other AM processes, parts are produced one layer at a time from 3D CAD designs, and complex geometries can be produced, including undercut and internal features. MICA Freeform also borrows from semiconductor manufacturing, benefiting from high resolution andrepeatability, and wafer scale production in a cleanroom. The process for making a part with MICA Freeform involves three key steps per layer. First, a structural metal is electrodeposited onto a substrate inselected regions corresponding to a cross section of the part. Then, a sacrificial metal is electrodepositedover the structural metal. Finally, both metals are planarized to yield a layer that is flat, planar, and ofprecise thickness. After all layers are formed, a chemical bath is used to dissolve ('release') the sacrificial metal, yielding a batch of parts that are ready-to-use without further processing.

UNIT 4. MATERIALS SCIENCE

Before You Read

I. Discuss the following questions with your partner:

1. What is materials science?
2. How many metals can you name in English?
3. When did man start to use and process metals?
4. What are traditional materials used in mechanical engineering?
5. What modern advanced materials do you know?

While You Read

II. Read the passage. Pay attention to the words **in bold**. Copy them down into your ***Vocabulary Notebook***.

Historical Introduction to the Development of Materials Science and Engineering

From the dawn of human existence **material**s have been fundamental to the development of civilisation. Anthropologists define the historical epochs by the materials used by the different civilisations such as the Stone, Copper, Bronze and Ironages. The different rates of progression towards more **sophisticated** materials between cultural groups correlated with different levels of **innovation** and the local **availability** of those materials, and led to varying standards of living.

The early lack of technological information **diffusion** led to significant differences in **advancement** between cultures at any one time. For example, in 1500BC those in Asia Minor (Turkey) were already experimenting with iron, whilst in Mesopotamia (Iraq) they were still in the Bronze Age. The Europeans, Palestinians and Egyptians were in the Copper and early Bronze Age; the Chinese had **melt**ed iron and were **advanced** in the development of Bronze; the Spaniards and Portuguese were still in the Chalcolithic period (an overlap of the Stone and Copper Age) whilst in North Africa there was still evidence of the late Stone Age. Those in the Americas were also still in the Chalcolithic period having not yet discovered bronze, but they made beautiful artefacts of **gold**, **silver** and **copper** − metals they found naturally (i.e. not combined with **sulphide**, **oxide** or other **ore**s). The Native Americans (unfortunately) had not progressed from the Chalcolithic period three millennia later when the Europeans arrived with **steel** guns to conquer, colonise and settle. Even more recently, in the late 19th century the first white settlers found Australia rich in **mineral**s of all kinds, however there too there was no evidence that the aborigines had made practical use of these minerals in their metallic form.

Metallurgy, defined as the science and art of **processing** and adapting metals, has been around for approximately 6000 years from when Neolithic man **recover**ed and used metals through observation and deduction.

Some significant developments took place in the pre-Roman period, e.g. **cold welding**; the lost **wax process** for **bronze casting**s including high **lead addition**s to improve **fluidity**; and the control of **carbon content** in iron, **forging** and the **heat treatment** of steel. **Manufacturing technique**s improved **steadily** during the Greek and Romanperiods but without any major progress in **alloy** development. In the Post Roman period metallurgy moved into the secretive period of alchemical experimentation, with an emphasis on **precious metal**s, **amalgam**s and **chemical properties**. Some advances were made and the emergence of chemistry as an independent discipline can be traced to the need for **assay**ing for standards of trade. However alchemy in the form of a belief in transmutation persisted into the 17th century. Even Newton (Warden of **the Royal Mint**) held some faith in it!

In the 18th and 19th centuries developments in iron and steel issued in the machine age that led the Industrial Revolution that was to transform Britain from a mainly agrarian economy to an industrial economy. This period was also called the Metallurgic Age.

However during the 20th century there ensued an explosive increase in the understanding of the fundamental nature of materials which has led to phenomenal advances across a wide range of materials, dwarfing those of previous ages.

After You Read

When you learn a new word, it's useful to learn other forms of the same word.

III. Complete the chart below by adding the missing word forms. Then check your ideas by looking in a dictionary.

noun	verb	adjective
existence		existing
	develop	developing developed
advancement		
explosive		
	add	
	define	
diffusion		
	manufacture	
		different
	process	

Critical Thinking

IV. Discuss these questions in a group.

1. Is knowledge in materials science important for a specialist in Mechanical and Automation Engineering? Why / Why not?
2. What advanced materials are essential for the development of mechanical engineering?

V. Make a list of advanced materials and rank them in order of their importance for future technological progress.

Translation Challenge

VI. Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

Advanced Materials

High-performance materials are materials that provide specific performance advantages in comparison with the counterpart conventional materials. Often it is difficult to place materials strictly into the group of high-performance group or other groups, but they may be divided into the following main groups:

• Standard materials, which are used in products that is exposed to noncritical environments and low-stress applications

• Standard Engineering Materials, which are used in products that must have general bearing and wear properties

• High-performance materials or advanced engineering materials, which are used in products that must have superior properties (extreme service environments, superior chemical resistance, wear resistance, and loading properties)

There are several types of materials currently called high-performance materials, for instance high-performance concrete, high-performance composites, high-performance plastics, high-performance aluminum, high-performance ceramics, and high-performance steel. What they all have in common is that they have outstanding properties compared to the materials we used earlier. In short time maybe the materials we know as HPM today may not be so high-performance tomorrow, since the materials-science is rapidly changing and growing. While research laboratories are still exploring ways to exploit these materials, some of them are ready for use.

UNIT 5. PRODUCTION

Before you read

I. Read the definition of ‘*production*’.

Production is the action of making or manufacturing from components or raw materials, or the process of being so manufactured.

II. Using your background knowledge in the organization of production process, discuss the following statements with your partner and decide whether they are true or false.

1. Mechanical Engineering is the subset of Production Engineering.
2. Production Engineering focuses on Machine Tools, Materials Science, Tribology, and Quality Control.
3. Professional production engineers are responsible for all aspects of the design, development, implementation, operation and management of a manufacturing system.
4. Technical Drawing is the most important element in any engineering process.
5. The primary commodities range from aero planes, turbines, engines and pumps - to integrated circuits and robotic equipment.
6. Production engineers plan and schedule the production in any manufacturing industry.
7. CNC (*Computerized and Numerically Controlled*) Machining is a process used in the manufacturing sector that involves the use of computers to design machine tools.
8. Production engineers programme CNC machines to produce engineering components such as gears, screws, bolts, etc.
9. Production engineers neglect quality control, distribution and inventory control.
10. The job of a production engineer involves the use of machine tools, materials and human resources in the most effective way to produce any goods.

While you read

III. Read the passage. Pay attention to the words **in bold**. Copy them down into your ***Vocabulary Notebook***.

Types of Production

The annual part or product quantities produced in a given factory can be classified into three ranges:

a) Low **Quantity** Production

The type of production facility usually associated with the quantity range of 1 to 100 **units per year** is the **job shop**, which makes low quantities of specialized and **customized product**s. The products are typically complex, such as space capsules, aircraft, and special machinery. Job shop production can also include fabricating the **component part**s for the products.

Customer orders for these kinds of items are often special, and repeat **order**s may never occur. Equipment in a job shop is general purpose and the **labor force** is highly skilled.

A job shop must be designed for maximum flexibility to deal with the wide part and **product variation**s encountered (**hard** product variety). If the product is large and heavy, and therefore difficult to move in the factory, it typically remains in a single location, at least during its final **assembly**. Workers and **processing equipment** are brought to the product, rather than moving the product to the equipment. This type of layout is referred to as a **fixed–position layout**.

b) Medium Quantity Production

In the medium quantity range (100–10,000 units annually), we distinguish between two different types of facility, depending on product variety. When product variety is hard, the traditional approach is **batch production**, in which a batch of one product is made, after which the facility is changed over to produce a batch of the next product, and so on. Orders for each product are frequently repeated.

The **production rate** of the equipment is greater than the demand rate for any single product type, and so the same equipment can be shared among multiple products. The **changeover** between **production run**s takes time. Called the **setup time** or **changeover time**, it is the time to **change tooling** and to **set up** and reprogram the **machinery**. This is lost production time, which is a disadvantage of batch manufacturing.

Batch production is commonly used in make-to-stock situations, in which items are manufactured to replenish inventory that has been gradually depleted by demand. The equipment is usually arranged in a **process layout**.

An alternative approach to medium range production is possible if product variety is soft. In this case, extensive changeovers between one product style and the next may not be required.

It is often possible to **configure** the equipment so that groups of similar parts or products can be made on the same equipment without significant lost time for changeovers.

The processing or assembly of different parts or products is accomplished in **cells** consisting of several **workstation**s or machines.

c) High Quantity Production

The high quantity range (10,000 to millions of units per year) is often referred to as **mass production**.The situation is characterized by a high **demand rate** for the product, and the **production facility** is dedicated to the manufacture of that product.

Two categories of mass production can be distinguished:

1) **Quantity production** involves the mass production of single parts on single pieces of equipment. The method of production typically involves standard machines (such as stamping presses) equipped with special tooling (e.g., dies and material handling devices), in effect dedicating the equipment to the production of one part type. The typical layout used in quantity production is the process layout.

2) **Flow line production** involves multiple workstations arranged in sequence, and the parts or assemblies are physically moved through the sequence to complete the product. The workstations consist of production machines and/or workers equipped with specialized tools. The collection of stations is designed specifically for the product to maximize efficiency. The layout is called a product layout, and the workstations are arranged into one long lineor into a series of connected line segments.

The work is usually moved between stations by powered conveyor. At each station, a small amount of the total work is completed on each unit of product. The most familiar example of flow line production is the assembly line, associated with products such as cars and household appliances.

The pure case of flow line production is where there is no variation in the products made on the line. Every product is identical, and the line is referred to as a single model production line. However, to successfully market a given product, it is often necessary to introduce model variations so that individual customers can choose the exact style and options that appeal to them.

After you read

IV. Do you know the difference between a '*word*' and a '*term*'?

A word is a meaningful element in a language. A term, on the other hand, is a word but has a particular meaning in a situation. Hence, these two cannot be used interchangeably. The relationship between a word and a term can simply be understood in the following manner. All terms are words, but not all words are terms. For example, a word '*bench*' meaning "*a long, usually hard seat for two or more people, often found in public places*" is not a term, while miners use the term '*bench*' when they speak about "*a ledge that forms a single level of operation above which mineral or waste materials are mined back to a bench face*".

V. Do you know the meanings of the words in the box below?

arm, batch, bench, nose, nut, part, pig, shop, station, tree

VI. Translate the sentences with them into Russian.

1. She sat back in her chair and wrapped her *arm*s around her knees.
2. The *batch* of new recruits had arrived at the camp.
3. A couple of old codgers were sitting on the park *bench*, grumbling about the children.
4. Menthol can help to clear your *nose* when you have a cold.
5. Squirrels store up *nut*s for the winter.
6. *Part* of my steak isn't cooked properly.
7. *Pig*s are omnivores — they eat both plants and meat — and on small farms, they're fed kitchen leftovers as well as their basic diet.
8. Most of the *shop*s are open on Sundays.
9. They hugged each other when they met at the *station*.
10. The birds built their nest in the small fir *tree*.

VII. Study the Russian equivalents for the following terms.

English	по-русски
arm	пильная рама (станка)
batch	партия (изделий)
bench	уступ карьера
nose	головка домкрата
nut	гайка
part	деталь
pig	болванка (чушка металла)
shop	цех, мастерская
station	рабочая станция
tree	фонтанная арматура

VIII. Use the terms from the table to complete the sentences below.

1. A … is a type of fastener with a threaded hole.
2. A job … is a production system where the material flow is subject to the location of the machines.
3. A radial saw is basically a circular saw mounted on a horizontal … that can slide from front to back.
4. In petroleum and natural gas extraction, a '…', is an assembly of valves, spools, and fittings used to regulate the flow of pipes in an oil well.
5. The … height in open pit mines will normally range from 15 m in large copper mines.
6. The … method can be an advantage for businesses that produce a range of products.
7. The back … of the car that opens is called the trunk.
8. The jack must be loaded with a minimum of 110 lbs. to lower step-by-step, otherwise the lifting … will drop.
9. The most important factors in the design of work …s are the working height, proper sizing of reach zones, leg room and range of vision.
10. The technology of casting molten iron into bars called …s changed dramatically over the years.

Critical Thinking

IX. Study the characteristic features of low, medium and high production summed up in the table below.

level	quantity range (units/year)	type	typical layout
low	1 to 100	job shop production	fixed position process
medium	100–10,000	batch production	process
		cellular production	cellular
high	10,000 to millions	quantity production	process
		flow line production	product

X. Discuss with your partner what the advantages and disadvantages of low, medium and high production might be.

XI. Report the results of your analysis to your groupmates using the following clichés:

The main benefit of ... is that ... .
Secondly, ...
In addition to this, ...
However, it also has some major disadvantages. Firstly, ...
Moreover, ...
Finally, ...

Translation Challenge

XII. Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

Cellular manufacturing, which is actually an application of group technology, has been described as a stepping stone to achieving world class manufacturing status. The objective of cellular manufacturing is to design cells in such a way that some measure of performance is optimized. This measure of performance could be productivity, cycle time, or some other logistics measure. Measures seen in practice include pieces per man hour, unit cost, on-time delivery, lead time, defect rates, and percentage of parts made cell-complete.

This process involves placing a cluster of carefully selected sets of functionally dissimilar machines in close proximity to each other. The result is small, stand-alone manufacturing units dedicated to the production of a set or family of parts — or essentially, a miniature version of a plant layout.

While the machinery may be functionally dissimilar, the family of parts produced contains similar processing requirements or has geometric similarities. Thus, all parts basically follow the same routing with some minor variations (e.g., skipping an operation). The cells may have no conveyorized movement of parts between machines, or they may have a flow line connected by a conveyor that can provide automatic transfer.

UNIT 6. AUTOMATION

Before you read

I. Answer the following questions.

1. What is industrial automation? What kinds of automation operations do you know?
2. Why do you think companies undertake projects in manufacturing automation?
3. What should a specialist in automation learn/know?

While you read

II. Read the passage. Pay attention to the words **in bold**. Copy them down into your ***Vocabulary Notebook***.

Types of Automation

Fixed automation is a system in which the sequence of **processing** (or **assembly**) **operation**s is fixed by the equipment **configuration**. Each of the operations in the sequence is usually simple, involving perhaps a plain linear or rotational motion or an uncomplicated combination of the two; for example, the feeding of a rotating spindle. It is the integration and coordination of many such operations into one piece of equipment that makes the system complex.

Typical features of fixed automation are:

• High initial investment for **custom-engineered** equipment
• High **production rate**s
• Relatively inflexible in accommodating product variety

In **programmable automation**, the **production equipment** is designed with the capability to change the **sequence** of operations to **accommodate** different product configurations. The operation sequence is controlled by a program, which is a set of instructions coded so that they can be read and interpreted by the system. New programs can be prepared and entered into the equipment to produce new products.

Some of the **feature**s that characterize programmable automation include:

• High investment in general purpose equipment
• Lower production rates than fixed automation

• Flexibility to deal with variations and changes in product configuration
• Most suitable for **batch production**

Flexible automation is an extension of programmable automation. A flexible automated system is capable of producing a variety of **part**s (or products) with virtually no time lost for **changeover**s from one part style to the next. There is no lost production time while reprogramming the system and altering the physical **setup** (tooling, fixtures, machine settings). Consequently, the system can produce various combinations and schedules of parts or products instead of requiring that they be made in batches. What makes flexible automation possible is that the differences between parts processed by the system are not significant. It is a case of soft variety, so that the amount of changeover required between styles is minimal.

The features of flexible automation can be summarized as follows:
• High investment for a custom-engineered system
• Continuous production of variable mixtures of products
• Medium production rates
• Flexibility to deal with product design variations

After you read

III. Match the words from column **A** with the words from column **B** to make word combinations. Then translate these combinations into Russian.

A	B
batch	automation
changeover	configurations
design	motion
fixed	operations
general	production
machine	purpose
processing	rates
product	settings
production	time
rotational	variations

Critical thinking

IV. Discuss these questions in a group.

1. What are the most challenging issues in industrial automation nowadays?
2. Which aspect of automation operations are you studying as part of your master's degree research project?

Translation Challenge

V. Translate the following passage from English into Russian, read it out to your groupmates and vote for the best variant of translation.

Gravity pallet loading reduces changeover times

Gravity powered, the *Lang EcoTower* brings automatic pallet loading and unloading within the grasp of every machinist. The system stores pallets in a helical slide arrangement that is compact in size, low maintenance and inexpensive to install. Automatic loading of pallets can more than double productive hours on the machine tool by reducing changeover times between jobs, enabling unmanned operation, and allowing the continuation of machining outside normal factory hours, producing significant cost reductions for each part manufactured. The *EcoTower* allows engineers to load a series of pallets onto the helical slide using its powered elevator. Reliable, hardened guide rails in the slide direct the pallets down, ready for picking and loading into the machine. This can either be done manually for small batch runs, or automatically with the Lang handling system. This unit can pick and place pallets in the machine tool, and optionally swivel them through 90º. Repeatability is ensured by the unit's pneumatic linear axle, while changing the set up to suit different machine tools is accomplished with the simple mechanical controls.

UNIT 7. THE FUTURE OF INDUSTRIAL AUTOMATION

Before you read

I. Answer the following questions.

1. Is it easy to make a forecast on the development of science and technology?
2. What factors should be taken into consideration while predicting the progress in industrial automation?
3. Earlier the purpose of automation was to increase productivity even automated systems can work 24 hours a day and to reduce the cost associated with human operators like wages. What do you think modern industrial automation is focused on?

While you read

II. Read the passage. Pay attention to the words **in bold**. Copy them down into your ***Vocabulary Notebook***.

The Rear-View Mirror

Because of the relatively small production volumes and huge varieties of **application**s, industrial automation typically utilizes new technologies developed in other markets. Automation companies tend to **customize** products for specific applications and **requirement**s. So the innovation comes from targeted applications, rather than any hot, new technology.

Over the past few decades, some innovations have indeed given industrial automation new surges of growth: The **programmable logic controller** (PLC) — developed by Dick Morley and others — was designed to replace relay-logic; it generated growth in applications where custom logic was difficult to **implement** and change. The PLC was a lot more reliable than relay-contacts, and much easier to program and reprogram. Growth was rapid in automobile test-installations, which had to be re-programmed often for new car models.

At about the same time that the PLC was developed, another surge of innovation came through the use of computers for control systems. Mini-computers replaced large central mainframes in central control rooms, and gave rise to **'distributed' control systems** (DCS), pioneered by Honeywell with its TDC 2000. But, these were not really ‘distributed’ because they were still relatively large clumps of **computer hardware** and cabinets filled with **I/O connections**.

The arrival of the PC brought low-cost PC-based hardware and **software**, which provided DCS functionality with significantly reduced cost and complexity. There was no fundamental technology innovation here — rather, these were innovative extensions of technology developed for other mass markets, **modified** and **adapted** for industrial automation requirements.

On the sensor side were indeed some significant innovations and developments which generated good growth for specific companies. With better specifications and good marketing, Rosemount’s **differential pressure flow-sensor** quickly displaced lesser products. And there were a host of other smaller technology developments that caused pockets of growth for some companies. But few grew beyond a few hundred million dollars in annual revenue.

Automation software has had its day, and can't go much further. No ‘inflection point’ here. In the future, software will embed within products and systems, with no major independent innovation on the horizon. The plethora of manufacturing software **solution**s and services will yield significant results, but all as part of other systems.

So, in general, innovation and technology can and will re-establish growth in industrial automation. But, there won't be any technology innovations that will generate the next Cisco or Apple or Microsoft.

We cannot figure out future trends merely by extending past trends; it’s like trying to drive by looking only at a rear-view mirror. The automation industry does NOT extrapolate to smaller and cheaper PLCs, DCSs, and **supervisory control** and **data acquisition system**s; those functions will simply be embedded in hardware and software. Instead, future growth will come from totally new directions.

After you read

International Scientific Vocabulary is a part of the vocabulary of the sciences and other specialized studies that consists of words or other linguistic forms current in two or more languages and differing from New Latin in being adapted to the structure of the individual languages in which they appear. For example, it is easy to guess about the meaning of the word ‘product’, because we have the analogues of the same root in Russian.

III. Underline or copy down the words in the reading passage that belong to the International Vocabulary.

Critical thinking

IV. Discuss these questions in a group.

1. Why do automation companies design software options for given application requirements?
2. What recent innovations are mentioned in the article?
3. Why do you think the author is pessimistic about independent innovations in industrial automation in the future?
4. How does the author comment on his choice of the article in the last paragraph?
5. In what way do you think industrial automation will develop in the future?

Translation Challenge

V. Translate the following passage from English into Russian, read it out to your groupmates and vote for the best variant of translation.

Advantages of Industrial Automation

Industrial automation reduces the operational cost by eliminating healthcare costs and paid leave and holidays associated with a human operator.

• High productivity

Even many companies hire hundreds of production workers and works for the maximum number of hours, the plant still needs to be closed for maintenance and holidays. Industrial automation helps to achieve the aim of the company by allowing the company to run a manufacturing plant for 24 hours in a day, 7 days in a week and 365 days a year. This leads to a significant improvement in the productivity of the company.

• High Quality

Error associated with a human being avoided with the replacing machines. Further, unlike human beings, robots do not involve any error, which results in products with uniform quality manufactured.

• High flexibility

Adding a new task in the assembly line requires training with a human operator, however, robots can be programmed to do any task. This makes the manufacturing process more flexible.

• High Information Accuracy

Adding automated data collection, can allow you to collect key production information, improve data accuracy, and reduce data collection costs. This provides you with the facts to make the right decisions when it comes to reducing waste and improving your processes.

• High safety

Robots handle hazardous condition so industrial automation can make the production line safe for the employees.

Because of these benefits automation has recently found more acceptance from many automation company.

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ДЕЛОВОЙ ИНОСТРАННЫЙ ЯЗЫК

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