В. В. Батманова, Е. К. Платонова

ENGINEERING

Сборник текстов и упражнений по английскому языку

Волгоград
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Министерство образования и науки Российской Федерации
Волгоградский государственный архитектурно-строительный университет

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Оглавление

Unit 1. CIVIL ENGINEERING

Civil engineering is a field of engineering that deals with the construction and maintenance of the structures that are required for human civilization, such as buildings, roads, and sewers. It is an umbrella field comprised of many related specialties.

Structural engineering, of which structural design is a component, is typically the largest part of civil engineering as a practice. Structural engineers design bridges, buildings, offshore oil platforms, dams etc. Structural analysis is another component of structural engineering and a key component in the structural design process. This involves computing the stresses and forces at work within a structure. There are some structural engineers who work in non-typical areas, designing aircraft, spacecraft and even biomedical devices.

Supporting structural engineering is the field of geotechnical engineering. The importance of geotechnical engineering can hardly be overstated: buildings must be connected to the ground. Geotechnical engineering is concerned with soil properties, foundations, footings and soil dynamics. Over time, researchers have derived empirical equations that work (it is not an exact science).

Transportation engineering is concerned with queuing theory and traffic flow planning. These are highly complex computational problems.

Environmental engineering deals with the treatment of chemical, biological, and/or thermal waste and with hydrology.

Sanitary engineering is primarily concerned with purifying water for drinking and with treating sewage.

Hydraulic engineering is concerned with the flow and conveyance of fluids, principally water. This area of engineering is, of course, intimately related to the design of bridges, dams, channels, canals, and levees, and to both Sanitary and Environmental engineering.

Construction engineering involves planning and execution of the designs from structural and geotechnical engineers.

Civil engineering also includes material science. Engineering materials include concrete, steel and recently, polymers and ceramics with potential engineering application.

A popular misconception is that civil engineering is far from the existing frontiers in mathematics and computer science. In actuality, much of what is now computer science was driven by work in civil engineering, where structural and network analysis problems required parallel computations and development of advanced algorithms.

There are also civil engineers who work in the area of safety engineering, applying probabilistic methods to structural design, safety analysis and even estimates of insurance losses due to natural and man-made hazards [1].

Key Words

Engineering — инженерное дело, строительство
Complex — сложный
Maintenance — содержание
Required — требуемый
Design — проектирование
Stress — давление
Aircraft — самолет
Device — устройство
Supporting — поддержка
Soil — почва
Foundation — фундамент
Equation — уравнение
To be concerned with — заниматься чем-либо
Traffic flow theory — теория транспортного потока
Computational — расчетный
Waste — отходы
Sewage — канализация
Intimately — глубоко
Dam — дамба
Execution — реализация
Queuing theory — теория очередности
Estimate — оценка
Loss — потеря
Structural engineering — структурное инженерное дело
To deal with — иметь дело с
Construction — строительство
Sewer — канализация
To design — проектировать
Force — сила
Spacecraft — космический корабль
To overstate — преувеличивать
Ground — земля
Properties — свойства
Footing — опора
Exact — точный
Civil engineering — строительство, инженерное дело
Misconception — неправильное представление
Treatment — обработка
Purifying — очистка
Conveyance — перемещение
Related to — связанный с
Levee — плотина, мол
Concrete — бетон
To compute — рассчитывать
Network — сеть
Due to — из-за, благодаря

Exercise 1. Answer the questions

1. What does the civil engineering deal with?
2. What is structural engineering?
3. What do structural engineers do?
4. What is structural analysis?
5. Why cannot the importance of geortechnical engineering be overstated?
6. What is transportation engineering concerned with?
7. What is sanitary engineering devoted to?
8. What is environmental engineering concerned with?
9. What does hydraulic engineering deal with?
10. What does construction engineering involve?
11. What does civil engineering also include?

Exercise 2. Find Russian equivalents

Empirical equations, over time, soil dynamics, footings, foundations, soil properties, is concerned with, the ground, geotechnical engineering, device, spacecraft, aircraft, within a structure, computing the stresses and forces, this involves, component, dams, offshore oil platforms, design, structural engineers, a practice, the largest part, structural design, structural engineering, insurance losses, estimates, probabilistic methods, network analysis problems, misconception, application, steel, concrete, to include, execution, construction engineering, level, related to, intimately, conveyance of fluids, treating sewage, purifying water, waste, the treatment of, environmental engineering, computational problems, complex, traffic flow planning, queuing theory, man-made hazards.

Exercise 3. Find English equivalents

Строительство, инженерное дело, иметь дело с …, строительство, поддержание, конструкции, необходимый для …, дороги, канализация, состоящий из …, структурное инженерное дело, структурное проектирование, обычно, практика, проектировать, морские платформы, дамбы, ключевой компонент, давление и силы, самолет, космический корабль, биомедицинские приборы, переоценить, земля, заниматься чем-либо, свойства почв, фундаменты, опоры, динамика почвы, с течением времени, транспортное строительство, теория очередей, теория потока транспортных средств, сложные расчетные задачи, очистка отходов, очистка воды, очистка канализационных стоков, тесно связанный с …, плотина (мол), включать в себя, строительные материалы, бетон, железо, применение, ошибочное представление, существующие границы, проблемы сетевого анализа, сложные алгоритмы, применение, вероятностные методы, созданные человеком угрозы.

Exercise 4. Say whether it is true or false

1. Construction engineering involves planning and execution of the designs from structural and geotechnical engineers.
2. Hydraulic engineering is concerned with purifying water for drinking and with treating sewage.
3. Sanitary engineering is primarily concerned with the flow and conveyance of fluids, principally water.
4. Environmental engineering deals with queuing theory and traffic flow planning.
5. Transportation engineering is concerned with the treatment of chemical, biological, and/or thermal waste and with hydrology.
6. Geotechnical engineering is concerned with computing the stresses and forces at work within a structure.
7. Civil engineering is a field of engineering that deals with soil properties, foundations, footings and soil dynamics.
8. Structural engineers design bridges, buildings, offshore oil platforms, dams etc.
9. Construction engineering involves the flow and conveyance of fluids, principally water.
10. Hydraulic engineering is concerned with planning and execution of the designs from structural and geotechnical engineers.
11. Engineering materials include concrete, steel and recently, polymers and ceramics with potential engineering application.

Exercise 5. Fill in the gaps with the words from the box

1. Hydraulic Engineering is concerned with the flow and ___________________ ___________________________ of fluids, principally water.

2. There are also civil engineers who work in the area of ___________________ ____.

3. Construction engineering involves planning and execution of _________________________________ from structural and geotechnical engineers.

4. ____, researchers have derived empirical equations that work (it is not an exact science).

5. There are some structural engineers who work in ________________________ ____________________________, designing aircraft, spacecraft and even biomedical devices.

6. This involves computing the stresses and forces at work__________________ ____.

7. Structural analysis is another component of structural engineering and a ____ ____________________________________ in the structural design process.

8. Structural engineers design bridges, buildings, __________________________ ________________________________, dams etc.

offshore oil platforms	within a structure	over time	safety engineering
a key component	non-typical areas	the designs	conveyance

Exercise 6. Fill in the gaps with prepositions

1. There are also civil engineers who work … the area of safety engineering.

2. This area of engineering is, of course, intimately related … the design of bridges, dams, channels, canals, and levees.

3. Sanitary engineering is primarily concerned with purifying water … drinking and with treating sewage.

4. Environmental engineering deals … the treatment of chemical, biological, or thermal waste.

5. Geotechnical engineering is concerned … soil properties, foundations, footings and soil dynamics.

6. Civil engineering is a field of engineering that deals with the construction and maintenance … the structures.

Exercise 7. Complete the sentences with the information from the text

1. There are also civil engineers who work …
2. A popular misconception is that …
3. Engineering materials include …
4. Civil engineering also includes …
5. Hydraulic engineering is concerned with …
6. Sanitary engineering is primarily concerned with …
7. Environmental engineering deals with …

8. Transportation engineering is concerned with …
9. The importance of geotechnical engineering …
10. There are some structural engineers who …
11. Structural analysis is …
12. Structural engineers design …
13. Civil engineering is a field of engineering …

Exercise 8. Complete the definitions below with the words from the box

1. ______________________________the process of preserving a condition.
2. ______________________________ the action of building something.
3. ______________________________ an underground conduit for carrying off drainage water and waste matter.
4. ____________________________ a barrier constructed to hold back water and raise its level.
5. ____________________________ a thing made or adapted for a particular purpose, especially a piece of mechanical or electronic equipment.
6. ____________________________ unwanted or unusable material, substances, or by-products.
7. ____________________________ a structure carrying a road, path, railway, etc. across a river, road, or other obstacle.
8. ____________________________ a building material made from a mixture of broken stone or gravel, sand, cement, and water.

Construction	Sewer	Dam	Device
Waste	Bridge	Concrete	Maintenance

Exercise 9. Speak about civil engineering

Unit 2. HISTORY OF ENGINEERING

The concept of engineering has existed since ancient times as humans devised fundamental inventions such as the pulley, lever, and wheel. Each of these inventions is consistent with the modern definition of engineering, exploiting basic mechanical principles to develop useful tools and objects.

The term engineering itself has a much more recent etymology, deriving from the word «engineer», which itself dates back to 1325, when an engine'er (literally, one who operates an engine) originally referred to «a constructor of military engines». In this context, now obsolete, an «engine» referred to a military machine, i. e., a mechanical contraption used in war (for example, a catapult). Notable exceptions of the obsolete usage which have survived to the present day are military engineering corps, e.g., the U.S. Army Corps of Engineers.

The word «engine» itself is of even older origin, ultimately deriving from the Latin ingenium, meaning «innate quality, especially mental power, hence a clever invention».

Later, as the design of civilian structures such as bridges and buildings matured as a technical discipline, the term civil engineering entered the lexicon as a way to distinguish between those specializing in the construction of such non-military projects and those involved in the older discipline of military engineering [2].

Key Words

Concept — понятие
Ancient — древний
To devise — придумать
Pulley — блок
Wheel — колесо
To exploit — использовать
To develop — разрабатывать
Term — термин
Obsolete — устаревший
Contraption — хитроумное изобретение
To survive — пережить
Origin — происхождение
Innate — врожденный
To mature — созреть
To exist — существовать
Human — человек
Invention — изобретение
Lever — рычаг
Consistent — соответствующий
To derive from — происходить из
Tool — инструмент
To refer to — относиться к
Military — военный
Notable — заметный
Corps — корпус (инженерный)
Ultimately — в конце концов
Hence — следовательно
To distinguish — различать

Exercise 1. Answer the questions

1. How long does the concept of engineering exist?
2. Which types of devices are known since ancient times?
3. Are these inventions consistent with modern engineering?
4. Which etymology does the term «engineering» have?
5. When does the term engineer date back?
6. What did the term «engineer» originally mean?
7. What does the word «engine» mean?
8. When did the term «civil engineering» enter the lexicon?

Exercise 2. Find Russian equivalents

Obsolete, referred to, who operates an engine, literally, dates back, deriving from, recent, useful tools, to develop, basic mechanical principles, exploiting, definition, is consistent with, wheel, lever, pulley, fundamental inventions, existed, devised, humans, ancient times, since, concept, involved in, to distinguish, matured, hence, innate quality, origin, survived, notable, exception, contraption, engineering corps.

Exercise 3. Find English equivalents

Понятие, инженерное искусство, древние времена, люди, придумывать, определение, соответствовать, использовать, основные принципы механики, разрабатывать, полезные инструменты, предметы, термин, новый, происходящий от, датируется, буквально, относиться к, конструктор, устаревший, война, хитроумное изобретение, внутреннее качество, настоящее время, заметное исключение, устаревшее использование, дожить до, умственная сила, умное изобретение, разработка, созреть, войти в лексикон, способ, разграничить, невоенный.

Exercise 4. Say whether it is true or false

1. The term «civil engineering» entered the lexicon as a way to distinguish between those specializing in the construction of such non-military projects and those involved in the older discipline of military engineering.
2. The design of civilian structures such as bridges and buildings matured as a humanitarian discipline.
3. The word «engine» itself is of even older origin, ultimately deriving from the Greek.
4. The term engineering itself has a much more recent etymology.
5. The concept of engineering has never existed.

Exercise 5. Fill in the gaps with the words from the box

1. The ________________ civil engineering entered the lexicon as a way to distinguish between those specializing in the construction of such non-military projects and those _____________________________ the older discipline of military engineering.
2. Later, as ________________________________ of civilian structures such as bridges and buildings matured as a technical discipline.
3. The word «engine» itself is of even older origin, ____________________ deriving from the Latin ingenium, meaning «innate quality, especially mental power, hence a clever invention».
4. The term engineering itself has a much more recent etymology, deriving from the word____.
5. Each of these inventions is consistent with the modern definition of engineering, ______________________ basic mechanical principles to develop useful tools and objects.
6. The concept of engineering has existed __________________ as humans devised fundamental inventions such as the_________________, lever and wheel.

pulley	since ancient times	exploiting	engineer
ultimately	the design	involved in	term

Exercise 6. Fill in the gaps with prepositions

1. Later, as the design of civilian structures … bridges and buildings matured as a technical discipline.
2. The word «engine» itself is of even older origin, ultimately deriving … the Latin «ingenium».
3. An «engine» referred … a military machine.
4. The term engineering itself has a much more recent etymology, deriving from the word engineer, which itself dates … … 1325.
5. Each of these inventions is consistent … the modern definition of engineering.
6. The concept of engineering has existed … ancient times.

Exercise 7. Complete the sentences with the information from the text

1. Later, as the design of civilian structures such as …
2. The word «engine» itself is …
3. Notable exceptions of the obsolete usage …
4. The term engineering itself has …
5. The concept of engineering has existed …

Exercise 8. Complete the definitions below with the words from the box

1. ________________________________ the action of inventing something, typically a process or device.
2. ________________________________ a circular object that revolves on an axle and is fixed below a vehicle or other object to enable it to move over the ground.
3. ________________________________ acting or done in the same way over time.
4. ________________________________ make full use of and derive benefit from.
5. ________________________________ no longer produced or used.
6. ________________________________ an apparatus using mechanical power and having several parts, each with a definite function and together performing a particular task.
7. ________________________________ continue to live or exist in spite of.
8. ________________________________ recognize or treat (someone or something) as different.

To exploit	Wheel	Obsolete	Consistent
To distinguish	Machine	To survive	Invention

Exercise 9. Speak about the history of engineering

Unit 3. MAIN BRANCHES OF ENGINEERING

Engineering, much like other science, is a broad discipline which is often broken down into several sub-disciplines. These disciplines concern themselves with differing areas of engineering work. Although initially an engineer will usually be trained in a specific discipline, throughout an engineer's career the engineer may become multi-disciplined, having worked in several of the outlined areas. Engineering is often characterized as having four main branches:

Chemical engineering — the exploitation of both engineering and chemical principles in order to carry out large scale chemical process.

Civil engineering — the design and construction of public and private works, such as infrastructure (airports, roads, railways, water supply and treatment etc.), bridges, dams, and buildings.

Electrical engineering — a very broad area that may encompass the design and study of various electrical and electronic systems, such as electrical circuits, generators, motors, electromagnetic/electromechanical devices, electronic devices, electronic circuits, optical fibers, optoelectronic devices, computer systems, telecommunications and electronics.

Mechanical engineering — ehe design of physical or mechanical systems, such as power and energy systems, aerospace/aircraft products, weapon systems, transportation products engines, compressors, power trains, kinematic chains, vacuum technology, and vibration isolation equipment.

Beyond these four, sources vary on other main branches. Historically, naval engineering and mining engineering were major branches. Modern fields sometimes included as major branches include aerospace, architectural, biomedical, industrial, materials science and nuclear engineering.

New specialties sometimes combine with the traditional fields and form new branches. A new or emerging area of application will commonly be defined temporarily as a permutation or subset of existing disciplines; there is often gray area as to when a given sub-field becomes large and/or prominent enough to warrant classification as a new «branch». One key indicator of such emergence is when major universities start establishing departments and programs in the new field.

For each of these fields there exists considerable overlap, especially in the areas of the application of sciences to their disciplines such as physics, chemistry and mathematics [3].

Key Words

Broad — широкий
To concern — затрагивать
Throughout — все время
Exploitation — использование
Works — сооружения
To encompass — включать в себя
Optical fiber — оптоволоконные кабели
Power train — трансмиссия
To vary on — изменяться
Nuclear — ядерный
Commonly — обычно
Subset — подмножество
Power and energy systems — электрические и энергетические системы
To be broken down — распадаться
Initially — сначала
Outlined — выделенный, указанный
To carry out — выполнять
Water supply — водоснабжение
Electrical circuit — электрическая цепь
Indicator — показатель
Equipment — оборудование
Naval — морской
Emerging — появляющийся
Permutation — перестановка
To warrant — подтвердить
Overlap — наслоение

Exercise 1. Answer the questions

1. Is engineering a broad or a narrow discipline?
2. Can it be broken down into sub disciplines?
3. What do these sub disciplines concern?
4. How will an engineer initially be trained?
5. What is chemical engineering?

6. What does civil engineering deal with?
7. Is electrical engineering concerned with electrical or transportation systems?
8. What can you say about mechanical engineering?
9. Are there more branches beyond these four?
10. Which branches do modern fields include as major branches?
11. How will a new area be commonly defined?
12. What is the key indicator of the emergence of a new branch of engineering?
13. Do some fields of engineering overlap?

Exercise 2. Find Russian equivalents

Power and energy systems, optical fibers, electronic devices, electrical circuits, encompass, railways, water supply and treatment, infrastructure, public and private works, the design, large scale chemical process, to carry out, in order to, chemical principles, the outlined areas, multi-disciplined, throughout, a specific discipline, initially, concern, often broken down into, a broad discipline, science, overlap, establish, prominent, subset, permutation, commonly, application, emerging area, mining engineering, naval, vary on, beyond, vibration isolation equipment, power trains, engine, weapon systems.

Exercise 3. Find English equivalents

Инженерное дело, наука, широка дисциплина, подразделяться на …, несколько, включать в себя, хотя, исходно, на всем протяжении, указанные сферы, ветвь, использование, масштабные химические процессы, выполнять, государственные и частные сооружения, инфраструктура, водоснабжение и очистка стоков, мост, дамба, здание, включать в себя, проектирование, изучение, электрические цепи, военные системы, электрические системы, машины, трансмиссии, оборудование по изоляции от вибрации, морское строительство, применение, обычно, перестановка, подмножество, заметный, обосновать, пересекаться.

Exercise 4. Say whether it is true or false

1. For each of new fields of engineering there isn’t overlap.
2. One key indicator of such emergence is when major universities start establishing departments and programs in the new field.
3. Mechanical engineering — the design and construction of public and private works, such as infrastructure, bridges, dams, and buildings.
4. Civil engineering — the design of physical or mechanical systems, such as power and energy systems.
5. Chemical engineering — the exploitation of both engineering and chemical principles in order to carry out large scale chemical process.
6. An engineer will usually be trained in all existing specific disciplines.
7. Engineering, much like other science, is a broad discipline which is often broken down into several sub-disciplines.

Exercise 5. Fill in the gaps with the words from the box

1. One key indicator of such emergence is when major universities start ______________________________ departments and programs in the new field.

2. There is often gray area as to when a given sub-field becomes large and/or __________________enough _______________ classification as a new «branch».

3. A new or _________________________ area of application will commonly be defined ______________________ as a permutation or subset of existing disciplines.

4. New specialties sometimes ________________________ the traditional fields and form new branches.

5. Historically, _________________________ and mining engineering were major branches.

6. Engineering is often ______________ as having four main branches.

7. ____________________ an engineer's career the engineer may become ____________________, having worked in several of the outlined areas.

8. These disciplines ________________________ themselves with differing __________________________ of engineering work.

establishing	emerging	naval engineering	temporarily
to warrant	combine with	characterized	prominent
throughout	multi-disciplined	concern	areas

Exercise 6. Fill in the gaps with prepositions

1. For each of these fields there exists considerable overlap, especially … the areas of the application of sciences to their disciplines.

2. New specialties sometimes combine … the traditional fields and form new branches.

3. … these four, sources vary on other main branches.

4. The exploitation of both engineering and chemical principles in order to carry … large scale chemical process.

5. Although initially an engineer will usually be trained … a specific discipline.

6. Engineering, much like other science, is a broad discipline which is often broken … into several sub-disciplines.

Exercise 7. Complete the sentences with the information from the text

1. A new or emerging area of application …

2. Beyond these four …

3. Mechanical engineering …

4. Electrical engineering …

5. Civil engineering…

6. Chemical engineering …

7. Although initially an engineer will usually be trained in …

8. These disciplines concern …

9. Engineering, much like other science, is a broad discipline which …

Exercise 8. Complete the definitions below with the words from the box

1. ________________________________ activity involving mental or physical effort done in order to achieve a result.
2. ________________________________ an occupation undertaken for a significant period of a person's life and with opportunities for progress.
3. ________________________________ perform a task.
4. ________________________________ teach (a person or animal) a particular skill or type of behaviour through sustained practice and instruction.
5. ________________________________ energy that is produced by mechanical, electrical, or other means and used to operate a device.
6. ________________________________ notably large in size, amount, or extent.
7. ________________________________ in every part of (a place or object).
8. ________________________________ (of a device) having or operating with components such as microchips and transistors that control and direct electric currents.

To carry out	To train	Considerably	Power
Career	Throughout	Electronic	Work

Exercise 9. Speak about main branches of engineering

Unit 4. ENGINEER

An engineer is a professional practitioner of engineering, concerned with applying scientific knowledge, mathematics and ingenuity to develop solutions for technical and practical problems. Engineers design materials, structures, machines and systems while considering the limitations imposed by practicality, safety and cost. The word engineer is derived from the Latin root «ingenerare», meaning «to create».

Engineers are grounded in applied sciences, and their work in research and development is distinct from the basic research focus of scientists. The work of engineers forms the link between scientific discoveries and their subsequent applications to human needs.

Engineers develop new technological solutions. During the engineering design process, the responsibilities of the engineer may include defining problems, conducting and narrowing research, analyzing criteria, finding and analyzing solutions, and making decisions. Much of an engineer's time is spent on researching, locating, applying, and transferring information. Indeed, research suggests engineers spend 56 % of their time engaged in various different information behaviours, including 14 % actively searching for information.

Engineers must weigh different design choices on their merits and choose the solution that best matches the requirements. Their crucial and unique task is to identify, understand, and interpret the constraints on a design in order to produce a successful result.

Engineers apply techniques of engineering analysis in testing, production, or maintenance. Analytical engineers may supervise production in factories and elsewhere, determine the causes of a process failure, and test output to maintain quality. They also estimate the time and cost required to complete projects. Supervisory engineers are responsible for major components or entire projects. Engineering analysis involves the application of scientific analytic principles and processes to reveal the properties and state of the system, device or mechanism under study. Engineering analysis proceeds by separating the engineering design into the mechanisms of operation or failure, analyzing or estimating each component of the operation or failure mechanism in isolation, and re-combining the components.

Many engineers use computers to produce and analyze designs, to simulate and test how a machine, structure, or system operates, to generate specifications for parts, to monitor the quality of products, and to control the efficiency of processes.

Most engineers specialize in one or more engineering disciplines.

Numerous specialties are recognized by professional societies, and each of the major branches of engineering has numerous subdivisions. Civil engineering, for example, includes structural and transportation engineering, and materials engineering includes ceramic, metallurgical, and polymer engineering. Engineers also may specialize in one industry, such as motor vehicles, or in one type of technology, such as turbines or semiconductor materials [4].

Key Words

Practitioner — исполнитель
Practicality — практикой
Solution — решение
To create — создавать
Discovery — открытие
To weight — взвесить
Output — выход
Failure — неудача
Ingenuity — изобретательность
To narrow — сужать
Limitation — ограничение
Distinct from — отличается от...
Subsequent — последующий
Merit — заслуга, достоинство
To simulate — имитировать
Crucial — ключевой

Exercise 1. Answer the questions

1. Who is an engineer?
2. What is an engineer concerned with?
3. What do engineers design?
4. What is the word engineer derived from?
5. Where do engineers work?
6. What does their work form?
7. What do engineers develop?
8. What is much of engineer’s time spent on?
9. How do the engineers take decisions?
10. Where do engineers apply their techniques?
11. Do many engineers use computers?
12. Do most engineers specialize in different engineering disciplines?

Exercise 2. Find Russian equivalents

Engaged in, making decisions, analyzing criteria, conducting and narrowing research, new technological solutions, human needs, subsequent applications, discoveries, the link, to form, basic research focus, distinct from, applied sciences, grounded in, practicality, imposed by, the limitations, design, to develop, ingenuity, applying, concerned with, practitioner, semiconductor materials, turbines, motor vehicles, industry, numerous, to generate specifications, to simulate, isolation, component, state, to reveal the properties, entire projects, to maintain, failure, to determine, to supervise, the constraints, to identify, the requirements, match, merit, to weigh.

Exercise 3. Find English equivalents

Иметь дело с, проектировать, решение, применение, научное знание, ограничения, проходить от, основан на, прикладные науки, исследование, разработка, связь, открытие, последовательное применение, техническое решение, процесс разработки, принятие решений, проведение исследований, анализ критериев, передача информации, на самом деле, связана в, поиск информации, взвесить, варианты выбора, по заслугам, выбрать решение, соответствовать требованиям, важное задание, интерпретировать, требования, проект, дать удачный результат, применять, техники, содержание, контролировать, проверить выход, закончить проекты, ответственный за, свойства, выявить свойства, состояние системы, устройство, механизм, отделение, неудача, оценка, изоляция, симулировать, работать, генерировать, контролировать качество продукции, признаваться, материалы, турбины, полупроводниковые материалы.

Exercise 4. Say whether it is true or false

1. Supervisory engineers are responsible for major components or entire projects.
2. Engineers apply techniques of engineering analysis in theoretical elaboration of a project.
3. The work of engineers forms the link between scientific discoveries and their subsequent applications to human needs.
4. Engineers develop new solutions in the Arts.
5. The work of engineers in research and development is distinct from the basic research focus of scientists.
6. Engineers are grounded in natural sciences.
7. The word engineer is derived from the Greek root «ingenerare», meaning «to create».
8. Engineers design furniture, fibres and textiles.
9. An engineer is a professional practitioner of engineering.

Exercise 5. Fill in the gaps with the words from the box

1. An engineer is a professional practitioner of engineering, concerned with applying scientific knowledge, mathematics and ________________________ to develop solutions for technical and practical problems.

2. Engineers design materials, structures, machines and systems while considering the limitations _______________________________ by practicality, safety and cost.

3. The work of engineers forms the link between scientific discoveries and their ____ applications to human needs.

4. During the engineering design process, _________________________ of the engineer may include defining problems, conducting and narrowing research, analyzing criteria, finding and analyzing solutions, and making decisions.

5. Engineers must weigh different design choices on their ________________ and choose the solution that best matches the requirements.

6. Their crucial and unique task is to identify, understand, and interpret the ______________________ on a design in order to produce a successful result.

7. Analytical engineers may ________________________________ production in factories and elsewhere.

8. Many engineers use computers to produce and analyze designs, ________________ and test how a machine, structure, or system operates.

subsequent	merits	imposed	the responsibilities
supervise	ingenuity	to simulate	constraints

Exercise 6. Fill in the gaps with prepositions

1. Supervisory engineers are responsible … major components or entire projects.

2. Engineering analysis proceeds … separating the engineering design … the mechanisms of operation or failure, analyzing or estimating each component of the operation or failure mechanism in isolation, and re-combining the components.

3. Most engineers specialize … one or more engineering disciplines.

4. Numerous specialties are recognized … professional societies, and each of the major branches of engineering has numerous subdivisions.

5. Engineers also may specialize in one industry, … … motor vehicles, or in one type of technology, such as turbines or semiconductor materials.

6. The work of engineers forms the link …scientific discoveries and their subsequent applications … human needs.

Exercise 7. Complete the sentences with the information from the text

1. An engineer is a professional practitioner of …
2. Engineers design …
3. Engineers are grounded in …
4. Engineers develop …
5. Much of an engineer's time is spent on …

6. Engineers must weigh …
7. Their crucial and unique task is to …
8. Engineers apply …
9. Analytical engineers may …

Exercise 8. Complete the definitions below with the words from the box

1. ________________________________ the quality of being clever, original, and inventive.
2. ________________________________ the condition of being protected from or unlikely to cause danger, risk, or injury.
3. ________________________________ recognizably different in nature from something else of a similar type.
4. ________________________________ grow or cause to grow and become more mature, advanced, or elaborate.
5. ________________________________ a thing that is needed or wanted.
6. ________________________________ decisive or critical, especially in the success or failure of something.
7. ____________________________imitate the appearance or character of.
8. ________________________________ make (previously unknown or secret information) known to others.

To develop	Crucial	Ingenuity	Requirement
Safety	Simulate	To reveal	Distinct

Exercise 9. Speak about the profession of the engineer

Unit 5. DESIGN

Design as a noun informally refers to a plan or convention for the construction of an object or a system (as in architectural blueprints, engineering drawing, business process, circuit diagrams and sewing patterns) while «to design» (verb) refers to making this plan. No generally-accepted definition of «design» exists, and the term has different connotations in different fields. However, one can also design by directly constructing an object.

The person designing is called a designer, which is also a term used for people who work professionally in one of the various design areas, usually also specifying which area is being dealt with (such as a fashion designer, concept designer or web designer). A designer’s sequence of activities is called a design process. The scientific study of design is called design science.

Designing often necessitates considering the aesthetic, functional, economic and sociopolitical dimensions of both the design object and design process. It may involve considerable research, thought, modeling, interactive adjustment, and redesign. Meanwhile, diverse kinds of objects may be designed, including clothing, graphical user interfaces, skyscrapers, corporate identities, business processes and even methods of designing.

Typical stages consistent with The Rational Model include the following.

1. Pre-production design.

Design brief or Parti — an early (often the beginning) statement of design goals.

Analysis — analysis of current design goals.

Research — investigating similar design solutions in the field or related topics.

Specification — specifying requirements of a design solution for a product (product design specification) or service.

Problem solving — conceptualizing and documenting design solutions.

Presentation — presenting design solutions.

2. Design during production.

Development — continuation and improvement of a designed solution.

Testing — in situ testing a designed solution.

3. Post-production design feedback for future designs.

Implementation — introducing the designed solution into the environment.

Evaluation and conclusion — summary of process and results, including constructive criticism and suggestions for future improvements.

4. Redesign — any or all stages in the design process repeated (with corrections made) at any time before, during, or after production.

Each stage has many associated best practices [5].

Key Words

Noun — существительное
Blueprint — проект
Sewing pattern — выкройка
Connotation — подтекст
Sequence — последовательность
Dimension — расширение
Evaluation — оценка
Current — текущий
Continuation — продолжение
Convention — договоренность
Circuit diagram — схема соединений
Accept — принимать
Term — термин
Aesthetic — эстетический
Summary — вывод
Stage — стадия
Goal — цель
Improvement — улучшение

Exercise 1. Answer the questions

1. What does the design informally refer to?
2. Is there a generally accepted definition of «design»?
3. Who is a designer?
4. What is a design process?
5. What does designing often necessitate?
6. What else can designing also involve?
7. What are the typical stages of the Rational Model of Design?

Exercise 2. Find Russian equivalents

Design, informally, refers to, convention, blueprint, engineering drawing, circuit diagrams, sewing patterns, generally-accepted definition, exist, directly, design areas, sequence of activities, to necessitate, dimensions, to involve, research, thought, meanwhile, interface, corporate identities, skyscrapers, consistent with, brief, statement, current, goal, similar, related topics, a design solution, continuation, improvement, environment, suggestions, future improvements, redesign, best practices.

Exercise 3. Find English equivalents

Проектирование, существительное, относиться, договоренность, объект, система, архитектурный проект, инженерный чертеж, круговая диаграмма, выкройка для шитья, определение, существовать, термин, дополнительное значение, тем не менее, непосредственно, конструируя объект, человек, проектировщик, различный, обычно, уточняя, сфера, дизайнер одежды, веб-дизайнер, требует, включать в себя, значительное исследование, обдумывание, моделирование, интерактивная корректировка, повторная разработка, в то же время, различные виды, одежда, интерфейс, небоскреб, деловой процесс, метод, утверждение, цели, анализ, исследование, уточнение, услуга, решение проблемы, документация, представление, разработка, улучшение, тестирование, выполнение, заключение, повторный дизайн.

Exercise 4. Say whether it is true or false

1. Design as a verb informally refers to a plan or convention for the construction of an object or a system.
2. No generally-accepted definition of «design» exists.
3. One can also design by inventing an object.
4. The person designing is called an engineer.
5. Analysis — investigating similar design solutions in the field or related topics.
6. Research — analysis of current design goals.
7. Specification — conceptualizing and documenting design solutions.
8. Problem solving — specifying requirements of a design solution for a product (product design specification) or service.
9. Presentation — continuation and improvement of a designed solution.
10. Development — presenting design solutions.
11. Testing — in situ testing a designed solution.

Exercise 5. Fill in the gaps with the words from the box

1. No generally-accepted ____________________________ of «design» exists, and the term has different connotations in different fields.
2. _________________, one can also design by directly constructing an object.
3. A designer's ____________________________ of activities is called a design process.
4. The _________________ study of design is called design science.
5. Designing often ______________________ considering the aesthetic, functional, economic and sociopolitical _____________________ of both the design object and design process.
6. It may involve considerable research, thought, modeling, interactive __________________________, and re-design.

7. ______________________________, diverse kinds of objects may be designed, including clothing, graphical user interfaces, skyscrapers, corporate identities, business processes and even methods of designing.

scientific	adjustment	sequence	necessitates
however	meanwhile	dimensions	definition

Exercise 6. Fill in the gaps with prepositions

1. Design brief — an early (often the beginning) statement … design goals.
2. Analysis — analysis … current design goals.
3. Research — investigating similar design solutions … the field or related topics.
4. Specification — specifying requirements of a design solution … a product (product design specification) or service.
5. Implementation — introducing the designed solution … the environment.
6. Evaluation and conclusion — summary of process and results, including constructive criticism and suggestions … future improvements.
7. Redesign — any or all stages in the design process repeated (with corrections made) at any time …, during, or … production.

Exercise 7. Complete the sentences with the information from the text

1. Design as a noun informally refers to …
2. However, one can also design by …
3. The person designing is called …
4. A designer's sequence of activities is called …
5. The scientific study of design is called …
6. Designing often necessitates …
7. Diverse kinds of objects may be …
8. Analysis is …
9. Research is …
10. Specification is …
11. Development is …

Exercise 8. Complete the definitions below with the words from the box

1. ________________________________ the action of building something, typically a large structure.
2. ________________________________ have objective reality or being.
3. ________________________________ a particular order in which related things follow each other.
4. ______________________________ the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions.
5. ________________________________ find an answer to, explanation for, or means of effectively dealing with.
6. ________________________________ a brief statement or account of the main points of something.

7. ________________________________ the making of a judgment about the amount, number, or value of something; assessment.

8. ________________________________ carry out a systematic or formal inquiry to discover and examine the facts of (an incident, allegation, etc.) so as to establish the truth.

Sequence	To solve	Research	To exist
Summary	Construction	Evaluation	To investigate

Exercise 9. Speak about the process of the design

Unit 6. ENVIRONMENTAL ENGINEERING

Environmental engineering is the application of science and engineering principles to minimize the adverse effects of human activities on the environment (pollution of air, water, and/or land resources). Although it is widely considered impossible to eliminate all negative impacts, it is thought human effects can be decreased and controlled through public education, conservation, regulations, and the application of good engineering practices (set up of processes, and facilities).

Development of environmental engineering.

Two of the principal environmental problems are:

1. The increasing number of humans on Earth. Along this line, one of the first applications of environmental engineering is the removal of sewage from cities, which became increasingly important as population grew. There were (and still is in many countries) initially no treatment: wastes are for example simply brought to the nearest stream. However, since sewage disposal eventually cause damages to natural waters, methods of treating wastewaters prior to discharge were developed. This has evolved into a large industry.

2. The second major factor is the rising standard of living in many nations, such as in Europe and Australia. A higher living standard generate more consumption of natural resources and more wastes. The standard of living of developed nations is due in part to development of synthetic chemical industry in the XX century and to the exploitation of fossil fuels for energy production. These industries produced toxic and hazardous chemicals in great quantities long before they were known to be dangerous. Unlike sewage, even small amounts of these molecules may be harmful, but the technology to detect them at low levels did not existed when the new industries appeared. It was then impossible to detect and identify them as factors in human health or environmental problems. There were initially no attempts to control their production, use and disposal.

«Pollutants» may be chemical, biological, thermal, radioactive, or even mechanical. Environmental engineering emphasizes several areas: process engineering, environmental chemistry, water and wastewater treatment (sanitary engineering), waste reduction, and pollution prevention. It is a branch of civil engineering, chemical engineering and sometimes a branch of public health and mechanical engineering [6].

Key Words

Application — применение
To minimize — минимизировать
Adverse — обратный
Facilities — оборудование
Sewage — сточные воды
Treatment — обработка
To cause — вызвать
Prior — раньше
To generate — получить
Hazardous — опасный
Harmful — вредный
Prevention — предупреждение
To eliminate — устранить
Pollution — загрязнение
To decrease — уменьшать
Increasing — увеличивающееся
Initially — исходно
Stream — река
Eventually — случайно
To discharge — выливать
Fossil — полезные ископаемые
To detect — определять
Reduction — снижение
Health — здоровье

Exercise 1. Answer the questions

1. What is environmental engineering?
2. What are two of the principal environmental problems?
3. Why is the increasing number of humans important?
4. What does a higher living standard in many nations imply?
5. What does environmental engineering emphasize?

Exercise 2. Find Russian equivalents

Environmental chemistry, environmental problems, human health, to detect, great quantities, hazardous chemicals, fossil fuels, to discharge, wastewaters, damages, to cause, population, removal, the Earth, increasing number, regulations, conservation, controlled through public education, all negative impacts, to eliminate, adverse effects, engineering, application.

Exercise 3. Find English equivalents

Экологическое строительство, применение, минимизировать, обратный, окружающая среда, устранить, влияние, хотя, снизить, регулирование, развитие, опыт, совокупность, вспомогательные средства, отрасль промышленности, человек, применение, устранение, сточные воды, население, исходно, очистка, выбрасывать, получилась, главный фактор, генерировать, потребление, ресурсы, отходы, отчасти, развитие, эксплуатация, опасный, сточные воды, попытка, использование, ставить акцент, снижение, отрасль.

Exercise 4. Say whether it is true or false

1. Mechanical engineering is the application of science and engineering principles to minimize the adverse effects of human activities on the environment.

2. Human effects cannot be decreased and controlled through public education, conservation, regulations, and the application of good engineering practices.

3. There are four main environmental problems.

4. Since sewage disposal eventually cause damages to natural waters, methods of treating wastewaters prior to discharge were developed.

5. The standard of living of developed nations is due in part to development of the car building industry in the XX century.

6. There were attempts to control their production, use and disposal.

7. «Pollutants» may be chemical, biological, thermal, radioactive, or even mechanical.

8. Environmental engineering is a branch of civil chemistry and sometimes a branch of public health and mechanical engineering.

Exercise 5. Fill in the gaps with the words from the box

1. Environmental engineering is the application of science and engineering principles ________________________________ the adverse effects of human activities on the environment.

2. It is widely considered impossible ___________________ all negative impacts.

3. It is thought human effects can be decreased and controlled through public education, ____________________________, regulations, and the application of good engineering practices.

4. One of the first applications of environmental engineering is the _____________________________ of sewage from cities, which became increasingly important as population grew.

5. There were (and still is in many countries) initially no treatment: wastes are for example simply brought to the nearest ____________________________.

6. However, since sewage disposal eventually cause damages to natural waters, methods of treating wastewaters _________________________ to discharge were developed.

7. These industries produced toxic and _____________________ chemicals in great quantities long before they were known to be dangerous.

8. ___________________________ sewage, even small amounts of these molecules may be harmful, but the technology to detect them at low levels did not existed when the new industries appeared.

to minimize	removal	prior	conservation
hazardous	unlike	to eliminate	stream

Exercise 6. Fill in the gaps with prepositions

1. Along this line, one of the first applications … environmental engineering is the removal of sewage from cities, which became increasingly important as population grew.

2. … sewage, even small amounts of these molecules may be harmful, but the technology to detect them at low levels did not existed when the new industries appeared.

3. … sewage disposal eventually cause damages to natural waters, methods of treating wastewaters prior to discharge were developed.

4. It was then impossible to detect and identify them as factors … human health or environmental problems.

5. It is a branch … civil engineering, chemical engineering and sometimes a branch of public health and mechanical engineering.

6. This has evolved … a large industry.

7. Environmental engineering is the application of science and engineering principles to minimize the adverse effects of human activities … the environment.

Exercise 7. Complete the sentences with the information from the text

1. Environmental engineering is the application of science and engineering principles to minimize the adverse effects of human activities …

2. Although it is widely considered impossible …

3. It is thought human effects can be decreased and controlled through public education, conservation, regulations, and the …

4. A higher living standard generate more consumption of …

5. The standard of living of developed nations is due in part to development of synthetic chemical industry …

6. These industries produced toxic and hazardous chemicals in great quantities long before ….

7. Unlike sewage, even small amounts of these molecules may be harmful, but the technology to ….

8. It was then impossible to detect and identify them as factors in human health or ….

Exercise 8. Complete the definitions below with the words from the box

1. ________________________________ a change which is a result or consequence of an action or other cause.

2. __________________________________ practical use or relevance.

3. __________________________________ produce or create.

4. __________________________________ waste water and excrement conveyed in sewers.

5. __________________________________ make (something, especially something bad) happen.

6. __________________________________ the application of scientific knowledge for practical purposes, especially in industry.

7. ___________________________________ causing or likely to cause harm.

8. ___________________________________ the action of stopping something from happening or arising.

Sewage	Application	Generate	To cause
Technology	Harmful	Prevention	Effect

Exercise 9. Speak about environmental engineering

Unit 7. ELECTRICAL ENGINEERING

Electrical engineering is an engineering discipline that deals with the study and application of electricity and electromagnetism. Its practitioners are called electrical engineers.

In the subfield of electronics, electrical engineers construct models of electrical components (such as resistors, capacitors, inductors, transistors, diodes, semiconductors) for simulation purposes. They combine these components into larger electrical networks.

The subfield of power engineering deals not only with electricity generation, electric power transmission and electricity distribution but also with electrical circuits and materials (e.g. insulators) that need to resist high voltages and currents.

Another subfield is accurate measurement of electrical properties. Measuring an electrical circuit inevitably changes the voltages and currents in it. The objective is to minimize the influence of the measuring circuit or even compensate for it. The field also includes sensors that use a material's electrical properties or electromechanical means of measurement. Examples of the former are piezoelectricity for measuring pressure and temperature-dependent resistors for measuring temperature. These sensors can be used in control engineering.

Other major subfields of electrical engineering are telecommunication and electromagnetism. Transmitting information from one place to another requires a transport channel such as a coax cable, optical fiber or free space. These channels can be accurately described using the laws of electromagnetism, particularly Maxwell's equations.

Some other examples of how electromagnetism is put to every day use are antenna design for use in mobile phones, and controlling the form of the electromagnetic field in an MRI scanner by the exact placement and alignment of its electromagnets. Another technology made possible by electromagnetism is the microwave oven. The field of high-power radio-frequency (RF) engineering was once feared to be a lost art. Because of the trend for low-power, miniaturized circuitry, there is a perception that the need for high-power radio engineering and engineers is diminishing. On the contrary, the need for engineers and technicians in this particular field has never been greater, and the need will only increase in the foreseeable future.

The tools and theories an electrical engineer can consult include mathematics and physics in general, the theory of electromagnetism, the theory of quantum mechanics, the mathematics of digital signal processing, control theory, the teachings of computer science.

Electronics that deal with both electrons (electricity) and photons (light) are also called optoelectronics. The related field of fibre optics has led to the development of fast telecommunication systems and the expansion of the Internet [7].

Key Words

Practitioner — исполнитель
Components — компоненты
Capacitor — конденсатор
Transistor — транзистор
Semiconductor — полупроводник
Electric power — электроэнергия
Distribution — распределение
Insulator — диэлектрик
Voltage — напряжение
Accurate — точный
Inevitably — неизбежно
Influence — влияние
Former — последний
To require — требовать
Coaxial cable — коаксиальный кабель
Optical fibre — оптоволокно
Alignment — выравнивание
Frequency — частота
High-power — мощный
Trend — тенденция
Perception — понимание
Foreseeable — прогнозируемый
Digital — цифровой
Subfield — подраздел
Resistor — резистор
Inductor — проводник
Diode — диод
Simulation — моделирование, имитация
Transmission — передача
Circuit — цепь
To resist — сопротивляться
Current — ток (электрический)
Measurement — измерение
Objective — цель
To compensate — компенсировать
Pressure — давление
To transmit — передавать
Equation — уравнение
Placement — ориентировка
Microwave oven — микроволновая печь
Circuitry — схема
Was feared to be a lost art — боялись, что был утерянным искусством
To diminish — опасаться
To include — включать
To lead to — привести к

Exercise 1. Answer the questions

1. What is electrical engineering?
2. Who are electrical engineers?
3. What does electrical engineering deal with?
4. Is accurate measurement of electrical properties another subfield of power engineering?
5. Does measuring an electric circuit change the voltages and currents in it?
6. What are other major fields of electrical engineering?
7. What does transmitting information from one place to another require?
8. Is antenna design for mobile phones an other example of electromagnetism?
9. Which tools and theories can an electric engineer use?

Exercise 2. Find Russian equivalents

That deals with, practitioner, construct, electrical components, resistor, capacitor, inductor, transistor, diode, semiconductor, simulation purposes, network, transmission, distribution, electrical circuits, insulator, voltage, current, accurate, measurement, inevitably, compensate, former, pressure, objective, influence, means, coax cable, optical fiber, free space, accurately, particularly, every day use, design, exact placement and alignment, microwave oven, high-power radio-frequency, a lost art, the trend for, low-power, miniaturized circuitry, perception, diminish, on the contrary, the foreseeable future, tools, development.

Exercise 3. Find English equivalents

Иметь дело с, изучение, применение, исполнитель, компонент, резистор, проводник, конденсатор, диод, диэлектрик, полупроводник, моделирование, комбинировать, сеть, электрическая цепь, распределение электроэнергии, высокое напряжение, ток, точное измерение, неизбежно, цель, минимизировать, влияние, компенсировать, последний, передача информации, давление, требовать, оптоволокно, коаксиальный кабель, точное размещение, выравнивание, магниты, микроволновая печь, мощный, миниатюрные схемы, восприятие, напротив, техники, распространение, цифровой, передача сигнала, привести к.

Exercise 4. Say whether it is true or false

1. Electrical engineering is an engineering discipline that deals with the study and application of chemistry.
2. Electric engineering practitioners are called mechanical engineers.
3. Electrical engineers construct models of electrical components for simulation purposes.
4. They combine these components into larger electrical networks.
5. Measuring an electrical circuit doesn't change the voltages and currents in it.
6. The objective is to maximize the influence of the measuring circuit or even compensate for it.
7. Other major subfields of electrical engineering are civil engineering and mechanical engineering.
8. Transmitting information from one place to another requires a vehicle and wind.
9. Some other examples of how electromagnetism is put to every day use are clothes design.
10. There is a perception that the need for high-power radio engineering and engineers is diminishing.
11. The need for engineers and technicians in electrical engineering has never been greater, and the need will only increase in the foreseeable future.

Exercise 5. Fill in the gaps with the words from the box

1. In the subfield of electronics, electrical engineers construct models of electrical components for ______________________________ purposes.
2. They ____ these components into larger electrical networks.
3. The subfield of power engineering deals not only with _________________________, electric power transmission and electricity distribution but also with electrical circuits and materials (e.g. insulators) that need to resist high voltages and currents.
4. The field also includes sensors that use a material's electrical properties or electromechanical ____.

5. Other major subfields of electrical engineering are telecommunication and ____.

6. These ____ can be accurately described using the laws of electromagnetism.

7. Another technology made possible by electromagnetism is the ____________ ____.

8. The field of high-power radio-frequency engineering was ________________ ________________________ feared to be a lost art.

means of measurement	electricity generation	simulation	electromagnetism
channels	combine	once	microwave oven

Exercise 6. Fill in the gaps with prepositions

1. Electrical engineering is an engineering discipline that deals … the study and application of electricity and electromagnetism.

2. They combine these components … larger electrical networks.

3. These sensors can be used … control engineering.

4. Another technology made possible … electromagnetism is the microwave oven.

5. The objective is to minimize the influence of the measuring circuit or even compensate … it.

6. On the contrary, the need … engineers and technicians … this particular field has never been greater, and the need will only increase … the foreseeable future.

7. The related field … fibre optics has led .. the development of fast telecommunication systems and the expansion … the Internet.

Exercise 7. Complete the sentences with the information from the text

1. Electrical engineering is an engineering discipline that deals with …
2. In the subfield of electronics, electrical engineers construct models of electrical components for …
3. The subfield of power engineering deals not only with …
4. Measuring an electrical circuit inevitably changes …
5. The objective is to minimize the influence of …
6. Other major subfields of electrical engineering are …
7. Transmitting information from one place to another requires …
8. The field of high-power radio-frequency (RF) engineering was …
9. Electronics that deal with both …
10. The related field of fibre optics has led to the development …

Exercise 8. Complete the definitions below with the words from the box

1. ____ a device having resistance to the passage of an electric current.

2. ____ a device used to store an electric charge, consisting of one or more pairs of conductors separated by an insulator.

3. ____ a solid substance that has a conductivity between that of an insulator and that of most metals, either due to the addition of an impurity or because of temperature effects.

4. ____ an electromotive force or potential difference expressed in volts.

5. ____ providing a faithful representation of someone or something.

6. ____ arrangement in a straight line or in correct relative positions.

7. ____ give a detailed account in words of.

8. ____ not approximated in any way precise.

Semiconductor	Accurate	Capacitor	Alignment
To describe	Resistor	Exact	Voltage

Exercise 9. Speak about electric engineering

Unit 8. MECHANICAL ENGINEERING

Mechanical engineering is the application of physical principles to the creation of useful devices, objects and machines. Mechanical engineers use principles such as heat, force, and the conservation of mass and energy to analyze static and dynamic physical systems, in contributing to the design of things such as automobiles, aircraft, and other vehicles, heating and cooling systems, household appliances, industrial equipment and machinery, weapons systems, etc.

Mechanical engineers often create simulations of the operation of objects, as well as the manufacturing processes to be used, in order to optimize performance, cost effectiveness, and energy efficiencies, before settling on a particular design.

Engineering drawings of the objects to be fabricated are typically created. Prior to the late 20th Century most engineering drawings were drawn by hand with the aid of mechanical drafting boards. The advent of the digital computer with graphical user interface made the creation of models and drawings using Computer Aided Design (CAD) programs possible. Most CAD programs now permit creation of three-dimensional models which may be viewed from any angle. Such models may be used as the basis for Finite Element Analysis (FEA) of the design. Through the application of Computer Aided Manufacture (CAM), the models may also be used directly by software to create «instructions» for the manufacture of objects represented by the models, through computer numerically-controlled (CNC) machining or other automated processes, without the need for intermediate drawings.

Fundamental subjects of mechanical engineering include: heat transfer, fluid mechanics, solid mechanics, pneumatics, hydraulics and applied thermodynamics.

Related disciplines include: electrical engineering, industrial engineering, systems engineering, civil engineering, aerospace engineering, and other engineering disciplines [8].

Key Words

Mechanical engineering — машиностроение
Heat — тепло
Energy — энергия
Vehicle — транспортное средство
Appliance — техническое устройство
Weapons system — военная система
Efficiency — эффективность
Drawing — чертежи
Aid — помощь
Software — программное обеспечение
Three dimensional — трехмерный
Fluid — жидкий
Device — электрическое устройство
Force — сила
Aircraft — самолет
Household — домашний
Machinery — оборудование
Performance — характеристика
Settle on — остановиться на
Advent — предвестник
Angle — угол
Permit — позволяет
Intermediate — непосредственный
Solid — твердый

Exercise 1. Answer the questions

1. What is mechanical engineering?
2. Which principles do mechanical engineers use?
3. What do mechanical engineers often create?
4. Are engineering drawings typically created?
5. How were drawings drawn prior to the late XX century?
6. What do CAD programs permit?
7. What do fundamental subjects of mechanical engineering include?

Exercise 2. Find Russian equivalents

Vehicle, heating, cooling systems, household appliances, industrial equipment, machinery, weapons systems, to create, simulation, the manufacturing processes, to optimize performance, energy efficiencies, a particular design, prior to, drawings were drawn, by hand, with the aid of, mechanical drafting boards, the advent of, permit, the digital computer, permit, creation, three-dimensional models, may be viewed from any angle, possible, directly, intermediate drawings, heat transfer, fluid mechanics, solid mechanics, pneumatics, hydraulics, applied thermodynamics.

Exercise 3. Find English equivalents

Машиностроение, применение, физические принципы, создание, полезные устройства, объекты и машины, тепло, сила, масса, энергия, анализировать, содействие, проектирование, самолет, домашние устройства, военные системы, оптимизировать характеристики, затраты, энергоэффективность, проект, вручную, при помощи, механические чертежные доски, чертеж, интерфейс, трехмерный, угол, основа, непосредственно, посредством, передача тепла, механика жидкости, механика твердых тел, пневматика, гидравлика, прикладная термодинамика, энергообеспечение, строительство.

Exercise 4. Say whether it is true or false

1. Mechanical engineering is the application of chemical principles to the creation of useful devices, objects and machines.
2. Electrical engineers use principles such as heat, force, and the conservation of mass and energy to analyze static and dynamic physical systems.
3. Civil engineers often create simulations of the operation of objects.
4. Engineering drawings of the objects to be fabricated are typically created.
5. Most CAD programs now permit creation of four-dimensional models which may be viewed from any angle.
6. Fundamental subjects of mechanical engineering include: heat transfer, fluid mechanics, solid mechanics, pneumatics, hydraulics and applied thermodynamics.

Exercise 5. Fill in the gaps with the words from the box

Mechanical engineers use principles such as heat, force, and the conservation of ____________________________ and energy to analyze static and ________________________ physical systems, ________________________ the design of ______________________________ such as automobiles, _____________________, and other vehicles, heating and cooling systems, ____________________________, _________________________ and machinery, _____________________________, etc.

household appliances	mass	in contributing to	weapons systems
industrial equipment	dynamic	aircraft	things

Exercise 6. Fill in the gaps with prepositions

1. Prior … the late 20th century most engineering drawings were drawn … hand … the aid of mechanical drafting boards.
2. The advent ... the digital computer … graphical user interface made the creation of models and drawings using Computer Aided Design (CAD) programs possible.
3. Most CAD programs now permit creation of three-dimensional models which may be viewed … any angle.
4. Such models may be used … the basis for Finite Element Analysis (FEA) of the design.
5. Through the application … Computer Aided Manufacture (CAM), the models may also be used directly … software to create «instructions» … the manufacture of objects represented by the models, … computer numerically-controlled (CNC) machining or other automated processes, … the need for intermediate drawings.

Exercise 7. Complete the sentences with the information from the text

1. Mechanical engineering is the application of physical principles to …
2. Mechanical engineers use principles such as heat, force, and the conservation of mass and energy to …

3. Mechanical engineers often create simulations of the operation of objects, as well as …

4. Such models may be used as the basis for …

5. Fundamental subjects of mechanical engineering include …

6. Related disciplines include …

Exercise 8. Complete the definitions below with the words from the box

1. ________________________________ a set of things working together as parts of a mechanism or an interconnecting network; a complex whole.

2. ________________________________ a thing designed or used for inflicting bodily harm or physical damage.

3. ________________________________ strength or energy as an attribute of physical action or movement.

4. ________________________________ bring (something) into existence.

5. ________________________________ the arrival of a notable person or thing.

6. ________________________________ (of signals or data) expressed as series of the digits 0 and 1, typically represented by values of a physical quantity such as voltage or magnetic polarization.

7. ________________________________ a point where two systems, subjects, organizations, etc. meet and interact.

8. ________________________________ in the absence of.

To create	System	Force	Interface
Advent	Digital	Without	Weapon

Exercise 9. Speak about mechanical engineering

Unit 9. ENGINEERING ECONOMICS

Engineering economics, previously known as engineering economy, is a subset of economics for application to engineering projects. Engineers seek solutions to problems, and the economic viability of each potential solution is normally considered along with the technical aspects.

In the U.S. undergraduate engineering curricula, engineering economics is often a required course. It is a topic on the Fundamentals of Engineering examination, and questions might also be asked on the Principles and Practice of Engineering examination; both are part of the Professional Engineering registration process.

Considering the time value of money is central to most engineering economic analyses. Cash flows are discounted using an interest rate, except in the most basic economic studies.

For each problem, there are usually many possible alternatives. One option that must be considered in each analysis, and is often the choice, is the do nothing alternative. The opportunity cost of making one choice over another must also be considered. There are also noneconomic factors to be considered, like color, style, public image, etc.; such factors are termed attributes.

Costs as well as revenues are considered, for each alternative, for an analysis period that is either a fixed number of years or the estimated life of the project. The salvage value is often forgotten, but is important, and is either the net cost or revenue for decommissioning the project.

Some other topics that may be addressed in engineering economics are inflation, uncertainty, replacements, depreciation, resource depletion, taxes, tax credits, accounting, cost estimations, or capital financing. All these topics are primary skills and knowledge areas in the field of cost engineering.

Since engineering is an important part of the manufacturing sector of the economy, engineering industrial economics is an important part of industrial or business economics. Major topics in engineering industrial economics are:

the economics of the management, operation, and growth and profitability of engineering firms;

macro-level engineering economic trends and issues;

engineering product markets and demand influences; and

the development, marketing, and financing of new engineering technologies and products [9].

Key Words

Economics — экономика
To seek — искать
Curriculum — учебная программа
Estimate — оценивать
To term — называть
Cost — стоимость
To discount — уменьшать цену
Inflation — инфляция
Depreciation — амортизация
Net cost — чистая стоимость
To decommission — списывать
Tax — налог
Primary — первичный
Trend — тенденция
Subset — подмножество
Viability — жизнеспособность
Examination — исследование
Salvage value — ликвидационная стоимость
Attribute — свойство
Revenue — доход
Interest rate — процентная ставка
Replacement — замещение
Depletion — уменьшение
Uncertainty — неопределенность
Accounting — учет
Tax credit — налоговая скидка
Profitability — доходность
Issue — проблема

Exercise 1. Answer the questions

1. What is engineering economics?

2. What do engineers seek?

3. Is engineering economics a required course in the U.S. undergraduate engineering curricula?

4. Considering the time value of money is central to most engineering economic analyses, isn’t it?

5. Are cash flows discounted using an interest rate?

6. Are there possible alternatives for each problem?

7. Must the opportunity cost be considered?

8. Are there noneconomic factors to be considered?
9. Are costs usually considered?
10. Is engineering an important part of the manufacturing sector of the economy?
11. What are major topics in engineering industrial economics?

Exercise 2. Find Russian equivalents

Previously, known as, engineering economy, a subset, application, solutions to problems, viability, normally, undergraduate engineering curricula, a required course, the time value of money, cash flows, interest rate, except, option, are termed attributes, revenue, the net cost, replacement, depreciation, resource depletion, taxes, tax credits, accounting, cost estimations, capital financing, primary skills, knowledge areas, cost engineering, the manufacturing sector, management, operation, growth, profitability.

Exercise 3. Find English equivalents

Инженерная экономика, применение, инженерные проекты, искать, решение проблем, жизнеспособность, потенциальное решение, обычно, требуемый курс, тема, стоимость денег во времени, амортизационная ставка, выбор, альтернатива, альтернативная стоимость, общественный имидж, оцениваемая жизнь проекта, ликвидационная стоимость, чистая стоимость, прибыль, списание, инфляция, неопределенность, замена, амортизация, уменьшение ресурсов, налоги, налоговые скидки, учет, оценка затрат, капитальное финансирование, первичные навыки, сфера знаний, промышленный сектор, основные сферы, управление, рост, доходность, проблемы, тенденции, товарные рынки, влияние спроса, развитие, финансирование.

Exercise 4. Say whether it is true or false

1. Engineering economics, previously known as engineering economy, is a subset of economics for application to engineering projects.
2. Engineers do not seek solutions to problems.
3. In the U.S. undergraduate engineering curricula, engineering economics is not often a required course.
4. Considering the time value of money is not central to most engineering economic analyses.
5. Cash flows are discounted using a fixed sum, except in the most basic economic studies.
6. For each problem, there are no possible alternatives.
7. The opportunity cost of making one choice over another must also be considered.
8. Engineering is not an important part of the manufacturing sector of the economy.

Exercise 5. Fill in the gaps with the words from the box

1. Costs as well as _________________________ are considered, for each alternative, for an analysis period that is either a ____________________________of years or the estimated life of the project.

2. The _________________________ is often forgotten, but is important, and is either the net cost or revenue for ____________________________ the project.

3. Some other topics that may be addressed in engineering economics are inflation, _______________________, replacements, ___________________________, resource ___________________________, taxes, _____________________________________, accounting, cost estimations, or capital financing.

salvage value	decommissioning	depreciation	revenues
uncertainty	fixed number	tax credits	depletion

Exercise 6. Fill in the gaps with prepositions

1. Engineers seek solutions to problems, and the economic viability … each potential solution is normally considered along … the technical aspects.

2. It is a topic … the Fundamentals of Engineering examination.

3. … each problem, there are usually many possible alternatives.

4. Costs … well as revenues are considered, … each alternative, for an analysis period that is either a fixed number … years or the estimated life … the project.

5. All these topics are primary skills and knowledge areas … the field … cost engineering.

Exercise 7. Complete the sentences with the information from the text

1. Engineering economics, previously known as engineering economy, is …
2. Engineers seek solutions to problems, and the economic viability …
3. Considering the time value of money is central …
4. Cash flows are discounted using an interest rate, except in …
5. One option that must be considered in each analysis …
6. The opportunity cost of making one choice over another …
6. There are also noneconomic factors to be considered, like …
7. Costs as well as revenues are considered, for …
8. The salvage value is often forgotten, but is important, and is …

Exercise 8. Complete the definitions below with the words from the box

1. ________________________________ the process of dealing with or controlling things or people.

2. ________________________________ a general direction in which something is developing or changing.

3. _________________________________ an important topic or problem for debate or discussion.

4. ________________________________ reduction in the number or quantity of something.

5. __________________________________ available as another possibility or choice.

6. _________________________________ a reduction in the value of an asset over time, due in particular to wear and tear.

7. _________________________________ income, especially when of an organization and of a substantial nature.

8. _________________________________ a compulsory contribution to state revenue, levied by the government on workers' income and business profits, or added to the cost of some goods, services, and transactions.

Issue	Alternative	Trend	Depletion
Depreciation	Management	Revenue	Tax

Exercise 9. Speak about engineering economics

Unit 10. INDUSTRIAL DESIGN

Industrial design is the use of a combination of applied art and applied science to improve the aesthetics, ergonomics, and usability of a product, but it may also be used to improve the product's marketability and production. The role of an industrial designer is to create and execute design solutions for problems of form, usability, physical ergonomics, marketing, brand development, and sales.

The objective of this area is to study both function and form, and the connection between product, the user and the environment — product as it happens in any other architecture area, being the only difference, that here the professionals that participate in the process are all specialized in small scale design, rather than in other massive colossal equipments like buildings or ships. Industrial designers do not design the gears or motors that make machines move, or the circuits that control the movement (that task is usually attributed to engineers), but they can affect technical aspects through usability design and form relationships. And usually, they partner a whole of other professionals like marketers, to identify and fulfill needs, wants and expectations.

Industrial design is the professional service of creating and developing concepts and specifications that optimize the function, value and appearance of products and systems for the mutual benefit of both user and manufacturer.

Although the process of design may be considered «creative», many analytical processes also take place. In fact, many industrial designers often use various design methodologies in their creative process. Some of the processes that are commonly used are user research, sketching, comparative product research, model making, prototyping and testing. These processes are best defined by the designers and/or other team members. Industrial designers often utilize 3D software, computer-aided industrial design and CAD programs to move from concept to production [10].

Key Words

Design — проектирование, дизайн
Applied art — прикладное искусство
Usability — практичность
Brand — торговая марка
Environment — окружающая среда
To design — проектировать
Circuit — цепь
Concept — понятие, концепт
Benefit — польза
Sketching — создание эскиза
Combination — комбинирование
Aesthetics — эстетика
Execute — выполнить
Participate — участвовать
Scale — масштаб
Gear — коробка передач
Marketer — маркетолог
Mutual — взаимный
Research — исследование
Prototype — опытный образец

Exercise 1. Answer the questions

1. What is the industrial design?
2. How can you define the role of an industrial designer?
3. What is the object of industrial design?
4. Do industrial designers design gears or motors?
5. Industrial design is the professional service of creating developing concepts and specifications that optimize the function, isn't it?
6. Is the process of design creative?
7. Which processes are commonly used by industrial designers?
8. What type of software do industrial designers often use?

Exercise 2. Find Russian equivalents

Industrial design, combination, applied art, applied science, to improve, usability of a product, marketability, industrial designer, to execute, physical ergonomics, brand development, the environment, the user, the gear, the circuits, to affect, to identify, to fulfill, to optimize the function, value, appearance, the mutual benefit, to take place, sketching, prototyping, model making, comparative product research.

Exercise 3. Find English equivalents

Промышленный дизайн, прикладное искусство, прикладная наука, улучшать, польза от продукта, создавать, выполнять, окружающая среда, участвовать в процессе, оборудование, здание, корабли, коробка передач, моторы, цепь, отдавать инженерам, влиять, связи, определять, выполнять, оптимизировать, оптимизировать функцию, взаимная выгода, исследование, создание эскиза, сравнительное исследование, создание опытного образца, тестирование, определяется, использовать.

Exercise 4. Say whether it is true or false

1. Industrial design is not the use of a combination of applied art and applied science to improve the aesthetics, ergonomics, and usability of a product.
2. The role of an industrial designer is to create and execute design solutions for problems of form, usability, physical ergonomics, marketing, brand development, and sales.

3. The objective of this area is to study the connection between product, the user and the environment.

4. Industrial designers do design the gears or motors that make machines move.

5. Industrial design is the professional service of creating and developing concepts and specifications that optimize the function, value and appearance of products.

6. The process of design may not be considered «creative», many analytical processes also take place.

7. Industrial designers do not use design methodologies in their creative process.

8. Some of the processes that are commonly used are user research, sketching, comparative product research, model making, prototyping and testing.

Exercise 5. Fill in the gaps with the words from the box

1. Industrial design is the use of a combination of ________________and applied science _____________ the aesthetics, ergonomics, and usability of a product, but it may also be used to improve the product's marketability and production.

2. The role of an industrial designer is to create and ___________________ — design solutions for problems of form, usability, physical ergonomics, marketing, _______________________________ and sales.

3. Industrial design is the professional ______________________________ of creating and developing concepts and specifications that ______________________ ______________ the function, value and _________________________ of products and systems for the mutual ___________________________________ of both user and manufacturer.

execute	brand development	to improve	appearance
service	applied art	optimize	benefit

Exercise 6. Fill in the gaps with prepositions

1. Industrial design is the professional service … creating and developing concepts and specifications that optimize the function, value and appearance of products and systems … the mutual benefit of both user and manufacturer.

2. … fact, many industrial designers often use various design methodologies … their creative process.

3. These processes are best defined … the designers and/or other team members.

4. Industrial designers often utilize 3D software, computer-aided industrial design and CAD programs to move … concept … production.

Exercise 7. Complete the sentences with the information from the text

1. The objective of this area is to study both function and form, and …

2. Industrial designers do not design the gears or motors that …

3. And usually, they partner a whole of other professionals like …

4. Although the process of design may be considered …
5. In fact, many industrial designers often use various design methodologies …
6. Some of the processes that are commonly used are …
7. These processes are best defined by …

Exercise 8. Complete the definitions below with the words from the box

1. ________________________________ a first or preliminary version of a device or vehicle from which other forms are developed.
2. ________________________________ a rough or unfinished drawing or painting, often made to assist in making a more finished picture.
3. ________________________________ state or describe exactly the nature, scope, or meaning of.
4. ________________________________ the surroundings or conditions in which a person, animal, or plant lives or operates.
5. ________________________________ be involved; take part.
6. ________________________________ make the best or most effective use of (a situation or resource).
7. ________________________________ all of; entire.
8. ________________________________ a person who uses or operates something.

Sketch	To optimize	To define	Prototype
To participate	Environment	User	Whole

Exercise 9. Speak about the industrial design

Unit 11. INFRASTRUCTURE

Infrastructure is basic physical and organizational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function. It can be generally defined as the set of interconnected structural elements that provide framework supporting framework supporting an entire structure of development

The term typically refers to the technical structures that support a society, such as roads, water supply, sewers, electrical grids, telecommunications, and so forth, and can be defined as «the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions».

Viewed functionally, infrastructure facilitates the production of goods and services, and also the distribution of finished products to markets, as well as basic social services such as schools and hospitals; for example, roads enable the transport of raw materials to a factory. In military parlance, the term refers to the buildings and permanent installations necessary for the support, redeployment, and operation of military forces.

The following list of hard infrastructure is limited to capital assets that serve the function of conveyance or channeling of people, vehicles, fluids, energy, or information, and which take the form either of a network or of a critical node used by vehicles, or used for the transmission of electro-magnetic waves.

Infrastructure systems include both the fixed assets, and the control systems and software required to operate, manage and monitor the systems, as well as any accessory buildings, plants, or vehicles that are an essential part of the system. Also included are fleets of vehicles operating according to schedules such as public transit buses and garbage collection, as well as basic energy or communications facilities that are not usually part of a physical network, such as oil refineries, radio, and television broadcasting facilities.

Engineers generally limit the use of the term «infrastructure» to describe fixed assets that are in the form of a large network, in other words, «hard» infrastructure. Recent efforts to devise more generic definitions of infrastructure have typically referred to the network aspects of most of the structures, and to the accumulated value of investments in the networks as assets. One such effort defines infrastructure as the network of assets, where the system as a whole is intended to be maintained indefinitely at a specified standard of service by the continuing replacement and refurbishment of its components [11].

Key Words

Accumulated value — суммарное значение
To monitor — следить
Fixed assets — основные средства
Conveyance — транспортировка
Redeployment — передислокация
Facilitate — способствовать
Sustain — поддерживать
Commodities — товары
Support — поддержать
Provide — обеспечить
Facilities — приспособления
Enterprise — предприятие
Operation — действие
Continuing replacement — постоянное пополнение
Investments — инвестиции
To devise — разрабатывать
Oil refineries — нефтеперерабатывающие предприятия
Schedules — расписание
Accessory buildings — вспомогательные сооружения
Software — программное обеспечение
Critical node — критический узел
Capital assets — основной капитал
Raw materials — сырье
Living conditions — жизненные условия
To enable — обеспечить
Development — развитие
Framework — основы
Set — комплекс
Services — вспомогательные службы
Society — общество
Refurbishment — реконструкция
Specified standard of service — определенный стандарт обслуживания
Infrastructure — инфраструктура
Efforts — усилия
Communications facilities — средства связи
Fleets of vehicles — транспортный парк

Exercise 1. Answer the questions

1. What is the infrastructure?
2. What does the term typically refer to?
3. What does infrastructure facilitate?

4. What does infrastructure refer to in military practice?
5. What function do capital assets serve?
6. What does infrastructure include?
7. How do engineers limit the use of the term «infrastructure»?
8. What are the most recent definitions of infrastructure?

Exercise 2. Find Russian equivalents

Infrastructure, operation, society, enterprise, facilities, to provide, support, development-commodities, to enable, to sustain, facilitate, raw materials, redeployment, capital assets, conveyance, critical node, fixed assets, software, to monitor, communications facilities, efforts, to devise, investments, specified standard of service, continuing replacement, refurbishment.

Exercise 3. Find English equivalents

Инфраструктура, действие, общество, вспомогательные службы приспособления, комплекс, основы, поддержать, развитие, товары, обеспечить, поддерживать жизненные условия, способствовать, сырье, передислокация, основной капитал, транспортировка, критический узел, основные средства, программное обеспечение, следить, вспомогательные сооружения, транспортный парк, расписание, средства связи, нефтеперерабатывающие предприятия, усилия, разрабатывать, суммарное значение, инвестиции, определенный стандарт обслуживания, постоянное пополнение, реконструкция.

Exercise 4. Say whether it is true or false

1. Infrastructure is basic physical structures.
2. Infrastructure can be generally defined as the set of separate structural elements.
3. The term typically refers to the technical structures that support a society, such as roads, water supply, sewers, electrical grids, telecommunications.
4. Infrastructure is not connected with the production of goods and services, and also the distribution of finished products to markets.
5. In military parlance, the term refers to the buildings and permanent installations necessary for the support, redeployment, and operation of military forces.
6. Hard infrastructure takes the form either of a network or of a critical node used by vehicles, or used for the transmission of electro-magnetic waves.
7. Infrastructure systems don't include the control systems and software.
8. Infrastructure systems include fleets of vehicles operating according to schedules.
9. Engineers generally limit the use of the term «infrastructure» to describe fixed assets that are in the form of a large network.
10. Infrastructure can be defined as the system as a whole which is intended to be maintained indefinitely at a specified standard of service by the continuing replacement and refurbishment of its components.

Exercise 5. Fill in the gaps with the words from the text

1. Infrastructure is the set of interconnected structural elements that ____________________ framework supporting an entire structure of development.

2. The term typically refers to the technical structures that support ____________________, such as roads, water supply, sewers, electrical grids, telecommunications.

3. Infrastructure ____________________ the production of goods and services.

4. In military parlance, the term refers to the buildings and permanent installations necessary for support, ________________, and operation of military forces.

5. ____________________________ serve the function of conveyance or channeling of people, vehicles, fluids, energy, or information.

6. Infrastructure systems __________________________ both fixed assets and ____________________ required to operate, manage and monitor the systems.

7. Engineers generally limit the use of the term «infrastructure» to describe ___________________________ that are in the form of a large network, in other words, «hard» infrastructure.

include	the control systems	fixed assets	facilitates
redeployment	a society	provide	capital assets

Exercise 6. Fill in the gaps with prepositions

1. Infrastructure is basic physical and organizational structures needed … the operation of a society or enterprise.

2. It can be generally defined … the set of interconnected structural elements.

3. The term typically refers … the technical structures.

4. Infrastructure facilitates the production … goods and services.

5. A network or of a critical node used … vehicles, or used … the transmission of electro-magnetic waves.

6. Fleets of vehicles operating according …

7. The system as a whole is intended to be maintained indefinitely … a specified standard of service.

Exercise 7. Complete the sentences with the information from the text

1. Infrastructure is basic physical and organizational structures needed for …

2. It can be generally defined as the set of interconnected structural elements that provide …

3. The term typically refers to the technical structures that support …

4. Basic social services such as …

5. Capital assets that serve the function of conveyance or channeling of ...

6. Software required to operate, manage and monitor ...

7. Communications facilities that are not usually part of a physical network, such as …

Exercise 8. Complete the definitions below with the words from the box

1. ____ basic systems and services that are needed for a country or organization to run smoothly.

2. ______________________________________ buildings, services, equipment that are provided for a particular purpose

3. ______________________________________ to give smth to smb or make it available for them to use.

4. _______________________________________ to help or encourage.

5. _______________________________________ wealth or property that is owned by a person or a business.

6. ______________________________________ the process of taking smb/smth from one place to another.

7. ______________________________________ to watch and check smth over a period of time in order to see how it develops.

8. _______________________________________ the process of cleaning and decorating a room or a building in order to make it more attractive, more useful.

refurbishment	capital assets	to monitor	conveyance
to provide	facilities	to support	infrastructure

Exercise 9. Speak about the infrastructure

Unit 12. STRUCTURAL ENGINEERING

Structural Engineering is largely the application of Mechanics, and can sometimes be generalized as a subfield of mechanical engineering. Traditionally it used careful placement of coordinate axis to simplify complex equations associated with tensor quantities such as stress and resulting displacements of beams or structural elements. This simplification was essential to being able to solve problems. The successful engineer must know that a structure could meet the loads specified to be placed upon it. As long as the design loads were not exceeded the structure must spring back when the load was lifted or hold steady indefinitely.

Modern use of advanced powerful desktop computers begs the question of when it will become economically advantageous to actually solve many of the structural problems via iterative methods rather than use knowledgeable human time to simplify the problem sufficient for accurate approximation as described above.

A typical task of a beginning structural engineer might consist of performing the analysis to size the beams necessary to support a chemical vat on the second or third floor of an operational manufacturing plant.

Structural engineers are responsible for engineering design and analysis. Entry-level structural engineers may design the individual structural elements of a structure, for example the beams, columns, and floors of a building. More experienced engineers would be responsible for the structural design and integrity of an entire system, such as a building.

Structural engineers often specialize in particular fields, such as bridge engineering, building engineering, pipeline engineering, industrial structures, or special mechanical structures such as vehicles or aircraft.

The role of a structural engineer today involves a significant understanding of both static and dynamic loading, and the structures that are available to resist them. The complexity of modern structures often requires a great deal of creativity from the engineer in order to ensure the structures support and resist the loads they are subjected to. A structural engineer will typically have a four or five year undergraduate degree, followed by a minimum of three years of professional practice before being considered fully qualified.

Structural engineers are licensed or accredited by different learned societies and regulatory bodies around the world. Depending on the degree course they have studied and/or the jurisdiction they are seeking licensure in, they may be accredited (or licensed) as just structural engineers, or as civil engineers, or as both civil and structural engineers [12].

Key Words

Coordinate axis — ось координат
Complex equations — сложные уравнения
To simplify — упростить
Tensor quantities — тензорные величины
Experienced — опытный
Beams — балки
Loads — нагрузки
To exceed — превысить
To spring back — отпрянуть, вернуться в исходное положение
Displacement — смещение
Iterative — повторяющийся
Sufficient — достаточный
Approximation — приближенное значение
To specialize in — специализироваться на...
Vat — бак, цистерна
Structural engineers — структурные инженеры
Column — колонна
Floors — полы
To hold steady — поддерживать на постоянном уровне
Responsible for — ответственный за
To be licensed — получить лицензию
Integrity — целостность
Entire system — целая система
Civil — гражданские
To involve — включать в себя
Significant — значительный
Static loading — статическая нагрузка
Dynamic loading — динамическая нагрузка
Available — пригодны для
To ensure — обеспечить
Subject to — подвергнуть
Learned societies — научные сообщества
Structural design — проектирование зданий и сооружений
To size — точно по размеру
Regulatory bodies — ответственные органы
Seek — стремиться
Entry-level — начальный уровень
To be accredited — получить аккредитацию

Exercise 1. Answer the questions

1. What is structural engineering?
2. What was placement of coordinate axis used for?
3. What must a successful engineer know?
4. What happens to a structure when the load is lifted?

5. How can modern computers help solve structural engineering problems?
6. What is a typical task of a beginning structural engineer?
7. What are structural engineers responsible for?
8. What fields do structural engineers specialize in?
9. What does a role of a structural engineer involve?
10. When is an engineer considered fully qualified?

Exercise 2. Find Russian equivalents

Coordinate axis, complex equations, tensor quantities, beams, loads, to exceed, sufficient, approximation, column, floors, structural design, entire system, involve, static loading, dynamic loading, available, ensure, structural engineers, civil engineers.

Exercise 3. Find English equivalents

Сложные уравнения, тензорные величины, смещение, упростить, структурные элементы, решать проблемы, превысить, вернуться в исходное положение, поддерживать на постоянном уровне, повторяющийся, достаточный, колонна, полы, ответственный за, целостность, включать в себя, значительный, пригодный, подвергнуть, стремиться.

Exercise 4. Say whether it is true or false

1. Structural Engineering is largely the application of civil engineering.
2. Traditionally it used careful placement of coordinate axis to solve complex equations.
3. Complex equations are associated with load quantities such as stress and resulting displacements of beams or structural elements.
4. The successful engineer must know that a structure could meet the stresses specified to be placed upon it.
5. Structural engineers are responsible for engineering design and construction.
6. Structural engineers often specialize in particular fields, such as beams, columns, and floors of a building.
7. The role of a structural engineer today involves a significant improvement of both static and dynamic loading.
8. The complexity of modern structures often requires a great deal of learning from the engineer in order to ensure the structures support and resist the loads they are subjected to.

Exercise 5. Fill in the gaps with the words from the text

1. Structural Engineering is largely the application of mechanics, and can sometimes be generalized as a subfield of______________________________.
2. The successful engineer must know that a structure could meet the ________ _________________________________ specified to be placed upon it.
3. As long as the design loads were not ____________________ the structure must spring back when the load was lifted or hold steady indefinitely.

4. Modern use of advanced powerful desktop computers begs the question of when it will become ____.

5. A typical task of a beginning structural engineer might consist of performing the analysis ______________ the beams necessary to support a chemical vat on the second or third floor of an operational manufacturing plant.

6. More experienced engineers would be responsible for the structural design and ____________________________ of an entire system, such as a building.

7. The role of a structural engineer today involves a significant understanding of both static and __________________________________.

8. Structural engineers are ____________________________ or accredited by different learned societies and regulatory bodies around the world.

loads	to size	integrity	exceeded
licensed	dynamic loading	economically advantageous	mechanical engineering

Exercise 6. Fill in the gaps with prepositions

1. Traditionally it used careful placement of coordinate axis to simplify complex equations associated … tensor quantities.

2. The successful engineer must know that a structure could meet the loads specified to be placed … it.

3. As long as the design loads were not exceeded the structure must spring … when the load was lifted or hold steady indefinitely.

4. Modern use of advanced powerful desktop computers begs the question of when it will become economically advantageous to actually solve many of the structural problems via iterative methods rather than use knowledgeable human time to simplify the problem sufficient … accurate approximation as described above.

5. A typical task of a beginning structural engineer might consist … performing the analysis.

6. Structural engineers often specialize … particular fields.

7. The structures support and resist the loads they are subjected …

8. Structural engineers are licensed or accredited … different learned societies and regulatory bodies around the world.

9. Depending … the degree course they have studied and/or the jurisdiction they are seeking licensure in.

Exercise 7. Complete the sentences with the information from the text

1. Traditionally it (structural engineering) used careful placement of coordinate axis to …

2. The successful engineer must know that …

3. As long as the design loads were not exceeded the structure must spring back when …

4. A typical task of a beginning structural engineer might consist of performing the analysis to …

5. Entry-level structural engineers may design the individual structural elements of a structure, for example …

6. More experienced engineers would be responsible for the structural design and …

7. Structural engineers often specialize in particular fields, such as …

8. The role of a structural engineer today involves a significant understanding of …

9. The complexity of modern structures often requires a great deal of …

10. A structural engineer will typically have a …

Exercise 8. Complete the definitions below with the words from the box

1. ________________________________ the science of movement and force.

2. ________________________________ to make sure that smth happens or is definite.

3. ________________________________ the process of making smth easier to do or understand.

4. ________________________________ to move suddenly and with a quick movement in a certain direction.

5. ______________________________ the amount of weight that is pressing down.

6. _______________________________ the art or process of deciding how smth will look, work by drawing plans, making models, etc.

7. _____________________________ good or useful in a particular situation.

8. ______________________________ large or important enough to have effect or be noticed.

To ensure	Simplification	To spring	Design
Significant	Advantageous	Mechanics	Load

Exercise 9. Speak about the Structural Engineering

Unit 13. MECHANICAL ENGINEERING

Mechanical engineering is a discipline of engineering that applies the principles of physics and materials science for analysis, design, manufacturing, and maintenance of mechanical systems. It is the branch of engineering that involves the production and usage of heat and mechanical power for the design, production, and operation of machines and tools. It is one of the oldest and broadest engineering disciplines.

The engineering field requires an understanding of core concepts including mechanics, kinematics, thermodynamics, materials science, and structural analysis. Mechanical engineers use these core principles along with tools like computer-aided engineering and product lifecycle management to design and analyze manufacturing plants, industrial equipment and machinery, heating and cooling systems, transport systems, aircraft, watercraft, robotics, medical devices and more.

Mechanical engineering emerged as a field during the industrial revolution in Europe in the 18th century; however, its development can be traced back several thousand years around the world. Mechanical engineering science emerged in the 19th century as a result of developments in the field of physics. The field has continually evolved to incorporate advancements in technology, and mechanical engineers today are pursuing developments in such fields as composites, mechatronics, and nanotechnology. Mechanical engineering overlaps with aerospace engineering, civil engineering, electrical engineering, petroleum engineering, and chemical engineering to varying amounts [13].

Key Words

Maintenance — эксплуатация
Heat — тепло
Operation — использование
Tool — инструмент
Materials science — материаловедение
Equipment — оборудование
Aircraft — воздушный транспорт
Robotics — робототехника
Emerge — появиться
Trace back — проследить до
Advancement — достижение
Composites — композиты
Along with — наряду с
Branch — отрасль
Mechanical power — механическая сила
Machine — станок
Core concepts — ключевые понятия
Medical devices — медицинские приборы
Machinery — станкостроение
Watercraft — водный транспорт
Lifecycle — жизненный цикл
Development — развитие
To incorporate — включать в себя
Pursue — применять, использовать
Overlap — пересекаться
Mechatronics — мехатроника

Exercise 1. Answer the questions

1. What is mechanical engineering?
2. What does mechanical engineering involve?
3. What core concepts does the engineering field require?
4. What tools do mechanical engineers use along with core concepts?
5. What do mechanical engineers design and analyze?
6. When did mechanical engineering emerge?
7. What developments are mechanical engineers pursuing today?
8. What does mechanical engineering overlap with?

Exercise 2. Find Russian equivalents

Maintenance, heat, operation, materials science, mechanics, kinematics, thermodynamics, structural analysis, core concepts, industrial equipment, heating and cooling systems, medical devices, robotics, nanotechnology, aerospace engineering, civil engineering, electrical engineering, petroleum engineering, chemical engineering.

Exercise 3. Find English equivalents

Инженерная наука, применять принципы физики, материаловедение, проектирование, производство и эксплуатация, отрасль инженерной науки, производство и использование, станки и инструменты, ключевые понятия, наряду с …, управление жизненным циклом продукта, промышленное оборудование, производственные цехи, системы обогрева и охлаждения, промышленная революция, проследить на несколько тысячелетий назад, в таких областях как, мехатроника, аэрокосмическое строительство, гражданское строительство, в различной степени.

Exercise 4. Say whether it is true or false

1. Mechanical engineering is a discipline of engineering that applies the principles of building and materials science.

2. It is the branch of engineering that involves the production and usage of mechanical power for the design, production, and operation of machines and tools.

3. The engineering field requires an understanding of core concepts including mechanics, kinematics, thermodynamics, materials science, and structural analysis.

4. Mechanical engineers use these core principles along with tools like structural analysis to design and analyze manufacturing plants, industrial equipment and machinery, heating and cooling systems, transport systems, aircraft, watercraft, robotics, medical devices and more.

5. Mechanical engineering science emerged in the 19th century.

6. Mechanical engineers today are pursuing developments in such fields as composites, mechatronics, and nanotechnology.

7. Mechanical engineering incorporates aerospace engineering, civil engineering, electrical engineering, petroleum engineering, and chemical engineering to varying amounts.

Exercise 5. Fill in the gaps with the words from the text

1. Mechanical engineering is a ______________________ of engineering.

2. It is the __________________________________ of engineering that involves the production and usage of heat and mechanical power for the design, production, and operation of machines and tools.

3. The engineering field requires an understanding of ______________________ including mechanics, kinematics, thermodynamics, materials science, and structural analysis.

4. Mechanical engineers use these core principles along with tools like ______________________________ and product lifecycle management.

5. Mechanical engineers use these core principles to ______________________ manufacturing plants, industrial equipment and machinery, heating and cooling systems, transport systems, aircraft, watercraft, robotics, medical devices and more.

6. Mechanical engineering emerged as a field during the __________________ in Europe in the 18th century.

7. Mechanical engineering __________________ emerged in the 19th century.

8. Mechanical engineering overlaps with aerospace engineering, ______________________, electrical engineering, petroleum engineering, and chemical engineering to varying amounts.

civil engineering	science	industrial revolution	computer-aided engineering
design and analyze	core concepts	branch	discipline

Exercise 6. Fill in the gaps with prepositions

1. Mechanical engineers use these core principles … tools like computer-aided engineering and product lifecycle management
2. Mechanical engineering emerged as a field during the industrial revolution in Europe … the 18th century.
3. Its development can be traced back several thousand years … the world.
4. The field has continually evolved to incorporate advancements … technology.
5. Mechanical engineering overlaps … erospace engineering.

Exercise 7. Complete the sentences with the information from the text

1. Mechanical engineering is …
2. It is the branch of engineering that involves …
3. It is one of the ... disciplines.
4. The engineering field requires an understanding of core concepts including …
5. Mechanical engineers use these core principles along with tools like …
6. Mechanical engineers use these core principles to design and analyze…
7. Mechanical engineers today are pursuing developments in such fields as …
8. Mechanical engineering overlaps …

Exercise 8. Complete the definitions below with the words from the box

1. ___________________________________ the practical study of machinery.
2. ____ machines as a group.
3. ______________________________________ the act of keeping smth in good condition by checking or repairing it regularly.
4. _______________________________________ connected with industry.
5. _______________________________________ the progress that is made.
6. _______________________________________ an instrument that you hold in your hand and use for making things.
7. ___________________________ to try to achieve smth over a period of time.
8. ________________________________ to start to exist to become known.

To pursue	Advancement	Industrial	Machinery
To emerge	Mechanics	Tool	Maintenance

Exercise 9. Speak about the Mechanical engineering

Unit 14. TRANSPORT ENGINEERING

Transport engineering (or Transportation engineering) is a branch of Civil engineering dealing with the planning, design, operation, and management of transportation facilities.

The planning aspects of transportation engineering relate to urban planning, and involve technical forecasting decisions and more difficult political factors. Technical forecasting or urban passenger travel presently involves what is called the four-step urban transportation planning model, requiring the estimation of trip generation (how many trips for what purpose), trip distribution (destination choice, where are you going), mode choice (what mode is being taken), and route choice (which streets, transit routes are being used).

The design aspects of transportation engineering include the sizing of transportation facilities (how many lanes or how much capacity the facility has), determining the materials and thickness used in pavement, designing the geometry (vertical and horizontal alignment) of the roadway (or track).

Operations and management involve traffic engineering, so that vehicles move smoothly on the road or track. Older techniques include signs, signals, and markings. Newer technologies involve Intelligent Transportation Systems, including Advanced Traveler Information Systems, such as variable message signs, and Advanced Traffic Control Systems, such as ramp meters. Human factors are an important aspect of transport engineering, particularly concerning driver-vehicle interface and user interface of road signs, signals, and markings [14].

Key Words

Relate to — относиться к
Capacity — мощность, пропускная способность
Presently — в настоящее время
Mode — режим работы
Alignment — выравнивание
Concern — касаться, иметь отношение к
Smoothly — плавно, гладко
Signs — знаки
Ramp meters — датчики уклона
User interface — пользовательский интерфейс
Determine — определить
Facilities — возможности
Forecasting — предвидение, предварительный расчет
Estimation — оценка
Route — маршрут
Pavement — мостовая
Particularly — особенно
Vehicles — транспортные средства
Variable — варьируемые
Advanced — усовершенствованный
Urban planning — городское планирование
Markings — маркировка

Exercise 1. Answer the questions

1. What is transport engineering dealing with?
2. What do aspects of transportation relate to?
3. What does technical forecasting involve?
4. What do the design aspects include?
5. What does traffic engineering involve?
6. What do older techniques include?
7. What do newer techniques include?
8. What can be said about human factors?

Exercise 2. Find Russian equivalents

Transportation engineering, civil engineering, planning, design, operation, management, transportation facilities, urban passenger travel, four-step model, trip generation, trip distribution, mode choice, route choice, the sizing, vertical and horizontal alignment, Advanced Traveler Information Systems, Advanced Traffic Control Systems, driver-vehicle interface.

Exercise 3. Find English equivalents

Автодорожное строительство, гражданское строительство, автодорожные средства, пассажиропоток, четырехступенчатая модель, оценка, формирование движения, распределение движения, выбор режима работы, определение размера, усовершенствованные системы информации путешествующих, взаимодействие водителя и транспортного средства.

Exercise 4. Fill in the gaps with the words from the text

1. Transport engineering (or Transportation engineering) is a branch of ____ dealing with the planning, design, operation, and management of transportation facilities.

2. The planning aspects of transportation engineering relate to ______________________________________.

3. ___________________________________ or urban passenger travel presently involves what is called the four-step urban transportation planning model, requiring the estimation of trip generation (how many trips for what purpose), trip distribution (destination choice, where are you going), mode choice (what mode is being taken), and route choice (which streets, transit routes are being used).

4. The design aspects of transportation engineering include ____ of transportation facilities (how many lanes or how much capacity the facility has).

5. Operations and management involve _________________________________, so that vehicles move smoothly on the road or track.

6. Older techniques include _________________________________, signals, and markings.

7. Newer technologies involve ______________________________________, including Advanced Traveler Information Systems, such as variable message signs, and Advanced Traffic Control Systems, such as ramp meters.

8. Human factors are an important aspect of transport engineering, particularly concerning driver-vehicle interface and ______________________________ of road signs, signals, and markings.

civil engineering	the sizing	urban planning	traffic engineering
signs	technical forecasting	intelligent transportation systems	user interface

Exercise 5. Fill in the gaps with prepositions

1. Transport engineering (or Transportation engineering) is a branch of Civil engineering dealing ______________________________ the planning, design, operation, and management of transportation facilities.

2. The planning aspects of transportation engineering relate ________________ ____________________ urban planning.

3. The design aspects of transportation engineering include determining the materials and thickness used _________________________________ pavement.

4. Vehicles move smoothly __________________________ the road or track.

5. User interface ____________________ road signs, signals, and markings.

Exercise 6. Complete the sentences with the information from the text

1. Transport engineering (or Transportation engineering) is a branch of Civil engineering dealing with …

2. The planning aspects of transportation engineering relate to urban planning, and involve …

3. Technical forecasting or urban passenger travel presently involves what is called the four-step urban transportation planning model, requiring …

4. The design aspects of transportation engineering include …

5. Operations and management involve traffic engineering, so that …

6. Older techniques include …

7. Newer technologies involve …

Exercise 7. Complete the definitions below with the words from the box

1. ____ to make smth part of smth.

2. ____ to calculate smth exactly.

3. ____ connected with a town or a city.

4. ____ often changing.

5. ____ the movement of vehicles along a particular route.

6. ____ the system of buses, trains, etc. provided for people to travel.

7. ____ a fixed way along which a car, a bus, etc., regularly travels.

8. ____ a statement about what will happen in the future.

Traffic	Forecasting	Transportation	Route
To include	To determine	Urban	Variable

Exercise 8. Speak about the transportation engineering

Unit 15. SAFETY ENGINEERING

Safety engineering is an applied science strongly related to systems engineering and the subset System Safety Engineering. Safety engineering assures that a life-critical system behaves as needed even when components fail.

Ideally, safety-engineers take an early design of a system, analyze it to find what faults can occur, and then propose safety requirements in design specifications up front and changes to existing systems to make the system safer. In an early design stage, often a fail-safe system can be made acceptably safe with a few sensors and some software to read them. Probabilistic fault-tolerant systems can often be made by using more, but smaller and less-expensive pieces of equipment.

Far too often, rather than actually influencing the design, safety engineers are assigned to prove that an existing, completed design is safe. If a safety engineer then discovers significant safety problems late in the design process, correcting them can be very expensive. This type of error has the potential to waste large sums of money.

The exception to this conventional approach is the way some large government agencies approach safety engineering from a more proactive and proven process perspective, known as «system safety». The system safety philosophy is to be applied to complex and critical systems, such as commercial airliners, complex weapon systems, spacecraft, rail and transportation systems, air traffic control system and other complex and safety-critical industrial systems. The proven system safety methods and techniques are to prevent, eliminate and control hazards and risks through designed influences by a collaboration of key engineering disciplines and product teams. Software safety is a fast growing field since modern systems functionality are increasingly being put under control of software. The whole concept of system safety and software safety, as a subset of systems engineering, is to influence safety-critical systems designs by conducting several types of hazard analyses to identify risks and to specify design safety features and procedures to strategically mitigate risk to acceptable levels before the system is certified.

Additionally, failure mitigation can go beyond design recommendations, particularly in the area of maintenance. There is an entire realm of safety and reliability engineering known as Reliability Centered Maintenance (RCM), which is a discipline that is a direct result of analyzing potential failures within a system and determining maintenance actions that can mitigate the risk of failure. This methodology is used extensively on aircraft and involves understanding the failure modes of the serviceable replaceable assemblies in addition to the means to detect or predict an impending failure. Every automobile owner is familiar with this concept when they take in their car to have the oil changed or brakes checked. Even filling up one's car with fuel is a simple example of a failure mode (failure due to fuel exhaustion), a means of detection (fuel gauge), and a maintenance action (filling the car's fuel tank).

For large scale complex systems, hundreds if not thousands of maintenance actions can result from the failure analysis. These maintenance actions are based on conditions (e. g., gauge reading or leaky valve), hard conditions (e. g., a component is known to fail after 100 hrs of operation with 95 % certainty), or require inspection to determine the maintenance action (e. g., metal fatigue). The RCM concept then analyzes each individual maintenance item for its risk contribution to safety, mission, operational readiness, or cost to repair if a failure does occur. Then the sum total of all the maintenance actions are bundled into maintenance intervals so that maintenance is not occurring around the clock, but rather, at regular intervals. This bundling process introduces further complexity, as it might stretch some maintenance cycles, thereby increasing risk, but reduce others, thereby potentially reducing risk, with the end result being a comprehensive maintenance schedule, purpose built to reduce operational risk and ensure acceptable levels of operational readiness and availability [15].

Key Words

Applied science — прикладная наука
Assure — гарантировать
Fault — дефект
Availability — пригодность
Up front — авансом, вперед
Probabilistic — вероятностный
To assign — поручать
Significant — значительный
Exception — исключение
Conventional — общепринятый
System safety — безопасность системы
Safety — critical
To eliminate — ликвидировать
Means of detection — средства обнаружения
To specify — указать
Acceptable — приемлемый
Maintenance — эксплуатация
Reliability — надежность
To determine — определить
Replaceable — заменяемый
To predict — предсказать
To fill up — заполнить
Due to — благодаря (чему-то)
Collaboration — сотрудничество
Condition — условие
Fatigue — износ
Contribution — вклад
To bundle — связать воедино
Comprehensive — комплексный, детальный
Safety requirements — требования безопасности

Subset — подраздел
Fail — сбой
To occur — случаться
To propose — предложить
Fault-tolerant — отказоустойчивый
Influence — влияние
To prove — доказать
To waste — тратить напрасно
Approach — подход, метод
Proactive — активный
Complex — сложный
To prevent — предотвратить
Hazards — опасности
Software safety — программное обеспечение безопасности
To mitigate — уменьшать
Beyond — свыше
Realm — сфера
Direct — прямой
Extensively — широко
Assembly — механизм
Impending — грозящий
Failure mode — характер отказа
Exhaustion — истощение
Fuel gauge — датчик топлива
Leaky valve — неплотный клапан
Item — пункт
Mission — задача
Around the clock — круглосуточно
Operational readiness — эксплуатационная готовность
Schedule — расписание

Exercise 1. Answer the questions

1. What is safety engineering?
2. What is safety engineering related to?
3. What does safety engineering assure?
4. What do safety-engineers ideally do?
5. How can fault-tolerant systems be done?
6. What are safety engineers usually assigned to?
7. What is the exception to this conventional approach?
8. Where is the system safety to be applied?
9. What are the proven system safety methods and techniques to do?
10. What is a software safety?
11. What is Reliability Centered Maintenance?
12. Where is Reliability Centered Maintenance applied?

Exercise 2. Find Russian equivalents

Safety engineering, applied science, life-critical system, an early design of a system, safety requirements, existing systems, fail-safe system, acceptably safe, fault-tolerant systems, less-expensive pieces of equipment, significant safety problems, complex weapon systems, air traffic control system, safety-critical industrial systems, key engineering disciplines, a fast growing field, hazard analyses, mitigate risk, go beyond design recommendations, determining maintenance actions, failure modes, serviceable replaceable assemblies, an impending failure, metal fatigue, a comprehensive maintenance schedule.

Exercise 3. Find English equivalents

Техника безопасности, прикладная наука, подраздел, гарантировать, жизненно важная система, требования безопасности, отказоустойчивая система, приемлемо безопасная, менее дорогие части оборудования, значительные проблемы безопасности, сложные системы оружия, системы контроля воздушного движения, жизненно важные промышленные системы, ведущие инженерные дисциплины, быстро растущая область, уменьшить риски, определить действия эксплуатации, характер отказа, обслуживание сменных узлов, грозящий сбой, износ металла, детальное расписание эксплуатационных действий.

Exercise 4. Say whether it is true or false

1. Safety engineering assures that a life-critical system behaves as needed even when components work normally.

2. Ideally, safety-engineers take an early design of a system, analyze it to find what faults can occur, and then write a report.

3. Probabilistic fault-tolerant systems can often be made by using more, but smaller and less-expensive pieces of equipment.

4. If a safety engineer then discovers significant safety problems late in the design process, correcting them can be very cheap.

5. The system safety philosophy is to be applied to simple and critical systems.

6. The whole concept of system safety and software safety, as a subset of systems engineering, is to influence safety-critical systems designs by conducting several types of hazard analyses to identify risks and to specify design safety features and procedures to strategically mitigate risk to acceptable levels before the system is certified.

7. Reliability Centered Maintenance is used only on aircraft.

8. These maintenance actions are based on conditions, hard conditions, or require inspection to determine the maintenance action.

9. Then the sum total of all the maintenance actions are bundled into maintenance intervals with the end result being a comprehensive maintenance schedule.

Exercise 5. Fill in the gaps with the words from the text

1. Safety engineering assures that a ________________________________ behaves as needed even when components fail.

2. Ideally, safety-engineers take an early design of a system, analyze it to find what faults can occur, and then propose _____________________________.

3. Probabilistic ______________________________________ can often be made by using more, but smaller and less-expensive pieces of equipment.

4. If a safety engineer then discovers _____________________________ late in the design process, correcting them can be very expensive.

5. This type of error has the potential ______________________________ large sums of money.

6. The proven system safety methods and techniques are to prevent, eliminate and control _______________________________________.

7. Additionally, _____________________________________ can go beyond design recommendations, particularly in the area of maintenance.

8. The sum total of all the maintenance actions __________________________ _______________ into maintenance intervals.

safety requirements	significant safety problems	fault-tolerant systems	failure mitigation
to waste	life-critical system	hazards and risks	are bundled

Exercise 6. Fill in the gaps with prepositions

1. Safety engineering is an applied science strongly related … systems engineering and the subset System Safety Engineering.

2. Probabilistic fault-tolerant systems can often be made … using more, but smaller and less-expensive pieces of equipment.

3. If a safety engineer then discovers significant safety problems late … the design process, correcting them can be very expensive.

4. The exception to this conventional approach is the way some large government agencies approach safety engineering … a more proactive and proven process perspective, known as «system safety».

5. Additionally, failure mitigation can go … design recommendations, particularly in the area of maintenance.

6. Every automobile owner is familiar … this concept when they take in their car to have the oil changed or brakes checked.

7. Even filling up one's car … fuel is a simple example … a failure mode (failure due to fuel exhaustion), a means of detection (fuel gauge), and a maintenance action (filling the car's fuel tank).

8. Then the sum total of all the maintenance actions are bundled … maintenance intervals so that maintenance is not occurring around the clock, but rather, at regular intervals.

Exercise 7. Complete the sentences with the information from the text

1. Safety engineering assures that a life-critical system behaves as needed even when …

2. In an early design stage, often a … — … can be made acceptably safe with a few sensors and some software to read them.

3. Far too often, rather than actually influencing the design, safety engineers are assigned …

4. The exception to this conventional approach is the way some large government agencies approach safety engineering from a more proactive and proven process perspective, known as …

5. The proven system safety methods and techniques are to …, … and … hazards and risks.

6. There is an entire realm of safety and reliability engineering known as …

7. This methodology is used extensively on aircraft and involves understanding the … of the … assemblies in addition to the means to detect or predict an impending failure.

8. Then the sum total of all the maintenance actions are bundled into … with the end result being a ...

Exercise 8. Complete the definitions below with the words from the box

1. ____________________ designed to stop working if anything goes wrong.

2. _______________ the state of being safe and protected from danger or harm.

3. ______________________ a thing that can be dangerous or cause damage.

4. ________________________ the act of keeping smith in good condition by checking or repairing it regularly.

5. __________________________________ to make smith certain to happen.

6. _____________________________________ to stop smth from happening.

7. ___________________________ to state smth by giving exact instructions.

8. _________________________________ to make smth less harmful, serious.

Safety	Fail-Safe	Maintenance	Hazard
To mitigate	To prevent	To specify	To assure

Exercise 9. Speak about the Safety engineering

ТЕКСТЫ ДЛЯ САМОСТОЯТЕЛЬНОГО ЧТЕНИЯ

Design

When applied to fine and applied arts, engineering, and other such creative efforts, design is both a noun and a verb. The verb is the process of originating and developing a plan for an artistic or engineered object, which may require countless hours of thought, modeling, iterative adjustment, and re-design. The noun is either the finalized plan of action, or the result of following that plan of action.

In philosophy, the abstract noun design refers to purpose/purposefulness, or teleology. Design is thus contrasted with purposelessness, randomness, or lack of complexity.

The traditional view is that design can only arise thanks to a sentient designer. Thus in the teleological argument, also known as the argument from design, the obvious presence of design in the world is thought to prove the existence of a designer, namely God.

In the past few decades, some at the intersection of philosophy and Neo-Darwinian evolutionary theory have proposed an alternative, in which it is meaningful to speak of design without always speaking of a sentient designer. It is seen as insightful to see humans, gods, and certain impersonal forces, especially natural selection, as equally capable of giving rise to one unified phenomenon: design. Daniel C. Dennett (1995) offers perhaps the most comprehensive framework along these lines.

Note that others at the intersection of philosophy and evolutionary theory argue that the term design should still be reserved for cases involving a sentient designer. This implies that followers of the standard, biological, materialistic account of the origin of the species should not use design or designed in discussions of organisms or parts thereof; since these have no designer, they were not designed in the proper sense of the word. Proponents of this view include Richard Dawkins.

Industrial and manufacturing engineering

In industrial and manufacturing engineering, engineering principles are utilized to produce an end product. This end product can be a chemical compound or mixture such as soap, gasoline or petrol, or and assembly of products from different manufacturing processes to produce some as complex as an automobile or an airplane.

There are a number of things engineers do to make products more manufacturable.

Value engineering

One is called «value engineering». Value engineering is based on the proposition that in any complex product, 80 % of the customers need 20 % of the features. By focusing product development, one can produce a superior product at a lower cost for the major part of a market. When a customer needs more features, sell them as options. This approach is valuable in complex electromagnetic products such as computer printers, in which the engineering is a major product cost.

To reduce a project's engineering and design costs, it is frequently «factored» into subassemblies that are designed and developed once and reused in many slightly different products. For example, a typical tape-player has a precision injection-molded tape-deck produced, assembled and tested by a small factory, and sold to numerous larger companies as a subassembly. The tooling and design expense for the tape deck is shared over many products that can look quite different. All that the other products need to have are the necessary mounting boles and electrical interface.

It's a truism that «quality is free». Very often, it costs no more to produce a product that always works, every time it comes off the assembly line. It requires a conscious effort during engineering, but it reduces the cost of waste and rework quite a bit.

Commercial quality efforts have two foci. First, to reduce the mechanical precision needed to get good performance. Second, to control all manufacturing operations to assure that every part and assembly are within tolerance.

Statistical process controls on manufacturing usually proceed by randomly sampling and testing a fraction of the output. Variances of critical tolerances are continuously tracked, and manufacturing processes are corrected before bad parts can be produced.

A valuable process to perform on a whole consumer product is called the «shake and bake». Every so often, a whole product is mounted on a shake table in an environmental oven, and operated under increasing vibration, temperatures and humidity until it fails. This finds many unanticipated weaknesses in a product. Another related technique is to operate samples of products till they fail. Generally the data is used to drive engineering and manufacturing process improvements. Often quite simple changes can dramatically improve product service, such as changing to mold-resistant paint, or adding lock-washed placement to the training for new assembly personnel.

Many organizations use statistical process control to bring the organization to Six Sigma levels of quality. In a six sigma organization, every item that creates customer value or disasstisfaction is controlled to assure that the total number of failures are beyond the sixth sigma of likelihood in a normal distribution of customers-setting a standard for failure of fewer than four parts in one million. Items controlled often include clerical tasks such as order-entry, as well as conventional manufacturing tasks.

Another engineering discipline is «producibility». Quite frequently, manufactured products have unnecessary precision, production operations or parts. Simple redesign can eliminate these, lowering costs and increasing manufacturability, reliability and profits.

For example, Russian liquid-fuel rocket motors are intentionally designed to permit ugly (though leak-free) welding, to eliminate grinding and finishing operations that do not help the motor function better.

Some Japanese disk brakes have parts toleranced to three millimeters, an easy-to-meet precision. When combined with crude statistical process controls, this assures that less than one in a million parts will fail to fit.

Many vehicle manufacturers have active programs to reduce the numbers and types of fasteners in their product, to reduce inventory, tooling and assembly costs.

Another producibility technique is «near net shape» forming. Often a premium forming process can eliminate hundreds of low-precision machining or drilling steps. Precision transfer stamping can quickly produce hundreds of high quality parts from generic rolls of steel and aluminum. Die casting is used to produce metal parts from aluminum or sturdy tin alloys (they're often about as strong as mild steels). Plastic injection molding is a powerful technique, especially if the part's special properties are supplemented with inserts of brass or steel.

When a product incorporates a computer, it replaces many parts with software that fits into a single light-weight, low-power memory part or microcontroller. As computers grow faster, digital signal processing software is beginning to replace many analog electronic circuits for audio and sometimes radio frequency processing.

On some printed circuit boards (itself a producibility technique), the conductors are intentionally sized to act as delay lines, resistors and inductors to reduce the parts count. An important recent innovation was to eliminate the leads of «surface mounted» components. At one stroke, this eliminated the need to drill most holes in a printed circuit board, as well as clip off the leads after soldering.

In Japan (the land where manufacturing engineers are most valued), it is a standard process to design printed circuit boards of inexpensive phenolic resin and paper, and reduce the number of copper layers to one or two to lower costs without harming specifications.

Mining engineering

Mining Engineering is an umbrella field that involves many of the other engineering disciplines as applied to extracting and processing minerals from a naturally occurring environment.

The need for mineral extraction and production is an essential activity of any technically proficient society. As minerals are produced from within a naturally occurring environment, disturbance of the environment as a result of mineral production is a given. Modern mining engineers must therefore be concerned not only with the production and processing of mineral commodities, but also with the mitigation of damage or changes to an environment as a result of that production and processing.

Engineering disciplines that are closely related to mining engineering are: Civil engineering, Environmental engineering, Geotechnical engineering, Hydraulic engineering, and Electrical engineering.

Specialized areas of mining engineering involve extraction of minerals from underground and open pit mines, underwater mines, seawater, in-situ retorting of rock, and underground gasification.

Petroleum engineering

Petroleum engineering is involved in the exploration and production activities of petroleum at the upstream end of the energy sector. The diverse topics covered by petroleum engineering are closely related to the earth sciences. Petroleum engineering topics include geology, geochemistry, geophysics, oil drilling, well logging, well completion, oil and gas production, reservoir development, and pipelining.

The Society of Petroleum Engineers is the largest professional society for petroleum engineers and is a good source of information. Petroleum engineering education is available at dozens of universities in the United States; primarily in oil producing states. A growing number of international programs offer petroleum engineering.

Petroleum engineers have historically been one of the highest paid engineering disciplines; this is offset by a tendency for mass layoffs when oil prices decline. Petroleum engineering offers a challenging blend of geology, operations, advanced mathematics and the opportunity to risk massive amounts of money. The rewards for successful engineers range from high paying jobs to the opportunities to start oil companies.

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