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Настоящее учебное пособие предназначено для студентов бакалавриата Механико-технологического факультета и рекомендуется к использованию на втором, и на некоторых специальностях, на третьем году обучения в рамках изучения темы «Latest Developments in my Branch of Engineering (ESP)».

Целью пособия является формирование у студентов коммуникативной языковой компетенции в области своей специальности, которая реализуется в различных видах речевой деятельности, как устной, так и письменной. Все тексты и задания связаны с профессиональной подготовкой будущих специалистов и соответствуют государственному образовательному стандарту.

Учебное пособие включает в себя шесть модулей, название каждого из которых соответствует названию определенной специальности факультета и отвечает тематике изучаемого по данному профилю материала. Каждый модуль состоит из двух разделов с системой лексических и грамматических упражнений с учетом словаря и грамматических структур, характерных для подъязыка специальности, а также дополнительных текстов, которые можно использовать для самостоятельной работы студентов и технического перевода по специальности.

Пособие может быть использовано для аудиторной и внеаудиторной работы, в зависимости от целей, поставленных преподавателем.

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MODULE 1

ENERGY – AND RESOURCE-SAVING PROCESSES IN CHEMICAL ENGINEERING AND BIOCHEMICAL TECHNOLOGY

UNIT 1. Environment and Ecology

1.1 Vocabulary

acid rain, n – кислотный дождь
act, n – акт, действие
affect, n – воздействие
best available techniques (BAT); самые лучшие доступные технологии
biodiversity, n – биоразнообразие
complex, a – сложный
concern, n, v – проблема, вопрос, затруднение; касаться, иметь дело с, вызывать беспокойство, тревогу
conservation, n – сохранение, охрана природы
consequences, n – обстоятельства
consumption, n – потребление
contaminate, v – загрязнять
decade, n – декада, десяток лет
degradation, n – ухудшение, понижение
develop, v – развивать, разрабатывать
discharge, n – сброс
discharge of effluents, n – отведение сточных вод;
effect, n – влияние, воздействие, результат
effluent, n – сток, выброс, вытекающий поток
effluent-free pulp mill, n – целлюлозно-бумажный завод без выбросов
environment, n – окружающая среда
environmental, adj – связанный с окружающей средой
fresh water, n – пресная вода

goal, n – цель
global warming, n – глобальное потепление
greenhouse effect, n – парниковый эффект
impact, n – воздействие, влияние, толчок
implementation, n – внедрение, воплощение в жизнь, реализация
issue, n – вопрос, проблема, выход
legislation, n – законодательство
limit, n – предел, норма, ограничение
meet the demands, v – удовлетворять требованиям
preserve, v – сохранять, оберегать, хранить
protect, protection, v, n – защищать, защита
reduce, v – сокращать
regulations, n – нормативно-правовые акты, установленные правила
save; сохранять, накапливать
technological standard, n – технологический стандарт
usage, n – использование
zero wastewater discharge, n – полное прекращение сброса сточных вод, бессточные технологии

1.2. Read and translate the following international words. Pay attention to the stress and the part of speech when translating them:

Baltic (Sea), Commission, conception, conference, coral reefs, chemical, ecosystem, emission, European, genetic, global, harmony, industry, international, metallurgical, modify, practical, tone, total control, tropical, zero.

1.3. Work in pairs. Discuss the following questions:

- What does ecology study?
- What is the environment?
- Why will people's activity have an effect back on them?
- Whose aim is to protect natural things?

1.4. Compare your answers with the information given below:

When we study ecology we study the environment and the way plants, animals and humans live together and affect each other. We can say that the **environment** includes the air, water and land in which people, animals

and plants live, but we can also say that it is everything around us. In our everyday life we live in various environments, e.g. in the countryside, in the streets, at home, in the cinema, on a beach, at a swimming pool etc. These different environments may not seem to be connected, but in fact they are.

Ecology is the study of living things in their natural surroundings, or environment. This is everything, living and non-living, that is around them. Its basic features stay very much the same, e.g. the air that you breathe, but the details are constantly changing.

Ecology investigates how plants and animals, including people, live with and affect each other and their environment. A good starting point is yourself. Notice how you affect your own environment. Anything you do to your environment will have an effect back on you, as well as on every other living thing sharing the environment with you. The connections between all living things stretch into a vast web.

If we compare ecology and environment we understand that these words are sometimes used in the same way although they have different meanings. What's the difference? **Ecology** is the natural relationship; **environment** refers to the places or situations. But 'ecological' and 'environmental' are sometimes used with the same nouns, e.g. an ecological disaster = an environmental disaster. Eco-friendly and environmentally friendly are also used as synonyms for products and methods which do not damage the environment.

People who are concerned about the environment are called eco-warriors (environmental activists). They are often referred to as 'greens', e.g. "Greenpeace" and "Friends of the Earth".

1.5. Translate the following word combinations:

1. contaminate (air, environment, food , ground, ground water)
2. (pollution, earthquake, land use, emission) intensity
3. (three, several, many, a few) decades
4. (ash, gaseous, hydrocarbon, industrial, power plant, smoke) emission
5. air, animal, biological plant, forest, fish and wildlife) protection
6. (effluent, wastewater, industrial, pollutants, radioactive waste, zero wastewater) discharge
7. complex (apparatus, situation, process)
8. (energy, heat, oxygen, water) consumption
9. (ecological, environmental, dramatic) consequences

10. (environmental, to feel great, to cause, to express great public concern over the environment) concern

11. (environmental, forest, land, water, water quality, antipollution, nature protective) legislation

12. current (problems, regulations, marine environment requirements, consequences, legislation)

1.6. Name the verbs from which the following nouns were formed from and translate all the words:

User – ; warning – ; degradation – ; conservation – ; production – ; contamination – ; consumption – ; emission – ; implementation – ; regulations – ; development – ; difference – ; prediction – ; pollution – .

1.7. Read the text:

Environment and Ecology

Environmental issues are at the forefront of the public debate as the human impact on the natural environment continues to grow. Almost every public figure is expected to have opinion in such matters as global warming through the greenhouse effect, acid rain, the environmental impacts, genetically modified crops, the long-term consequences of the loss of biodiversity and the degradation of ecosystems such as coral reefs and tropical forests. Current environmental problems are complex and multifaceted. The need to predict the effects of humanity on the natural world, together with public concern over the environment, have made environment and conservation one of the most important areas of science.

Pulp and paper industry is one of the heaviest users of air and water resources among all industries. In its water intensity it is the fourth after the metallurgical and chemical industries and water power engineering. The production of one tonne of pulp requires 250–300 m^3 of fresh water. In total discharges of contaminated wastewater by industrial enterprises the share of pulp and paper industry exceeds 20 %.

That is why many mills throughout the world are striving to find technologies that could dramatically reduce their fresh water usage. Large consumption of water by the paper industry began to change in the 1960s and 1970s with the implementation of various environmental

regulations which are reflected in such important documents as the Clean Water Act (U.S.), the Clean Air Act (Great Britain, Canada, U.S.), the Recommendations of the Helsinki Commission on the protection of the marine environment of the Baltic Sea area, the Canadian Environmental Protection Act (CEPA) and many other acts which among other things promulgated limits on emissions and discharges that reflected what was technologically feasible and practical at the time.

Another way to save water is zero wastewater discharge. An effluent-free pulp mill was and sometimes is still the dream of the environmentalists and of many engineers and scientists. Research towards this goal has been ongoing for over four decades. During the last few years, the effluent-free pulp mill has been a hot subject of technical conferences and industry trade and research journals. Effluents from the pulp and paper industry have received a great deal of public attention. Today there are many mills in the world that have no effluent flows.

In the Russian Federation the nature protective legislation still differs from that of most foreign countries with the highly developed pulp and paper industry. The development of the industry and the competitiveness of the product made negative effects. In 2002 the Federal Law concerning the environment protection came into effect which for the first time in the country introduced the conception of "Best Available Techniques" – BAT corresponding to that used in all the countries, and the conception of technological standard".

It is absolutely necessary that the production technology and the product be brought into accord with the international standards. Full compliance of the Federal nature protective legislation with the international standards and first of all with those of European Community is of primary importance.

Meeting environmental demands presents some tough challenges for pulp-and-papermakers. They are constantly looking for better ways to make the most of their valuable forest and water resources while preserving the world in which we live. They are much more active than ever developing new technologies to work in harmony with the environment.

at the forefront – на первом плане
multifaceted – многосторонний, многогранный
come into effect – вступить в силу, в действие

bring into accord (with) – приводить в соответствие (с)
compliance – соответствие
make the most (of) – использовать наилучшим образом, максимально
the Clean Water Act (U.S.) – Закон о чистой воде
Canadian Environmental Protection Act (CEPA) – Закон Канады об охране окружающей среды
European Community – Европейское сообщество
challenge – сложная задача

1.8. Find the English equivalents in the text above:

Парниковый эффект, кислотный дождь, гидроэнергетика, биологическое многообразие, коралловые рифы, пресная вода, Закон о чистой воде, Закон о чистом воздухе, морская среда, наилучшая разработанная технология, удовлетворять требования, глобальное потепление, сточные воды, законодательство, бессточный технологический процесс, целлюлозно-бумажная промышленность, охрана (окружающей среды), область науки, действие (влияние, результат), предсказывать (прогнозировать), настоящий (текущий, современный), загрязнять, спасать (беречь, экономить).

1.9. Complete the following sentences:

1. Environmental issues are……
2. Current environmental problems are……..
3. One of the heaviest users of air and water resources among all industries is…
4. The production of one ton of pulp requires…….
5. Large consumption of water by the paper industry began to change in……..
6. Another way to save water is…….
7. The effluent-free pulp mill has been……
8. In the Russian Federation the nature protective legislation still differs from…
9. The production technology and the product should be brought……
10. Meeting environmental demands are constantly looking for……

1.10. Translate the words having the same root paying attention to suffixes, prefixes and other determiners:

intensity – intensive – intensively – intensify

science –scientific – scientist

production – product – productivity – to produce – productive – nonproductive

pollution – will pollute – gaseous pollutant – nonpolluting

best available technique – availability (of water) – unavailable

contaminate – contamination – contaminated atmosphere – industrial contaminant – uncontaminated

a complex device – complexity

to use – user – when using this instrument – by using this instrument – the use of this instrument – the instrument used by them – useful – useless – usage

environment – environmental – environmentalist

1.11. Pay special attention to the following "false friends". Mind that you can choose the right meaning of the word only while reading the text and trying to understand it. Use the dictionary.

Human, *a*; public, *a*; public figure, matter, *n*; effect, *n*; degradation, *n*; complex, *a*; concern, *n,v*; production, *n*; technology, *n*; dramatic(al)ly; regulations, *n*; act, *n*; protection, *n*; decade, *n*.

1.12. Match the words with the similar meaning.

A	B
effect	decrease
issue	ten years
impact, *n*	purpose
current, *a*	conserve
reduce	problem
goal	much
decade	pollute
a great deal of	technology
receive	influence
preserve, *v*	present, *a*
contaminate	consequence
technique	get

1.13. Revise different meanings of the word *that (those)* and translate.

A) 1. technologies *that* could reduce fresh water usage;

2. limits on emissions and discharges *that* reflected what was technologically feasible and practical at the time

3. There are many mills *that* have no effluent flows.

4. Our legislation still differs from *that* of most countries; the conception of BAT corresponding to *that* used in all the countries.

5. It is necessary *that* the production technology and the product be brought into accord with the international standards and with *those* of European Community is very important.

B) The flux (поток) in scheme (схема) B is lower than *that* in scheme A. Toxicity of TMP effluents is comparable to that of groundwood (древесная масса) effluents.

1.14. Translate the following word combinations with *"free (of)".* Pay attention to different ways of translation.

*Model: This compound is **free of** impurities.*

1. *Это вещество **не содержит** примесей.*
2. *В этом веществе **отсутствуют** примеси.*
3. *Это вещество **свободно от** примесей.*
4. *acid free – **не содержащий** кислоты.*

a) free of sulphur/nitrogen/suspended solids/chlorine admixtures

b) a trouble-free operation, a chlorine-free process, elemental, chlorine-free bleaching (отбелка) pollution-free environment

c) oxygen-free, alkaline-free, moist-free, sulfur-free, effluent-free mill, wood-free papers

d) 1. Biocides (биоциды) should be free of organic solvents and heavy metals and contain no dioxins or furans.

2. The fact that recycling operations are odor free allows mills to be located in metropolitan areas that are close to both the raw material supply and the consumer.

3. The fibers were immersed (погружать) in the cell-free extract, prepared as described above.

4. This gas is free of hydrogen chloride and other acidic gases.

5. An effluent-free pulp mill is the dream of environmentalists and many engineers and scientists.

UNIT 2. Industrial Waste

2.1. Study the words and word combinations.

activated carbon, n – активированный углерод
activated sludge, n – активированный ил
advanced wastewater treatment, n – усовершенствованная очистка сточных вод
alternative, n – альтернатива, вариант
ammonia stripping, n – отгонка аммиака
availability, n – доступность
by-product, n – побочный продукт
capital costs, n – капитальные затраты
clarifier, n – очиститель, осветлитель
contaminant, n – загрязнитель, посторонние примеси
contaminate, v – загрязнять
equalize, v – уравнивать, уравновешивать
float, v – держаться на поверхности
fluctuation, n – колебание, неустойчивость
in addition (to) в дополнение к
Municipal plant, n – городская станция очистки сточных вод
objective, n – цель
operational costs, n – расходы, затраты на эксплуатацию
pretreatment, n – предварительная обработка, предочистка (сточных вод)
primary treatment, n – первичная очистка (сточных вод)
receiving water, n – приемник очищенных сточных вод
recirculate, v – повторно пропускать через циркуляционную систему, рециркулировать
recover, v – восстанавливать
reduction, n – сокращение, уменьшение
secondary treatment, n – вторичная очистка
segregate, v – изолировать, отделять
separate adj отдельный, раздельный
short-term (storage), n – кратковременное хранение
sludge disposal, n – удаление осадка
storage, n – хранение
strength, n – прочность, сила

substitute, v – заменять
tertiary treatment, n – доочистка, третичная очистка (сточных вод)
treat, n – обрабатывать
trickling filter, n – бактериальный, биологический фильтр
wastewater load, n – загрузка сточных вод

2.2. Read and translate the following international words. Pay attention to the part of speech when translating them.

scheme [skiːm] n
limit n, v [ˈlɪm.ɪt]
function n, v [ˈfʌŋk.ʃən]
nitrification n [ˌnaɪ.trə.fəˈkeɪ.ʃən]
ozone n [ˈəʊ.zəʊn]

2.3. Form "attribute chains" instead of word combinations with the preposition "*of*". Translate them.

Model: the concentration of the solids – the solids concentration
The quantity of wastewater; the bottom of a tank; availability of land; maintenance of new cells; the surface of the packing; characteristics of the wastewater; disposal of sludge; the treatment of industrial wastes; the process of wastewater treatment; primary reduction of solids; biodegradability of waste; a portion of the thickened biomass; removal of phosphorus compounds; removal of dissolved solids.

2.4. Read and translate the text.

Industrial Wastes

Since industrial wastes have a broader range of characteristics than domestic wastes, they are treated by a wider variety of processing schemes. Industrial wastes are more likely to contain toxic and non-bio-degradable components that require physical-chemical instead of biological treatment. In some cases, industrial wastes are discharged to a municipal plant directly or after limited pretreatment. In other cases, they are treated in a separate plant designed for the specific wastes. The wastewater load in an industrial plant can often be reduced by recirculating slightly contaminated water, segregating low and high strength wastes for separate

treatment, substituting less polluting chemicals or process, and recovering selected contaminants as byproducts or for reuse.

Design of a wastewater treatment process for industrial or domestic wastes depends upon many factors, such as characteristics of the wastewater, required effluent quality, availability of land, and options for sludge disposal. In addition to capital and operating costs, stability, reliability, and flexibility are important considerations when selecting a process from the various alternatives.

Wastewater Treatment Processes

The main objectives of conventional wastewater treatment processes are reduction of biochemical oxygen demand, suspended solids, and pathogenic organisms. In addition, it may be necessary to remove nutrients, toxic components, non-bio-degradable compounds, and dissolved solids. Since most contaminants are present in low concentrations, the treatment processes must be able to function effectively with dilute streams. Many operations are used to purify water before discharge to the environment.

Classification of processes

Conventional wastewater treatment processes are often classified as pretreatment, primary treatment, secondary treatment, tertiary treatment and sludge disposal.

Pre-and Primary Treatment

Pretreatment processes are used to screen out coarse solids, to reduce the size of solids, to separate floating oils and to equalize fluctuations in flow or concentration through short-term storage. Primary treatment usually refers to the removal of suspended solids by settling or floating.

Sedimentation is currently the most widely used primary treatment operation. In a sedimentation unit, solid particles are allowed to settle to the bottom of a tank under quiescent conditions. Chemicals may be added in primary treatment to neutralize the stream or to improve the removal of small suspended solid particles. Primary reduction of solids reduces oxygen requirements in a subsequent biological step and also reduces the solids loading to the secondary sedimentation tank.

Secondary Treatment

Secondary treatment generally involves a biological process to remove organic matter through biochemical oxidation. The particular biological process selected depends upon such factors as quantity of wastewater, biodegradability of waste, and availability of land. Activated sludge reactors and tricking filters are the most commonly used biological processes.

In the activated sludge process, wastewater is fed to an aerated tank where microorganisms consume organic wastes for maintenance and for generation of new cells. A portion of the thickened biomass is usually recycled to the reactor to improve performance through higher cell concentrations. Trickling filters are beds packed with rocks, plastic structures, or other media. Microbial films grow on the surface of the packing and remove soluble organics from the wastewater flowing over the packing. Excess biological growth washes off the packing and is removed in a clarifier.

Tertiary Treatment

Many effluent standards require tertiary or advanced wastewater treatment to remove particular contaminants or to prepare the water for reuse. Some common tertiary operations are removal of phosphorus compounds by coagulation with chemicals, removal of nitrogen compounds by ammonia stripping with air or by nitrification-denitrification in biological reactors, removal of residual organic and color compounds by adsorption on activated carbon, and removal of dissolved solids by membrane processes.

The effluent water is often treated with chlorine or ozone to destroy pathogenic organisms before discharge into the receiving waters.

2.5. Mark each statement as T (True), F (False) or N (Not Mentioned).

1) Industrial wastes have a narrower range of characteristics than domestic wastes.

2) Recirculating slightly contaminated water is one of the ways of reducing wastewater load in an industrial plant.

3) The design of water purification processes is based on empirical formulas and procedures.

4) Availability of land is not an important factor in the design of a wastewater treatment process for industrial or domestic wastes.

5) The primary goal of conventional wastewater treatment processes is removing nutrients.

6) Pretreatment, primary treatment, secondary treatment, tertiary treatment and sludge disposal are among widely-used wastewater treatment processes.

7) The pollutant levels in wastewater are often characterized by solids content and by biochemical oxygen demand (BOD).

8) Primary treatment usually refers to the removal of organic matter through biochemical oxidation.

9) The particular biological process selected depends upon the only factor: biodegradability of waste.

10) Most of the effluent standards d o n ' t require tertiary wastewater treatment to remove particular contaminants or to prepare the water for reuse.

2.6. Mind the stress when pronouncing the verbs. Translate them into Russian.

The general rule here is: these verbs have the stress on the third syllable from the end.

Contaminate, condensate, segregate, separate, equalize, neutralize, recirculate, fluctuate, precipitate, approximate, ultimate

2.7. Pronounce the following nouns and adjectives having the suffix – *ate*. Mind that the suffix – *ate* in nouns and adjectives should be pronounced [-it]. Translate the words.

Model: gradu**ate v** [-eit]

Graduate, separate, estimate, approximate, coordinate, precipitate, ultimate.

2.8. Name the verbs the following nouns were formed from. Translate all of them.

Fluctuation, storage, floating, settling, generation, coagulation, adsorption.

2.9. Match the words of similar meaning.

1 portion	a) lower
2 particular	b) purpose
3 option	c) generally
4 primary	d) amount
5 reduce	e) fraction
6 quantity	f) mainly
7 commonly	g) specific
8 largely	h) main
9 objective n	i) choice

2.10. In what meaning are the following words used in the text?

Since, through, performance, packing, film

2.11. Find in the text "Industrial Wastes" and translate:

a) one sentence with the Complex Subject (Subjective Infinitive Construction);
b) two sentences with the Gerund;
c) seven sentences with the Infinitive of purpose;
d) two sentences with Participle II used as an attribute;
f) two sentences with Participle I.

2.12. Define the function of Present Participle I and translate the word combinations and sentences:

1. a. While selecting a method for…
   b. they are selecting the only possible method for…
   c. a researcher selecting the only possible method for…
2. a. We are classifying conventional wastewater treatment processes.
   b. when classifying conventional wastewater treatment processes…
   c. specialists classifying the processes
3. a. biochemical oxidation removing organic matter.
   b. biochemical oxidation is removing organic matter.
   c. removing organic matter biochemical oxidation creates conditions for…
4. a. Pretreatment processes are reducing the size of solids and screening out coarse solids.

b. Pretreatment processes reducing the size of solids and screening out coarse solids.

c. Reducing the size of solids and screening out coarse solids they carry out the wastewater treatment at the pretreatment stage.

5. a. Treating industrial wastes a wide variety of processing schemes is used.

b. A wide variety of processing schemes is treating industrial wastes.

c. a wide variety of processing schemes treating industrial wastes

SUPPLEMENTARY READING

TEXT 1

Wastewater Treatment

To meet current and proposed water pollution standards, it is often necessary to use newer treatment operations and to improve the efficiency of conventional processes. Since technology in the water treatment field is evolving rapidly, an enhanced knowledge of fundamentals will permit the engineer or scientist to adapt more readily to new processes. In many cases, the design of water purification processes is based on empirical formulas and procedures. Since these empirical methods are often inadequate for interpreting data and optimizing the process, a good understanding of basic principles is required.

The treatment of water and wastewater requires a variety of techniques and processes involving unit operations, transfer processes, thermodynamics and reaction kinetics.

The United States, as an industrial nation has a tremendous appetite for water. In 1970 about 370 billion gal per day (bgd) were withdrawn from all sources for use, a rate equivalent to 1800 gallons per person per day. Hydroelectric plants consumed an additional 2800 bgd. Of the 370 bgd industry withdrew over one-half and irrigation used most of the remainder. Consumption of water, which is water incorporated into a product or lost to the atmosphere, was 87 bgd in 1970 or about 24 % of the water withdrawn. Irrigation consumed 84% of the 87 bgd, mainly through evaporation to the atmosphere.

Ground water furnished 19 % of all water withdrawn, fresh surface water 67 % and saline surface water 14 %. The supply of water is unevenly distributed due to hydrologic features in the different sections of the United

States. Since withdrawals are around 72 % of the 1980 supply, future water supplies will have to rely more heavily on reuse and recycle.

Since industry is the largest user of water, future industrial growth will be restricted largely to regions having adequate water supplies. The major industrial users of water are the primary manufacturers of metals, chemicals, paper, petroleum, and food products. The pollutant levels in wastewater are often characterized by solids content and by biochemical oxygen demand, (BOD), which is a measure of the dissolved oxygen used by microorganisms in biological oxidation of organic matter. The total biochemical oxygen demand of aqueous industrial wastes is three times the total BOD of wastes entering municipal wastewater treatment plants. Over 90 % of the industrial BOD is generated by the chemical, paper, food, and petroleum industries. The primary metals industry together with these four industries contribute 90 % of the solids entering industrial wastewater. The total solids entering sewage treatment plants from domestic wastes are less than one half of the total solids in industrial wastes. It is apparent that heavier industrial use of the available water must be accompanied by greater treatment to ensure that the levels of toxic chemicals do not accumulate and become harmful.

As our standard of living advances, our demand for water accelerates. We have to meet the needs of an increasing world population by irrigating more of the unproductive areas and fulfilling the demands for an even greater industrial output. These needs require a stewardship (забота) of our water resources to preserve water quality through waste treatment and to ensure adequate quantities through recycle.

TEXT 2

Sedimentation, Thickening and Flotation

Sedimentation is the removal of solid particles from a suspension by gravitational settling. Sedimentation basins are often referred to as either clarifiers or thickeners. If the main purpose of the operation is to produce an effluent stream with low suspended solids, the vessel is usually called a clarifier. If the major concern is the production of a concentrated suspension, the vessel is normally called a thickener. The terms clarifier and thickener are often used interchangeably in describing settling tanks for effluent streams from activated sludge reactors. Since both clarification and

thickening occur in any sedimentation basin, both functions should be considered in the design.

In water treatment plants, sedimentation is used to remove readily settleable particles, flocculated or coagulated impurities, and precipitated impurities from softening operations. In wastewater treatment plants, sedimentation is applied to a variety of organic and inorganic solids from raw or treated wastes. Primary settling tanks are used to remove solids from the waste stream entering the plant. Secondary settling tanks handle the solids in the effluent from a biological reactor. Proper design of the secondary settling tank is especially critical in conventional waste treatment plants. The performance of a biological reactor depends upon the concentration of active biological solids in the reactor. Most of these solids are usually provided by recycle underflow from the sedimentation vessel. A recycle stream with a high concentration of settled solids enhances the efficiency of the reactor.

Classifications of settling

The settling characteristics of suspended particles depend upon the nature of the particles, their concentration, and the conditions in the settling device. Settling behavior is often classified into four separate categories. In class 1 clarification, the suspension is dilute and the particles have little or no tendency to adhere upon collision. Each discrete particle has a constant settling rate that is independent of the other particles. A grit chamber for heavy granular materials may approach this type of clarification. In class 2 clarification, the suspension is again dilute but some of the particles coalesce or flocculate during the settling period. Since the larger particles formed by agglomeration have higher settling velocities, the rate of settling changes with time. The wastes entering primary settling basins frequently exhibit class 2 behavior.

With cohesive particles at higher solids concentration, class 3 settling is observed in which the suspension settles as a mass with a distinct interface between sludge and clarified liquor. Forces between particles are sufficiently strong to maintain roughly the same relative position of particles as they settle. Since the particles in the structure have little tendency to move past one another, a clear line of demarcation is established between solids and clear fluid. Secondary settling tanks usually operate in this zone settling regime. In practice, some solids always escape in the clarified effluent because of hydrodynamic factors.

As the floc structure builds up from the bottom of the vessel, each layer of solids provides a degree of mechanical support to the layers above. Since the weight of the solids is no longer supported by hydraulic forces alone, the solids are objected to a compressive stress which compacts the floc structure. When the floc provides support, it is in a compression regime (class 4). The solids concentration in the compression zone is related to the sludge depth and solids detention time in this zone.

TEXT 3

Sludge Treatment Processes

Since direct land or water disposal of raw wastewater sludges is rarely feasible or acceptable, sludge treatment is usually necessary to reduce its volume and to make it less offensive. The most common sludge processing methods have been grouped in several categories according to function and the categories are presented in the usual sequence found in treatment plants.

Selection of treatment processes for sludges depends upon the nature of the sludge, environmental factors, and ultimate disposal options. The various alternatives should be examined to select the most economical sequence of operations for a given location. The major processes are concentration, stabilization, conditioning, and dewatering.

Aeration and mass transfer

Mass transfer is an important consideration in many wastewater treatment systems. In order to carry out chemical or biological reactions, it is necessary to transfer substances into or out of the wastewater, as well as to move them adequately within the water to control concentration differences. The material transferred can be as diverse as gases, liquids, ions, charged colloids, or suspended solids. However, the rate at which these substances are transferred is the important consideration and is the primary concern of the field of mass transfer. The principles of mass transfer do not vary with each treatment process.

Sludge disposal

Wastewater treatment processes generate significant quantities of sludge from suspended solids in the feed biomass generated by biological operations and precipitates from added chemicals. Selection of a treatment

sequence for sludges depends upon the nature of the sludge, environmental factors, and ultimate disposal options.

Concentration operations, such as gravity or flotation thickeners, increase the solids concentration and achieve a significant reduction in sludge volume. Stabilization operations, such as anaerobic digestion, convert sludges into a less offensive form in terms of odor, degradability, and pathogen content. Sludge conditioning by chemicals or heat improves rates of dewatering. In dewatering operations, the water content of sludges is reduced to a level where they can be handled as damp solids. Vacuum filtration centrifugation and sand beds are the most common dewatering methods. Thermal processes, such as heat drying and incineration, are used to either dry the sludge or to oxidize its organic content. Residual sludge and ash from sludge treatment processes must be disposed of in the ocean or on land. Some of the options for ultimate disposal on land are landfill, land reclamation, and crop fertilization.

Step aeration

Unlike the conventional plant, the step aeration system introduces the feed wastewater at several points along the aeration tank. This feed method, which might be more properly called step loading, keeps the process loading factor U, and the oxygen demand in the tank more uniform than the conventional process. Step aeration plants are usually designed for the same solids loadings but higher volumetric loadings than the conventional plant, because of the increased biological efficiency made possible by a more uniform waste concentration.

In the conventional process the solids concentration is nearly constant along the length of the reactor. In the step aeration process, it decreases sharply after each point of influent. Assume for example that a step aeration plant is running with a recycle solids concentration of 10,000 mg/l, a return sludge rate R, equal to 25%, and influent feed locations at the beginning of the tank and at the middle. The solids concentration in the first half of the tank would be 3333 mg/l while in the second half it would be 2000 mg/l, giving an average tank concentration of 2667 mg/l. Although the average solids concentration in the reactor is higher, the effluent solids concentration is the same as the conventional system allowing the conventional final clarifiers to be used.

MODULE 2

TRANSPORT AND TECHNOLOGICAL MACHINE SERVICE

UNIT 1. The Profession of a Car Mechanic

Vocabulary

accuracy, n – точность; правильность; тщательность
to assume, v – предполагать; допускать; притворяться
assumption, n – предположение. прогноз
Byzantine maze, n – Византийский лабиринт
to commence work, v – приступить к работе
cranky –расшатанный (о механизме); неисправный
crucial, adj –решающий (о моменте, опыте); ключевой;
dealership, n – посредничество, местное представительство; агентство (фирмы)
disassembly, n – разборка; демонтаж; размонтирование
to examine, v – проверять; исследовать; изучать;
fading, n – затухание; увядание
hazardous, adj – рисковый, опасный,вредный
millennia (pl от millennium), n – тысячелетие
plumbing, n – сантехнические работы; водопроводная система; прокладка труб
tool box, n – ящик для инструментов
vehicle, n – транспортное средство

1.1. Say if you chose your future profession yourself or you followed some-body's advice. What arguments did you take into consideration?

1.2. Read the text and try to understand the meanings of the underlined words and word combinations.

TEXT 1. Car mechanic

A car mechanic (or car mechanic in British English and motor mechanic in Australian English) is a mechanic who specializes in automobile maintenance, repair, and sometimes modification. The mechanic may be knowledgeable in working on all parts of a variety of car makes or may specialize either in a specific area or in a specific make of car. In repairing cars, their main role is to diagnose the problem accurately and quickly. They often have to quote prices for their customers before commencing work or after partial disassembly for inspection. The mechanic uses both electronic means of gathering data and their senses. Their job may involve the repair of a specifi c part or the replacement of one or more parts.

Basic vehicle maintenance is a fundamental part of the mechanic's job in some countries. Preventative maintenance is also a fundamental part of the mechanic's job, but this is not possible in the case of vehicles that are not regularly maintained by the mechanic. One misunderstood aspect of preventative maintenance is "scheduled replacement" of various parts, which occurs before failure to avoid far more expensive damage. Because this means that parts are replaced before any problem is observed, many vehicle owners will not understand why the expense is necessary.

With the rapid advancement in technology, the mechanic's job has evolved from purely mechanical, to include electronic technology. Because vehicles today possess complex computer and electronic systems, mechanics need to have a broader base of knowledge than in the past. The term "automechanic" is being used less and less frequently and is being replaced by the title "auto-motive service technician". Fading quickly is the day of the mechanic, who needed little knowledge of today's computerized systems. Most automobile dealerships now provide sophisticated diagnostic computers to each technician, without which they would be unable to diagnose or repair a vehicle.

1.3. Find the passages in the text above for which the next word combinations would be the key words:

1. car mechanic's job
2. electronic technologies
3. vehicle maintenance

1.4. Answer the questions.

1. What is a car mechanic called in Australian English?
2. What are the main functions of the car mechanic?
3. Does the mechanic's job include electronic technology?
4. Do most automobile dealerships now provide sophisticated diagnostic computers to each technician?

1.5. Match translations.

a) preventive maintenance	1) диагностировать
b) maintenance	2) профилактическое обслуживание
c) repair	3) поломка, отказ
d) to diagnose	4) замена
e) partial disassembly	5) ремонт
f) replacement	6) обслуживание
g) failure	7) частичная разборка

1.6. Put in prepositions where necessary.

1. A car mechanic specializes … automobile repair.
2. Mechanics should be knowledgeable in working … all parts of cars.
3. This job involves the replacement … some parts.
4. Nowadays mechanics need to have more knowledge than … the past.
5. Most dealerships provide diagnostic computers … each technician.

1.7. Match the words to the definitions.

A	B
1 misunderstand	a) progress or development in your job, level of knowledge etc
2 occur	b) well-informed
3 advancement	c) very often or many times
4 frequently	d) fail to understand someone or something correctly
5 knowledgeable	e) happen or exist in a particular place or situation

1.8. Give some reasons for your professional choice. You may use the following phrases: to be fond of automobiles; to be well-paid; to give prospects for career growth; to involve electronic technology; to require much knowledge.

Example: I chose this profession because I like machinery.

1.9. Read the text and try to understand the meaning of the underlined words and word combinations.

TEXT 2

Car mechanics repair and maintain cars. Some mechanics work on all parts of any car, while others specialize in one area or on one type of car. The most challenging aspect of car repair is often the mechanic's favorite part: diagnosing the problem. Speed and accuracy in diagnosis and quoting prices to the customer are crucial if the mechanic intends to keep long-term clients. The mechanic examines the engine while it is running (if possible) to see if his initial assumptions are correct.

Electronic diagnostic equipment is useful but the good mechanic can tell a lot by using eyes, ears, a nose as he searches for problems. Sometimes he repairs parts, but if the part is worn or damaged, he replaces it. Some mechanics compare their field to that of the physician, because most people come to them only when their car is in dire straits. When people come in for an automotive check-up, mechanics often replace worn parts before they become hazardous to the driver, even though drivers can be suspicious of mechanics who recommend the replacement of parts that haven't stopped functioning.

The best mechanics have mastery of a wide variety of integrated skills: electrical systems (a car's wiring is more complicated than an average home's); computerized electronics (a television set seems simple by comparison); fuel system (a car's "plumbing" is a Byzantine maze of tubes). Car mechanics proudly compare themselves to doctors, since they mainly see people with complaints; but whereas the human body and its problems have remained essentially unchanged for millennia, the designs of cars change every year. As a result, the job requires more preparation than ever before. More and more, cars are controlled by electronic instruments, so mechanics are using computers constantly. "Computers have become as much a part of the tool box as wrenches," said one mechanic.

Most car mechanics start in an automotive repair school, then work full time at the same dealerships. They read trade papers daily to know about of changes and trends in their industry. As they gain experience they can move into higher-paying, specialized positions. They can also rise to the ranks of supervisor or manager, particularly if they have strong interpersonal skills to calm cranky customers who are displeased by high service bills and inconvenience.

1.10. Using the information from the text, make up the list of operations which car mechanics must perform. Write them down into your exercise-books.

1.11. Answer the following questions.

1. Which of the operations (exercise 1.10) can you manage?
2. Do you agree that "electronic diagnostic equipment is useful but the good mechanic can tell a lot by using eyes, ears, a nose as he searches for problems". Explain your point of view.
3. Why do car mechanics compare themselves to doctors? What is similar and what is different in their work?
4. What is the way car mechanics can move into higher-paying positions?

1.12. Read "th" as [θ] or [ð] in these words.

[θ]	[ð]
lengh	other
thanks	than
think	their
thin	that
worth	then
theme	with
through	though

1.13. Match translations.

a) diagnosis	1) топливная система
b) long-term clients	2) изношенные детали
c) examine	3) диагностика
d) electronic diagnostic equipment	4) постоянные клиенты

e) worn parts	5) осматривать
f) replace	6) электронное оборудование для диагностики
g) mastery	7) заменить
h) maintain	8) мастерство
i) fuel system	9) обслуживать
j) wrench	10) гаечный ключ
k) interpersonal skills	11) коробка с инструментами
l) tool box	12) навыки межличностного взаимодействия

1.14. Choose from the list below characteristics, which you consider necessary in your profession, add others if necessary.

Accurate, tolerant, patient, sociable, good-mannered, exact, cautious, attentive, hardworking, scrupulous, sharp, widely-read, competent, organized, impulsive, impatient, balanced.

1.15. Read the information below, agree or disagree. Prove your point of view.

Car mechanics can rise to the ranks of supervisor or manager, particularly if they have strong interpersonal skills to calm cranky customers who are displeased by high service bills and inconvenience.

1.16. Name positive and negative aspects of your profession.

Example: This job is well-paid, but it requires significant physical efforts.

1.17. Work in pairs. Make up a dialogue about positive and negative aspects of your profession, using the phrases:

On the one hand… but on the other… (С одной стороны…, а с другой…)

I can't agree… (Я не могу согласиться...)

As far as I know … (Насколько я знаю...)

You are right but… (Вы правы, но…) At the same time … (В то же время…)

Quite the opposite… (Совсем наоборот...)

I don't think so … (Я так не думаю…)

UNIT 2. Car Repair and Maintenance

Vocabulary

to adjust, v – настраивать, регулировать, устанавливать
to be jammed – заклинивать
dipstick, n – щуп для измерения уровня (жидкости)
engine, n – двигатель
air-cooled – engine двигатель с воздушным охлаждением
2-stroke engine, n – двухтактный двигатель
internal combustion engine, n – двигатель внутреннего сгорания
petrol engine, n – бензиновый двигатель
water-cooled engine, n – двигатель с водяным охлаждением
fault, n – недостаток; дефект, ошибка, неисправность
flat, adj. – плоский
flat battery – разрядившаяся батарея
fuel, n – топливо
fuel pipe, n – топливопровод;
to maintain, v – обслуживать, содержать в исправности, поддерживать в хорошем состоянии
petrol pump, n – бензонасос
plug, n –штепсель
to repair, v – чинить
to replace, v – заменять, замещать
to require, v – требовать
requirement, n – требование
to meet requirements – соответствовать требованиям
spark, n – искра
spark plug, n – свеча зажигания
steering, n – рулевое управление
steering wheel – рулевое колесо
timing belt, n – зубчатый ремень привода
tyre, n – шина
tune- up – регулировка
schedule, n – расписание. распорядок
to wax, v – натирать воском, парафинировать
wear, n – износ
wheel, n – колесо
worn – изношенный

2.1. Say what the preventive maintenance includes. Make the list of tips how to help the car to last longer.

2.2. Read the text below and complete your list of tips with the information from the text.

Few basic car maintenance tips

Preventive maintenance is important to keep your car safe. With proper care your car will last longer and some of the possible problems can be avoided. Well-maintained car is not only safer, it's also more economical and produces less pollutions. If the car is well-maintained, you can expect higher price when you decide to sell it.

Regular oil changes are very important to keep your engine in a good shape. Wash your car regularly, wax it once in a while to keep the car body shiny and free from corrosion. Take care of any minor concerns as soon as you can, so it won't cause serious problems and an expensive repair later. Avoid overheating the engine.

Changing spark plugs, air filter, timing belt and other items according to maintenance schedule may save you from costly repairs. Use only original parts.

2.3. Answer the following questions.

1. Preventive maintenance is important to keep the car safe, isn't it?
2. Why should we take care of any minor concerns as soon as possible?
3. What a driver or a car mechanic should do to keep the engine in a good shape?
4. Do we need to undertake anything if the fuel filter is dirty?
5. What fault device can cause loss of engine power and increased fuel consumption?

2.4. Give the English equivalents to the word combinations and phrases.

Профилактическое обслуживание, время от времени, уберечь кузов от коррозии, вызывать серьёзные проблемы, содержать двигатель в хорошем состоянии, машина прослужит дольше, можно избежать проблем.

2.5. There are certain vehicle components that need periodical replacement. Make up sentences to explain what damages the faulty device can cause, using the information from the table.

Example: Dirty fuel filter may cause engine stalling and loss of engine power.

Device	Damage the faulty device can cause
dirty fuel filter	engine stalling and loss of engine power
dirty air filter	loss of engine power, increased fuel consumption, air flow sensor failure, etc.
old engine coolant	loses its anti-corrosive and other characteristics and may cause water pump to fail
spark plugs	spark plugs replacement can signifi cantly improve the engine performance
timing belt	cause serious engine damage, especially if it's a diesel engine
fuel injectors	a problem with fuel consumption

2.6. Read the text and fill in the gaps with the words and word combinations: *pressure, plugs, filter, injectors, tune-up, oil, gas, warmed up.*

Few tips how to improve emission test results

– Change the engine … before testing. For old or high mileage car (автомобиль с большим пробегом) using thicker oil may help.

– Change the spark … and the air … if you changed them a long time ago. – Complete … may be an option for older cars.

– Flushing (промывание) the fuel … usually helps. Before the test:

– Check and adjust a tyre … .

– Fill the car with premium … .

– Make sure, the engine is fully … before test.

2.7. Read the following text and fill in the gaps with the words below.

Level, replace, plugs, adjust, forwards, faults, start, fill, clean, recharge, broken, repaired, replaced.

Finding a fault in a car

If your car doesn't … in the morning, you should check three things first: the battery, the fuel … and the spark … . It is easy to repair these … . If the battery is flat, you should … it. If this doesn't work, you should … it. If the petrol tank is empty, … it up. If the spark plugs are dirty, … them, and if the gap in a spark plug is too narrow or too wide, … it to the correct width.

If your car doesn't start, the petrol pump may be …, or the fuel pipe may be blocked. If the pump is broken, it must be … or replaced. If the fuel pipe is blocked, take it off and unblock it.

If there is a loud CLICK! When you turn the key, the starter motor may be jammed. If it is, you can try to release it by pushing the car … and backwards (in 2nd gear). If the car still doesn't start, the starter motor should be repaired or … .

2.8. Use the information from the text to complete the dialogue. Act it out.

Client: Could I ask you for advice? You see, my car doesn't start in the morning. What should I do?

You: … .

Client: But I checked the battery yesterday. It was flat. I tried to recharge it, but it was still flat. What do I do next?

You: … .

Client: If the gap in a spark plug is too narrow, how to adjust it? You: … .

Client: How do you know that the starter motor might be jammed? You: … .

Client: How can I repair this fault? You: … .

Client: But I pushed the car forwards and backwards, the starter still didn't work.

You: … .

Client: Thank you. You were very helpful.

2.9. Speak about the role of preventive maintenance in keeping the car in a good shape.

2.10. Read the following text and find the English equivalents to the word combinations below.

Пополнить его, на отметке «Полный», дайте маслу стечь, щуп для измерения уровня моторного масла, вытрите его.

How to check the oil level

Stop the engine. Wait for a while to let the engine oil pour down to the oil pan. Pull the engine oil dipstick, usually it has a bright handle saying "engine oil".

Wipe it off with a clean rag or tissue. Then insert it back all the way down into its place.

Now, pull the dipstick again and check the oil level. Normally it should be at "FULL" mark. You can see that it's a bit lower. It's not a big problem yet, but it's better to top it up.

2.11. Arrange the sentences in the correct order to consult your client how to top up the engine oil.

1. Wait for a minute to let the oil pour down.
2. Add a little amount of the oil.
3. It would be better to add the same type and brand of the engine oil as you already have in the engine.
4. Don't forget to install the dipstick back and close the oil filler cap when you finish.
5. Check the oil level again with the dipstick.
6. If it's still low, add some more. But don't overfill it.

2.12. Depending on the colour of the oil it is necessary to undertake this or that action. Fill in the table, using the expressions below.

The colour of the oil	Action needed
a) too black	
b) white (coffee with milk colour)	
c) slightly-brown	
d) dark-brown, but still transparent	

1. it's O.K.
2. it's definitely time to change it

3. it's admissible but it's better to change it soon

4. it means the engine coolant mixes with the engine oil because of some internal engine problem

2.13. Read the text and restore the word order in the underlined word combinations.

How to check automatic transmission fluid

Place your car at a level surface and parking engage the brake. Start the engine. Set transmission shifter in "P" (Park) position, and let the engine idle. On some cars this procedure may be different, check the manual owner's (руководство пользователя) for details.

Pull the transmission dipstick. Wipe off it with a clean lint free rag. Then insert it back carefully all the way down into its place.

Pull again and check level the fluid. If the engine is cold, it should be within "COLD" marks. If the car was driven and is fully warmed up, the level should be at the upper end of mark the "HOT". If it's just a little bit lower I wouldn't worry about it. Otherwise I'd top it up. Check the fluid condition also. If it's too black and dirty with burnt smell – your transmission is not going to last. Normally it clean should be and transparent. The new fluid comes red. Over the time it becomes brownish. If it is brown, check your owner's manual, may be it's time change to it. Some manufacturers require to change the transmission fluid at 30,000 or 50,000 miles. Others specify that you never have to change it – check what's your car owner's manual says.

2.14. Arrange the sentences in the correct order to consult your client how to top up the transmission fluid.

1. Recheck the level again.

2. It's very important to use only specified transmission fluid – check your owner's manual or simply visit your local dealer, they always have proper transmission fluid in stock.

3. Add a small amount of the fluid through the dipstick pipe.

4. Do not overfill, it also may cause problems with your transmission.

5. Wait for a few minutes – let the fluid flow down.

2.15. Low coolant level will cause engine overheating, which may cause serious damage to the engine. Depending on the level of the engine coolant it is necessary to undertake this or that action. Look at the picture and fill in the table, using the expressions below:

The level of the engine coolant	Action needed
a) coolant level is lower than "LOW" mark	
b) coolant level is between "LOW" and "FULL" marks in the coolant overflow tank	
c) there is no coolant in overflow	

1) It's OK
2) Top it up
3) Have your car inspected in the garage, possibly there is a coolant leak

2.16. Make up a dialogue in which a car mechanic consults a client on how to check the oil level.

SUPPLEMENTARY READING

TEXT 1

1. Match the translation:

mechanical engineer	a. долгий срок службы
to deal (with)	b. запустить в массовое производство
designing cars	c. подвергать испытаниям
to put into mass production	d. плавное сцепление
long service life	e. отвечать современным требованиям
driving safety	f. иметь дело (с кем-л., чем-л.)
to meet up-to-date demands	g. надежные тормоза и рулевое управление –
smooth-acting clutch	h. безопасность езды (вождения)
silent gearbox	i. бесшумная коробка передач
dependable brakes and steeringsystem	j. инженер-механик
to subject to tests	k. конструирование автомобилей

2. Translate into Russian:

mechanical, mechanism, specialist, industry, phase, technology, process, laboratory, test, fact, automobile, engineer, method, principle, corrosion, type, material, comfortable.

3. Read the text:

AUTOMOBILE PRODUCTION

1. Specialists in automobile industry deal with designing and manufacturing cars, so they should know that the production of the automobile comprises the following phases:

Designing,

Working out the technology of manufacturing processes,

Laboratory tests,

Road tests.

Mass production (manufacturing).

2. Why is it necessary to know all these facts?

It is important to know them as before the automobile (car or truck) is put into mass production, it should be properly designed and the automobile must meet up-to-date requirements.

3. What are these requirements?

The automobile must have high efficiency, long service life, driving safety, ease of maintenance and pleasant appearance.

In order to obtain all these qualities engineers should develop up-to-date methods of designing cars, using new types of resistant to corrosion light materials. Also it is important to know computer science because it is intended to shorten the time between designing and manufacturing. Computers offer quick and optimal solutions of problems.

But before the car is put into mass production all its units and mechanisms are subjected to tests, first in the plant's laboratory, then the car undergoes a rigid quality control in road tests. Only then the car is put into mass production. Why are these tests required? What qualities are required of the automobile? The modern automobile must be rapid in acceleration, must have smooth acting clutch, silent gearbox, dependable brakes and steering system, as well as pleasant appearance. Also it must be comfortable and have all conveniences.

4. Translate paragraphs 3 and 4 into Russian.

5. Match answers to the questions:

- What phases does the production of the automobile comprise?
- What requirements must the automobile meet?
- Why are cars subjected to road tests?
- What qualities are required of the automobile?
- Why is it important for the specialists in automobile industry to know computing methods?

Answers:

a. It must have high efficiency, long service life, driving safety, ease of maintenance and pleasant appearance.

b. They should be able to develop up-to-date methods of designing cars and shorten the time between designing and manufacturing.

c Because they must meet up-to-date requirements.

d. Designing, working out technological processes, laboratory and road tests, mass production.

e. It must be rapid in acceleration, must have smooth acting clutch, silent gearbox, dependable brakes and steering system.

6. Match the beginning to the ending:

1. The cars are subjected to road tests in order....

a) to shorten the time between designing and manufacturing
to meet up-to-date requirements
to work out new technological processes

2. The car must have the following units....

3. The car must have the following qualities....

a) high efficiency, long service life, driving safety and pleasant appearance;

b) smooth acting clutch, silent gearbox dependable brakes and steering system.

TEXT 2

1. Match the translations:

body	a. тормоза срабатывают
car wheels	b. силовая передача
power train	c. главная передача
power plant	d. коленчатый вал двигателя
springs	e. нажимать на педаль
steering system	f. силовая установка
clutch	g. колеса автомобиля
final drive	h. рама с осями
engine crankshaft	i. топливная система
push down the pedal	j. рулевая система
brakes are applied	k. сцепление
frame with axles	1. вспомогательные устройства
fuel system	m. система смазки
lubricating system	n. кузов
accessories	o. рессоры

2. Translate into Russian:

automobile, chassis, speedometer, electric, system, cylinder, cardan, control, hydraulic, pedal, accessories, differential.

3. Read the text:

COMPONENTS OF THE AUTOMOBILE

1. Basically, the automobile consists of three parts: the power plant, or the engine, the chassis and the body. To these may be added the accessories: the heater, lights, radio, speedometer and other devices.

2. The power plant or engine is the source of power that makes the wheels rotate and the car move. It includes electric, fuel, cooling and lubricating systems. Most automobile engines have six or eight cylinders.

3. The chassis consists of a power train, frame with axles, wheels and springs. The chassis includes brakes and steering system.

4. The power train carries the power from the engine to the car wheels and contains the clutch, gearbox, propeller or cardan shaft, differential and the final drive.

5. The clutch is a friction device connecting (or disconnecting) the engine crankshaft to the gears in the gearbox. It is used for freeing the gearbox from the engine and is controlled by the clutch pedal.

6. Brakes are important mechanisms of the car. They are used to slow or stop the car. Most braking systems in use today are hydraulic. They are operated by the brake pedal. When the driver pushes down on the brake pedal, they are applied and the car stops.

4. Give written translation of paragraphs 1,3,5,6.

5. Match the questions to the answers.

- What are the main basic parts of the automobile?
- What does the chassis consist of?
- What units does the power train contain?
- What is the function of the clutch?
- Why are brakes needed?

Answers:

a. The clutch, gearbox, cardan shaft and the final drive.
b. Freeing the engine from the gearbox.
c The power plant, the chassis and the body.
d. A power train, frame with axles, wheels and springs.
e. To slow or stop the car.

6. Match the beginning to the ending:

1) The mechanism used for stopping the car is....
2) The mechanism used for changing the speed is....
a) clutch
b) gearbox
c) brakes
3) The mechanism used for connecting (or disconnecting) the engine from the gearbox is ....
a) brakes
b) clutch
c) steering system
4). The unit carrying the power from the engine to the car wheels is....
a) power plant

b) power train
c) chassis
5). The instrument measuring the speed of the car is…
a) heater
b) lights
c) speedometer

TEXT 3

1. Match the translations:

internal combustion engine	a. поршень
combustion chamber	b. верхняя мертвая точка
stroke	c. четырехтактный двигатель
piston	d .коленчатый вал
top dead centre	e. отверстие клапана
bottom dead centre	f. двигатель внутреннего сгорания
four-stroke cycle engine	g. нижняя мертвая точка
two-cycle engine	h. топливная система
crankshaft	i. такт впрыска (топлива)
intake stroke	j. двухтактный двигатель
valve opening	k. камера сгорания
fuel system	1. ход, такт (поршня)
power stroke	m. выхлоп
exhaust	n. рабочий ход поршня

2. Translate into Russian:

cylinder, automobile, limit, centre, cycle, compression, gas.

3. Read the text:

THE ENGINE

The engine is the source of power that makes the car move. It is usually called an internal combustion engine because gasoline is burned within its cylinders or combustion chambers. Most automobile engines have six or eight cylinders.

The operating cycle of the four-stroke engine that takes place in the engine cylinder can be divided into four strokes. The upper limit of the piston movement is called the top dead centre. The lower limit of piston movement is called the bottom dead centre. A stroke is the piston movement from the top dead centre to the bottom dead centre or from bottom dead centre to the top dead centre. In other words, the piston the completes a stroke each time it changes the direction of its motion.

Where the entire cycle of events in the cylinder requires four strokes (two crankshaft revolutions), the engine is called a four-stroke cycle engine. The four strokes are: intake, compression, power and exhaust.

Two-cycle engines have also been made, and in such engines the entire cycle of events is completed in two strokes or one revolution of the crankshaft.

On the intake stroke the intake valve is opened. The mixture of air and vaporized gasoline is delivered into the cylinder through the inlet valve. On the compression stroke the inlet valve is closed so that the mixture can be compressed. On the power stroke both valves (inlet and exhaust) are closed in order to raise pressure during the mixture combustion. On the exhaust stroke the exhaust valve is opened to exhaust the residual gas.

4. Write the translation of paragraphs 2 and 5.

5. Match the questions to the answers:

- What is the top dead centre?
- What is the bottom dead centre?
- When the engine is called a four-stroke cycle engine?
- When the engine is called a two-cycle engine?
- What kind of strokes can the events in the engine cylinder be divided into?

Answers:

a. When the entire cycle of events is completed in two strokes.
b. The lower limit of the piston movement.
c. The upper limit of the piston movement.
d. When the entire cycle of events in the cylinder is completed in four strokes.
e. Intake, compression, power and exhaust strokes.

6. Finish the sentences:

1An internal combustion engine is called so because gasoline is burned....

a) inside the combustion chamber

b) outside the combustion chamber

2. The upper limit of the piston movement is called...

3. The lower limit of the piston movement is called....

a) the bottom dead centre

b) the top dead centre

4. The four-cycle engine requires....

a) two strokes of piston movement

b) four strokes of piston movement

5. The mixture of air and gasoline is delivered into the cylinder....

a) on the power stroke

b) on the exhaust stroke

c) on the intake stroke

d) on the compression stroke

MODULE 3
CHEMICAL ENGINEERING

UNIT 1. What is Chemical Engineering

Vocabulary

acid, n – кислота (stearic acid – стеариновая)
beneficial, adj – благотворный; полезный; целительный; выгодный
to bind, v – связывать
CEO (chief executive officer), n – единоличный исполнительный орган
deposition, n – выпадение; выпадение (осаждение)
derivative, n – производное соединение, продукт химических превращений
distillation, n – дистилляция; перегонка; очищение
elastomer, n – упругий полимер; эластомер (прибор)
to employ, n – употреблять; использовать; применять;
to envy, n – завидовать
explosive, n – взрывчатое вещество
fertilizer, n – удобритель; минеральное удобрение;
flavor, n – запах; отдушка; привкус; аромат
fragrance, n – благоухание; благовоние; ароматизатор
inherent, adj – свойственный; неотъемлемый; присущий
lard, n – жир; мазь; топлёный свиной жир
medium, n – среда
molten, adj – плавленый, жидкий, литой
momentum transfer – передача импульса
oleochemical, adj – олеохимический, продукт переработки масел
refining (oil refining), n – рафинирование масел; нефтеочистка
scale-up, n – масштабирование, линейное увеличение
solution, n – растворённое состояние; раствор
solvent, n – растворитель, сольвент, среда для растворения
to repell, n – отталкивать; отражать; отбивать.

1.1. Look at the picture and agree or disagree with the statement *"chemical engineering is the nucleus of discovery"*.

1.2. Discuss these questions.

 How is chemical engineering connected with scientific fields given in the picture?

 Which of these fields do you study at NSTU?

 What do you expect from being a chemical engineer? Are there any future prospects in your career as a chemical engineer?

1.3. Fill in the words or word combinations from the list below.

chemistry, mathematics, chemical engineer, engineering, physics, physical science, materials, research and development, chemicals

Chemical engineering is the branch of **1**_____ that deals with the application of **2**_____ (e.g. **3**_____ and **4**_____), with **5**_____, to the process of converting raw **6**_____ or **7**_____ into more useful or valuable forms. As well as producing useful materials, chemical engineering is also concerned with pioneering valuable new materials and techniques; an important form of **8**_____. A person employed in this field is called a **9**_____.

1.4. Read the sentences and fill in the missing information. Skim the texts (A and B) and check your answers.

1. Chemical engineers do much more with chemistry than just make _____. 2. The "Big Four" engineering fields consist of civil, _____, electrical, and chemical engineers. 3. Chemical engineers concern themselves with the chemical processes that turn _____ into valuable products.

1.5. Scan the texts (A and B) for the information you need to complete the following statements.

- It is true that chemical engineers are comfortable with chemistry and …
- Chemical engineers should use such necessary skills as …

Text A

It is true that chemical engineers are comfortable with chemistry, but they do much more with this knowledge than just make **chemicals**. In fact, the term "chemical engineer" is not even intended to describe the type of work a chemical engineer performs. Instead it is meant to reveal what makes the field different from the other branches of engineering.

All engineers employ mathematics, physics, and the engineering art to overcome technical problems in a safe and economical fashion. Yet, it is the chemical engineer alone that draws upon the vast and powerful science of chemistry to solve a wide range of problems. The strong technical and social ties that bind chemistry and chemical engineering are unique in the fields of science and technology. This **marriage** between chemists and chemical engineers has been beneficial to both sides and has rightfully brought the envy of the other engineering fields.

The breadth of scientific and technical knowledge inherent in the profession has caused some to describe the chemical engineer as the *"universal engineer"*. Despite a title that suggests a profession composed of **narrow specialists**, chemical engineers are actually extremely **versatile** and able to handle a wide range of technical problems.

Text B

The "Big Four" engineering fields consist of civil, mechanical, electrical, and chemical engineers. Of these, chemical engineers are numerically the smallest group. However, this relatively small group holds a very **prominent** position in many industries, and chemical engineers are, on average, the highest paid of the "Big Four". Additionally, many chemical engineers have found their way into upper management. A chemical engineer is either currently, or has previously, occupied the CEO position for: *3M, Du Pont, General Electric, Dow Chemical, Exxon, BASF, Gulf Oil, Texaco, and B.F. Goodrich*. Even a former director of the CIA, John M. Deutch, was a chemical engineer by training.

More typically, chemical engineers concern themselves with the chemical processes that turn **raw materials** into valuable products. The necessary skills **encompass** all aspects of design, testing, scale-up, operation, control, and optimization, and require a detailed understanding of the various "unit operations", such as distillation, mixing, and biological processes, which make these **conversions** possible. Chemical engineering science **utilizes** mass, momentum, and energy transfer along with thermodynamics and chemical kinetics to analyze and improve on these "unit operations."

1.6. Look at the following words in bold in the texts and try to explain them. Consult the dictionary if necessary.

chemicals, marriage, narrow specialist, versatile, prominent, raw materials, encompass, conversion, to utilize

1.7. Answer the following questions.

1) Is the term "chemical engineer" intended to describe the type of work a chemical engineer performs?
2) What fields of science do all engineers employ to overcome technical problems in a safe and economical fashion?
3) What engineers draw upon the vast and powerful science of chemistry to solve a wide range of problems?
4) How are chemistry and chemical engineering connected?
5) Why can the chemical engineer be called the *"universal engineer"*?
6) What do The "Big Four" engineering fields consist of?
7) Are chemical engineers numerically the largest group?
8) What position do chemical engineers hold in many industries?
9) What kind of processes do the chemical engineers concern with?
10) What are the necessary skills for the chemical engineer?

1.8. Fill in the words from the list below. Use the words only once.

ties, conversions, universal, recognized, to utilize, range, valuable, to overcome, understanding, branches

1. to solve a wide _____ of problems
2. strong technical and social _____

3. to turn raw materials into _____ products
4. to make _____ possible
5. _____ technical problems
6. to describe the chemical engineer as the _____ engineer
7. to require a detailed_____
8. to be_____ all over the world
9. different_____ of chemical technology 10. _____ natural resources.

1.9. Fill in the correct preposition and make sentences using the completed phrases.

1) to be comfortable _____
2) to be different _____
3) to draw _____
4) marriage _____
5) to consist _____
6) _____ average
7) to turn smth _____smth
8) _____ the faculty
9) to lead _____
10) to be trained _____

1.10. Match the product types of chemical industry with their examples.

Product Type: 1) inorganic products 2) organic products 3) ceramic products 4) petrochemicals 5) agrochemicals 6) polymers 7) elastomers 8) oleochemicals 9) explosives 10) fragrances and flavors.

Examples: A) silica brick, frit **B)** polyethylene, Bakelite, polyester **C)** nitroglycerin, ammonium nitrate, nitrocellulose **D)** acrylonitrile, phenol, ethylene oxide, urea **E)** ammonia, nitrogen, sodium hydroxide, sulfuric acid **F)** benzene, ethylene, styrene **G)** fertilizers, insecticides, herbicides **H)** benzyl benzoate, coumarin, vanillin **I)** polyisoprene, neoprene, polyurethane **J)** lard, soybean oil, stearic acid.

1.11. Fill in the words from the list below.

organic, polymers, elastomers, oleochemicals, explosives, chemical processes, refining, chemical reactions, manufacture, solvents

As accepted by chemical engineers, the chemical industry involves the use of **1**_____ such as **2**_____ and **3**_____ methods to

produce a wide variety of solid, liquid, and gaseous materials. Most of these products are used in **4**_____ of other items, although a smaller number are used directly by consumers. **5**_____, pesticides, lye, washing soda, and portland cement are a few examples of product used by consumers. The industry includes manufacturers of inorganic- and **6**_____-industrial chemicals, ceramic products, petrochemicals, agrochemicals, **7**_____ and rubber (**8**_____), **9**_____ (oils, fats, and waxes), **10**_____, fragrances and flavors. Although the pharmaceutical industry is often considered a chemical industry, it has many different characteristics that put it in a separate category. Other closely related industries include petroleum, glass, paint, ink, sealant, adhesive, and food processing manufacturers.

1.12. Read the text below and look carefully at each line. Some of the lines are correct, and some are incorrect. Find and correct the mistakes.

Chemical Engineering degree

A Chemical Engineering degree can provide you an excellent starting point to launch a variety rewarding careers. Chemical Engineers are at the forefront of technology and their role in modern society is becoming increasingly important. Chemical Engineers design, implement and supervise industrial processes where matter undergoes change. This could be in the pharmaceutical, pulp and paper, food or plastics industries example; anywhere where a transformation of matter occurs. Chemical Engineers also play major role in the new, emerging field of nanotechnology with applications in the development of new materials, and devices. They also develop new processes prevent pollutants from being released into our environment or to remove them after they are already there. They decrease our energy use increasing the efficiency in our fossil fuel refining plants, or by experimenting with new forms of energy generation and storage. Increasingly Chemical Engineers are becoming involved in the control, manipulation and production of biological systems as well, which have many important applications in the area of health care and food production for example.

1.13. Many students who are interested in chemistry think of chemical engineering as their major – what is the difference? Both disciplines deal with much the same things and there is much overlap, but the basic differences are novelty and scale. Read the sentences and fill in the blanks with proper word (A or B).

Chemist – A; Chemical engineer – B.

1. A _____ is more likely to be developing new compounds and materials; a _____ is more likely to be working with existing substances.
2. A _____ deals with large scale reactions with factory scale equipment.
3. The _____ deals with small amounts of materials in glassware on a laboratory. bench. The _____ deals with large scale reactions with factory scale equipment.
4. A _____ may make a few grams of a new compound, while a _____ will scale up the process to make it by the ton, and at a profit.
5. The _____ will be more concerned with heating and cooling large reaction vessels, pumps and piping to transfer materials, and plant design and operation, while a _____ will be more concerned with establishing the details of the reactions before the plant is designed.

1.13 As you know, there are more than thirty branches of chemistry. Below you're given the names of the main fields the chemical engineers work in.

What do these engineers deal with? Place the letter of the term beside the correct definition.

Definition	Term
_____1. Studies the separation, identification, and quantification of the chemical components of natural and artificial materials.	a. Physical Chemist
_____2. Develops a fundamental understanding at the molecular and atomic level of how chemical reactions occur.	b. Inorganic Chemist
_____3. Studies chemical processes in living organisms and governs all living organisms and living processes.	c. Organic Chemist

_____4. Studies scientific structure, properties, composition, reactions, and preparation (by synthesis or by	d. Analytical Chemist
_____5. Searches and uses new knowledge about chemicals to improve the way we live and develops products, such as synthetic fibers, drugs and cosmetics, and processes, including oil refining and petrochemical processing, that reduce energy use and pollution.	e. Medical Chemist
_____6. His work is based on understanding the behavior and the analogues for inorganic elements, and how these materials can be modified, separated or used– often in product applications.	f. Biochemist

Main Branches of Chemical Engineering

The field of chemistry is now a very large one. There are more than 30 different branches of chemistry. Some of them are inorganic chemistry, organic chemistry, physical chemistry, analytical chemistry, pharmaceutical chemistry, nuclear chemistry, industrial chemistry, colloidal chemistry, electrochemistry, magnetochemistry, and biochemistry.

Inorganic chemistry. It was originally considered that the field of inorganic chemistry consists of the study of materials not derived from living organisms. However, it now includes all substances except the hydrocarbons and their derivatives.

Organic chemistry. At one time it was thought that all substances found in plants and animals could be made only by using part of a living plant or animal. The study of these substances, most of which contain carbon, was therefore called organic chemistry. It is now known that this idea is quite wrong. In 1828 Fr. Wohler, a German scientist, made an "organic" substance using a simple laboratory process. Organic chemistry now merely means the chemistry of carbon compounds.

Physical chemistry. This field of chemistry is concerned with those parts of chemistry which are closely linked with physics as, for instance, the behaviour of substances when a current of electricity is passed through them.

Electrochemistry is concerned with the relation between electrical energy and chemical change. Electrolysis is the process whereby electrical energy causes a chemical change in the conducting medium, which usually is a solution or a molten substance. The process is generally used as a method of deposition metals from a solution.

Magnetochemistry is the study of behaviour of a chemical substance in the presence of a magnetic field. A paramagnetic substance, i.e. a substance having unpaired electrons, is drawn into a magnetic field. Diamagnetic substances, i.e. substances having no unpaired electrons, are repelled by a magnetic field.

Biochemistry. Just as the physical chemist works on the boundaries between physics and chemistry, so the biochemist works on the boundaries between biology and chemistry. Much of the work of the biochemist is connected with food-stuffs and medicines. The medicines known as antibiotics, of which penicillin is an early example, were prepared by biochemists.

1.14. ***Answer the following questions.***

1. How many different branches of chemistry are there? 2. Which are the better known fields of chemistry? 3. What does inorganic chemistry deal with? 4. Give an example of an inorganic compound. 5. How many elements does water consist of? 6. What is the subject of electrochemistry? 7. What is the study of behaviour of chemical substances in the presence of a magnetic field called? 8. What is the difference between paramagnetic and diamagnetic substances? 9. By whom were the medicines known as antibiotics prepared?

1.15. Fill in the blanks using appropriate words from the text.

1. Inorganic chemistry now _____ all substances except the _____ and their _____. 2. Once scientists thought that all substances found in _____ and _____ were organic. 3. _____ chemist studies the _____ of substances when a current of _____ is passed through them. 4._____ is generally used as a method of deposition metals from their _____. 5. _____ such as _____ are prepared by biochemists.

1.16. Decide which word or word combination is defined in these sentences.

1. a subdivision of a family, knowledge, etc.
2. a thing got from some particular source

3. the way of acting upon something under particular conditions
4. the ordered movement of electrically charged particles
5. a physical environment etc. of a living organism
6. a conversion of a solid or gas into a liquid by mixture with a liquid
7. the area of force around a magnet
8. the limits of an area
9. a substance used as food
10. a substance that can inhibit or destroy susceptible micro-organisms

UNIT 2. Technological Process in Chemical Industry: Tools and Equipment

Vocabulary

beaker, n – мензурка, стакан (лабораторный)

boiler, n – бойлер, котел

boiling flask, n – длинногорлая колба

borosilicate, n – борасиликат; смешанная соль борной и кремнёвой кислот

cork, n – пробка; лакмусовый ягель (краситель)

culture tube, n – пробирка с выросшей культурой

distillation column, n – дистилляционная колонна; бражная колонна

extruder, n – шприц-машина; экструзивный пресс; выталкиватель; расплавитель

flask (volumetric), n – мерная лабораторная колба, пикнометр

funnel, n – воронка, труба, дымоход

furnace, n – печь, топка

graduated cylinders, n – градуированный(калибровочный) цилиндр

lab glassware, n – лабораторная посуда

lid, n – крышка, колпачок

lip, n – край, скос, кромка, носик сосуда

particulate counter, n – счетчик частиц распыленности

pipet, pipette, n – пипетка

recovery system, n – регенерационная установка; система возвращения

safety goggles, n – закрытые защитные очки

seal, n – печать, закупорка; укупорить

shatter, v – разрушаться; раскалываться

sieve, n – сито, решето

spout, n – горловина; жёлоб, носик сосуда

transfer pump, n – перекачивающий насос, транспортирующий насос.




2.1 Answer the questions

1. **What kinds of chemical equipment do you know?**

2. **Choose words from the list to label the pictures:**

Fraction distillation column; extruder; boilers; reactor; furnace; mixer; centrifuge; heat exchanger.

3. **What are these kinds of equipment used for?**




2.2. Work in pairs and describe the following unit operations: *distillation, crystallization, dissolution, filtration* and *extraction*.

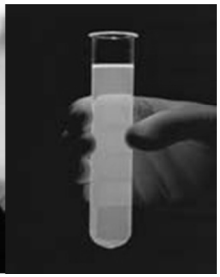
2.3. Match the terms to the definitions and compare it with your ideas to check yourselves.

distillation	the process of evaporating or boiling a liquid and condensing its vapour; purification or separation of mixture by using different evaporation rates or boiling points of their components
extraction	conversion of liquid into solid
dissolution	the act of extracting or the condition of being extracted
crystallization	the act or process of filtering
filtration	the resolution or separation into component parts; disintegration; destruction by breaking up and dispersing

2.4 Read the following extracts about *chemistry lab glassware*. Match the pictures with their definitions (A-J) and underline the names of the lab equipment you see in the pictures. What are these pieces of lab glassware used for?







TEXT A

A Erlenmeyer flasks are used to measure, mix, and store liquids. The shape makes this flask very stable. They are one of the most common and useful pieces of chemistry lab glassware. Most Erlenmeyer flasks are made of borosilicate glass so that they can be heated over a flame or autoclaved. The most common sizes of Erlenmeyer flasks are 250 ml and 500 ml. However, they can be found in 50, 125, 250, 500, 1000 ml. You can seal them with a cork or stopper or place plastic or paraffin film or a watch glass on top of them.

B No lab would be complete without beakers. Beakers are used for routine measuring and mixing in the lab. They are used to measure volumes to within 10% accuracy. Most beakers are made from borosilicate glass, though other materials may be used. The flat bottom and spout allow this piece of glassware to be stable on the lab bench or hot plate, plus it's easy to pour a liquid without making a mess. Beakers are also easy to clean.

C Test tubes are round-bottom cylinders, usually made of borosilicate glass so that they can withstand temperature changes and resist reaction with chemicals. In some cases, test tubes are made from plastic. Test tubes come in several sizes. The most common size is smaller than the test tube shown in this photo (18x150mm is a standard lab test tube size). Sometimes test tubes are called culture tubes. A culture tube is a test tube without a lip.

D Volumetric flasks are used to accurately prepare solutions for chemistry. This piece of glassware is characterized by a long neck with a line for measuring a specified volume. Volumetric flasks usually are made of borosilicate glass. They may have flat or round bottoms (usually flat). Typical sizes are 25, 50, 100, 250, 500, 1000 ml.

E Graduated cylinders are used to measure volumes accurately. The can be used to calculate the density of an object if its mass is known. Graduated cylinders usually are made from borosilicate glass, though there are plastic cylinders, too. Common sizes are 10, 25, 50, 100, 250, 500, 1000 ml. Choose a cylinder such that the volume to be measured will be in the upper half of the container. This minimizes measurement error.

F A Florence flask or boiling flask is a round-bottom borosilicate glass container with thick walls, capable of withstanding temperature changes. Never place hot glassware on a cold surface, such as a lab

bench. It's important to inspect a Florence flask or any piece of glassware prior to heating or cooling and to wear safety goggles when changing the temperature of glass. Improperly heated glassware or weakened glass may shatter when the temperature is changed. Additionally, certain chemicals may weaken the glass.

G Petri dishes come as a set, with a flat bottom dish and a flat lid that rests loosely over the bottom. The contents of the dish are exposed to air and light, but the air is exchanged by diffusion, preventing ontamination of the contents by microorganisms. Petri dishes that are intended to be autoclaved are made from a borosilicate glass, such as Pyrex or Kimax. Single-use sterile or non-sterile plastic petri dishes also are available. Petri dishes commonly are used for culturing bacteria in a microbiology lab, containing small living specimens, and holding chemical samples.

H A funnel is a conical piece of glass or plastic that is used to transfer chemicals from one container to another. Some funnels act as filters, either because of their design or because of filter paper or a sieve placed on the funnel. There are several different types of funnels.

I Glass bottles with ground glass stoppers are often used to store stock solutions of chemicals. To avoid contamination, it helps to use one bottle for one chemical. For example, the ammonium hydroxide bottle has to be used only for ammonium hydroxide.

J Pipets (pipettes) are used to measure and transfer small volumes. There are many different types of pipets. Examples of pipet types include disposable, reusable, autoclavable, and manual. Pipets or pipettes are droppers calibrated to deliver a specific volume. Some pipets are marked like graduated cylinders. Other pipets are filled to a line to reliably deliver one volume again and again. Pipettes may be made of glass or plastic.

2.5. Match the tools and pieces of equipment with their functions.

Tools / equipment	Function
1. Oil Pre -Heaters	a) used to settle the output from the reactor into its separate fractions, typically methyl-esters and glycerol.
2. Biodiesel Reactor	b) to weigh out chemicals such as lye.
3. Methoxide Mixer	c) used to calculate the correct dosing of catalyst based on oil quality.
4. Settling Tanks	d) used for water removal and used to heat oil to correct temperature for transesterification.

Tools / equipment	Function
5. Washing system	e) used to move oil from each aspect of the biodiesel process e.g. from reactor to a settling tank.
6. Final storage	f) used to mix lye and methanol for the tranesterification process.
7. Oil Storage	g) This can range from IBC's to underground / over ground storage tanks or even a fuel tanker for delivery to customer.
8. Transfer Pumps	h) used to batch correct quantities of methanol and oil. Many systems will use level indicators to achieve the same thing.
9. Scales	i) used to perform transesterification on pre heated feedstock oil and methoxide (Other catalysts can be used but methoxide is most common).
10. Flow meters	j) Once again storage for your feedstock oil, which could be IBC's or general storage tanks.
11. Titration testing equipment	k) used to purify biodiesel to commercial standards for use in modern diesel powered vehicles.
12. Centrifuge	l) used to recover methanol from produced biodiesel to raise quality and to recover methanol from glycerol. Methanol recovery can be considered as a product that can be re-used to lower costs and as one stage of the glycerol purification process.
13. Gas Chromatagraph	m) used at various stages of production to indicate quality is being maintained.
14. Particulate counters	n) used to analyze the quality of feedstock oil and to check quality of produced biodiesel
15 Methanol recovery system	o) can be used to remove water, and particles separate glycerol from biodiesel instead of settling.

2.6. Fill in the gaps with the appropriate word from the list below.

Specialists, petroleum, quality, valves, assurance, building, gas

At present JSC Sumy Frunze is one of leading machine-**1**_____ complexes in Europe manufacturing equipment for oil, gas and chemical industries. The unique types of chemical equipment, centrifuges, compressors and **2**_____ turbine driven centrifugal compressor packages, pumps and gas pipeline **3**_____, oil field equipment and drill collars is not a complete list of manufactured products. The huge production potential, high quality and

professionalism of **4**_____, availability of advanced testing benches and Quality **5**_____ System valid in company, corresponding to ISO 9001 Standard, allow performing on reliable and high **6**_____ level any complex of works beginning with manufacture of the individual package up to construction of up-to-date **7**_____ refinery on EPC Contract terms.

2.7. a) Study the following information about acetylene.

Acetylene

Acetylene (C_2H_2), a compound of carbon and hydrogen, is a colorless, highly flammable gas. It is slightly lighter than air and has a garlic-like odor. Acetylene is stored in high pressure cylinders filled with a porous material and containing acetone, into which the acetylene is dissolved. Unless dissolved in a solvent, acetylene will dissociate at pressures above 15 psig and form lamp black and hydrogen. Heat is generated with dissociation, which in turn, produces a danger of explosion. Acetylene is manufactured by the reaction of water with calcium carbide. It is also manufactured by thermal cracking of hydrocarbons, or by partial combustion of methane and oxygen.

b). In groups complete the table using the words/word combinations from the text above. See the examples in italics.

Process	Equipment	(Raw) material	Action
distillation	*gas heated reformer*	*gas* *sulfur compounds*	*to be compressed* *to be purified **by***

2.8. Use the words given in capitals to form the words that fit in the spaces.

The DST500 temperature **1**_____, and the DSX500 transmitter thermometers are wide range, high accuracy units designed for **2**_____ where accurate and reliable temperature monitoring and transmitting are critical. Both offer high precision temperature **3**_____ technology and feature a 1-	**INDICATE** **APPLICATE** **MEASURE**

in. high LCD display – readable from 30 ft. away. They are available in a **4**_____ of standard and custom built probe configurations including MIG standard tapered bulb for drop-in direct MIG **5**_____. The quick disconnect option allows the user to remove the probe and meter for calibration without **6**_____ the permanently installed cable. The adjustable angle probe option allows easy adjustment of the display for the best viewing option. Special **7**_____ can be supplied for tight fit installations. Temperature range is -328°F to 1,472°F (-200° to 800°C).

VARY

REPLACE

REMOVE

CONFIGURATE

2.9. Design Power Point slides and prepare a short presentation about a technological process of a chemical product.

SUPPLEMENTARY READING

TEXT 1

Selection of plant location for establishing a chemical industry

The geographical location of the plant contributes a lot to the success of any chemical business venture. Utmost care and judgment is required to select the plant site, and many different factors must be considered while selecting the plant site.

The plant site should be ideally located where the cost of production and distribution can be at a minimum level. Also there has to be a good scope for plant expansion and a conducive environment, safe living conditions for easy plant operation. But other factors, such as safe living conditions for plant personnel as well as the surrounding community are also important.

The major factors in the selection of chemical plant sites are raw materials, markets, energy supply, climate, transportation facilities, and water supply. For a preliminary survey, the first four factors should be considered. On the basis of raw materials availability, market survey, energy supply, and climate, acceptable locations can usually be reduced to one or two general geographical regions.

In the second step, the effects of transportation facilities and water supply are taken into account. This permits reduction of the possible plant location to few general target areas. These areas can be reduced further by considering all the factors that have an influence on plant location.

As a third step, a detailed analysis of the remaining sites can be made, exact data on items such as freight rates, labor conditions, tax rates, price of land, and general local conditions can be obtained. The various sites can be inspected and appraised on the basis of all the factors influencing the final decision. The final decision on selecting the plant site should take into consideration all the factors that can affect the ultimate success of the overall plant operation.

The choice of the final site should be based on a detailed survey of various geographical areas, and ultimately, on the advantages and disadvantages of available real estate. An initial outline regarding the plant location should be obtained before a design project reaches the detailed estimate stage, and a firm location should be established upon completion of the detailed estimate design. The factors that must be evaluated in a plant location study indicate the need for a vast amount of information.

TEXT 2

Task: Read the text and design a scheme or diagram for presenting the products of Chemical Industry

Product Category Breakdown

Sales of the chemical business can be divided into a few broad categories, including basic chemicals (about 35 to 37 percent of the dollar output), life sciences (30 percent), specialty chemicals (20 to 25 percent) and consumer products (about 10 percent).

Basic chemicals is a broad chemical category including polymers, bulk petrochemicals and intermediates, other derivatives and basic industrials, inorganic chemicals, and fertilizers. Typical growth rates for basic chemicals are about 0.5 to 0.7 times GDP (Gross Domestic Product). The major markets for plastics are packaging, followed by home construction, containers, appliances, pipe, transportation, toys, and games. The largest-volume polymer product, polyethylene (PE), is used mainly in packaging

films and other markets such as milk bottles, containers, and pipe. Polyvinyl chloride (PVC), another large-volume product, is principally used to make pipe for construction markets as well as siding and, to a much smaller extent, transportation and packaging materials. Polypropylene (PP), similar in volume to PVC, is used in markets ranging from packaging, appliances, and containers to clothing and carpeting. Polystyrene (PS), another large-volume plastic, is used principally for appliances and packaging as well as toys and recreation. The leading man-made fibers include polyester, nylon, polypropylene, and acrylics, with applications including apparel, home furnishings, and other industrial and consumer use. The principal raw materials for polymers are bulk petrochemicals.

Chemicals in the bulk petrochemicals and intermediates are primarily made from liquefied petroleum gas (LPG), natural gas, and crude oil. Their sales volume is close to 30 percent of overall basic chemicals. Typical large-volume products include ethylene, propylene, benzene, toluene, xylenes, methanol, vinyl chloride monomer (VCM), styrene, butadiene, and ethylene oxide. These chemicals are the starting points for most polymers and other organic chemicals as well as much of the specialty chemicals category.

Other derivatives and basic industrials include synthetic rubber, surfactants, dyes and pigments, turpentine, resins, carbon black, explosives, and rubber products and contribute about 20 percent of the basic chemicals' external sales. Inorganic chemicals (about 12 percent of the revenue output) make up the oldest of the chemical categories. Products include salt, chlorine, caustic soda, soda ash, acids (such as nitric, phosphoric, and sulfuric), titanium dioxide, and hydrogen peroxide. Fertilizers are the smallest category (about 6 percent) and include phosphates, ammonia, and potash chemicals.

Life sciences (about 30 percent of the dollar output of the chemistry business) includes differentiated chemical and biological substances, pharmaceuticals, diagnostics, animal health products, vitamins, and crop protection chemicals. While much smaller in volume than other chemical sectors, their products tend to have very high prices – over ten dollars per pound – growth rates of 1.5 to 6 times GDP, and research and development spending from 15

to 25 percent of sales. Life science products are usually produced with very high specifications and are closely scrutinized by government agencies such as the Food and Drug Administration. Crop protection chemicals,

about 10 percent of this category, include herbicides, insecticides, and fungicides.

Specialty chemicals is a category of relatively high valued, rapidly growing chemicals with diverse end product markets. They are generally characterized by their innovative aspects. Products are sold for what they can do rather than for what chemicals they contain. Products include electronic chemicals, industrial gases, adhesives and sealants as well as coatings, industrial and institutional cleaning chemicals, and catalysts. Coatings make up about 15 percent of specialty chemicals sales, with other products ranging from 10 to 13 percent.

Consumer products include direct sale of chemical products such as soaps, detergents, and cosmetics. Typical growth rates are 0.8 to 1.0 times GDP.

TEXT 3

Task: Read the text "Chemistry Laboratory Safety Rules" and choose an appropriate heading for each passage.

Chemistry Laboratory Safety Rules

Some rules are NOT made to be broken. That is true of the rules used in a chemistry lab. They are really, truly for your safety and not your humiliation. Read these and follow the recommendations for safe use and disposal of the material.

1	

You say, "But it's only water." Even if it is, how clean do you think that glassware *really* is? Using disposable pipettes? I know lots of people who rinse them and put them back! Learn to use the pipette bulb or automated pipetter. Don't pipette by mouth at home either. Gasoline and kerosene should be obvious, but people get hospitalized or die every year, right? I know someone who used his mouth to start the suction on a waterbed to drain it. Do you know what they put in some waterbed additives? Carbon-14. Mmmm...radiation. He couldn't retch fast enough! The lesson is that even seemingly harmless substances may be dangerous!

2	

A Material Safety Data Sheet (MSDS) should be available for every chemical you use in lab.

3

No sandals, no clothes you love more than life, no contact lenses, and long pants are preferable to shorts or short skirts. Tie long hair back. Wear safety goggles and a lab coat. Even if you aren't clumsy, someone else in the lab probably is. If you take even a few chemistry courses you will probably see people set themselves on fire, spill acid on themselves, others, or notes, splash themselves in the eye, etc. Don't be the bad example to others, remembered for all time for something stupid!

4

And know how to use it! Given that some people (possibly you) will need them, know the locations of the fire blanket, extinguishers, eyewash, and shower. Ask for demonstrations! If the eyewash hasn't been used in a while the discoloration of the water is usually sufficient to inspire use of safety glasses.

5

For many chemicals, if you can smell them then you are exposing yourself to a dose that can harm you! If the safety information says that a chemical should only be used inside a fume hood, then don't use it anywhere else. This isn't cooking class - don't taste your experiments!

6

Some chemicals can be washed down the drain, while others require a different method of disposal. If a chemical can go in the sink, be sure to wash it away rather than risk an unexpected reaction between chemical 'leftovers' later.

7

It's tempting, but oh so dangerous... just don't do it!

8

Don't haphazardly mix chemicals! Pay attention to the order in which chemicals are to be added to each other and do not deviate from the instructions. Even chemicals that mix to produce seemingly safe products should be handled carefully. For example, hydrochloric acid and sodium hydroxide will give you salt water, but the reaction could break your glassware or splash the reactants onto you if you aren't careful!

9	

Not after lab, on the assumption that it will be neater. Put data directly in your lab book rather than transcribing from another source (e.g., notebook or lab partner). There are lots of reasons for this, but the practical one is that it is much harder for the data to get lost in your lab book. For some experiments, it may be helpful to take data *before* lab. No, I'm not telling you to dry-lab or cheat, but being able to project likely data will help you catch bad lab procedure before you are three hours or so into a project. Know what to expect. You should always read the experiment in advance.

A Don't Taste or Sniff Chemicals
B Do Not Pipette By Mouth – Never
C Don't Casually Dispose of Chemicals Down the Drain
D Read the Chemical Safety Information
E Don't Eat or Drink in Lab
F Dress Appropriately (for chemistry lab, not fashion or the weather)
G Don't Play Mad Scientist
H Identify the Safety Equipment
I Take Data *During* Lab

MODULE 4
MECHATRONICS AND ROBOTICS

UNIT 1. Mechatronics

Vocabulary

a prime example, n – лучший, классический пример (also a classic example)
agile, adj – быстрый
avionics, n – авиакосмическое электронное оборудование
collaboration, n – совместная работа, сотрудничество
flexible, adj – гибкий
in the scope of – в пределах, в масштабе
robustness, n – прочность, устойчивость
stiffness, n – жёсткость
to advance, v – продвигаться (вперед)
to broaden, v – расширить
to call for, v – требовать
to coin (a word), v – придумать, ввести в употребление (о слове)
to imply, v – подразумевать
to inherit, v – наследовать, перенимать
to multiply, v – увеличиваться в количестве
to originate, v – происходить (откуда-то), возникнуть
to release, v – сделать доступным, выпустить
to unify, v – объединять

1.1. Before you read:

1) What is mechatronics? Can you give a definition?
2) What is the origin of the word?
3) Why is this field important?
4) What may be the difference between multi- and interdisciplinary?

Text 1

Mechatronics

Mechatronics is a multidisciplinary field of science that includes a combination of mechanical engineering, electronics, computer engineering, telecommunications engineering, systems engineering and control engineering. As technology advances, the subfields of engineering multiply and adapt. Mechatronics' aim is a design process that unifies these subfields. At the very beginning, mechatronics just included the combination of mechanics and electronics; however, as technical systems have become more and more complex the definition has been broadened to include more technical areas.

The word "mechatronics" originated in Japanese-English. Tetsuro Mori, an engineer of Yaskawa Electric Corporation, coined it. A company in Japan registered the word "mechatronics" as trademark in 1971. Afterward the company released the right of using the word to public, and the word "mechatronics" spread to the rest of the world.

A mechatronics engineer unites the principles of mechanics, electronics, and computing to generate a simpler, more economical and reliable system. An industrial robot is a prime example of a mechatronics system; it includes aspects of electronics, mechanics, and computing to do its day-to-day jobs.

Engineering cybernetics deals with the question of control engineering of mechatronic systems. We may use it to control or regulate such a system. Through collaboration, the mechatronic modules perform the production goals and inherit flexible and agile manufacturing properties in the production scheme.

Mechanical modeling calls for modeling and simulating physical complex phenomena in the scope of a multi-scale and multi-physical approach. This implies to implement and to manage modeling and optimization methods and tools. The whole approach is systemic. If you wish to open your mind to systems engineering or learn more about optimization and multidisciplinary simulation technics, this specialty is for you.

A new variant of the field is biomechatronics, whose purpose is to integrate mechanical parts with a human being, usually in the form of removable gadgets such as an exoskeleton. Another variant is Motion

control. The robustness of motion control is a function of stiffness and a basis for practical realization. Target of motion depends on control stiffness which could be variable according to the task. However, the system robustness of motion always requires very high stiffness in the controller. Avionics is also a variant of mechatronics as it combines several fields such as electronics and telecom with Aerospace Engineering.

1.2. Read the text and answer the questions.

1) What does mechatronics include currently?
2) What is the aim of mechatronics?
3) What combination did mechatronics consist of at first?
4) What is the origin of the word 'mechatronics'?
5) What does the mechatronics engineer unite?
6) What is the best example of a mechatronic system? Why?
7) What is an industrial robot?
8) What does engineering cybernetics deal with?
9) What is the purpose of biomechatronics?

1.3. Note that the sciences and fields of research which end in -ics are singular:

Mechatronics is a field of science…
Mathematics studies…
Robotics deals with…

a) Make sentences with other similar words from the text (e.g. avionics, mechanics, electronics).

b) Complete the table about the subfields of mechatronics.

subfield	description	usage
engineering cybernetics	achieving collaboration of modules	
mechanical modeling		systems engineering, simulation
biomechatronics		
motion control		
avionics		

1.4. Match the words with their definitions.

1) To advance	a) consisting of many different parts
2) collaboration	b) to move forward in a purposeful way
3) industrial	c) inability to move easily and without pain
4) integrated	d) with various parts or aspects linked or coordinated
5) stiffness	e) the action of working with someone to produce something
6) to implement	f) to put into effect
7) to broaden	g) to become wider / to cause something to become wider
8) to inherit	h) to derive genetically from ancestors
9) reliable	i) relating to or characterized by industry
10) complex	j) consistently good in quality or performance

1.5. Guess the meaning of the following international words:

multidisciplinary, cybernetics, avionics, telecommunications engineering, complex phenomena, integrate, exoskeleton, aerospace engineering, principles, control engineering.

1.6. Word formation: fill in the table and translate all the words.

verb	noun	adjective
to imply	implication	x
x		robust
to collaborate		collaborative
	origin	original
	removal	removable
to stiffen		stiff
	multiplication	multiple
	unification	unified
to flex	flexibility	
x	agility	

1.7. Choose the right answer.

1) Control _____ is a field of study important for complex systems.

a) engineer; b) engineering; c) to engineer

2) The definition of mechatronics broadened _____ some new areas.

a) including; b) included; c) to include

3) The Japanese company released the right of _____ the word ‘mechatronics all over the world.

a) use; b) using; c) to use

4) This field is for those who want _____ their minds to systems engineering.

a) opening; b) opened; c) to open

5) Control stiffness can change _____ to the task.

a) according; b) accorded; c) accordingly

6) Mechatronics is a _____ field: it contains mechanics and electronics.

a) unify; b) unifying; c) unified

1.8. Translate into English.

1) Слово «мехатроника», придуманное инженером Тэцуро Мори, вскоре стало использоваться по всему миру.

2) Механическое моделирование – это моделирование и симуляция явлений в пределах системного подхода.

3) Авиакосмическое моделирование (моделирование авиакосмического электронного оборудования) – вариант мехатроники, объединяющий несколько областей, такие как электроника и телекоммуникации.

4) Предполагается, что модули в мехатронике выполняют производственные задачи и сохраняют («наследуют») свойства, важные для производства.

5) Идея биомехатроники – интегрировать механические части в тело живого существа.

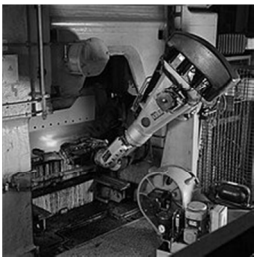
UNIT 2. Robots and Their Types

Vocabulary

an increase, n – увеличение
appearance, n – внешность
application, n – применение
behavior, n – поведение
concern, n – беспокойство
consumer, n/adj – потребитель(ский)
end effector, n – конечное звено, рабочий орган (у робота)
external, adj– внешний;
gripper assembly, n – захватное устройство
hazard, n – опасность, угроза
internal, adj – внутренний
jointed arm, n (multi-linked manipulator – сочлененная рука (у робота)
limitation, n – ограничение
repetitive, adj – повторяющийся
to assess,v – оценить
to attach, v – прикрепить
to increase, v – увеличить(ся)
to perform, v – исполнять, выполнять
to resemble, v – напоминать, быть похожим (на)
vehicle, n – транспортное средство

2.1. Before you read:

- What can you see in those pictures? What do they have in common?
- What may be the purposes of these devices?



2.2. Match the pictures with the descriptions:

a) a vacuum cleaning robot
b) a humanoid for playing Ping-Pong
c) a robotic surgery machine
d) an automated guided vehicle for carrying things
e) a pick-and-place factory robot

A robot is a programmable machine capable of performing a complex series of actions automatically. External or internal control devices can guide them. Robots can have various forms: from humanoids such as TOSY Ping Pong Playing Robot (TOPIO) to industrial robots, medical operating and patient assist robots, pet robots, drones and even microscopic nano robots. By copying a lifelike appearance or automating movements, a robot may seem intelligent.

The term comes from a Czech word, robota, meaning "forced work"; the word "robot" first denoted a humanoid in a 1920 play R.U.R. by the Czech writer, Karel Čapek but the word's true inventor was Karel's brother Josef.

The branch of technology that deals with the design, construction, operation, application and controlling of robots is robotics. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance or behavior.

The first electronic autonomous robots were created in Britain and the USA in the late 1940s. The first commercial, digital and programmable robot was built by George Devol in 1954. It lifted hot metal at a plant in New Jersey.

Robots have replaced humans in performing repetitive and dangerous tasks which humans prefer not to do, or are unable to do because of size limitations, or which take place in extreme environments such as outer space or the bottom of the sea. There are concerns about the increasing use of robots and their role in society, e. g. about them rising unemployment.

Modern robots

Mobile robots are able to move around. An example of a mobile robot is the automatic guided vehicle (AGV), a robot that follows markers or wires in the floor, or uses vision or lasers. Mobile robots may also be consumer products, for entertainment or to perform tasks like cleaning.

Industrial robots usually consist of a jointed arm (multi-linked manipulator) and an end effector attached to a fixed surface. One of the most common types of end effector is a gripper assembly.

There are also educational robots used as assistants to teachers. From the 1980s, robots such as turtles were used in schools and programmed using the Logo language. Robots help children learn about mathematics, physics, programming, and electronics. Robotics is also used in elementary and high school life in the form of robot competitions with the company FIRST (For Inspiration and Recognition of Science and Technology).

A collaborative robot or cobot is a robot that can safely interact with human workers while performing simple industrial tasks. However, end effectors and other conditions may create hazards, and engineers should always assess the risks.

2.3. Define if the statements are True or False:

1) A robot always has a human form.
2) It was NOT Karel Čapek who invented the word ‘robot’.
3) The first robot was built in New Jersey.
4) There is a danger of robots causing unemployment.
5) An industrial robot often consists of a manipulator and an end effector.
6) FIRST is a school where robots teach.

2.4. Answer the following questions:

1) What is a robot?
2) What kinds of devices can guide a robot?
3) By what means a robot may seem intelligent?
4) Who was the true inventor of the word "robot"?
5) How is the branch of technology designing the robots called?
6) Where were the first robots created?
7) When was the first commercial robot built?

8) Where have robots replaced humans?
9) What are mobile robots able to do?
10) What do industrial robots consist of?

2.5. Match the words with their synonyms.

1) hazard	a) to carry out
2) repetitive	b) to evaluate
3) concern	c) worry
4) to resemble	d) danger
5) to perform	e) usage
6) external	f) restriction
7) to assess	g) to look like
8) application	h) outer
9) limitation	i) monotonous

2.6. Match the words with their definitions

1) **machine**	a) consisting of many different and connected parts
2) **perform**	b) the surroundings or conditions in which a person lives or operates
3) **complex**	c) carry out, accomplish or fulfil
4) **humanoid**	d) a thing used for transporting people or goods
5) **environment**	e) the action of gathering together for a common purpose
6) **manufacturing**	f) an event or contest to establish superiority
7) **vehicle**	g) make on a large scale using machinery
8) **joint**	h) a being resembling a human in its shape
9) **assembly**	i) an apparatus using mechanical power and having several parts
10) **competition**	j) a point at which parts of an artificial structure are joined

2.7. Fill in with the prepositions or particles.

1) Robots can resemble human beings _____ appearance.
2) Robotics deals _____ the design, construction, operation and application of robots.

3) There are concerns _____ robots taking over the world.
4) A robot is capable _____ performing complicated actions.
5) We can use robots _____ school life.

2.8. Choose the correct form.

1) Can our hospital afford _____ a medical _____ robot?
a) buying, operating b) to buy, to operate c) to by, operating d) to buy, operated
2) By _____ people's movements or appearance, a robot can _____ human-like.
a) copying, seem b) copy, seem c) to copy, to seem d) copying, to seem
3) Robots perform tasks which humans prefer _____.
a) not doing b) not to do c) not do d) not done
4) Engineers produce various kinds of _____ machines.
a) automating b) automate c) to automate d) automated
5) We may use mobile robots _____ tasks like cleaning.
a) to perform b) perform c) performing d) performed
6) AGV stands for 'automatic _____ vehicle'.
a) guiding b) guided c) guide

2.9. Translate into Russian.

1) Слово «робот» происходит от чешского слова, означающего принужденный труд.
2) Роботы – программируемые машины, которые участвуют в опасных производственных процессах или просто являются потребительским продуктом, напоминающим человека внешностью или поведением.
3) Промышленные роботы состоят из манипулятора и рабочего органа, прикрепленного к поверхности.
4) Есть ли опасность увеличения безработицы на производстве?
5) Существуют также роботы, используемые в образовательном процессе.

MODULE 5
TECHNOLOGICAL MACHINES AND EQUIPMENT

UNIT 1. Computers and Computing

Vocabulary

arbitrary sequence, n – произвольная последовательность
consumer, adj – потребитель(ский)
external, n – внешний
input, n – ввод (информации)
loom, n – ткацкий станок
manual, adj – ручной, управляемый вручную
microwave oven, n – микроволновая печь
output, n – вывод (информации)
tedious, adj – скучный, монотонный
to aid, v – помогать (aid, n – помощь)
to automate, v – автоматизировать
to carry out, to perform, v – выполнять
to enable, v – позволять, делать возможным (able, adj – возможный)
to generalize, v – обобщать
to increase, v – увеличивать(ся)
versatility, n – многоплановость

1.1. Before you read

1) What is a computer?
2) What kinds of computers do you know?
3) What is the origin of the word ‘computer’?

A computer is a device that can carry out arbitrary sequences of arithmetic or logical operations automatically. The ability of computers to follow generalized sets of operations, called programs, enables them to perform an extremely wide range of tasks.

We can use such computers as control systems for a very wide variety of industrial and consumer devices. This includes simple special purpose

devices like microwave ovens and remote controls, factory devices such as industrial robots and computer assisted design (CAD), but also in general purpose devices like personal computers and mobile devices such as smartphones. The Internet works on computers and it connects millions of other computers.

Since ancient times, simple manual devices like the abacus aided people in doing calculations. Early in the Industrial Revolution, some mechanical devices were built to automate long tedious tasks, such as guiding patterns for looms. More sophisticated electrical machines did specialized analog calculations in the early 20th century. The first digital electronic calculating machines were developed during World War II. The speed, power, and versatility of computers have greatly increased since then.

A modern computer consists of at least one processing element, typically a central processing unit (CPU), and some form of memory. The processing element carries out arithmetic and logical operations, and a sequencing and control unit can change the order of operations. Peripheral devices include input devices (keyboards, mice, joystick, etc.), output devices (monitor screens, printers, etc.), and input/output devices that perform both functions (e.g., the 2000s-era touchscreen). Peripheral devices get information from an external source and they enable the result of operations to be saved.

The Online Etymology Dictionary gives the first use of "computer" in the "1640s, [meaning] "one who calculates"; this is an "... agent noun from compute (v.)". According to the Online Etymology Dictionary, the use of the term to mean "calculating machine" (of any type) is from 1897.

1.2. Define if the statements are True or False

1) A program is a general set of operations that helps the computer perform tasks.
2) Computers can only be used for industrial purposes.
3) Microwave ovens are general purpose devices.
4) Long ago ancient computers helped people to calculate.
5) A touchscreen is both an input and an output device.
6) The internet can work on simple manual devices.
7) The word ‘computer’ appeared only in the 20th century.
8) The first digital electronic calculating machines were developed during World War I.

9) Peripheral devices can get information from internal source only.
10) Generalized sets of operations are called units.

1.3. Find two synonyms to the following words:

1) to perform – a) to entitle; b) to fulfil; c) to accomplish
2) to help – a) to assist; b) to sanction; c) to support
3) monotonous – a) boring; b) lively; c) uninteresting
4) to grow – a) to achieve; b) to originate; c) to arise
5) to allow – a) to permit; b) to reduce; c) to authorize
6) a device – a) an apparatus; b) a unit; c) a gadget
7) to automate – a) to robotize; b) to humanize; c) to automize

1.4. Match the words with their definitions:

arbitrary	a place where power or information leaves the system
sequence	based on random choice or personal whim
consumer	put data into a computer
purpose	an enumerated collection of objects
generalized	relating to or done with hands
to enable	one that utilizes economic goods
manual	give power, competence or ability
input	the reason for which something is done or created
output	outer
external	make more widespread

1.5. Guess the meaning of the following international words.

To automate; arithmetic; logical; analog; peripheral; processing element; calculations; devices; smartphones.

1.6. Choose the correct grammatical form.

1) That program is _____ Microsoft Power Point.
a) called; b) calling; c) call
2) This loom was built _____ weaving .
a) automating; b) automate; c) to automate
3) Peripheral devices include, among others, input/output devices _____ both input and output functions.

a) performed; b) performing; c) perform

4) Can it do _____ analog calculations?

a) specializing; b) to specialize; c) specialized

5) The word ‘to calculate’ was first used in the 16th century _____ ‘to count’.

a) mean; b) meaning; c) to mean

1.8. Translate into English:

1) Компьютер состоит из процессора и периферийных устройств, включающих устройства ввода и вывода.

2) Периферийные устройства позволяют нам сохранить информацию, полученную из внешних источников.

3) Компьютеры активно используются в промышленных целях.

4) Процессор производит арифметические и логические операции.

5) Скорость и мощность компьютеров очень возросли за последнее время.

6) Разработчики стремятся увеличить многофункциональность мобильных телефонов.

7) Программы – обобщенные последовательности операций, которые управляют ресурсами компьютера.

8) Специальные программы помогают потребителям в переводе текстов.

UNIT 2. Lathes

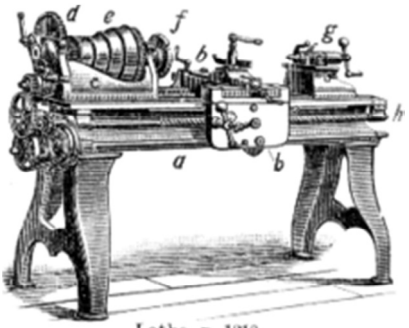
Vocabulary

axis (pl. axes), n – ось
axle, n – вал, ось
beam, n – балка
flywheel, n – маховое колесо
foot power, n – ножной привод
gear drive, n – зубчатый привод
glass-working, n – стекольное производство
hollow, adj – полый
metal spinning, n – токарная вытяжка;

metalworking, n – обработка металла;
plane surface, n – плоская (лицевая) поверхность
potter's wheel, n – гончарный круг;
pottery, n – гончарное ремесло и изделия
precision, n – точность
screw thread (helix, pl. helices) , n – винт, винтовая нарезка
solid of revolution, n – тело вращения
spindle, n – шпиндель
taper, n – резцедержатель
thermal spraying, n – термическое напыление
to drill, v – сверлить
to elevate, v – поднимать
to impart motion, v – приводить в движение
to knurl, v – делать насечку (knurl – насечка)
to rotate, v – вращать(ся)
to sand, v – шлифовать, шкурить
to turn, v – обтачивать (на станке): turning – токарное ремесло
treadle, n – педаль
workpiece, n – заготовка, обрабатываемая деталь

2.1. Before you read

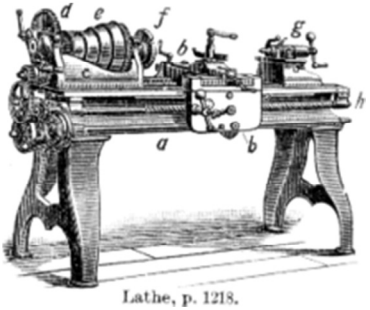
- What can you see in the picture? What is this device used for?
- What is each part called? Match the names with the letters.



Lathe, p. 1218.

1) leadscrew [ˈliːd ˌskruː] – ходовой винт
2) back gear [ˈbæk ˈgɪə(r)] – привод заднего хода

3) bed [bed] – станина
4) faceplate [ˈfeɪsˌpleɪt] – круглый стол, планшайба
5) headstock [ˈhedˌstɒk] – передняя бабка
6) cone pulley [ˈkəʊn ˈpʊli] – ступенчатый шкив
7) tailstock [ˈteɪlˌstɒk] – задняя бабка, упор
8) carriage [ˈkærɪdʒ] – суппорт



Lathe, p. 1218.

A metalworking lathe from 1911, showing component parts:

a – bed
b – carriage
c – headstock
d – back gear
e – cone pulley
f – faceplate on spindle
g – tailstock
h – leadscrew

2.2. Read the text and choose the right answer(s).

1) A lathe that shapes pottery has a form of a…
   a) barrel; b) wheel; c) box; d) square
2) Another word for a screw thread is a…
   a) taper; b) grip; c) helix; d) flywheel
3) What do the spindles do?
   a) elevate the lathe
b) make the work piece move
   c) cut
   d) grip the work piece

4) What does the taper in the tailstock do?
   a) powers the lathe
   b) stops the lathe
   c) grips the tools
   d) drills

A lathe /leıð/ is a tool that rotates the workpiece about an axis of rotation to perform different operations such as cutting, sanding, knurling, drilling, deformation, turning, with tools that we apply to the workpiece to create an object with symmetry about that axis.

Lathes are used in woodturning, metalworking, metal spinning, thermal spraying, parts improvement, and glass-working. Lathes can be used to shape pottery. The best-known lathe design for that is the potter's wheel. Most suitably equipped metalworking lathes can also be used to produce most solids of revolution, plane surfaces and screw threads or helices. Examples of objects produced on a lathe include candlestick holders, gun barrels, cue sticks, table legs, bowls, baseball bats, musical instruments and many others.

A lathe may or may not have legs, which sit on the floor and elevate the lathe bed to a working height. Almost all lathes have a bed, which is a horizontal beam. At one end of the bed (almost always the left) is a headstock. The headstock provides spinning with high precision. Within the bearings a horizontal axle rotates. Its axis is parallel to the bed and called the spindle. Spindles are often hollow. They are powered and impart motion to the workpiece. We can drive the spindle either by foot power from a treadle and flywheel or by a belt or gear drive to a power source. In most modern lathes this power source is an integral electric motor.

Opposite to the headstock there is the tailstock. The tailstock contains a barrel, which does not rotate, but can slide in and out parallel to the axis of the bed and directly in line with the headstock spindle. The barrel is hollow and usually contains a taper to make the gripping of different types of tools easier.

2.3. Match the words with their definitions.

1) component	a) an object being worked on with tool or machine
2) integral	b) raise or lift to a higher position

3) helix	c) essential or fundamental
4) to impart	d) member of an ordered pair of numbers
5) gear	e) an object having a three- dimensional shape
6) barrel	f) make information known
7) workpiece	g) the speed of the driven parts
8) elevate	h) a cylindrical container bulging out in the middle

2.4. Fill in with the prepositions.

1) _____ the left end of the bed there is a headstock, and _____ the right end a tailstock.

2) The barrel can slide _____ and _____ parallel _____ the axis of the bed and _____ line _____ the spindle.

3) We take the work piece and rotate it _____ an axis.

4) _____ a modern lathe, an electric motor can impart motion _____ the workpiece.

5) Can we produce a pot _____ a lathe?

6) We can use lathes _____ woodturning and metalworking.

7) The legs sit _____ the floor and elevate the bed _____ the necessary height.

2.5. Choose the correct answer(s).

1) The taper makes it easy _____ the tools.

a) gripping b) to grip c) grip

2) This equipment can perform operations such as _____ and _____.

a) cutting, sanding b) cut, sand c) to cut, to sand d) cutting, to sand

3) We can use a metalworking lathe _____ solids of revolution.

a) producing b) produced c) to produce

4) May a metalworking lathe _____ legs?

a) having b) have c) to have

5) We apply some tools to the workpiece _____ a symmetrical object.

a) to create b) creating c) created.

2.6. Translate into English.

1) Части станка вращают предмет вокруг своей оси для выполнения различных операций, например, сверления и насечек.

2) Металлообрабатывающие станки, оборудованные надлежащим образом, используются для производства винтов.

3) Ось, называемая шпинделем, параллельна станине.

4) Вращение на станке осуществляется с высокой точностью.

2.7. Find a picture of a modern lathe and describe what it does and how it works.

MODULE 6
MATERIAL CRAFT PROCESSING TECHNOLOGY

UNIT 1. Woodworking

Vocabulary

available, adj – доступный
broadleaf tree, n – лиственное / широколистное дерево;
cabinetry, n – изготовление кухонной мебели, шкафов (cabinet – шкаф)
cam, n – кулачок, кулачковый механизм
carpenter, n – плотник
carpentry, n – плотницкое дело
coniferous tree, n – хвойное дерево
craftsman, n – ремесленник
demand, n – спрос
drill, n – дрель
joiner, n – столяр
joinery, n – столярное ремесло; сборка, соединение
lever, n – рычаг
man-made, adj – искусственный, сделанный руками человека
manually, adv – вручную
MDF (medium-density fibreboard), n – древесноволокнистая плита (ДВП) средней плотности
plywood, n – фанера
rechargeable, adj – перезаряжаемый
saw, n – пила
to bore, v – сверлить
to execute, v – выполнять
to recharge, v – (пере)заряжать
trade, n – торговля
wood carving, n – резьба по дереву
woodturning, n – токарные работы по дереву (turner – токарь)

1.1. Before you read

What can you see in the pictures?

1)

2)

3)

4)

5)

2.1. Match the pictures with the activities. What do they all have in common?

a) Joinery
b) Carpentry

c) Woodcarving
d) Cabinet working
e) Woodturning

Woodworking is the activity or skill of making items from wood, and includes cabinet making (cabinetry and furniture), wood carving, joinery, carpentry, and woodturning.

Historically, wood was one of the first materials early humans were using. The development of civilization was closely connected to the development of greater degrees of skill in working these materials. First woodworkers relied upon the woods native to their region, until transportation and trade innovations made more exotic woods available to the craftsman. We can divide woods into three basic types:

- hardwoods from broadleaf trees,
- softwoods from coniferous trees,
- man-made materials such as plywood and MDF.

Furniture such as tables and chairs is usually made of hardwood, and cabinet makers use plywood and other man-made panel products.

With the advances in modern technology and the demands of industry, woodwork as a field has greatly developed. Computer Numeric Controlled (CNC) Machines, for example, make us able to mass-produce and reproduce products faster, with less waste, and often more complex in design than ever before.

Computer numerical control (CNC) is the automation of machine tools by means of computers executing programmed sequences of machine control commands. This is in contrast to machines manually controlled by wheels or levers, or mechanically automated by cams alone.

In modern CNC systems, the design of a mechanical part and its manufacturing program is highly automated. The part's mechanical dimensions are defined with the help of computer-aided design (CAD) software, and then translated into manufacturing directives by computer-aided manufacturing (CAM) software. Then the directives are transformed into the specific commands and after that loaded into the CNC machine. As any particular component might require the use of a number of different tools – drills, saws, etc. – modern machines often combine several tools into a complex one.

CNC Routers can carve complicated and highly detailed shapes to create signs or art. Rechargeable power tools speed up creation of many projects

and require much less body strength than in the past, for example when boring many holes. However, there still remains demand for handcrafted work such as furniture and arts.

2.2. Define if the statements are True or false.

1) Modern woodworkers use only wood of trees growing in their region.
2) All furniture is made of wood from broadleaf trees.
3) CNC includes computer programs that make woodworking automatic.
4) With CNC, we can only use separate tools for each purpose.
5) Handcrafted woodworking is considered to be very important nowadays.

2.3. Match the words with their definitions.

1) man-made	a) make deep holes
2) manually	b) ready for use
3) available	c) artificial
4) bore	d) per hand
5) execute	e) interest, need
6) demand	f) business, enterprise
7) trade	g) perform, carry out

2.4. Write the words for each definition.

1. A tree with leaves like needles is…
2. A material made from thin layers of wood is…
3. A wood product made by breaking down wood residuals (остатки) into wood fibres is…
4. A long handle that you pull or push to operate a machine is…
5. A tool with teeth used for cutting wood or metal is…

2.5. Fill in with the prepositions.

1) The progress of civilization is connected _____ the development of skill _____ woodworking.
2) First craftsmen relied _____ the trees native _____ the countries they lived in, but innovations made other woods available them.
3) Woods can be divided _____ three types.

4) Cabinets are made _____ plywood.

5) _____ the advances _____ modern technology, woodworking has greatly developed.

6) _____ contrast _____ machines manually controlled, CNC uses software to control the process of production.

7) There is still demand _____ fine woodworking.

2.6. Choose the correct answer(s).

1) Woodcarving is an activity of _____ ornamental wooden figures.

a) make; b) made ; c) making ; d) to make

2) CNC makes us able _____ items of woodworking easier.

a) to produce; b) produce ; c) producing; d) produced

3) This machine is mechanically _____ by a cam.

a) automating; b) automate; c) automated ; d) to automate

4) The software translated the dimensions into _____ directives.

a) manufacture; b) manufactured; c) to manufacture; d) manufacturing

5) The computers execute _____ of commands.

a) programmed; b) programming; c) to program; d) program

2.7. Translate into English.

1) Исторически деревообработку осуществляли ремесленники. Модернизация в этой области произошла, когда фирма HONKA изобрела деревообрабатывающий станок (lathe).

2) Дрель – орудие (tool) для сверления отверстий.

3) Перезаряжаемые электрические станки требуют меньше физической силы.

4) Обработка таких материалов, как дерево и камень, требует особых навыков / умений.

5) Кулачок – орудие, прикрепленное к колесу и заставляющее что-либо двигаться вперед или назад.

UNIT 2. Colorimetry

Vocabulary

band of wavelength, n – спектральная полоса, волновой диапазон
beyond – за пределами
colo(u)r matching function, n – функция цветового баланса
cone cells, n – колбочки (клетки сетчатки глаза, распознающие цвет)
consistency, n – стабильность, постоянство
curve, n – кривая (в частности, график)
iIlluminant, n – осветитель
irradiance, n – зд. интенсивность
numerical integration, n – численное интегрирование
perception, n – восприятие
reading, n – показатель (при измерении)
reflectance, n – отражательная способность
spectral radiance, n – спектральная энергетическая яркость, светимость
to appear to + V = to seem to (казаться)
to convert, v – переводить (во что-л.)
to quantify, v – количественно измерять
transmittance, n – пропускание
tristimulus, adj – трехкоординатный, трехцветный;
tristimulus values (pl.), n – координаты цвета
visible region, n – видимая область (спектра)

2.1. Answer the questions:

1) What does the word ‘colorimetry’ mean (judging from its form: color + ‘metry’)?
2) Where (and what for) can we use the results obtained by means of colorimetry?
3) Match the words to form the collocations . Read the text and check. Are other variants possible? What do the collocations mean?

1) spectral	a) region
2) tristimulus	b) cells
3) to take	c) radiance
4) band	d) measurements
5) color matching	e) of wavelengths
6) cone	f) values
7) numerical	g) function
8) visible	h) integration

Colorimetry is the science and technology used to quantify and describe physically the human color perception. Colorimetric equipment is similar to that used in spectrophotometry.

According to what aspect is measured, we can single out several devices used for quantifying and describing colors. They are as follows:

- A tristimulus colorimeter measures the tristimulus values of a color. These values represent three levels of stimulus corresponding to three kinds of cone cells that sense light of short, middle and long wavelength.
- A spectroradiometer measures the absolute spectral radiance (intensity) or irradiance of a light source.
- A spectrophotometer measures the spectral reflectance, transmittance, or relative irradiance of a color sample.
- A spectrocolorimeter is a spectrophotometer that can calculate tristimulus values.
- A color temperature meter measures the color temperature of an illuminant.

In digital imaging, colorimeters are tristimulus devices used for color calibration. Accurate color profiles ensure consistency of the imaging process.

We can measure the absolute spectral power distribution of a light source with the help of a spectroradiometer. It collects the lights by optical means, passes it through a monochromator and then reads it in narrow bands of wavelengths.

Reflected color can be measured using a spectrophotometer (also called spectroreflectometer or reflectometer), which takes measurements in

the visible region (and a little beyond) of a given color sample. We typically use these readings to draw the sample's spectral reflectance curve (how much it reflects, as a function of wavelength).

The readings by themselves are typically not as useful as their tristimulus values, which we can convert into chromaticity co-ordinates and manipulate through color space transformations. For this purpose we may need a spectrocolorimeter. A spectrocolorimeter is a spectrophotometer that can measure tristimulus values by numerical integration (of the color matching functions' inner product with the illuminant's spectral power distribution).

Photographers and cinematographers use information they obtain from color temperature meters to decide what color balancing they should do to make different light sources appear to have the same color temperature.

2.2. Complete the table:

Device	**What it measures**	**Purposes (where and what for)**
tristimulus colorimeter	tristimulus color values	color calibration (e. g. in digital imaging)
spectrocardiometer		
spectrophotometer		
spectrocolorimeter		
color temperature meter		

2.3. Match the words with their definitions.

1) beyond	a) the quality of being intense
2) convert	b) express or measure the quantity of
3) intensity	c) become visible, come into sight
4) quantify	d) happening or continuing after
5) consistency	e) the way in which the substance holds together
6) visible	f) able to be seen
7) appear	g) change the form or function

2.4. Fill in the table with the words from the text and translate them:

Verb	Noun
to perceive	perception
	quantity
to measure	
to reflect	
to transmit	
	conversion (переход)
to illuminate	
to acquire	
to irradiate	

2.5. Insert the English word(s) in the appropriate form(s).

1) What should we do (чтобы обнаружить источники) of the light?
2) (Кажется, что они имеют) the same color temperature.
3) (Построение кривой) requires exact measurements.
4) Colorimetric equipment is similar to the equipment (используемое) in spectrophotometry.
5) Tristimulus values represent three levels (соответствующие) to three kinds of human cells.
6) This spectrophotometer (может вычислять) tristimulus values.

2.6. Translate into English:

1) Известно, что цветовые (трехцветные) координаты соответствуют особым уровням восприятия цвета.
2) Можно измерить отраженный цвет с использованием спектрофотометра.
3) Фотографы используют измеритель цветовой температуры, чтобы решить, как делать балансировку цвета.
4) Мы используем эти показатели для построения кривой.

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АНГЛИЙСКИЙ ЯЗЫК
ДЛЯ ИНЖЕНЕРОВ-МЕХАНИКОВ

Учебное пособие

В авторской редакции

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