ФЕДЕРАЛЬНОЕ АГЕНТСТВО ВОЗДУШНОГО ТРАНСПОРТА

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ИНОСТРАННЫЙ ЯЗЫК

ИСТОРИЧЕСКАЯ ЭВОЛЮЦИЯ АВИАЦИОННЫХ ДВИЖУЩИХ СИЛ

ПОСОБИЕ
по английскому языку

*для студентов I-II курсов
всех направлений и специальностей
всех форм обучения*

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Содержание

Предисловие

Целью настоящего учебного пособия является не только чтение, понимание и обсуждение текстового материала, но и создание собственных письменных и устных текстов, адекватных научно-публицистическому содержанию информационной литературы на современном английском языке.

Научная проблематика данного учебного пособия не только моделирует реальные коммуникативные задачи, поставленные профессиональной интеллектуальной средой, но и освещает пути их решения на уровне современного развития науки и техники. Текст данного учебного пособия носит "поддерживающий" характер, расширяющий порог кругозора и эрудиции у студентов.

Состав лексики имеет базовый уровень терминологии, позволяющий учащимся корректировать свою речь в соответствии с образцами английской научной речи, представленной в виде учебного дискуссионного текста.

Грамматические комментарии и упражнения, предлагаемые в пособии, полностью отражают научное содержание его текста. В этой работе особое внимание уделено частотным конструкциям английского языка, характерным для стиля, композиции и риторики научной речи.

Ответственный курс постановки произношения, всегда требующий корректирующих занятий со студентами, изложен в разделе "Приложение", где приведены все правила чтения знаков международной фонетической транскрипции, принятых IPA (International Phonetic Association, Gr. Britain).

Introduction

This learning book deals with modeling of biological systems, aiming at the creation of more efficient mechanical systems. The involvement of more sophisticated mathematics and computer science here for the solution of the problem in question as obvious.

This text will give you an idea of how the facts gathered by study, investigation or observation as well as ideas required by inference from such facts and tricky insight in one branch of learning can be employed for understanding some processes during in organism, which is the subject of investigation in the other branch of learning. These branches of learning are avionics, mathematics, mechanic systems, biology and bioengineering.

Task 1. Read the title, the sub-title of the text and the key words: *engineer, nature, researcher, model, propulsion system, mechanical system, biological system, nervous system, neural system, computer technology, model system, engineering application, very large-scale integrated (VLSI) circuits, motor system, motor control, replicate, sensory feedback, central pattern generator, motor behavior, repetitive action, mechanical model, robotic model.*

Without reading the text what could you guess about its content? What problem will be considered? Make a prediction. Write own as many ideas as you can.

Reading

Task 2. Read the text in order to understand the main ideas. Compare your guessed ideas with those considered in the text. Tell where you were right and where you were wrong.

BETTER DESIGNS FROM A BLOOD SUCKER

Understanding the nervous system of a leech may help build better robots

For centuries, engineers have taken inspiration from nature in designing their creations. It's no coincidence, for example, that the shape of an aircraft wing is similar to a bird's.

If researchers were able to more accurately model the propulsion system of, say, a bird or a fish, then perhaps the mechanical systems they produced would be more efficient than those that currently exist. With advances in computer technology - including the development of advanced modeling systems with very large - scale integrated (VLSI) circuits - researchers are now exploring scale more deeply the way biological systems operate. Greater understanding of the nervous system of a leech, for example, may help engineers develop more efficient mechanical devices, including better motors, pumps, robots, prosthetic limbs, aircraft.

"We are now at a point where we can use neural systems as au inspiration for engineering," said Steve DeWeerth, an assistant professor in the School of Electrical and Computer Engineering at Georgia Institute of Technology in Atlanta. DeWeerth has done most of his work in neuromorphic engineering, a field in which researchers study biological systems for potential engineering applications. Researchers have already developed VLSI models of early visual processing in the retina and early auditory processing in the inner ear. But until now they have developed few VLSI circuit models of motor systems, the devices that make biological parts move.

Biological organisms perform sophisticated sensory motor tasks. Fine motor control in the human hand, for example, is extremely complex, and engineers have not yet been able to replicate such a system in a machine. One of the challenges of modeling neural systems is finding the correct level of system complexity. While certain biological

systems are too complicated to engineer, replicating a biological system that is relatively unsophisticated doesn't really take advantage of VLSI technology, in which complicated electronic circuits are easily and inexpensively replicated dozens of times.

DeWeerth, a VLSI designer, has teamed up with Ron Calabrese. director of the neuroscience program at Emory University in Atlanta, who is studying neural control of the leech circulatory system and leech locomotion. They are studying how biological motor systems work and how sensory feedback improves performance.

The biological systems they selected the nervous systems of a leech and a lamprey, an eel-like jawless fish are particularly suited to VLSI-circuit modeling. The leech's body, for example, is divided into more than 20 segments that operate similarly. The lamprey has 100 such segments along its spine. In both the leech and the lamprey. each segment has a central pattern generator which the researchers call an oscillator. "An individual oscillator can be modeled with VLSI circuits, and these circuits can be replicated many times to model the entire intersegmental system," DeWeerth said.

Much motor behavior, from a human serving a tennis ball to a fish swimming, is regulated by these central pattern generators, which generate a motor pattern or a repetitive action. When a human walks, for example, the motor pattern for the first step is continuously repeated. Sensory feedback to the central pattern generators helps the human adapt the stride to changing conditions.

A leech's swimming motion similarly uses repetitive movements. By studying this motion, the researchers can observe how sensory input, pattern generation, and reflex action are coordinated to provide efficient propulsion.

DeWeerth and Calabrese plan to build a mechanical model of the leech to test the circuits they develop. The leech model will not swim, however, because the researchers are not studying its hydrodynamics.

Instead, the model will oscillate back and forth on a bench making sinusoidal movements.

DeWeerth hopes to eventually merge his work with research into hydrodynamic modeling of mechanical structures. "If we can learn more about both the hydrodynamics and the neural dynamics, we can use this work to build more efficient propulsion systems in water," he said. An example of this type of hydrodynamic research is underway at the Massachusetts Institute of Technology. Michael Triantafyllou, a research professor, is leading a team developing a robotic tuna to help in studying the fundamental fluid mechanics of how the fish swims and to evaluate control circuits and for ocean sensors based autonomous-vehicle applications. The MIT researchers plan to launch a 15-foot robotic model in Boston Harbor.

Meanwhile, studying the leech may lead to more than better motors. Its efficient circulatory system may also yield n methods of pumping fluids. And by building physical models of biological neuromotor systems, DeWeerth hopes to develop a thorough knowledge of how the systems work. If we can understand their organizational principles," he said, "we may be able to build better prosthetic limbs and robots that can move more smoothly and have reflex-like behavior."

Leo O'Connor

Vocabulary

Task 3. Below are some words taken from the text. Try to guess their meaning by thinking about the context in which they are found. In each case choose one of the three answers which you think best expresses the meaning.

inspiration (line 1)

(a) communication of ideas from a supernatural source;

(b) a bright idea, something conveyed to the mind when under extraordinary influence;

(c) state of animal and plants in which the natural functions are performed.

coincidence (line 2)

(a) correspondence in nature, circumstances etc., the fact that two or more things share certain characteristics, have identical elements;

(b) a lack of order;

(c) heat and light caused by combustion.

currently (line 6)

(a) at once;

(b) in a moment, belonging to the present time, generally;

(c) with great force or energy.

explore (line 9)

(a) to make an attempt to learn more about an unknown; to search through with the view of making discovery, to investigate;

(b) to expose a theory;

(c) to become a member of.

device (line 12)

(a) an instrument which measures a variable quantity, usually having a scale;

(b) an object cleverly or especially made for a special purpose;

(c) a picture used to make a description.

unsophisticated (line 31)

(a) simple;

(b) tall ;

(c) strange.

advantage (*in* take advantage of) (line 32)

(a) favorable state, superiority, a factor or set of factors in a competition giving a position of superiority of any kind;

(b) (in tennis) a point gained after deuce;

(c) a state, intermediate between a solid and a gas.

feedback (line 38)

(a) the upper part of a man's or animal's body;

(b) the action by which the output of a process is coupled to the input;

(c) a reward for services.

eventual(ly) (line 64)

(a) in a short period of time;

(b) willingly;

(c) that which happens as a consequence, which is bound to follow as the final effect of causes already in operation.

vehicle (line 74)

(a) the gravitational force between the Earth and a body;

(b) any form of land or air transport;

(c) a substance in which solid substances are suspended.

Task 4. Below is a list of words in the text, you came across in the text, which are considered as biological in neuromorphic engineering. Neuromorphic engineering is defined in the text (paragraph 3). Scan the text and find some complementary information about those biological systems answering the following questions. The paragraph you'll find the required information is marked.

a human, a bird, a leech, a fish, a lamprey, an eel, a tuna

1. What is an aircraft wing similar to? (1)
2. How do people sometimes call a leech? (the title)
3. What are the researchers attempting to model more accurately to produce more efficient mechanical systems? (2)
4. What are motor systems? (3)
5. What is considered to be extremely complex to replicate in a machine? (4)
6. What is Ron Calabrese studying? (5)
7. What is a lamprey? (6)
8. Whose body is divided into 20 segments and whose body has 100 segments? (6)
9. Who has a central pattern generator - an oscillator for each segment along its spine? (6)
10. What are the biological systems, whose motor behavior is regulated by the central pattern generators and what is a motor pattern? (7)
11. whom does sensory feedback to the central pattern generator help adapt the stride to changing conditions? (7)
12. whose swimming motion uses repetitive movements? (8)
13. what mechanical model will be built to test the circuits developed by the researchers? (9)
14. what are Michael Triantafyllou and a team he is leading developing to help in studying the fundamental fluid mechanics of how the fish swims? (11)
15. What may lead to more than better motors? (12)

Grammar notes and grammar tasks

Task 5. Below are some sentences taken from the text. Read them and tell where the verb to *have* is a main and where it is a helping or an auxiliary one.

1. For centuries, engineers *have* taken inspiration from nature in designing their creations.

2. He may be able to build better prosthetic limbs and robots that can move more smoothly and *have* reflex-like behavior.

3. Researchers *have* already developed VLSI models of early visual processing in the retina and early auditory processing in the inner ear.

4. In both the leech and lamprey each segment *has* a central pattern generator.

5. Fine motor control in the human hand, for example, is extremely complex and engineers *have* not yet been able to replicate such a system in a machine.

6. The lamprey *has* 100 such segments along its spine.

7. DeWeerth, a VLSI designer, *has* teamed up with Ron Calabrese, director of the neuroscience program at Emory University in Atlanta.

8. But until now they *have* developed few VLSI circuit models of motor systems.

9. DeWeerth has done most of his work in neuromorphic engineering.

Grammar notes 1

The Present Perfect is used with action or stative verbs. when the speaker is referring to an activity or state which either begins in the past and continues up to the moment of speaking, or occurs at some unspecified time within the pre-past period. If we say that something has happened we are generally thinking about the present as well as the past. When we make a present perfect sentence, we could usually make a present tense sentence about the same situation.

Example:

We have known each other for a long time

We met 10 years ago. **We are all friends.**
(the past) **(the present)**

Task 6. Make a past tense sentence and a present tense sentence for each of the six present perfect sentences from Task 5. Show the connection between the past and the present. For facts more consult the text. In your sentences use verbs other than in the basic sentences from the text as in the example above.

Task 7. Below are some sentences taken from the text. Read them and tell where the verb to be is main verb and where it is a helping or an auxiliary one.

1. Researchers *are* now exploring more deeply the way biological systems operate.

2. An individual oscillator can *be* modeled with VLSI circuits.

3. If we can understand their organizational principles we may *be* able to build better prosthetic limbs and robots.

4. The leech model will not swim, however, because the re- searchers *are* not studying its hydrodynamic.

5. When a human walks, the motor pattern for the first step *is* continuously repeated.

6. Fine motor control in the human hand is extremely complex and engineers have not yet *been* able to replicate such a system in a machine.

7. The biological systems they selected *are* particularly suited to circuit modeling

8. The leech's body *is* divided into more than 20 segments.

9. Ron Calabrese *is* studying neural control of the leech circulatory system and leech locomotion.

10. If researchers *were* able to more accurately model the propulsion system then perhaps the mechanical systems they produced would *be* more efficient.

11. Much motor behavior *is* regulated by the central pattern generators.

12. Michael Triantafyllou, a research professor, *is* leading a team developing a robotic tuna to help in studying the fundamental fluid mechanics.

13. We *are* now at a point where we can use neural systems as an inspiration for engineering.

14. An example of this type of hydrodynamic research *is* underway at the MIT.

15. These circuits can *be* replicated many times to model the entire intersegmental system.

16. Sensory input, pattern generation and reflex action *are* coordinated to provide efficient propulsion.

17. Complicated electronic circuits *are* easily and inexpensively replicated dozens of times.

18. Certain biological systems *are* too complicated to engineer.

19. A biological system that *is* relatively unsophisticated doesn't really take advantage of VLSI technology.

20. *It's* no coincidence that the shape of an aircraft wing *is* similar to a bird's.

21. They *are* studying how biological motor systems work and how sensory feedback improves performance.

Grammar notes 2

Be is often used as full verb, as in: *He was my best friend. He was so nice*. *Be + present participle* is an expression of the Progressive Aspect in which *be* is an auxiliary or helping verb (e.g. They are waiting). The auxiliary *Be + past participle* produces the Passive Voice, in contrast with Active Voice. The verb is 'active' in:

(1) The headmaster places George and me in the same class. but 'passive' in:

(2) George and I were placed in the same class. For more information consult your grammar book.

Task 8. Write an essay on the topic "Where robots have been applied. are being applied and will be applied in the nearest future" The essay should not exceed 150-200 words. Try to use to be as a full verb and as an auxiliary in not less than 10 sentences.

Task 9. Below are three sentences taken from the text. Study them, and analyse thoroughly the information from the text relating to these sentences. Answer the questions.

1. If researchers were able to more accurately model the propulsion system of, say, a bird or a fish, then perhaps the mechanical systems they produced would be more efficient than those that currently exist.

2. If we can learn more about both the hydrodynamics and neural dynamics we can use this work to build more efficient propulsion systems in water.

3. If we can understand their organizational principles may be able to build better prosthetic limbs and robots that can move more smoothly and have reflex-like behavior.

Questions:

1. Can researchers model accurately enough the propulsion systems of a bird or a fish?

Are the mechanical systems produced and currently existing efficient enough?

Is more accurate modeling of the biological objects' propulsion system a fact or a non-fact at the moment?

2. Do DeWeerth and his team know much about both the hydrodynamics and the neural dynamics at the moment?

Is it real possibility that they will be able to build more efficient propulsion systems in water?

3. Do Deweerth and his team understand organizational principles of biological neuromotor systems?

Is it real possibility that they will understand it and will have opportunity to build better prosthetic limbs and robots that can move more smoothly and have reflex-like behavior?

Grammar notes 3

Conditional sentences can be divided into 3 groups.

Type 1: *Present tense in the if-clause, will or imperative in the main clause*. In this type what is said in the main clause is dependent on something that may not happen, though this "something" is assumed by the speaker to be *a real possibility*.

E.g. If you *read* this article { *tell* me. I want to know your opinion. we *will* discuss it later

Can, may, must are acceptable in the if-clause when *will* is not.

E.g. If you *read* this article we *can discuss* it later.

(See 2 and 3 in Task 9).

Type 2: *Past in the if-clause, would in the main clause.* Here what is said in the main clause is an imaginary consequence of a present *non-fact.* The if-clause states the non-fact and its verb is accordingly in the past tense.

E.g. If you read [red] this article { Would discuss it / Could discuss it

If I were you I *would* read this article. (See 1 in Task 9).

Type 3: *Past Perfect in the if-clause, would + perfect in the main clause*. What is said in the main clause is now seen as an imaginary consequence of a past non-fact - something that did not happen.

E.g. If you had read [red] this article we *would have discussed* it, or we *could have discussed* it.

Task 10. Make if-clauses considering each action or state in the first column as: a) a real possibility; b) a present non-fact: c) a past non-fact; add a main clause using the verb in the second column:

I	**II**
to have any vehicle	to come in time
to use a computer	to solve a problem
to swim faster	to win a prize
to understand better	to design a device
to perform a task	to be the fast
to be a researcher	to develop . . .

Discussion of facts, ideas and concepts

Task 11. Read the first two paragraphs, thoroughly analyze the facts stated and answer the questions.

1. What is the system researchers are planning to more accurately model?
2. What is supposed to be improved being a result of the research described in the text?
3. What advanced device will help to explore more deeply the way biological systems operate?
4. What is meant by more efficient mechanical devices in the text?

Task 12. One of the key words in the text is *MODEL*. Read the definition from *Longman Dictionary of Scientific Usage.*

Model. A model is a physical device which represents an object. By examining the model we can find out facts about the object, e.g. a model of a bridge: a model of the solar system. Such models are called *representational models*, and they can be described as *true adequate, distorted* or *analogue* models.

A *true model* is one made accurately to a known scale (also known as a scale *model*), model of a bridge in which the e.g. a length, breadth, and thickness of each part in the model is exactly 1/100 of the corresponding measurements in the bridge.

An *adequate model* is one in which only some of the measurements or characteristics are made to a scale, but sufficient detail is given for the purpose of the model.

A *distorted model* is one which uses different scales for different characteristics or measurements, e.g. a model of the solar system in which the distances between the planets are on a different scale because otherwise they would be too small to see.

An *analogue model* represents an analogy with the object. For example there is an analogy between the diffusion of molecules in a gas and the movement of a swarm of bees. The movement of the swarm of bees is the model: the diffusion of gas molecules is the object. An analogue model need not be built, but only described.

A *theoretical model* describes an object or a system by using observables, the behaviour of which explains various properties shown by the object or system. The model is not built, only discussed. Usually the theoretical model uses an analogy of the object or system, e.g. a) the Kinetic Theory of Gases uses a billiard ball model to describe the structure of a gas. A billiard ball is an observable, and the behaviour of the billiard balls explains the properties of the gas. In a theoretical model, the characteristics of the observables must be stated, i.e. that billiard balls have the characteristic of being perfectly elastic; b) the passage of an electric current through metals is explained by the free electron model of metals. Note the difference between a theoretical model and an analogue representational model. In a representational model, steel balls moving on a tray represent gas molecules, and no characteristics are stated. In the theoretical model the behaviour of the billiard balls describes the behaviour of the gas molecules. The description of the behaviour is more accurate than the representation of the behaviour of gas molecules.

Longman Dictionary does not give a definition of a mathematical model. Try to formulate what is a mathematical model.

Task 13. DeWeerth and Calabrese plan to build a mechanical model of the leech to test the circuits they develop. The leech model will not swim, however, because the researchers are not studying its hydrodynamics. Classify the type of the model the researchers plan to build. How does the model move? What is the final goal of their research? Do they have any kind of competition? What are their competitors working on and what is underway at the MIT?

Task 14. It is a well-known fact that research in any sphere demands great investments. The money can be taken either from a state budget, from private investors. The money the private investor owns comes from business. Imagine yourself being a businessman and tell what kind of product you would like to produce if had enough money to invest into the researches described in you the text. Give your arguments.

List of products:

(1) better motors;

(2) pumps based on better methods of pumping fluids:

(3) robots } that can move more smoothly

(4) prosthetic limbs } and have reflex-like behavior:

(5) more efficient propulsion systems in water;

(6) ocean-based autonomous vehicles.

Task 15. Below are the words taken from the text.

research (n)	engineering (n)
to research (v)	to engineer (v)
researcher (n)	engineer (n)

They are rather frequently used in the text, because the article tells us about the joined efforts of researchers and engineers to produce better devices. Both research and engineering are spheres of human intellectual activity. *Research* is a diligent search or seeking of facts and principles, scientific investigation or study to discover facts, while *Engineering* is the application of science to the design, construction, and maintenance of works, machinery, roads, railways, bridges, harbour installations, engines, ships, aircraft and spacecraft and space stations and the generation, transmission, The main divisions of engineering are aerospace, chemical, civil, electrical, electronic, gas, marine, materials, mechanical, mining, production, radio and structural. Neuromorphic engineering is mentioned in the text. *Engineer* literally means to lay out and manage the construction of some project.

Find the sentences in the text which will give you more information about the particular activity of researchers and engineers in developing and designing better devices. (7 cases with engineer and its derivatives, 10 cases with research and its derivatives.)

Tell what attracts you more:

(1) searching of facts and principles, or

(2) realization of new findings of scientists in new devices, technologies, etc.

Give arguments to support your ideas.

Task 16. The object of the research described in the text is to build a physical model of biological neuromotor systems, to develop thorough knowledge of how the systems work and what are their organization principles. Read the text again and answer the following questions.

1. What biological objects are discussed in the text?

2.What interests the researchers in biological systems?

3. What interests the engineers in biological systems?

4. What have you known about the biological objects' motor behaviour?

5. Why does the replication of motor control in the human hand in a machine prove to be a very complicated problem?

6. Why are the leech circulatory system and its locomotion expected to be replicated?

Locomotion - the action of an individual organism in moving itself from place to place; this ability is usually restricted to animals. Locomotion of an organism is brought about by movements of parts of the body. Methods of locomotion include running, walking, flying and swimming.

7. Sensory input, pattern generation, and reflex action are coordinated in a leech to provide *efficient* propulsion. *Propulsion*- the action of propelling an object, e.g. a jet engine is used for the propulsion of an airplane.

Leech's swimming is a propulsion motion.

Fill in the blanks. Insert any information you think appropriate.

1) Fish's swimming is . . . . How does a fish move?

Describe what a fish does to move.

2) Bird's flying is . . . . How does a bird fly?

Describe what a bird does to fly.

3) Snake's crawling is . . . . How does a snake crawl?

Describe what snake does to crawl.

(Describe the mechanical part of each motion in the Newtonian mechanics.)

8. What probable applications of the results obtained can you see?

Task 17. Read the text and discuss it in the class.

WHEN ROBOTS DO THE REALLY DANGEROUS JOBS

Robots that can strip radioactive waste from ventilation ducts or seal spent fuel and debris inside secure metal containers reduce the risks for human operators. They are opening up the field for consultants, engineers and companies to tackle the 100-year task of making Britain's obsolete nuclear power stations safe for future generations.

Once at the forefront of the postwar race to develop a source of low-cost energy and plutonium for atom bombs, Britain is world leader now in clean-up technology.

Nuclear decommissioning is a painfully slow that has to be process carried out step by step and costs in Britain will run into tens of billions over the next century.

Key to cutting long-term costs are robots. which carry out a range of tasks, such as controlled-circuit TV inspections, pumping and removal of radioactive sludge, and heavy-duty tasks.

On a project at nearby Sellafield, floating robot is being used to a drain and dismantle a tank of highly active liquid waste. David Young, of BNFL, says: "At Sellafield we have had to invest £20 million in new ventilation system and robots just to get the work started. The sums involved are enormous but robots used in the early stages can pave way for conventional civil engineering and demolition operations.

Stephen Hoare

ПРИЛОЖЕНИЕ

ПРАВИЛА ЧТЕНИЯ ЗНАКОВ МЕЖДУНАРОДНОЙ ФОНЕТИЧЕСКОЙ ТРАНСКРИПЦИИ, ПРИНЯТЫХ IPA /INTERNATIONAL PHONETIC ASSOCIATION, GR. BRITAIN/

Приводимые ниже общие правила чтения знаков Международной Фонетической Транскрипции помогут недостаточно знакомому с фонетикой английского языка студенту, программисту или инженеру правильно произносить приводимые в толковых притекстовых словарях транскрипции слов, терминов и иной лексики, используемой в учебных материалах данного пособия. При чтении транскрипции лексики следует обращать особое внимание на долгие звуки [i:], [a:], [ɔ:], [u:], [ə:], [æ]. Общее представление о разнице фонетического строя двух языков дают известные графические модели алгоритмов языка JOVIAL: - jogging (бег трусцой) - для русского языка и skiing (бег на лыжах) - для английского:

Russian speaker……jogging model of speech

English speaker…___...___...___...skiing model of speech

Черточки в модели бега на лыжах соответствуют долгим звукам, а точки - коротким звукам и укороченным интервалам между ними, весьма характерным для фонетики современного английского языка.

Произносительные нормы английского языка не являются жестко фиксированными и могут меняться, например, от университета к университету или даже от лектора к лектору. Так, оставаясь в рамках произносительных норм, которым следует Лингафонный Институт Великобритании и дикторы BBC и CNN, можно отметить, что в некоторых случаях такие звуки, как [ə], [d], [t] могут быть факультативными, т.е. необязательными для произношения, и иногда выделяться в современных словарях с помощью курсива либо круглых скобок.

(а) ГЛАСНЫЕ ЗВУКИ

В разделе приводятся русские аналоги английских звуков и после точки с запятой - английские примеры.

[i] - долгий звук u; tree

[ɪ] - краткий, открытый звук u; bit

[e] - как э в словах этот, экий; get

[æ]- более открытый звук, чем э (занимает промежуточное положение между русскими а и я; map

[a:] - долгий, глубокий звук а; car

[ɔ] - краткий, открытый звук о; pot

[ɔ:] - долгий звук о; walk

[o] - закрытый, короткий звук о, большей частью встречающийся в дифтонгах, занимает промежуточное положение между русскими о и у; low

[u] - короткий звук “у” в дифтонгах, произносится со слабым округлением губ; tone

[u:]-долгий звук у; move

[ʌ] - краткий гласный звук, приближающийся к русскому а в словах варить, бранить. Этот английский звук всегда стоит под ударением; cut

[ə:] - долгий гласный звук, напоминающий долгий звук э; work

[ə]- безударный гласный звук, примерно соответствующий безударной гласной в словах нужен, комната; worker

(б) ДВУГЛАСНЫЕ ЗВУКИ - ДИФТОНГИ

Приводятся русские аналоги произношения и после точки с запятой - английские примеры:

[eɪ] - эй; take

[ou] - оу; phone

[aɪ] - ай; write

[au] - ау; round

[ɔɪ] - ой; boy
[ɪə] - иа; here
[ɛə] - эа; there
[uə] - уа; poor

(в) СОГЛАСНЫЕ ЗВУКИ

Приводятся русские аналоги произношения и после точки с запятой - английские примеры:

[p] - п; poor
[b] - б; bit
[m]- м; map
[w] – звук, занимающий промежуточное положение между “уи” и “в”; wind
[a] - ф; five
[v] - в; vector
[θ] [ð] - оба этих звука образуются простым продуванием воздуха между передними зубами при прижатом к ним кончике языка, причем первый звук воспроизводится без голоса, второй - с голосом; think, that
[s] - с; sell
[z] - з; zero
[t] - т, произнесенное не у зубов, а у десен; take
[d] - д, произнесенное не у зубов, а у десен; dot
[n] - н, произнесенное не у зубов, а у десен; now
[l] - л; load
[r] - р, произнесенное без вибрации кончика языка; wrong
[ʃ] - ш, произнесенное мягко; push
[dʒ]- дж; job
[tʃ] - ч; child
[k] - к; keep
[g] - г, gold
[ŋ] - н(г), произнесенное задней частью языка; wrong
[h] - простой выдох; hot