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ENGLISH FOR STUDENTS STUDYING AUTOMATION TECHNOLOGY

Учебно-методическое пособие по английскому языку для студентов энергетических специальностей

направления подготовки 15.03.04
«Автоматизация технологических процессов и производств»

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Учебно-методическое пособие составлено в соответствии с программой курса «Профессиональный иностранный язык». Пособие содержит оригинальные интернет-статьи профессиональной направленности по автоматизации и комплекс заданий с учетом профессиональных интересов обучаемых и соблюдением принципа междисциплинарности обучения.

Предназначено для развития профессионально-коммуникативных умений и навыков у студентов высших учебных заведений направления подготовки 15.03.04 «Автоматизация технологических процессов и производств» очной и заочной форм обучения, а также соискателей и аспирантов при изучении английского языка. Рекомендуется как для аудиторной, так и для самостоятельной подготовки студентов 2-3 курсов к профессионально-ориентированному иноязычному общению.

Учебно-методическое пособие пособие состоит из трех тематических разделов (Units), представленных оригинальными интернет-статьями профессиональной направленности, предназначенными для обучения чтению, критическому анализу прочитанного, а также элементам говорения на основе прочитанного. Наряду с текстами в пособии предлагается комплекс лексико-грамматических упражнений, способствующих активному усвоению лексики, правильному употреблению терминов, повторению некоторых аспектов грамматики.

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ПРЕДИСЛОВИЕ

Профессиональный иностранный язык относится к дисциплинам по выбору Блока 1 (Б1.В.ДВ.). Данная дисциплина, с одной стороны, предполагает успешное овладение дисциплиной «Иностранный язык», а с другой – связана со следующими дисциплинами профессионального цикла: «Моделирование систем и процессов», «Технические средства автоматизации», «Информатика», «Автоматизация технологических процессов и производств», «Технологические процессы автоматизированных производств» и др.

Дисциплина «Профессиональный иностранный язык» является логичным продолжением дисциплины «Иностранный язык» и предполагает повышение следующих *общекультурных и профессиональных компетенций:*

- способность к коммуникации в устной и письменной формах на русском и иностранном языках для решения задач межличностного и межкультурного взаимодействия (ОК-3);

- способность аккумулировать научно-техническую информацию, отечественный и зарубежный опыт в области автоматизации технологических процессов и производств, автоматизированного управления жизненным циклом продукции, компьютерных систем управления ее качеством (ПК-18).

В первую очередь, дисциплина способствует эффективному осуществлению профессиональной деятельности с использованием иностранного языка.

Целью пособия является совершенствование и систематизация знаний и умений студентов, обогащение их словарного запаса по предлагаемой тематике, формирование навыков понимания, перевода и реферирования текстов по специальности, дальнейшее развитие навыков монологического высказывания на основе письменного текста. При разработке системы заданий положен принцип интегративности обучения иностранному языку, предполагающий комплексную тематическую организацию учебного материала для взаимосвязанного обучения всем видам речевой деятельности.

Учебное пособие состоит из трех тематических разделов (Units), представленных оригинальными интернет-статьями профессиональной направленности, предназначенными для обучения чтению, критическому анализу прочитанного, а также элементам говорения на основе прочитанного. В статьях рассматривается спектр тем, соответствующих профессиональным интересам студентов направления подготовки 15.03.04 «Автоматизация технологических процессов и производств»: «Автоматизация», «Развитие автоматизации», «Современная автоматизация», «Применение автоматизации в промышленности», «Автоматическое управление», «Автоматизация в промышленности», «Компьютеры», «Робототехника» и др.

Наряду с текстами в пособии предлагается комплекс лексико-грамматических упражнений, способствующих активному усвоению лексики, правильному употреблению терминов, повторению некоторых аспектов грамматики. Грамматический блок состоит из 7 тематических разделов, включающих теоретический материал и тренировочные упражнения, обеспечивающие многостороннюю проработку каждой темы.

Пособие также содержит примерный план для составления аннотации и реферата статьи, список неправильных глаголов, таблицу времен английского языка (Supplements).

UNUT 1 AUTOMATION

Article 1

Why is Industrial Automation Important?

Over the past years, there has been a positive growth in the global industrial automation industry. According to a report, industrial automation market is expected to reach USD 153.83 Billion by 2022, growing at a CAGR of 5.10% between 2017 and 2022. Moreover, usage of automation techniques is on the rise and is expected to continue rising for the foreseeable future.

These expectations showcase that global industrial automation companies are preferring automation to reduce manual labor inputs and decrease costs. It further eliminates the requirement for many low-paying offshore jobs and allows the companies to increase the need for high-skilled activities.

The major advantages of using automation are:

- Reduced direct human labor costs and expenses
- Increased productivity
- Enhanced consistency of processes or product
- Delivery of quality productsWhy is industrial automation so important?

The industrial world is facing many technological changes which increased the urgent demand for the premium quality products and services that can only be supplied by a high level of productivity. This requirement needs process engineering systems, automated manufacturing, and industrial automation.

Hence, industrial automation plays a key role in solving the requirements of companies. It is extremely significant to face the tasks of:

Globalization – Global industrial automation market demands superior, practical services

Productivity – Automation companies want to enhance their productivity by producing a higher level of Automation. The key factors include costs, time and quality.

On the other hand, industrial automation is all about working smarter, faster, and proficiently. This makes automation more powerful and that's why customers are looking for pioneering, end-to-end technologies with open, modern architecture and new data from new connections. As the industrial automation industry comprehends the advantages of the Internet of Things (IoT), it is becoming essential that organizations adopt these technologies.

Industrial Automation Becomes a 'Solutions' Business:

Industrial automation is important as it becomes a solution business. Let us check how it becomes a solutions business:

Industrial automation refers the categorization of software and hardware and a mechanism that combines them (hardware & software). Moreover, it involves the process of rolling out new features using advanced technology in business to reduce limitations. Automation can be achieved by installing automated devices or embedded systems as well as automation software performing the logical tasks and control the operation processes.

Implementation of these devices, software, and hardware will be the 'Solution' to deliver the operation to be automated. These solutions are widely used nowadays to enhance efficiency and productivity of businesses.

Using Android is not feasible in industrial Automation:

Using Android in industrial automation is not feasible due to various reasons. Here are some of them:

- Future expansion as Android is not modular
- Ruggedness and environmental factors
- Android cannot handle sizable and complex systems
- Not reliable
- You cannot guarantee the safety of the process

Future of Industrial Automation:

Industrial Automation is moving towards exceptional productivity spurred by superior energy efficiency, rigorous safety standards, and better design. Instrumentation and controls have always been a source of new products such as amplifiers, displays, control elements etc.

Automation has been using everywhere nowadays. SCADA, DCS, Process Instruments etc have made automation more reliable and powerful.

Article 2

How Integrated Automation Makes Industrial Plant Safer?

Integration of safety functionality into all standard components using advancing automation technologies will facilitate to enhance system performance and business productivity. Integrating most advanced automation technology will assist to surpass global safety-compliance requirements promptly and cost-effectively.

In the present scenario, several manufacturing plants are finding it difficult to contribute to their companies' growth and success. Moreover, manufacturing facilities are deploying intelligent, integrated safety solutions to increase their business efficiency and productivity. This may contribute to the continuous development and operational excellence.

Major developments in the automation industry and the advent of latest technologies helped the companies to safeguard their machines, workers, and the automation environment while improving productivity, reducing costs, and following environmental regulations. Faster and cost-effective implementation of safe and productive machines can be achieved by integrating the highest performing automation systems.

Plant facilities are required to follow a strategic approach to improve modern automation technology that not only improves the overall performance of their systems but also complies with global safety norms.

Below mentioned are the four ways that are required to make industrial plants safer:

1) Integrating Safety Features

A few years ago, plant engineers used to hardwire each and every safety equipment to protect the plant. This means that they used to combine gate interlocks, light curtains, e-stops, and other monitoring and safety shutdown equipments for the purpose.

Now, with the advent of contemporary techniques and innovative automation solutions, which include equipment safety and plant safety measures, there is a seamless integration between production and safety setup in the plant.

Whether it is for safety or standard hardware, all programming is carried out within the same software package. With this, safety planning becomes universal.

Integration of safety features helps to reduce the cost of ownership, reduce stress on workers on engineering and maintenance tasks. Inclusion of safety features in the automation machinery helps to attain greater system availability, run quickest system diagnostic for troubleshooting which ultimately leads to higher uptimes and productivity.

2) Compliance with Safety Standards

Plant's safety norms can be maximized by complying with safety standards which include IEC 61508, A NSI/ISA-84, IEC 62061, EN ISO 13849- and IEC 61511. For example: Consider IEC 61508

According to Wikipedia, "IEC 61508 is an international standard published by the International Electrotechnical Commission of rules applied in industry. It is titled Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems (E/E/PE, or E/E/PES)."

"IEC 61508 is intended to be a basic functional safety standard applicable to all kinds of industry. It defines functional safety as: "part of the overall safety relating to the EUC (Equipment Under Control) and the EUC control system which depends on the correct functioning of the E/E/PE safety-related systems, other technology safety-related systems and external risk reduction facilities."

3) Usage of Standard Fieldbus

In the past, two separate fieldbuses were required to maintain safety and transfer data within the plant. But, with the advancement of the technology, there is no need to run two separate field buses.

Plants can be fixed with standard Fieldbus to transmit data safely which reduces wiring complexity and system costs. Usage of standard Fieldbus also improves diagnostic capabilities.

4) Integrated Diagnostic Function Competence

Industrial plant remains safer when it is integrated with diagnostic functions that are offered by components such as PLCs, HMIs, drives and network switches. These components make troubleshooting and maintenance of the plant easier and safer than ever before.

Functioning of all these components can be viewed by integrating the latest technology in a networked computer or mobile device. Automatic alerts will be sent to mobile devices, and, if necessary, personnel can open the system to check, assess and correct the data. Operators and maintenance technicians can detect, report, and clear faults quickly and safely using integrated diagnostic functional capabilities.

Implementing these four ways, integrated automation can make the industrial plant safer and also improves the overall performance of a plant while complying with global safety norms.

Article 3

Making Plant Automation Intelligent

Most of us in the automation industry have recovered from the economic crisis of the last few years, but many factories have not yet hired new personnel to meet the growing demands. Efficiency matters more than ever, and plant managers are seeking ways to streamline their manufacturing processes.

Thanks to lower cost control systems and advances in software, I/O, and Ethernet infrastructure, control engineers can better use industrial automation for its core purpose—to increase production flexibility and reduce the cost of ownership in a manufacturing or process facility.

The programmable controller is the heart of a control system. Whether it is a simple nano programmable logic controller (PLC) or a full-scale industrial PC, today's control platforms are much more affordable than similar models were just a few years ago. It is also easier than ever to closely match the control platform's processing performance to the machine's requirements. There is no need to purchase more controller capability than the system requires.

In the past, smaller machines were a particular problem. It was difficult to find a cost-effective controller with built-in Ethernet connectivity. However, inexpensive nano class PLCs can now control small to midsize machines.

High-end PC control systems are at the other end of the spectrum. Plant managers require easy-to-program software with fast and comprehensive debugging and seamless integration into a human machine interface (HMI) package.

In an ideal world, a single vendor can supply a turnkey hardware/software solution. Benefits of a "one-stop-shop" include faster programming and machine start-up, a simpler machine design, less troubleshooting, and a reduced risk of downtime and lost production. Realistically, though, a single-vendor solution is not always possible, especially in a larger, more complex automation system.

Thanks to standardization of field bus protocols, it is now possible to "mix and match" fieldbus products from different vendors within a machine or system. In addition, the automation industry has standardized on Ethernet as the physical layer for reading and writing data to devices.

While commercial-grade Ethernet components might cost less initially, they cannot withstand the extreme conditions typical on the plant floor and in the field. Choosing industrial-grade Ethernet switches, Power over Ethernet, and wireless products will save money in the long run.

For small, isolated networks, unmanaged switches are the more cost-effective choice. They require no configuration and transmit the required data to the intended receiving port.

More complex networks require a managed switch. With a managed switch, you can add network configuration capability, remote monitoring and diagnostics, and essential IT-compatible network redundancy.

Managed switches have IT-friendly features such as Simple Network Management Protocol and web-based management via a standard web browser. If the application needs fast, self-healing connections between the corporate network and the factory floor, look for a managed switch with higher level functions such as Rapid Spanning Tree Protocol or Fast Ring high-speed redundancy, IGMP Snooping and Query, VLAN, and port security.

In recent years, wireless technology has become more reliable and secure, making it an attractive option in cases where physical cabling is cost-prohibitive or even impossible. In many cases, wireless can even rescue stranded data that was previously inaccessible.

By integrating modern controllers with innovations in software, Ethernet infrastructure, and I/O, control engineers can build a more flexible, powerful, and affordable automation system.

Automation has revolutionized manufacturing processes and transportation systems during the past three decades, reducing costs and improving efficiency. Enterprises and institutions in the manufacturing, process control, and transportation industries face similar challenges as they strive to build on these gains and compete effectively in a global economic environment. These challenges include:

Making strategic business decisions supported by precise real-time operations information

- Minimizing operational, supply chain and service fulfillment risks
- Reducing excess inventory through improved visibility into production performance and demand information

- Delivering high quality products and services consistently
- Ensuring on-time delivery and service performance
- Improving asset lifecycle management by processing more data from equipment and processes
- Reducing support costs for automation, equipment and industrial networks
- Delivering repeatable customer experiences with high satisfaction
- Enhancing the company's ability to compete effectively in a global business environment.

Where can organizations in the manufacturing, process control, and transportation industries look for solutions? The answer lies with "industrial intelligence," which simply put, is the enablement of enterprises to more intelligently and responsively manages industrial operations globally. Traditional industrial automation tools, including plant systems running programmable logic controllers (PLCs) and supervisory control and data acquisition (SCADA) systems are only part of what constitutes industrial intelligence.

Manufacturing and supply chain management businesses can reduce operations costs and improve manufacturing flexibility and agility by providing greater visibility into real-time production information with real-time business and economic context.

Chemical manufacturers, upstream and downstream oil and gas operations, as well as process manufacturers in the pharmaceutical, mining, metals, materials, food and beverage, and water and wastewater industries can implement industrial intelligence to improve operational performance.

Industrial intelligence works with transportation systems to enable real-time video surveillance, real-time signage, IP-enabled traffic controllers, and IP sensors.

Today, industrial intelligence extends beyond operations, connecting production environments to the rest of the business.

Article 4

Two Major Factors turning Automation

Most of the intellectuals moved to IT leaving Automation. Now, automation supported Artificial Intelligence and Augmented reality are exploding its benefits rapidly into the world. Artificial Intelligence and Augmented Reality acts as the front end for the industrial automation. It includes self-driving cars, face recognition, web search, industrial robots, missile guidance, tumor detection and many more.

What is Artificial Intelligence (AI)?

AI is a programme encoded with a coding embedded self-learning intelligence. Everyone discuss AI as a future but look around it is the present.

- An area of computer science
- Simulation of human intelligence process by the machine
- A programme or a machine to think and learn
- A machine intelligence that performs any intellectual task that a human being can do

Artificial Intelligence can be divided into three stages they are

- Artificial Narrow Intelligence (ANI)
- Artificial General Intelligence (AGI)
- Artificial Super Intelligence (ASI)

Artificial Narrow Intelligence : Narrow artificial intelligence focuses on a single subset of cognitive intelligence and advances in that bracket. Narrow intelligence is limited in a boundary an AI used in driving a car is limited to the car and Siri, Google AI and Cortana are best examples of weak AI.

Artificial General Intelligence: It is also known as strong AI and full AI. General intelligence perform any task that human being can. A group of Narrow or weak AI together form a general intelligence the ability to think that of a human being.

Artificial Superintelligence: Artificial superintelligence is a term referring to the time when the ability of computers will surpass humans. Artificial superintelligence

goes a step beyond and postulates a world in which a computer's cognitive intelligence is superior to a human's.

How does Artificial Intelligence learn?

There are lots of different ways of learning – supervised, unsupervised, semi-supervised, and many algorithms within each of that management. And nobody knows what the "optimal learning algorithm" is, or even if there is such a thing.

Optimal learning algorithm collects data efficiently it observes phenomena and learns the best out of the results. For example a drug delivery, it observes all the possible ways and learns the best potential combination for curing a particular disease. Artificial Intelligence learns through a subset called Machine learning.

Machine learning:

It is a subset of AI that analyze data and make predictions. The encoded algorithms make them learn how to make decisions. The process of learning begins with the observation. all machine learning is Artificial Intelligence, but not all Artificial Intelligence is machine learning.

Deep learning:

These are self-educating machines and a subset of machine learning. Artificial neural network is a single output from many inputs, It helps deep Learning makes a machine see, amalgamate unique art, translate languages, provide a medical diagnosis, or build a car that can drive itself.

Artificial Neural networks:

Neural network is a subset of deep learning. it associates with the transferring of knowledge from one system to other. An Artificial Neural Network (ANN) is an information processing model that is inspired by the biological nervous systems, such as the brain, process information. The key factor of this paradigm is the novel structure of the information processing system. It is comprised of a large number of highly interconnected processing elements working in cooperation to solve specific problems.

How AI is used in Automation?

At the present AI is used in various industries like transportation, gaming, robotics, security, education, mobile and business. Intelligent automation is a combination of Artificial Intelligence (AI) and automation. Intelligent automation tools unlock the existing platforms in a managed and controlled manner, ensuring it is applied where it can deliver optimal value to the business. AI predicts failures, reduce maintenance cost, optimising inventory and resources. Co-bots are the best examples of AI used in automation.

Experts opinion on AI

Elon Musk

"It's just like if we're building a road, and an anthill happens to be in the way. We don't hate ants, we're just building a road. So, goodbye, anthill."

Ray Kurzweil _Futurist

"Law of Accepting Returns"

Stephen Hawking

"The development of full artificial intelligence could spell the end of the human race."

What is Augmented Reality?

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that sojourn in the real-world are "augmented" by computer predicted information, sometimes it uses multiple sensory experiences like visual, auditory, hepatic and emanation. The overlaid sensory information can be constructive (i.e. additive to the natural environment) or destructive (i.e. masking of the natural environment) and is seamlessly mixed with the physical world such that it is recognised as an immersive aspect of the real environment.

How is Augmented Reality is used in automation?

Since Microsoft rolled out its HoloLens commercial suite in July 2016, it has seen an uptick in activity on the industrial AR front, across vertical industry segments with many customers moving from pilot stage into production. Independent software vendor (ISV) partnerships, making it easier for companies to develop AR apps with

out-of-the-box functionality instead of requiring the skilled resources of do-it-yourself (DIY) custom programming, says Greg Sullivan, Microsoft's director of communications for mixed reality.

- Valvo has been enterprising with AR on its assembly line using Microsoft Hololens.
- Mitsubishi Electric has been developing maintenance-support technology using AR based on the 3d model.
- An Elevator manufacturer uses Hololens in service operations to have remote, hand free access to technical and expert information on site.
- In Siemens, Augmented Reality is used to train maintenance engineers.

Article 5

An Insight into Intelligent Process Automation (IPA)

As part of the transformation, many companies are driven by the rapid development of technology. Complying with current trends, competitiveness, market shares etc play a dominant role.

To eradicate waste resources and reduce inefficiencies and errors, Intelligent Process Automation(IPA) is used. But, the question is, what to automate? How to automate? How to make it intelligent?

Processes can be made smarter using the Intelligent Process Automation (IPA) Solutions. They help to automate tasks as well as perform end-to-end business operations. Streamlined business performance, enhanced customer experiences and more efficient and effective operations can be obtained using the IPA solutions.

Market Trend of Intelligent Process Automation (IPA)

According to a report by Markets and Markets Analysis, the Intelligent Process Automation market was valued at USD 6.25 billion in 2017 and is projected to reach USD 13.75 billion by 2023, at a CAGR of 12.9% from 2018 to 2023.

The demand for enhanced automated IT systems, necessity for optimized resource utilization, enhanced decision-making, and increased investments for digital transformation of organizations are the key factors for the major growth of the market.

What is Intelligent Process Automation (IPA)?

Intelligent Process Automation (IPA) represents an evolved version of automation in which machines mimic human actions and posses cognitive capabilities, including natural language processing, speech recognition, computer vision technology, and machine learning.

These machines with automated intelligence understand the vast amount of unstructured, structured data and analyze, understand & learn it on the go. They intelligently automate processes to bring in more operational efficiency as well as business efficiency.

Implementing IPA in the business helps for business-process improvements and also assists the workers by removing duplicate, repetitive, and routine tasks. This will result in enhancing interactions and speeding up processes.

"Intelligent Process Automation (IPA) is Transforming the World of Automation."

Benefits of choosing Intelligent Process Automation (IPA):

- Increasing process efficiency
- Improving customer experience
- Optimizing back office operations
- Reducing costs as well as risks
- Optimizing the work force productivity
- More effective monitoring and fraud detection
- Product and service innovationIPA in its full extent encompasses five core technologies:

Robotic Process Automation (RPA):

Robotic Process Automation (RPA) is used to automate rules-based tasks like document creation, calculations, checking files for errors. It involves the automation

of standardized rules, system-based activities, other methods to support efficient business processes. RPA is suitable for executing the tasks or processes where they are too expensive or inefficient for humans to perform.

Example: A robot will be assigned a user ID just like a person to perform rules-based tasks such as accessing email and systems, performing calculations, creating documents and reports, and checking files.

Smart Workflow:

Smart workflow includes a process-management software tool that integrates tasks performed by groups of humans and machines. This workflow helps users to initiate and track the status of an end-to-end process in real time.

This process-management software helps to manage work between different groups, including between robots and human users, and provide statistical data on bottlenecks.

Machine Learning/Advanced Analytics:

Machine Learning is an application of Artificial Intelligence. The major aim of machine learning is to create intelligent machines which can think and work like human beings. Machine Learning involves statistical algorithms to make computers work in a certain way without being programmed. The algorithms receive an input value and predict an output, using certain statistical methods.

Applications of Machine Learning include Cognitive Services, Medical Services, Language Processing, Business Management, Image Recognition, Face Detection, Video Games

Advanced Analytics assist in enhancing compliance, reduce cost structures, and gain a competitive advantage from new insights.

Natural-Language Generation (NLG):

Natural-Language Generation (NLG) is a software process that automatically transforms data into written narrative. NLG tools will automatically analyze, interpret data, they will identify the most significant parts, and generate written reports in plain English.

Natural-Language Generation (NLG) brings artificial intelligence to business intelligence (BI), automating routine analysis, saving business users time and money.

Cognitive Agents:

Cognitive Agents combine machine learning and Natural-Language Generation (NLG) to build a virtual workforce (agent) that is capable of executing tasks, communicating, learning from data sets, and even making decisions based on emotion detection. Usually, cognitive agents are used to support customers/employees over the phone or via chat.

Conclusion:

Intelligent Process Automation (IPA) helps to identify and eliminate the performance bottlenecks while managing the business processes. Deploying IPA to your business, enhances efficiency, increases worker performance, reduces operational risks, and improves response times and customer journey experiences.

Article 6

Transformation of the Automation Industry

Industry 4.0 is projected to add $36 billion to Singapore's total manufacturing output, boost labour productivity by 30 per cent and create 22,000 new jobs.1

This is in accordance to a study conducted by the Boston Consulting Group and substantiated by Singapore's Economic Development Board, which states that Industry 4.0 will enable Singapore to further cement its position as a global manufacturing hub.

Companies nowadays are continuously identifying ways to grow and to remain competitive. For various industries including the manufacturing sector, this translates into the desire for companies to adopt technologies that would suit their needs and address any potential challenges to the organisation internally and externally.

We are now on the threshold of the fourth industrial revolution. Automation processes are now being followed suit by the digitalisation of production. This is evident by the fact that more manufacturers are now looking to integrate digitalisation solutions

to their current processes as an integral step to grow. The goal is to increase productivity, efficiency, speed, and quality, in order to achieve higher competitiveness in the market.

Going wireless

The demand for wireless connectivity solutions in manufacturing processes has skyrocketed in the last decade and is even more prevalent in the past few years.

The reliability of wireless technologies and the benefits of adopting it could outweigh the concerns of many automation facilities. What would the use of wireless technology mean to the automation industry?

Automation facilities are gradually seeing the benefits of self-configuring and self-healing networks to manipulate and run machines instead of modems that are hardwired to a physical instrument. Furthermore, from low-power chips for simple devices to high-power mobile chips, it is now increasingly easy to build devices that can communicate wirelessly at high speeds. By embracing wireless technologies into automation facilities, companies can gather and analyse data across machines, allowing them to assess and manage issues before they even arise. Adopting wireless also enables the ability for remote monitoring and by building in wireless chips and sensors, all kinds of devices can automatically report back to base effectively.

Digitalisation – Moving forward from automation

Digitalisation is a step forward from automation, with the interaction of the virtual and real worlds through integrated software tools and systems, industry-capable communication and security solutions as well as data based services. As a major trend and innovation driver, digitalisation creates entirely new business and growth opportunities for companies with aim to increase productivity, efficiency and flexibility.

Many manufacturers foresee the improvements that will benefit the organisation as a result of adopting digitalisation – including and not limited to productivity, employment, revenue growth, and investment. Gathering and analysing of data across machines is possible with the revolution of wireless technology.

At Siemens, we launched ZerOne.DesIgn™ Digital Factory Manufacturing Design two years ago to help manufacturers chart their Industry 4.0 transformation roadmap. The consultancy offers technical consultancy services to propose effective technology improvements that would not only help customers optimise their manufacturing processes, but also digitalise their assets and machineries to enable analytics to better manage operations on a facility-wide level.

It aims to enable manufacturers to improve their quality, productivity, flexibility and efficiency.

Conclusion

It is important for companies to note is that digitalisation is not a one-size-fits-all solution and each process should be tailor-made to suit the requirements of the specific manufacturing plant and its related processes.

As the industry becomes more glocal, it is crucial for companies to adopt digital technologies to overcome challenges and to remain competitive. Decision makers also have to realise that digitalisation does not happen at a push of a button and in most instance, the process is a gradual transition.

With the right direction aided with proper support in the form of services such as ZerOne.DesIgn™, manufacturers today have all the support required to work towards their digitalisation goals.

Reference:

1.https://www.edb.gov.sg/content/dam/edb/en/news%20and%20events/News/2017/advanced-manufacturing-release/Copyrighted-The-SG-Smart-Industry-Readiness-Index-Whitepaper.pdf

Article 7

Top 9 Automation Technologies Used In Manufacturing Industry

The manufacturing sector is most likely to transform in the coming years. Currently, the industry is witnessing a shift from manual assistance to automation, thus

giving rise to the term "industrial automation". Most of the modern large-scale manufacturing operations are automated and require minimum or no human intervention. To meet the current requirements, industrial automation is certainly the need of the hour and this is because the conventional manufacturing mechanisms are inadequate to meet the current requirements. The two major factors driving industrial automation are the introduction of favorable policies towards the manufacturing sector and increased focus on economic diversification in emerging markets. The growth of this market can be attributed to the increasing use of enabling technologies in manufacturing, connected supply chain along with mass production to cater to the rising population, rising adoption of industrial robots in the manufacturing sector, government initiatives towards the adoption of industrial automation in various industries. Automation in the manufacturing industry uses intelligent machines in factories to carry out the manufacturing processes with minimal human intervention and tasks that require endurance, speed, and precision. Some of the top benefits of automation in manufacturing include:

- Productivity
- Accuracy
- Safety
- Quality
- Smart factories
- Repeatability

A few of the automation technologies used in the manufacturing industry are

- Industry 4.0
- The Industrial Internet Of Things
- Robotics
- Artificial Intelligence
- Big Data
- The Cloud
- Cybersecurity
- Advanced Materials And Additive Manufacturing

- Modeling, Simulation, Visualization, And Immersion

  Industry 4.0

With Industry 4.0, we have reached the next milestone in the revolutionizing industry. Connecting the emerging technologies and established trends between automation and data exchange in manufacturing is industry 4.0. It's also referred to as the fourth industrial revolution as it is focused on bringing cyber-physical systems into the mainstream and placing them at the forefront of the manufacturing industry. With technologies that are only now being conceptualized and brought into existence, Industry 5.0 has already appeared on the horizon. Our factories will become more productive and efficient and less wasteful as a result of the support of smart machines that keep getting smarter as they get access to more data. Eventually, it's the network of these machines that are digitally connected and create and share information that results in the true power of Industry 4.0.

Article 8

Machine-to-Machine (M2M) communication advances Industrial Automation

With changing times, modern buildings and infrastructure have become more automated, organizations today rely on wireless machine-to-machine (M2M) communications. M2M technology allows private and public organizations to monitor and control telemetry systems, sensors, cameras, industrial equipment, and virtually any other system remotely and cost-effectively. As a result, organizations can more efficiently manage manufacturing facilities, and dozens of other remote and hard-to-reach systems.

Traditionally, M2M focused on industrial and enterprise applications. The present status of the M2M market and the core driver behind the boom is the ongoing advancement of wireless technologies. While early industrial M2M applications em-

ployed wired networks for localized automation, communications, and control, wireless technologies, and specifically cellular, have greatly expanded the possibilities for these products, taking them beyond the factory or industrial site.

Industrial and manufacturing companies face constant pressure to lower costs and improve speed and efficiency. As these companies seek to enhance productivity, they are using high end sophisticated manufacturing and supply chain automation applications. To reap the benefits of automation, however, they need to be able to gather more real-time data from the plant floor. Cellular technologies allow these companies to monitor and control equipment virtually anywhere, even in hard-to reach and temporary locations. They enable companies to operate supervisory control and data acquisition (SCADA) systems from anywhere in the facility or even remotely, and help drive down costs by integrating industrial equipment with security and environmental controls.

Cellular M2M solutions provide a means to integrate all environmental controls into one remotely controllable system, and to integrate with video surveillance and security systems. Ultimately, companies can secure multiple properties from anywhere, even as they improve power efficiency and reduce operating expenses.

Be it maintaining machines and plants installed across the globe from a central point, or a requirement to scan data from distant outstations and mobile applications, or controlling plant-wide processes - implementation of M2M solutions can reap benefits in terms of time and cost savings, operational efficiency gains and optimised performance from key remote plant or other assets.

There is a huge increase in the use of unmanned plants in the companies who rely upon keeping critical assets performing at their best. The benefits of this kind of technology are that it can deliver remote access to gather real-time process data, which becomes self-evident in the absence of skilled and costly personnel.

The benefit of enabling an engineer to remotely undertake diagnostic fault-finding via the Internet or mobile connection delivers substantial time and cost savings. Thus, the heart of M2M is the ability to quickly identify and rectify production line

faults, or develop preventative maintenance strategies to tackle potential problems before they become expensive.

Teleservice an important part of M2M communication involves data exchange over the telephone line or via the Internet with distant technical systems, such as machines, plants or computers for error detection, diagnostics, maintenance, repair or machine optimisation. Teleservice offers an efficient, bespoke and resource-saving answer to diagnose distant systems, or to help plan and implement preventative maintenance.

Telecontrol another aspect of M2M communication involves the connection of distant process stations to one or more central control systems. Various public or private networks can be used for communication for monitoring and control.

For these diverse applications and businesses, cellular M2M connectivity can address many business and technical challenges, and enable important benefits. With M2M connectivity, organizations can gain real-time information about infrastructure, equipment, or any other system from virtually anywhere and remotely monitor, update, and control equipment used for environmental controls, manufacturing equipment for irrigation systems, and others.

Statistics prove that implementing such a solution has reduced on-site service visits by up to 60%. For workers of plant spread across a wide, geographical area, or machine builders/OEMs trying to secure orders, being able to access remote locations to optimise performance, undertake real-time data analysis, carry out preventative maintenance, or simply keep plant running by minimising downtime are some of the critical benefits. M2M communication systems, which are modular, flexible and secure, are providing efficient remote access to machines and plants. They are also making a tangible contribution to cost and productivity effectiveness when managing remote industrial assets.

Additionally, M2M systems can be designed to withstand harsh environmental conditions and easily manage and control connected devices across the country or around the world. M2M systems provide flexibility to move equipment as needed, or

bring up and tear down systems quickly for temporary or seasonal deployments. By using modern M2M management and application platforms, and taking care to choose platforms designed to meet real-world requirements, organizations can take full advantage of the M2M revolution.

Being all explained, it is essential to understand the everchanging needs of the M2M application that will be spread. The need for reliability and network period of time, widespread geographic cellular coverage, or a long lifespan will largely guide design considerations and deployment strategy. With knowledge of the available technologies M2M success is attainable and will go far to provide operational efficiencies and cost benefits for organizations of all sizes and in a wide range of industries.

UNIT 2 ROBOTICS

Article 9

Why industrial robots remain as future of the automation world?

Robots are the trend today and will continue to be so in the future to a very great extent in the automation industry. The ones which are utilized in plants, factories are termed as industrial robots.

An industrial robot is a manipulator which is designed in order to shift materials, parts and tools and even carry out various programmed tasks in the manufacturing as well as production settings.

They're restructuring the manufacturing industry and very often utilized to execute duties that are dangerous and inappropriate for humans. According to a report released by market research company Forrester, by 2021 robots take up 6% of all jobs in the US including customer service representatives and taxi drivers.

In this article, we shall discuss on why industrial robots will forever be the future of the automation world?

1. Enhancement of Work:

The human being is all-time prone to injuries in the plant but this is not the case with industrial robots. They're susceptible to injuries and can perform the same work for long period with augmented quality and output.

Therefore, Industrial robots can be applicable for heavy lifting, monotonous work, working in harmful & contaminated environment and work which requires excessive levels of concentration.

Sometimes, humans have to work in environments which give out immense solvents, noise, heat, dust. These can be very much harmful to the health of the being in a long run. Hence, industrial robots will forever be the future of the automation world.

2. Economical:

Industrial robots will forever be the future of the automation world because of economic reasons as well. As humans, we tend to charge nominal wages when working on our daily routine. But, then again, when it comes to working dangerous situations, we ask greater and expensive amounts.

But, this is not the same case with industrial robots. All one i.e. manufacturer has to do install robots whenever required in a way that they can operate continuously for 24 hours per day and get the best productivity from them.

Yes, 24 hrs. Making humans work continuously for 24hrs is also not possible in the manufacturing sectors. Because of fatigue and many other reasons, human needs breaks as well.

3. Pliability:

Robots can be more flexible to change and faster as well. The other benefit of using a robot for any kind of application includes the quality of the resultant components has augmented.

Because of the available programmable controls, end-of-arm tooling and machine vision systems, the industrial robots can perform an extensive variety of repeatable tasks without any break and expensive wages.

Some advanced robotics also bring in flexibility and adaptability to unstable customer needs and on rising expectations for developing new products faster.

Hence, industrial robots will forever be the future of the automation world and a knight in shining armour every single time when a human gives up.

Article 10

Role Of Cobots In Industrial Automation

To replace human labor in crucial and risky factory jobs, robots have been widely used in the manufacturing industry for many years. But, they operated within safety measures. However, it’s an entirely different scenario with collaborative robots or "cobots". Allowing to work alongside humans, cobots or collaborative robots take away some of the spatial, environmental dangers caused by traditional robots. Cobots

in manufacturing industry are very easily reprogrammed and they share the same work-space. Also, their interaction with humans is more natural.

Cobots in industrial automation are the new frontier and will drive the automation market going forward. Designed with inherent safety features like the collision detection and force feedback, cobots excel as they function in work areas previously occupied by human counterparts. One of the leaders in cobot market, is the universal robot.

Role Of Cobots In Industry 4.0

A new phase in the industrial revolution that focuses heavily on automation, real-time data, interconnectivity and machine-learning is referred as Industry 4.0 or IIoT or smart manufacturing. Most cobots as devices, are fully compatible with the design principles of Industry 4.0. The cobots in industry 4.0 are easily able to join the Internet of Things (IoT) in any factory environment and are interoperable. They are equipped with powerful onboard computers and with their ability to pass and collect data, they promote information transparency for modeling, analysis and so on. Technical assistance is provided by conducting a range of tasks that are unsafe, unpleasant or too exhausting for their human co-workers.

Although cobots are normally used more as tools than as autonomous entities, they are able to facilitate decentralized decisions. Additionally, cobots in industry are digital products that continue evolving through software updates and their own programmability. A major role is played by cobots in industry 4.0, in enabling companies that might not have been able to afford industrial robots to begin automating their processes. Cobots are being deployed at SMEs as they are easy to program, light weight, affordable, small and versatile.

Cobots In Industrial Automation

Established by the International Organization for Standardization (ISO), the new technical specification for cobot deployment and production comply with ISO/TS 15066. The cobots are designed with safety-related control systems. For industrial robots, there's a standard 10218-1:2011 5.4 or 10218-2:2011. 5.2. Hand guiding, power

and force limiting mechanisms, safety rated monitored stop, speed and separation monitoring are the different functions of cobots in industry. Ensuring safety, these features enable cobots to work closely and collaboratively with their human co-workers.

Compared to the old-generation industrial robots, many financial benefits are offered using cobots. To automate for higher efficiency and output quality, cobots are economically viable for businesses of all sizes and more affordable. Moreover, the ease of use and safety features, make implementation and integration inexpensive. Due to their flexibility in deployment, cobots can be used for multiple functions. They offer faster payback and higher returns on investment.

For different applications such as palletizing, machine tending, pick-and-place operations, they can be customized cost-effectively and easily. This implies that instead of utilizing the cobot for only a limited period tied to a single process, business owners can use the cobot for its entire lifespan automating different processes. While relieving the amount of arduous physical effort required, other long-term tangible benefits include increase in production quality and efficiency, reduction in material wastage, helping employees by reducing mistakes by ensuring dependable, consistent output. So, rather than as a replacement for human staff, cobots enhance productivity by delivering high-quality results each time, serving as an assistive tool in such instances.

Cobots In Manufacturing Industry

Global management consulting firm, Boston Consulting Group predicts that "investment in industrial robots will increase 10% every year for the next ten years, when the robots will take over 23% of the manufacturing jobs, in the world's 25 biggest export nations. So far, only 10% of the jobs that can be automated have been taken over by the robots."

A wide range of potential applications for cobots can be seen in the manufacturing environment such as in an automobile manufacturing plant. There are applications in some manufacturing processes, where it makes sense for workers to perform a manual task. The best option, in other applications, is overall automation. Small and medium-sized manufacturers are eager to take on this technology, because cobots are

highly adaptable and affordable and some analysts expect that this section of robotics will see significant growth.

According to a recent research report by Interact Analysis, "the nascent collaborative robot market grew by more than 60% in 2018. In 2017, the industry was worth less than $400 million, but grew to nearly $600 million in the next year," said the research firm. Over the next 5 to 10 years, revenues and shipments of collaborative robots are forecast to grow rapidly.

With the advent of cobots, advances in technology have broken new ground, making automation a lot more exciting today. Cobots can be used in varied sectors, and will change the way businesses work, sell and produce. With these collaborative robotic workers, business owners will gain much profit, if they develop new ways to optimize production and rethink new automation strategy.

Article 11

Latest Trends In Industrial Robotics

In the recent decades, robots have revolutionized the industrial and manufacturing world, and are starting to leave their mark in our homes as well as in the wider world of business. Top firms are in a constant race to change the way robotics are implemented in everyday lives, which will lead us to a really exciting future. As we all know, robotic automation is a rapidly evolving technology and is only gaining popularity for their profitability and productivity.

Based on the latest trends in industrial robotics, below are few ways, we can expect robotics to transform our future.

1) Adoption Of Industrial Internet of Things (IIoT) Technology

Smart sensors and actuators will be increasingly deployed by these robots at the edge of production, to collect data that was earlier inaccessible to manufacturers. Currently, this trend is underway and will lead to new levels of efficiency and productivity. Also popularly known as Industry 4.0 or industrial internet, IIoT leverages the power

of real-time analytics and smart machines to take advantage of the data, which dumb machines have produced in industrial settings over the years.

The driving idea behind IIoT is, apart from capturing and analyzing data in real time, smart machines are better than humans at communicating vital information that can be used to take business decisions accurately and in a faster way.

2) Big Data Analysis Becomes A Competitive Differentiator

On the factory level, robots will become a main source of information. However, the data collection is just one piece of the mystery. In order to act on it, manufacturers will have to implement systems to analyze and organize all of this information.

3) Industrial Cyber security As A Priority

The future of industrial robotics can be seen in the field of cyber security even. The risk of cyber security increases, as robots become more connected to internal systems for data collection. To ensure reliable and safe production, manufacturers will be forced to invest heavily in cyber security and deal with vulnerabilities in their processes. Cyber-physical systems are on the rise and for a robot to be safe, it must also be secure. The future of industrial robotics is continuing to bloom because of the vision of smart, connected factories and Industry 4.0.

Networked robots and insightful data they generate are being used by savvy manufacturers to maximize production efficiency, simplify robot maintenance and improve product quality. Cyber risks mount as more robots are connected to each other, the cloud and the enterprise. Highly powerful and quick robotic systems come with serious safety concerns that are targeted by cyber attacks.

Cyber security, which requires everyone's vigilance, is no longer someone else's problem, but is everyone's responsibility in this age of the Industrial Internet of Things (IIoT).

4) Open Automation Architectures Will Be Implemented

The need for open automation architecture nurtures, as Robotic Process Automation (RPA) gains widespread adoption. To produce open documentation and standards, large industry players will work with industry organizations. This would make

robotic integration easier, while improving product compatibility. With no complex system integration required, robotic automation interacts with the existing IT architecture. Just like how human being was doing task across application and systems, robotic process automation also allows organizations to automate task.

Robotic Process Automation is a software program which runs on an end user's mobile, laptop or PC. The main agenda behind RPA is to replace boring and repetitive clerical task performed by humans, with a virtual workforce.

5) Collaborative Robots Will Continue To Grow In Popularity

In comparison to the industrial counterparts, collaborative robots can work safely alongside humans and are often far cheaper. These robots will see greater adoption by manufacturers with strict ROI requirements, when they become more capable in tough industrial settings, over the time. Collaborative robots also incorporate hand guiding- teaching by demonstration, power and force limiting, safety-rated stop monitoring and speed and separation monitoring.

In the manufacturing sector, robotic automation has been a revolutionary technology. But over the next couple of years, it's still on the edge to change the industry.

Article 12

An Overview And A Best Buying Guide For The Robotic Process Automation (RPA)

Robotic process automation is a software with preprogrammed learning capabilities to emulate and integrate the actions of a human interacting within digital systems.

"A Grand View Research, Inc. report expects that RPA market would reach $8.75 billion by 2024".

At present RPA is applied in various industries like Customer support, Accounting, Financial Services, Healthcare and Supply chain management.

A research gateway reveals that 20% of the women and 21% of the men, jobs would be displaced by 2030. It is 60% of the Global GDP and more than 50% of the global population.

RPA is divided into three major workbots

Pro Bots: Probots are bots that follow simple, repeatable rules to process data.

Know Bots: Knowbots are bots that search the net to gather and store user-specified information.

Chat Bots: Chatbots are virtual agents who can respond to customer queries.

Features:

- Better accuracy
- Improved compliance
- Fast cost saving
- Super scalable
- Increased speed and productivity
- Reduce processing errors.

Dive Brief:

- RPA platforms can be managed centrally and scale massively.
- As it can read, write, copy and paste, it also understands the advancements and use it to built improved automation.
- They are really quick and also monitors and analyze the system temperature ensuring its long and smooth run.
- As they are real-quick, optimizing or restricting the bot working hours helps in monitoring the process.

Upcoming Milestones:

- Organizers using RPA are realizing that automation tools do not function best as stand-alone systems, integrating with other tools get most out of them.
- RPA integrating with the AI and self learning capabilities for the futuristic RPA 2.0 market.
- Smart process Automation (SPA) is an extension to automate the unstructured data work, as robots are unable to manage by itself.
- You can create your own bot with a configurable set of software program to work on your specific task.

- Simplifying and standardizing the RPA program, would slowly lead to No Code RPA.

Best buying guide for RPA:

- Figure out a clear picture on the RPA and its applications.
- You will gain extensive knowledge by comparing the work process of the RPA to that of the traditional automation.
- Choose the right process which suits your automation, and retrospect the process dependencies.
- Research and compare the RPA tools in the existing market.

Make sure your business don't suffer any loss while you experience the first automation task.Business Line:

An operations service provider from the Europe was processing 2,500 sick leave certificates per month, with an average handling time of four minutes per each sick leave. After implementing RPA solution they achieved 90% process automation. The RPA robot extracts data from a transaction in SAP, inserts the information into the customer's systems, and prints it. The HR service provider achieved a return-on-investment within six months, with 0% error rates, manual effort reduced to 5%, and processing time reduced by 80%.

"Organizations using RPA are achieving 80% of the ROI in just 12 months, and potential accumulative cost reductions can reach 20% within less time."

Article 13

The coming evolution of Service Robots: From Shape-Shifting Robots to Robot Inclusive Cities

There is no denying it: like it or not we are witnessing a service robotics revolution, in both professional and personal domains. From residential floor cleaning to logistics delivery missions, robotics offers enormous advantages in improving productivity, efficiency and safety in both professional and personal settings. Professional service robots are mainly used in professional settings outside the traditional home or

manufacturing scenarios. While industrial robots are primarily used in the automation of manufacturing tasks, today's rapid technological advances has resulted in the development of non-factory robotic automation of a wide range of menial, repetitive, time consuming or dangerous tasks thereby freeing human workers for engagement in more cognitive functions. According to the International Federation of Robotics (IFR), the market of the professional service robots is expected to grow at an average rate of 20 to 25% between the year 2018 and 2020, eventually hitting an estimated value of $27 billion1. On the other hand, personal service robots mainly consist of consumer based robots commonly used for automation of home related tasks some of which include autonomous window cleaners of vacuum cleaners. Although this is a comparatively smaller segment of service robots, IFR predictions indicate that personal service robots will acquire an estimated market worth of $11 billion by the year 2020.

For far too long now, much of the debate around service robots has been mainly inclined towards them stealing our jobs and we humans becoming slaves to machines. This discussion has not been really true. We have to reframe this discussion in terms of the potential of service robots. Many of these intelligent machines have the potential to mitigate the combined pressure of skyrocketing costs, aging populations in industrialized countries, and a shortage of qualified workers, as well as the need to continuously improve the quality of services and results. More market surveys on the potential of service robots have shed some promising light on the advantages such machines have as they continuously enter our social spaces and actually make lives better for humans.

With rapidly expanding application venues and continuous drive towards improving productivity, cost and safety, designing these intelligent machines are becoming increasingly challenging mainly attributed to the complex nature of the environments in which they operate and the dynamic nature of the tasks they perform. In response to these recent challenges, researchers in the field are pushing for a two-pronged approach that involves 1) designing shape-shifting robots that are able to automatically

adapt their morphologies to maximize their performance and 2) designing an inclusive and friendlier environment so that robots can function more efficiently.

Shape-shifting robots are electromechanical machines with variable degrees of morphology. Beyond typical perception, actuation and control capabilities found in fixed morphology robotic platforms, shape-shifting robots are also capable of deliberately changing their physical form in order to overcome environmental constraints, undertake new tasks, or recover from damage. Such robots have tremendous potential in advancing robotics as a field in general. Their promise of high degree of versatility, robustness and modularity is set to open up a wide range of new applications for robots. To see how shape-shifting robots can boost productivity, we need look no further than Singapore University of Technology and Design (SUTD) where a research group has developed a series of seven transformative robotic solutions for cleaning and maintenance jobs supported by the National Robotics Research & Development Programme Office (NR2PO). These shape-shifting robots are proving to be more efficient in comparison to traditional fixed morphology designs in a wide array of deployment situations ranging from floor cleaning, glass façade cleaning, staircase cleaning, and inspection of drains.

Shape-shifting robots have tremendous potential in advancing robotics as a field in general. Their promise of high degree of versatility, robustness and modularity is set to open up a wide range of new applications for robots.

One of the solutions — sTetro is a shape-shifting robot that switches between cleaning flat floor and staircases. Considering the crucial role staircases play and their permanent presence even after the advent of lifts and escalators virtually in every multi-storey building, the subject of cleaning staircases has received so little attention from roboticists. Even though there exists tens of thousands of robotic products in the market that tackle floor cleaning, they all make big claims on how well the robots avoid staircases with no viable solutions towards cleaning staircases. With staircase cleaning being more strenuous job than floor cleaning, sTetro is being developed to target this large segment within cleaning robotics industry. sTetro is capable of autonomously

navigate and clean a given space including staircases. It is equipped with sensors and software algorithms to automatically detect and adapt to different types of staircases.

Mantis is another shape-shifting robot developed at SUTD aimed at glass façade cleaning. Conventional robots deployed for façade cleaning demands human intervention to manually move them from one glass panel to another. Mantis is capable of autonomously cleaning vertical glass facades as well as move over obstacles and transiting between glass panels without any human intervention. This presents a breakthrough in surface propagation robots opening up potential new applications in construction, aircraft maintenance and infrastructure facility inspection. The prototypes are currently on trial at various parts of the SUTD campus.

Generally, the expected increase in robotics population is not inherently bad as robots are playing a critically essential role in helping with many dull, menial, repetitive, time consuming or dangerous tasks for humans. Some of the robots have proven to be highly efficient and this is a significant advantage. Recent technological advancements such as developments in machine learning, cloud, IoT and artificial intelligence have made the adoption of robots to be highly beneficial and easy. However, as we embrace the expected surge of robots, it is imperative to change and adapt our infrastructure. Consequently, policy makers, architects and town planners should prepare for this to ensure that the robots will be able to lead inclusive lives within society. This will provide a significant push to the growth of service robots in the commercial marketplace. It is widely believed that a significant majority of service robots will likely be found in cities. This will present enormous challenges and it is inevitable that the cities will need to adapt in order to accommodate the rising number of robots in the workforce.

To enable and empower service robots to contribute productively in the workplace, we need to rethink the designs of their workplaces. Traditionally, design of contemporary new spaces and everyday artefacts such as lighting and furniture target the majority of well able-bodied population until recently when apposite design principles were introduced in response to individuals with special needs such as children, elderly

and user groups with physical and/or sensory disabilities. Since cognitive capacity, physical strength and speed, visual acuity, and auditory sensitivity are still evolving, ergonomic workplace designs that accounts for robots as stakeholders will become increasingly important. Given how robots, like human workers, are an incredibly diverse group with different needs, it will also be necessary to apply universal design principles to promote wellbeing and safety for robots of all applications. To this end, Singapore University of Technology and Design (SUTD) is developing an emerging research field "Robot Ergonomics" that bridges traditional disciplines including architecture, product design and robotics based on the premise that service robots and the everyday environments that they inhabit with humans (buildings, products, furniture, tools, etc.) are more adequately conceived when designers across disciplines work in unison. Robot Ergonomics remains a marginal research area, despite the significant growth in the adoption of service robots. In robotics, increasingly complex and autonomous systems are being developed in order to cope with everyday tasks in pre-defined physical environments. Strategies place all the responsibility on the robot by combining advanced sensors, control and actuators to achieve relatively simple capabilities such as turning a handle to open doors, when the location, shape and behavior of the handles are unpredictable and highly variant. Robot Ergonomics design significantly decreases the difficulty of such tasks by taking into consideration the characteristics of robots when designing the space without overstepping into human preferences. Bridging the decision-making in robot and spatial design carries a twofold advantage: designers and architects view robots as target stakeholders, and roboticians build upon the environmental features to make future robots highly capable at manageable costs. Through an inductive study of popular cleaning and logistics robots in the market, the team at SUTD has derived a set of design principles that can be used by practitioners to generate robot-inclusive solutions. The principles put forward offers valuable insights for ethnographic studies of such service robots and the type of effects that everyday furniture and spaces have in their performance. In the future, the way forward in designing workplaces will not be to adopt a one size fits all approach, but rather one that gives robots

the flexibility to adapt the workplace to suit their own needs while prioritizing the human preferences.

As cities experience a growing robotics workforce, the need for robot friendly design is becoming ever more critical. From our hawker centers to parks, the future of urban housing and mobility may just be shaped for and by the robots that we will live with.

The ongoing work at SUTD is just an example of how workplaces can be successfully redesigned to help robots work productively. We need to expand and adapt these efforts to all other lines of work – be they food and beverage, transport, construction, or healthcare. We would need more generalized education so that it is possible for architects and roboticians to co-design robots and spaces unleashing potentially tens of thousands of robots from research labs into commercial world. Given that colleges and universities have institutional inertia in brining disciplines together, this challenge is not trivial.

Ultimately, efforts to design for a robotic workforce need to go hand in hand with other initiatives to make the workplace more robot inclusive. There needs to be a shift to more acceptance and flexible workplace arrangements involving humans and robots and a shift in attitudes about robots. The bigger challenge however, is to be cognizant with human preferences, costs and risks to develop future proof resilient robots. Robots are co-workers that make lives better for us and not there to steel our jobs, and it is time we take efforts to recognize that.

To get a better understanding of the unique capabilities of these robots to change their shape and adapt, please check out the following videos online:

hTetro – self-reconfigurable floor cleaning robot

Mantis – a highly agile glass façade cleaning robot

Article 14

8 Latest And Trending Robotic Innovations

Robots have been steadily advancing into our everyday lives. The machines are expected to continue its epic migration and venture into new spheres and various fields such as pharmacies, the automotive sector, and many more. In the manufacturing sector, there is already a huge contribution to higher quality products and shorter turnaround times by these countless robots. At very basic tasks and jobs, these robots are proving to be effective. They require less downtime, are more cost-effective, and are prone to fewer errors. As a result, they enjoy higher retention rates. Industrial robotics might invoke huge, fast-moving machines engaged in the kind of repetitive, dangerous work that humans used to handle. The innovations in industrial robotics have started to lead humanity in intriguing new directions, although those machines will certainly continue to take on larger roles in manufacturing. Some of society's most pressing issues such as worker-safety improvements and labor shortages could be solved with these industrial-robotics innovations. We have provided some of the latest and trending robotic innovations in this article.

Robotic Innovations

1) Modbot

It is the first industrial modular robotics platform. Modbot decided to develop a modular robotics system that would be affordable, agile, and simple, after witnessing the difficulties of prototyping with the current state of robotics. The ultimate goal of Modbot technology is to see solutions that will solve real-world problems in the education, manufacturing, consumer, and engineering industries. Industrial quality robotics are delivered by Modbot at affordable prices accessible to not only educational institutions, and individual consumers but also to larger industrial firms. The Modbot platform provides many different applications using a system of reusable modules that snap together to create a variety of robotic configurations. The user can not only program the robot but also can track data analytics, create a 3D environment and generate user interfaces once the robot is assembled.

2) AIBO

Infused with artificial intelligence, AIBO is an adorable robot dog created by Sony. However, AIBO was discontinued after its release almost a decade ago. But, now it has returned with even more abilities for human operations. This mechanical pup combines artificial intelligence with image sensors, enabling it to recognize faces and learn behaviors. The personalities of AIBO robots develop based on the interactions with people and depending on its human companions it gives each a unique character. Reacting to words of praise or scratches on the head, it can learn tricks and will seek out owners. One feature which makes it exceptional from real-life dogs is that it has an application that owners can use to adjust system settings or add new tricks, and can store memories by connecting to the internet cloud.

3) Robot Atlas

Developed by the American robotics company, Boston Dynamics, the bipedal humanoid robot Atlas has its new ability to clear obstacles and jump like a parkour expert. Atlas is one of the most physically impressive robots ever developed due to its combination of control software and real-time computer vision, that balances arms, legs, and torso. The humanoid robot uses computer vision to locate itself with respect to visible markers on the approach to hit the terrain accurately. It can simultaneously perform tasks such as range sensing, 3D printing, object manipulation, and stereo vision. Recently, the robot made strides by completing a backflip.

4) DelFly Nimble Robot

The latest iteration of the DelFly robot was created by the Delft University of Technology called the Nimble. Featuring a quad-wing flapping system, Nimble is a super agile robot that is capable of flying just as nimbly as a real winged insect. The DelFly Nimble is less vulnerable to damage and highly agile, allowing outdoor operations in light winds, due to the lack of the tail, unlike its predecessors. Operating at a top speed of 25km/h, the robot can even perform aggressive maneuvers, such as 360-degree flips, resembling loops and barrel rolls.

5) Da Vinci

In recent years, robotic surgery represents one of the most important medical innovations. More robotic platforms are emerging although their availability and usage depend on factors such as cost. The maker of the da Vinci platform, California-based company Intuitive Surgical, is a pioneer and global market leader in the field of surgical robotics and continues to cross the boundaries. Recently, the company launched its da Vinci single-port surgical system, which brings innovation into the operating room. With this technology, a 3D HD view is provided inside a patient's body, so that the surgeons can complete more accurate surgeries. With an ergonomically designed console, patient-side cart and instruments that rotate and bend beyond the limitations of the human hand, the system is capable of performing various operations through minimal incisions.

6) Wearable Robots

These wearable robotic suits can make life easier for tons of workers used for loading cargo or those on their feet for long hours. A lightweight, stretchy exosuit provides new ways of integrating robotic control, fabric design, sensor development, and muscular aid to increase a wearer's balance, strength, and endurance. The possible applications include rehabilitating adults and children who have movement disorders caused by infirmities such as multiple sclerosis, stroke or Parkinson's disease, assisting the elderly in enhancing their muscular strength and supporting their independence and mobility. Each individual wearer will have personalized control over their suit's physical enhancements with the sophisticated application of robotics.

7) 3D Printed Liquid Elastic For Soft Robotics

These 3D printed shape-shifting liquid elastics are perfect for soft robotics and are projected to bring in new fabrication schemes and give robots new abilities for developing devices and controls that are multifunctional, easily deployed and are power-efficient. This could indeed be one of the main challenges of robotics. Earlier, versatile shape-changing liquid crystal mechanisms have been used, but now we are seeing how elastomers can be fabricated with 3D printing. A demo was already given

by these devices which showed the ability to manage significantly more weight than other liquid crystal elastomers.

8) Nanoscale Robots

The nanoscale robots can self-assemble. The robots were developed based on origami concepts using DNA strands and can transport nanoparticles. Few intrinsic basic rules are used by the DNA origami for folding the DNA double helix into the nanostructure. Under an externally applied electric field, these DNA origami structures can be made to be self-assembling, combined with a system of latches formed by single-stranded DNAs, and controlled at precise nanoscale movements. To electrically drive the transport of nanoparticles or molecules, such nanoscale robotic systems can be used in groups over tens of nanometers or more.

Market Insights For Robotics Globally-

Due to the presence of number of companies operating in the market, the robotics market is highly conciliated globally. Some of the main players operating in the global robotics market are –

- Fanuc corporation
- iRobot Corporation
- Northrop Grumman Corporation
- Google Inc.

As per industry reports, the robotics market globally is expected to reach a value of US$147.26bn by the end of 2025, with a CAGR of 17.4% over the estimated period of 2017 to 2025.

UNIT 3 COMPUTERS

Article 15

'Internet of Things': How connected networks can make automation more efficient

Make way for the new revolutionary conglomeration of digital devices that pledges to innovate industrial production through a massive weave of all potent interconnected IPs (Internet Protocol) – the Internet of Things or IoT.

The phenomenon of Internet of Things has transformed from its origins in RFID to another that encloses all devices that are networked, both external and internal in a manufacturing operation.

The massive thrust to embrace IoT in manufacturing corresponds to a recurrent trend that talks about the usage of industrial Ethernet and wireless network technologies within the automated production environment. IoT envelops intelligent sensors and machines, cloud computing, analytics, Big Data, mobility and universal visualization.

The main objectives that manufacturers like to see are: improved business performance, production efficiency and asset optimization.

Today, IP-enabled microprocessors connect the usual automation equipment such as input/output modules and drives of variable frequency.

With respect to manufacturing, these objectives are met by collecting numerous data from an array of sensors, devices, machines and other entities that carry out functions on the plant floor. This particular data is then made accessible globally through a cloud or an identical framework to all approved personnel for use in analytics, optimization, and a variety of other applications.

It is a massive move to progress into a more integrated system that is functional in all possible directions and can be accessed in a more synergetic environment, potentially improving business performance and bringing in more innovation. Generally,

plant floor sensors, devices, machines and systems will be compulsory to transmit their data to the cloud computing platform for analysis and then be capable of accepting real-time feedback from the analytical engine(s) for performance improvement.

Security of plant floor operation is a major issue when such an integrated, network-dependent phenomenon is involved. Automation suppliers now offer their own firewalls and other security mechanisms, as well as more models are gradually becoming prevalent in this field.

'The IEEE 802.1x standard supported in many Ethernet switches, for example, offers port-based network access control.'

In order to gain the best out of such intellectual technology, every device within a plant need to be able to communicate with each other: using an IP centric framework even at the enterprise level. Industrial IP becomes of importance, hence.

Automation providers who've stuck to non-standard, multiple systems of networks have managed to assure their consumers that separate networks lead to high-performance production.

Among these are functions the rest of the computing world – almost every other industry – take for granted. For instance, FTP: to send files, SMTP: for sending an email and HTTP: web browsing. VoIP (Voice Over Internet Protocol) is the latest addition that one could think of.

Common Industrial Protocol (CIP), developed especially for industrial applications, is a comprehensive suite of messages and services for the collection of manufacturing automation applications – control, safety, synchronization, motion, configuration and information. CIP provides a communication architecture throughout the manufacturing enterprise, allowing users to integrate these manufacturing applications with enterprise-level Ethernet networks, as well as the Internet too. Industrial automation, must move to an integrated digital communications consistent framework, that will be able to support all sub-systems present within industrial applications.

Industrial IP or more specifically, IoT can collaborate and place together automation, surveillance, facility management and access-control subsystems within a single framework to reduce distribution and operational costs.

It will establish consistency of security policy and procedure. These can be achieved by doing away with duplicated networks, and letting go of all finance and human resources to place focus on improving production and innovation through automation in an array of industries.

Article 16

An Overview Of Industrial PCs In Industrial Automation

First of all, industrial computers are specially designed to withstand harsh industrial-floor environments (extremes of temperature, dust, humidity, vibration, and power surges). The manufacturing companies are focusing on consolidating the production capabilities to reduce costs by increasing production efficiency. The growing demand for energy-efficient manufacturing operations propelled the demand for adoption of industrial PC's.

The global industrial PC market is projected to witness a compound annual growth rate of 7.52% during the forecast period to reach a total market size of US$6.546 billion by 2023, increasing from US$4.236 billion in 2017.

Types of Industrial PCs:

Mini Rugged Industrial PC:

- Rugged mini PC line is designed with industrial and military grade components for reliable operation under harsh conditions.
- It is mostly used in manufacturing facilities, warehouse floors, forklift and other vehicle installations.
- It adds most versatile functionality via full-size and mini PCI Express slots, USB ports, mSATA and RS232 ports.
- The multiple PCI Express slots enable mini rugged PC to be configured for nearly any industrial automation functionality.

- There are only a few environments where rugged mini PC can be operated 24/7.

Rugged PC:

Virtually all rugged computers are having the same underlying design policy of providing a controlled environment for the installed electronics.

Rugged computers are engineered to operate in the face of multiple challenges including:

- Shock/Vibration
- Temperature and humidity
- Corrosion and abrasion
- Minimal size, weight, and power
- Durable life
- Acoustic noise reduction
- Low pressure/altitude
- Ingress Protection
- Electromagnetic interference

Panel PC:

The development of the panel PC is usually a custom made, which is totally dependent on the type of the industry it is used.

Panel PC are equipped with a fanless cooling systems, sophisticated, silent and able to reduce both the dust and maintenance costs. The fanless system allows the Panel PC to dissipate the heat without using the fans, only by using copper, reducing the powder dispersion.

Touch Panel PC:

Touch panel PCs are becoming an increasingly common device in the latest industrial units.

As touch Panel PCs do not contain a fan, they can be moved easily. It also reduces the risk of regular cleanings and increases the reliability of the devices in the automation industry.

Embedded PC:

Embedded PC series provides a full line of varied fanless embedded computers of different sizes to consolidate applications in transportation, environmental and industrial facility monitoring, biometrics, industrial manufacturing, automation control and surveillance management, building automation, and other relevant areas. These are engineered for longevity, resilience, durable, highly scalable, and applicable for extreme environments.

Rack mounted PC:

The rack-mounted PC is the perfect flexible solution for a wide range of applications. They maximize productivity while offering industry-leading performance, energy efficiency and scalability. The architectural design of the rack-mounted PC accepts IBM PC-, XT-, AT-compatible, or PCI cards, and a variety of single-board computers.

Applications of Industrial PCs:

- Data collection.
- Industrial imaging and video surveillance and analytics, and other applications requires high-speed data for HD image capturing, facial recognition, real-time detection, and post analytics.
- Controller in machine monitor and automate quality control systems.
- Automatic inspection, measurement, verification, automated-traffic control and flaw detection.

Best Buying Guide for an Industrial PC (IPC)

- Check cooling fans, external to the chassis are usually provided with special filters to keep out dust and other similar contaminants.
- Check direct cooling of magnetic media (floppy disk, hard disk, CDROM), system components and power supply
- IP/NEMA Protection
- Expandability/Longevity
- Power supply capabilities
- Humidity proof

- Shock and Vibration resistance
- Ensure, the industrial PC that you're going to buy can work up to 450 C and more
- Depending upon the model, an Industrial PC can be rack-mounted, or mounted on a swivel-arm support, providing flexible arrangement for any physical environment.

Key Market Players:

The major industrial automation companies operating the industrial PC market are:

- Advantech Co., Ltd
- Schneider Electric
- Siemens AG
- Mitsubishi Electric Corporation
- Beckhoff Automation GmbH & Co. KG
- MPL AG

The industrial PC markets are now having the advanced technology of single board computers with all the functions integrated into a single circuit board. The single circuit board is very light in weight and compact in size, making the Industrial PCs to provide their best services.

Article 17

Industrial Ethernet Solutions in the Manufacturing Industry

Manufacturing industry majorly depends on Ethernet solutions to enhance ruggedness, real-time performance required by industrial applications. Using ethernet solutions, large data handling, maintaining faster speed in the network is possible.

What Is Ethernet?

Ethernet is the major local-area network (LAN) technology, which is used extensively used for LAN-connected PCs and workstations. It refers to the family of LAN products covered by the IEEE 802.3 standard, and the technology can run over both twisted-pair cables and optical fiber.

Ethernet technology is easy to understand, deploy, manage, and maintain and it is low-cost and flexible.

Deploying ethernet solutions can help in increasing additional performance and network intelligence. This has made ethernet an excellent solution for industrial applications.

It supports a variety of network topologies and can be connected over any Ethernet-compliant device from any vendor.

Why and how does Ethernet work so well in manufacturing industries? There are many reasons behind its rise, but a few to note include:

a)There are various options for protocols and topologies, offered by the industrial ethernet. For instance, plants can dominate commercial Ethernet when they move outside the star topologies. In this case, using ring topologies for rapid recovery and redundancy will be helpful. Moreover, protocols such as EtherNet/IP® and EtherCAT® cover a wide range of use cases and system designs.

b) Factories such as oil and natural gas refineries, wind farms etc are often subject to harsh environmental and operating conditions. There will be a requirement for operators to respond for vibrations, extreme temperatures. In this case, they can do so by using industrial ethernet cables and connectors in their automation and control systems. This made ethernet to become a viable option for in-plant automation.

How Industrial Ethernet is useful to manufacturing companies?

To make the manufacturing processes more productive and competent, manufacturing companies are rapidly migrating to Industrial Ethernet technology. Deploying industrial ethernet enables companies to control costs by moving from costly proprietary systems to a proven technology that is more secure, reliable, and deterministic.

Ethernet solutions assist in enhancing bandwidth, opening connectivity, delivering the resiliency and network security field-bus solutions, and standardization. Organizations/manufacturing companies can control over their networked manufacturing equipments using industrial ethernet.

Migration to Ethernet solution is gaining momentum in the industry as these solutions reduce expenses, improve processes, and enhance productivity.

According to a recent ARC Advisory Group study, the worldwide market for Industrial Ethernet devices is expected to grow at a rate of more than 84 percent over the next five years.

Industrial ethernet uses intelligent switching technology that can meet the unique requirements of the manufacturing arena. And, it delivers the network security, performance, and availability required to support critical manufacturing applications.

5 key benefits of Industrial Ethernet

1)Industrial Ethernet Switches are extensively used for harsh environments. They have DIN-rail mounting capability, direct DC power, dual power inputs, shock and vibration approvals, hardened enclosures etc to provide appropriate solutions to manufacturing companies.

2) Instead of serial (RS232, RS422 or RS485) communications, using Ethernet massively enhances the flexibility of the installed network. These solutions can also be used for voice, video, and many different types of data.

3) Using Power over Ethernet (PoE), power can be delivered over the same piece of Cat 5 or Cat 6 cables. It indicates that devices such as gas analyzers, IP cameras, and embedded computers can be placed without additional costs. This is one of the reasons why PoE is another compelling argument for using Ethernet in distributed industrial applications.

4) Adopting industrial Ethernet provides the fast network redundancy. i.e. it is possible to build a network of devices that can continue to communicate with each other if a cable is broken or unplugged or if one of the network switches fails.

5) Ethernet solutions are capable to withstand failures in network cabling or network infrastructure.

Article 18

The Industrial Internet Of Things

The Industrial Internet of Things (IIOT) utilizes relevant information and essential tasks are completed through tablets, smartphones, and other edge devices. In real-time, businesses can use this performance data to adapt and change their operations into a more streamlined process externally and internally for both long-term and short-term goals. Due to this super connectivity, faster response times are facilitated from all departments and brings with it improved agility for operations of every size. Smart machines are not only better than humans at capturing and analyzing data in real-time, but they are also better at communicating important information that can be used to drive business decisions faster and more accurately. IIoT in manufacturing holds great potential for quality control, supply chain traceability, sustainable and green practices, and overall supply chain efficiency. Predictive maintenance, asset tracking, improved field service, enhanced customer satisfaction, and facility management are the top touted benefits of IIoT.

Robotics

The robots will command a greater presence in shaping the manufacturing industry as these entities become cheaper, smarter, and more efficient in their roles on the factory edge. With advances in robotics technology, these machines are allowed to take on more complex traits, including heightened dexterity, machine learning, memory, and the ability to collaborate more effectively. Hence, these robots will usher in a new set of standards that every manufacturer will need to adapt to remain relevant. Robots have been relied upon as an essential part of manufacturing. Robotic presence provides incredible benefits, including enhanced accuracy, speed, and tireless labor. However, they cannot do it all. As a result, these smaller and agiler implements on the manufacturing edge are engineered to work collaboratively alongside their human counterparts and are referred to as collaborative robotics.

Artificial Intelligence

The artificial intelligence technology is already in our daily lives in the form of self-driving cars and industrial robotics. The technology in manufacturing applications will become the new standard by which large sets of data are analyzed and predictive maintenance is undergone. In short, to survive, the companies will have no choice but to "go digital". The AI algorithms can also be used to optimize manufacturing supply chains, thus helping companies anticipate market changes. By looking for patterns linking location, weather patterns, consumer behavior, political status, socioeconomic and macroeconomic factors, the AI algorithms formulate estimations of market demands. The manufacturing industry will have the biggest impact of AI coupled with automation.

Big Data

As far as the variety and depth of the product are concerned, the manufacturing industry is the most complex one. The global development challenges such as opening new factories in new locations, transferring production to other countries can be tackled by companies using big data in manufacturing. How we store and capture data is changing by the day. As a result, new standards in sharing, transfer, updating, search, visualization, querying, and information privacy are emerging. More robust technologies need to be adopted by the manufacturers to keep up with the data, which is where specialized Enterprise Resource Planning (ERP) solutions give your business the critical edge it needs to thrive. The best example of how automation technologies are increasing productivity and how we manage data in the manufacturing environment is the robotic process automation (RPA).

The Cloud

The cloud technology is new and traditional operators across industries are skeptical of its intangible nature. As it is not maintained locally and cannot be stored, monitored, or secured using traditional methods, the cloud-based technology is how the companies of the future will operate as it allows remote workforces and in-house to collaborate in real-time more effectively compared with traditional data systems. One

advantage of cloud technology is that the cloud approach is faster, reduces maintenance, and improves manageability. One of the recent examples of innovation in industry 4.0 that has reinvigorated the manufacturing space for enterprises of every size is the Cloud ERP. The cloud ERP solutions without the high cost of on-premises solutions provide significantly improved levels of insight into operations by omitting the costly expenses of maintenance, hardware, and security. And with the extra capital provided by these all-in-one solutions, the small and medium businesses are finding it easier to make their mark in the marketplace, in many cases built specifically for their industry.

Cybersecurity

Maintaining the integrity and security of the systems becomes a much larger issue, as more and more operations move toward cloud-based solutions and rely more heavily on a robotic workforce. More opportunities for threats emerge as more manufacturers simultaneously build and integrate their systems through the Industrial Internet of Things. Moreover, new technological advancements are being implemented by manufacturers to enhance automation processes every day. The experts are increasingly aware of their need for heightened security in an increasingly insecure digital landscape, as modernization presents multiple opportunities for growth and process enhancement. To address the vulnerabilities, a closer look is being laid at cloud-based ERP and unified systems by manufacturing and other industries. As time goes on, cloud-based ERP systems are being relied upon by enterprises of every size. Perhaps, cloud-based security is one of the major topics surrounding the efficacy of modern ERP systems. It's not that security risks don't exist in the cloud. They are always present. But, apart from the cost, handling security issues for cloud-based ERP is a challenging and complex process.

Advanced Materials And Additive Manufacturing

The advanced materials and additive manufacturing are known by the more common name of 3D printing, which is emerging advanced manufacturing technology. 3D printing can now build large and complex structures like housing in less than a day,

unlike the old processes that used to take weeks to accomplish on a small scale. Using new special consumables materials is the main development direction of additive manufacturing, such as 3D printing. The technique is relatively easy to metals and tough to high strength alloys. It's relatively more difficult to some ceramics and may be harder to the nanoceramics. Some new nano modifier 3 printing materials are prepared to solve the problems of 3D printing materials, such as limited properties and applications. To characterize the obtained NiCrAlY, WC-10Co-4Cr and ceramic powders and coatings, scanning electron microscopy (SEM), microhardness and friction and wear tests are used. The results obtained show that the optimized process can be used to prepare the nano modifier materials successfully. The coatings possess high bonding strength and good wear resistance. High strength alloy materials and even nano-ceramic materials are prepared with nano-modification and nanostructured spherical particles powder through 3D printing.

Modeling, Simulation, Visualization, And Immersion

When it comes to making decisions on the future of any business, manipulating, analyzing, and leveraging data is important. Businesses can leverage the latest technology to more effectively report, review, and forecast their data with new forms of simulation, visualization, and the interaction available. A few of the innovations like virtual reality, immersion tools, and 3D visualization are available to a host of businesses that depend on massive amounts of data daily including sciences, manufacturing, healthcare, energy, and finance. These innovations and associated tools, beyond data, help develop lead teams and tech to greater success rates with more effective and thorough preparation for mission-critical tasks. The integration of simulation, modeling, visualization tools and facilities with other product life cycle software and management tools made its advances in the virtual product development systems.

RENDERING

A rendering is a brief summary of a book, an article, or other publication. The purpose of a rendering is to describe the work in such a way that the reader can decide

whether or not to read the work itself. A rendering helps the reader understand the particular usefulness of each item. The ideal rendering shows the relationships among individual items and may compare their strengths or shortcomings.

The following points provide guidance for writing renderings. As appropriate each of these issues might be assessed and commented on in the rendering.

1. Qualifications of the author, unless very well known.
2. The scope and main purpose of the publication (book, article, web site).
3. The intended audience and level of reading difficulty.
4. The author's bias or assumptions, upon which the work's rationale rests.
5. The method of obtaining data or doing research.
6. The author's conclusions.
7. Comparison with other works on the same subject.
8. Materials appended to the work – maps, charts, graphs, photos, etc.
9. The work's importance or usefulness for the study of a subject.

Not all of these points are necessary for every rendering, and they certainly do not have to be noted in the order listed here, but they at least ought to be kept in mind when writing a rendering.

HOW TO WRITE RENDERING

I. Formulate the theme of information from the text using the following clichés: the text deals with (touches upon, is devoted to, describes), the main idea of the texts is to show (to analyze, to describe). Determine the sphere of knowledge this information belongs to.

II. Process the information given in the text in the following way:

a) divide the text into some parts according to its content; b) write out a number of key–words to each part of the text; c) retell each part using the keywords; d) determine the main idea of the text; e) retell the text in 10–12 sentences.

III. Give the summary of each paragraph using key words and language clichés: it is reported about the development of (the improvement of, the experiment in the field of, the results of, a new design of, the characteristics of); details of design (technology, process) are given; it is told in details about; a brief description of … is given; it is told in short about; special (much) attention is given (is paid) to; it is specially noted that; some facts (figures, terms, characteristics) are given.

IV. Present your rendering of the text according to the following structure.

1. Sphere of knowledge this information belongs to.
2. The theme of the text.
3. Summary of the text.

ABSTRACT

An abstract is a condensed version of a longer piece of writing that highlights the major points covered, concisely describes the content and scope of the writing, and reviews the writing's contents in abbreviated form. There are two types of abstracts are typically used:

1) descriptive abstracts – their purpose is to tell readers what information the report, article, or paper contains;

2) informative abstracts – their purpose is to communicate specific information from the report, article, or paper.

Writing an abstract you may use the following steps:

1. Reread the article, paper, or report with the goal of abstracting in mind. Look specifically for these main parts of the article, paper, or report: purpose, methods, scope, results, conclusions, and recommendation.

2. Use the headings, outline heads, and table of contents as a guide to writing your abstract.

3. If you're writing an abstract about another person's article, paper, or report, the introduction and the summary are good places to begin. These areas generally cover what the article emphasizes.

4. After you've finished rereading the article, paper, or report, write a rough draft without looking back at what you're abstracting.

5. Don't merely copy key sentences from the article, paper, or report: you'll put in too much or too little information.

6. Don't rely on the way material was phrased in the article, paper, or report: summarize information in a new way.

7. Revise your rough draft to correct weaknesses in organization.

8. Improve transitions from point to point.

9. Drop unnecessary information.

10. Add important information you left out.

11. Fix errors in grammar, spelling, and punctuation.

HOW TO WRITE ABSTRACT

I. Formulate the theme of information from the text using the following clichés: the text deals with (touches upon, is devoted to, describes).

II. Process the information given in the text in the following way:

a) divide the text into some parts according to its content; b) write out a number of key–words to each part of the text; c) retell each part using the key–words; d) determine the main idea of the text; e) retell the text in 10–12 sentences.

III. Find out author's conclusion in the text; write it down using the following clichés:

the author concludes with a consideration of, the author comes to the conclusion that, in conclusion the author says that.

IV. Give your own comments on the information from the text.

Try to answer the questions: a) how do you evaluate the actuality of this information; b) how do you think who and for what purposes could use it. Use the following clichés: the information of the texts is addressed to the students (graduates, engineers, specialists, all those interested in); the texts may be recommended to; the information of the texts is interesting (important, useful, hard to understand).

V. Present your abstract of the information from the text according to the following structure:

1. The theme of the text.
2. The main idea of the text.
3. Summary of the text.
4. Author's conclusion.
5. Your own comments.

THE SCHEME OF RENDERING THE ARTICLE

1. The headline of the article

The article (we deal with) is headlined (entitled)... – статья (с которой мы имеем дело) озаглавлена…

The headline of the article (under consideration) is the following... – заголовок статьи (которую мы рассматриваем) следующий…

The title of the article is… – заголовок статьи…

2. The author of the article

The author of it is... – её автор …

The article (under consideration/ under review) is written by... – статья, которую мы рассматриваем, написана…

3. Where and when the article was published

It is published (printed) in... – она опубликована (напечатана) в...

It is a first (second) page article – это статья первой (второй страницы)

The article is published under the rubric... – статья опубликована под рубрикой

4. The main idea of the article

The article is devoted to the problem... – статья посвящена проблеме...

The article (author) deals with the problem of... – статья (автор) имеет дело с проблемой...

The author of the article dwells on the certain idea of… – автор подробно останавливается на...

The author concentrates on... – автор концентрируется на...

The article (briefly) touches upon... – статья (коротко) затрагивает...

The purpose of the article is... (to give information to the reader) – цель статьи...

The aim of the author is to provide the reader with some material of... – цель автора – обеспечить читателя материалом...

5. The content of the article (With my own simultaneous commentary)

The problem revealed... – раскрытая проблема...

The author starts by telling the reader about... – автор начинает с того, что говорит читателю о...

The author writes, considers, points out, etc. – автор пишет, полагает, выделяет, и т.д.

According to the problem of the article I should... – в соответствии с проблемой статьи я должен

The author reports that... – автор сообщает, что...

In conclusion... – в заключении...

The author concludes with the following... – автор делает вывод (заключает) следующим...

The author comes to the following conclusion... – автор приходит к следующему заключению...

The author sums up by telling... – автор суммирует следующим...

Summing everything up the author says… – суммируя все, автор говорит…

6. Our own opinion of the article (My understanding, opinion of the article)

I found the article… – я считаю статью…

important – важной

acute – острой

actual – актуальной

dull – скучной

of no value – не представляющей из себя никакой ценности

worth attention – стоящей внимания

quite to the point – как раз кстати (по теме, к делу)

I express approval of… (support of…) – я выражаю одобрение… (поддержку…)

I express alarm (concern, disappointment)… – я выражаю тревогу (озабоченность, разочарование)…

I strongly protest against… – я протестую против…

Neutral Arguments

The article draws attention to the fact that... – статья обращает внимание на тот факт, что...

The paper finds a good deal to say... – в газете много говорится о…

In the author's view (opinion)... – по мнению автора

The author brings out the problem of... – автор выносит на рассмотрение проблему…

The author describes... – автор описывает…

The author points out... – автор выделяет…

The paper comments on – газета комментирует...

The article focuses its attention on (the fact that)… – статья фокусирует внимание на (том факте, что)…

As the paper puts it... – как излагает газета...

In its comment the paper reviews… – в своем комментарии газета обозревает...

CONVERSATIONAL PHRASES

Agreement

I think (believe so) – думаю, что это так

I suppose so – полагаю, что это так

I quite agree with you here – я в этом с вами полностью согласен

Absolutely – конечно, точно, именно

Yes, indeed – да, в самом деле

You are right (right you are) – вы правы

Of course – конечно

Sure – конечно

Certainly – конечно

No doubt – без сомнения

It goes without saying – само собой разумеется

That’s right – правильно

There’s no doubt about it – в этом нет никакого сомнения

Looks like that – похоже на это

There’s no denying it – это нельзя отрицать

I won’t deny it – я не буду это отрицать

That’s it – точно

Most likely – наверняка

Exactly – точно, конечно

I fully agree with you – я с вами полностью согласен

I can’t help agreeing with you – не могу не согласиться с вами

Beyond all doubt – вне всякого сомнения

True enough – верно

By all means – обязательно, во что бы то ни стало

Disagreement

I don’t agree (with you here) – я не согласен (с вами в этом)

I can’t agree with you here – я не могу согласиться с вами

I don’t think so – я так не думаю

I’m afraid not – боюсь, что нет

I disagree with you – я не согласен с вами

You are wrong – вы не правы

You are mistaken – вы ошибаетесь

By no means – ни в коем случае

Rubbish – чепуха

Nonsense – нонсенс

It’s far from it – это далеко не так

Just the other way round – как раз наоборот

On the contrary – наоборот

I hardly think… – не думаю, что

Absolutely wrong – совершенно неправильно

Excuse me, but… – простите, но

That’s not right – это неправильно

Of course not (certainly not) – конечно нет

Nothing of the kind – ничего подобного

I’m not (so) sure – я не уверен

I doubt it – сомневаюсь в этом

I object to it – я возражаю

I see what you mean, but… – я понимаю, что вы имеете ввиду, но…

I see your point here, but… – я понимаю вас, но…

I don’t think it’s quite right – я не думаю, что это правильно

INTRODUCTORY PHRASES

Actually… – дело в том, что; фактически; на самом деле…

In fact… – дело в том, что…

As a matter of fact… – дело в том, что…

The fact is… – дело в том, что…

First of all (at first, to begin with) I'd like to say… – для начала я бы хотел сказать…

If you ask me… – я думаю, что…

As for me… – что касается меня …

In my opinion… – по моему мнению…

As I see it… – как я понимаю …

To tell the truth… – по правде говоря …

Frankly speaking… – честно говоря …

Generally (speaking)… – в общем говоря …

Practically (speaking)… – на самом деле …

As far as I know… – насколько я знаю …

As far as I remember… – насколько я помню …

I think (believe)… – я думаю …

I suppose… – я полагаю …

Fortunately… – к счастью …

Unfortunately… – к несчастью …

Sorry to say… – к сожалению …

Evidently… – очевидно …

And besides… – и кроме того …

What's more… – более того …

Moreover… – более того …

Further on I'd like to say, that… – далее я бы хотел сказать, что …

On the whole… – в целом …

It is interesting to note… – интересно отметить …

I’d like to remark… – мне бы хотелось отметить …

As a result… – в результате …

On the one hand (on the other hand) – с одной стороны…(с другой стороны)

To be more exact… – если быть более точным …

In addition… – в добавлении …

Nevertheless… – тем не менее …

I’m inclined to think… – я склонен думать …

No wonder… – не удивительно …

Today I am going to talk about... –сегодня я собираюсь поговорить о...

I am going to give you a very general view on... – я собираюсь дать вам общее представление о...

The subject of my talk is... – предмет моего разговора...

Today I shall be dealing with... – сегодня я буду иметь дело с...

I am going to discuss the question of... – я собираюсь обсудить вопрос о...

I should like in particular to talk about… – я бы хотел в особенности поговорить о...

The aspect I intend to concentrate on is... – аспект, на котором, я намериваюсь сконцентрироваться...

The area I hope to cover is concerned with... – область, которую я надеюсь охватить связана с...

What I hope to do is to show how/what... – что я надеюсь сделать, это показать как/что...

The aim of my talk is to show that... – цель моего разговора показать, что...

There are (three) main points I intend to make... – я намериваюсь сделать (три) главных пункта...

There are (three) areas I d like to deal with... – я бы хотел иметь дело с (тремя) областями...

Then I’d like to move on to... – далее я бы хотел перейти к...

The next point I’d like to mention is... – следующий пункт, который я хотел бы упомянуть...

Another aspect I want to discuss concerns... – следующий аспект, который я хочу обсудить, касается…

The first point I want to make is... – первый пункт, который я хочу сделать...

Perhaps I could just point out right at the beginning, that... – возможно, я бы мог выделить с самого начала, что…

I'd like to start by talking about… – я бы хотел начать, говоря о...

Another problem is... – другая (следующая) проблема...

Now I d like to move on to the question of... – сейчас я бы хотел перейти к вопросу...

Lastly, there's a matter of… to be considered.– в конце, нужно рассмотреть вопрос...

I am sure you will agree, that... – я уверен, вы согласитесь, что...

You may disagree, but... – вы можете не согласиться, но...

It is common knowledge, that... – это общеизвестно, что...

Before I end… – перед тем, как я закончу...

There is quite a lot more to say about..., but I hope I have managed to cover the main points. – Еще много чего можно сказать о..., но я надеюсь, мне удалось охватить главные пункты.

And by way of conclusion I d like to point out, that… – и в качестве заключения я бы хотел выделить, что...

In short we can say, that... – коротко, можно сказать, что...

To summarize what I have said so far... – суммируя все, что я сказал...

To sum it up... – суммируя...

In conclusion let me remind you... – в заключении позвольте мне напомнить вам...

Let me conclude by saying that... – позвольте мне сделать вывод (заключение), говоря, что...

In conclusion I d like to repeat/emphasize (point out) that... – в заключении я бы хотел повторить / подчеркнуть, что...

GRAMMAR REFERENCES

UNIT 1 THE PASSIVE VOICE

В английском языке имеются **два залога**:

а) действительный залог показывает, что лицо (или предмет), являющееся подлежащим, само производит действие:

They **equipped** the laboratory with modem devices.	Они *оборудовали* лабораторию современными приборами.

б) страдательный залог показывает, что лицо (или предмет), являющееся подлежащим, подвергается действию со стороны другого лица (или предмета):

The laboratory **was equipped** with modem devices.	Лаборатория *была оборудована* современными приборами.

Страдательный залог широко употребляется для научных описаний, для описаний технических процессов, в отчетах, объявлениях и х д.

Страдательный залог времен группы Indefinite образуется при помощи вспомогательного глагола **to be** в соответствующем времени Indefinite и **Participle II** (III форма) смыслового глагола. Показателем времени. лица и числа является вспомогательный глагол **to be.** Смысловой глагол в форме причастия прошедшего времени (Participle II) не изменяется.

The tools **are made** of steel.	Эти инструменты *делаются (изготовляются)* из стали.
The tools **were made** of steel.	Эти инструменты *были изготовлены* из стали.
The tools **will be made** of steel.	Эти инструменты *будут* изготовлены из стали.

Сказуемое в страдательном залоге может переводиться тремя способами:

1) сочетанием глагола *быть* (в прошедшем и будущем времени) и краткой формой причастия страдательного залога:

The article **was written...** Статья *была написана...*

The article **will be written...** Статья *будет написана...*

Глагол-связка *быть* в настоящем времени в русском языке опускается:

The article **is written.** *Статья написана.*

2) возвратным глаголом с окончанием *-ся, -сь:*

Houses **will be built** here. Здесь *будут строиться* дома.

1) неопределенно-личной формой глагола (3-е лицо множественного числа):

The paper **was translated** a week ago. Эту статью *перевели* неделю назад.

В **отрицательной форме** отрицание **not** ставится после глагола **to be.**

В **вопросительной форме** глагол **to be** ставится перед подлежащим.

При наличии двух вспомогательных глаголов отрицание **not** ставится после первого глагола, а в вопросительной форме перед подлежащим ставится первый вспомогательный глагол.

The article is written. The article will be written.

The article is **not** written. The article will **not** be written.

Is the article written? **Will** the article be written?

Если в предложении говорится о лице или предмете, воздействующем на подлежащее, которое выражено существительным (или местоимением) с предлогом **by**, то возможен перевод: 1) глаголом в страдательном залоге или 2) глаголом в действительном залоге. Причем в последнем случае это лицо или предмет становится подлежащим русского предложения.

The plan was changed **by** the engineer. План был изменен *инженером:* (*Инженер* изменил план.)

Особенности перевода подлежащего. Подлежащее английского предложения при сказуемом в страдательном залоге может переводиться на русский язык существительным (или местоимением) в именительном падеже и во всех косвенных падежах:

The **house** was built by a new method.	*Дом (им. п.)* был построен новым методом.
He was seen in the laboratory two hours ago.	*Его (вин. п.)* видели в лаборатории два часа назад.
He was given a new job to do.	*Ему (дат. п.)* поручили выполнить новую работу.

Если за сказуемым в страдательном залоге следует предлог, относящийся к глаголу, то подлежащее английского предложения, как правило, переводится существительным (или местоимением) с предлогом, который ставится перед ним:

The design of the house was much worked **at.**	*Над* проектом этого дома много работали.
This engineer can be relied **upon.**	*На* этого инженера можно положиться.
The scientist's works are often referred **to.**	*На* труды этого ученого часто ссылаются.

Такие страдательные обороты возможны только с некоторыми глаголами. Наиболее употребительные из них:

- to act **on (upon)** влиять, воздействовать на
- to deal **with** — иметь дело с, рассматривать
- to experiment **on (upon)** экспериментировать над
- to insist **on** — настаивать на
- to look **at** — смотреть на
- to refer **to** — ссылаться на
- to rely **on (upon)** — полагаться на

- to send **for** — посылать за
- to speak **about (of)** — говорить о
- to work **at** — работать над

У некоторых глаголов предлог не переводится:

- to comment **on (upon)** — комментировать, рецензировать
- to listen **to** — слушать
- to look **for** — искать
- to look **upon** — считать, рассматривать

После этих глаголов предложное косвенное дополнение в действительном залоге может стать подлежащим страдательного залога:

We looked **for the device** every where, *(предложное косв, доп.)* — Мы искали этот прибор всюду.

The device was looked for everywhere, *(подлеж.)*

В английском языке имеется ряд глаголов, которые требуют после себя прямого дополнения, в то время как соответствующие русские глаголы требуют после себя косвенного дополнения с предлогом:

- to influence
- to affect

} влиять на

- to follow – следовать за

The lively discussion followed the report. — За докладом последовала оживленная дискуссия.

report was followed by a lively discussion.

Итак, подлежащее английского предложения при сказуемом в страдательном залоге может переводиться на русский язык существительным (или местоимением) во всех падежах, кроме родительного.

Страдательный залог времен группы Continuous образуется при помощи вспомогательного глагола **to be** в Present или Past Continuous + **Participle II** смыслового глагола и переводится по общим правилам перевода глагола в страдательном залоге, но глаголом несовершенного вида

During the experiment the in the laboratory was being purified by two ventilators.	Во время эксперимента воздух в лаборатории *очищался* двумя вентиляторами.

Страдательный залог времен группы Perfect образуется при помощи вспомогательного глагола **to be** в соответствующем времени Perfect и **Participle II** смыслового глагола.

Страдательный залог времен группы Perfect переводится по общим правилам перевода глагола в страдательном залоге:

Great deposits of coal **have been discovered** in our region.	Крупные залежи угля *(были) открыты* в нашем районе.
The construction of this hydroelectric plant **had been finished** by the end of last year.	Строительство этой гидроэлектростанции *было завершено к концу* прошлого года.

Времена группы **Perfect Continuous** не имеют формы страдательного залога.

UNIT 2. THE INFINITIVE

Инфинитив, или неопределенная форма глагола, отвечает на вопрос *что делать?* или *что сделать?* Показателем инфинитиц является частица **to**. В английском языке существуют простая и **сложная формы инфинитива.**

Indefinite	Active	Passive	Выражают действия, одновременные с действием Глагола□сказуемого
	to write	to be written	
Continuous	to be writing	—	
Perfect	to have written	to have been written	Выражают действия, предшествующие действию глагола-сказуемого и переводятся прошедшим временем.
Perfect Continuous	to have been writing	—	

Инфинитив с относящимися к нему словами образует **инфинитивный оборот**.

В предложении инфинитив или инфинитивный оборот может быть:

1) **подлежащим** (переводится существительным или неопределенной формой глагола):

To operate the complex device is rather difficult.	*Управлять (управление)* этим сложным механизмом довольно трудно

Признаком инфинитива-подлежащего является его положение в начале предложения перед сказуемым и отсутствие другого слова, являющегося подлежащим.

2) **частью сказуемого:**

а) **составного глагольного** (переводится неопределенной формой глагола):

You must **(had to) improve** your methods of work.	Вы *должны (должны были) улучшить* методы работы.
This engineer **is to design** a new high-speeddevice.	Этот инженер *должен спроектировать* новый скоростной механизм.

б) **именной частью сказуемого** после подлежащего, выраженного словами **aim, purpose** *цель*, **duty** *долг, обязанность*, **task** *задача,* **method** *метод*, **wish** *желание*, **plan** *план*, **function** *назначение, функция,* **problem** *проблема, задача* и др., и глагола-связки **to be**, причем глагол-связка либо совсем не переводится на русский язык, либо переводится словами *заключаться в том, что(бы); состоять в том, чтобы:*

Our *aim* **is to fulfil** our work in time.	Наша цель — *выполнить* работу в срок. (Наша цель *заключается в том, чтобы; состоит в том, чтобы...)*

Сравните:

They were to install the new equipment.	*Они должны были установить* новое оборудование.
Our *task* **was to install** the new equipment in time.	Наша задача *заключалась в том, чтобы установить* новое оборудование вовремя.

3) **дополнением** (переводится неопределенной формой глагола):

We hope **to get** new data in a week or two.	Мы надеемся *получить* новые данные через неделю или две.

4) **определением;** инфинитив в функции определения всегда стоит после определяемого существительного и переводится: а) определительным придаточ-

ным предложением, сказуемое которого выражает долженствование, возможность или будущее время; б) неопределенной формой глагола; в) существительным:

The metal **to be used** in our experiment is to be hard.	Металл*, который будет использован (нужно, можно использовать)* в нашем опыте, должен быть твердым.
The idea **to use** this new substance didn't leave us.	Мысль *об использовании (о том, чтобы использовать...)* этого нового вещества не покидала нас.

Инфинитив после слов **the first (the second, the third, etc.), the last** тоже является определением и переводится на русский язык голом в том времени, в котором стоит глагол **to be:**

S. Kovalevskaya **was the first** among women **to become** a professor.	С. Ковалевская *первой* среди женщин *стала* профессором.
The laboratory assistant **is the last to leave** the laboratory.	Лаборант *уходит* из лаборатории *последним.*

5) **обстоятельством цели;** стоит в начале предложения перед подлежащим или в конце предложения. Иногда вводится союзом **in order to** *для того чтобы.* Переводится на русский язык неопределенной формой глагола с союзом *чтобы, для того чтобы* или существительным с предлогом *для:*

To reinforce the metal engineers use artificial fibres.	*Чтобы усилить* металл *(для усиления...),* инженеры используют искусственные волокна.
A number of devices were developed in order to detect cosmic rays.	Было разработано несколько приборов *для обнаружения (чтобы обнаружить...)* космических лучей.

Инфинитив в функции обстоятельства следствия (со словами **too, enough** перед инфинитивом) часто при переводе имеет модальный оттенок:

This metal is *too* brittle **to be used** in our case.	Этот металл *слишком* хрупок, *чтобы его можно было использовать* в нашем случае.

Итак, инфинитив переводится на русский язык:

1. неопределенной формой глагола,
2. существительным,
3. придаточным предложением.

Кроме перечисленных функций, инфинитив может входить в состав сложного дополнения (объектный инфинитивный оборот) и сложного подлежащего (субъектный инфинитивный оборот).

Объектный инфинитивный оборот (сложное дополнение) состоит из:

существительного (в общем падеже) или местоимения (в объектном падеже: **me, him, her, us, you, them**)	+	инфинитив смыслового глагола

We consider **the results to be satisfactory.**	Мы считаем, что результаты удовлетворительны.

Сложное дополнение употребляется после глаголов, выражающих:

1) **желание, требование, просьбу: to want** *хотеть,* **to wish** *желать,* **to like** *нравиться,* **should (would) like** *хотелось бы,* **to request** *просить*, **to require, to demand** *требовать,* **to command** *приказывать;*

2) **мнение, суждение, предположение: to assume** *предполагать, допускать,* **to believe** *полагать, считать,* **to think** *думать, считать,* **to consider, to take** *считать,* **to expect** *ожидать, полагать,* **to find** *находить, признавать,* **to know** *знать,* **to suppose** *полагать,* **to show** *показывать,* **to prove** *доказывать, оказываться;*

3) **чувственное восприятие: to see** *видеть,* **to hear** *слышать,* **to feel** *чувствовать.*

После глаголов последней группы инфинитив стоит без частицы **to**.

На русский язык объектный инфинитивный оборот, как правило, переводится придаточным дополнительным предложением, подлежащим которого является дополнение, а сказуемым — инфинитив английского предложения:

We wanted him **to take part** in the conference.	Мы хотели, *чтобы он принял участие* в этой конференции.
We know **television to be** widely used in everyday life and in industry.	Мы знаем, *что телевидение* широко *используется* как в повседневной жизни, так и в промышленности.
The students saw **the device begin to operate.**	Студенты увидели, *как прибор начал работать.*

После глаголов **to make, to cause** в значении *заставлять, вызывать,* **to allow, to permit** *разрешать,* **to enable** *давать возможность* инфинитив объектного оборота может стоять в действительном и страдательном залоге. При переводе можно: 1) сохрани порядок слов английского предложения; 2) переводить инфинитив существительным сразу после глагола или неопределенной формой. глагола в действительном залоге:

Heat *causes* **most materials to become** slightly **bigger.**	Тепло заставляет *большинство материалов немного расширяться.* Тепло вызывает незначительное *расширение большинства материалов.*
The use of this device *permits* **more complex experiments to be carried out.**	Применение этого прибора *позволяет провести (проведение...) более сложные эксперименты.*

Примечание: После глагола **to make** в значении *заставлять* ннфинитив употребляется без частицы **to:**

This energy can **make** an electron **pass** from one orbit to another.	Этот вид энергии может заставить электрон перейти с одной орбиты на другую.

(Но в пассиве to остается: I was made to repeat the story. — Меня заставили повторить мой рассказ.)

После глаголов, выражающих чувственное восприятие, в сложном дополнении вместо инфинитива можно употреблять Participle I, если необходимо подчеркнуть процесс действия:

We *saw* **the experienced worker operating** a new very complex machine with great skill.	Мы видели, *как опытный рабочий* умело *управлял* новой, очень сложной машиной.

Субъектный инфинитивный оборот (сложное подлежащее) состоит из:

существительного (в общем падеже) или местоимения (в именительном падеже: **I, you, he** и т.д.)	+	инфинитив, стоящий после сказуемого

The results obtained *are considered* **to be satisfactory.**	Считают, *что полученные Результаты удовлетворительны.*

Субъектный инфинитивный оборот употребляется:

1) когда сказуемое выражено следующими глаголами в страдательном залоге **to know** *знать,* **to consider** *считать, рассматривать,* **to say** *говорить,* **to state** *заявлять, сообщать,* **to report** *сообщать,* **to think** *думать, считать,* **to believe, to find** *полагать, считать,* **to suppose, to assume** *предполагать,* **to expect** *ожидать* и др.:

The **atom** *is known* **to emit** rays of different length.	*Известно, что атом испускает* лучи различной длины. *Или: Атом,* как известно, *испускает* лучи различной длины.

2) когда сказуемое выражено глаголами, которые употребляются в **действительном** залоге: **to seem, to appear** *казаться,* **to prove** *оказываться,* **to happen** *оказываться, случаться:*

The capacity of this mobile power station *seems* **to range** from 600 to 700 kilowatts.	*Мощность этой передвижной электростанции*, как оказывается, колеблется от 600 до 700 киловатт.

Глагол **to appear** в таких предложениях часто переводится *по-видимому:*

This laboratory *appears* **to be working out** new possible applications of a laser.	По-видимому,*в этой лаборатории разрабатываются* новые возможные применения лазера.

3) когда сказуемое выражено прилагательными: **likely** *вероятный,* **unlikely** *маловероятный,* **certain** *несомненный,* **sure** *верный* в сочетании с глаголом **to be:**

Under these conditions **the output of the plant** *is likely* **to increase.**	При этих условиях *производительность завода,* вероятно, *увеличится.*
The application of this device *is certain* **to give** better results.	*Применение этого прибора* несомненно *даст* лучшие результаты.

Предложение с субъектным инфинитивным оборотом переводится на русский язык: 1) сложноподчиненным предложением. Сказуемое английского предложения, которое стоит в страдательном залоге **(is said, was considered),** переводится на русский язык глаголом в 3-м лице множественного числа (*говорят, полагали* и т. д.), за которым следует придаточное дополнительное предложение с союзом *что;* 2) простым предложением с вводными словами *как известно, как считали, вероятно,по-видимому.*

Как уже говорилось, перфектные формы инфинитива выражают действие, предшествующее действию глагола-сказуемого, и переводятся на русский язык глаголом в прошедшем времени:

The new device *is reported*	Сообщают, *что* этот новый

to have been put into mass production.	*прибор уже запущен* в массовое производство.

Предложный инфинитивный оборот *for* + существительное (местоимение) + инфинитив с *to* выполняет роль любого члена предложения — дополнения, обстоятельства, части сказуемого и т. д. и переводится придаточным предложением, вводимым союзами *что, чтобы, для того чтобы,* подлежащим которого становится существительное или местоимение, стоящее перед инфинитивом, а сказуемым — инфинитив:

Everybody waited *for the new data* of the experiment *to be published*.	*Все ожидали, что новые данные* эксперимента *будут опубликованы.*

Возможен перевод этого оборота существительным или инфинитивом:

It was important **for us to solve** this problem as soon as possible.	Нам было важно *решить* эту проблему как можно скорее.

UNIT 3. THE GERUND

Герундий — это неличная форма глагола, обладающая одновременно свойствами **существительного** и **глагола.** Герундий выражает процесс действия. Существуют **простые** и **сложные** формы герундия.

	Active	Passive	Выражает действие, одновременное с действием глагола-сказуемого, или действие, относящееся к будущему.
Indefinite Gerund	reading	being read	
Perfect Gerund	having read	having been read	Выражает действие, предшествующее действию глагола-сказуемого.

Герундий с относящимися к нему словами образует **герундиальный оборот.**

Характерным признаком герундия является наличие перед ним:

1) предлога,
2) притяжательного местоимения или
3) существительного в притяжательном или общем падеже.

Gerund Indefinite Active *(burning)* образуется путеми прибавления -ing к основе глагола (правила образования и правописания совпадают с причастием).

В предложении герундий (или герундиальный оборот) может быть:

1) **подлежащим;** переводится существительным или неопределенной формой глагола:

Measuring distances to the planets and stars has a lot of difficulties.	*Измерение* расстояний до планет и звезд представляет большие трудности.
Heating the substance up to	*Нагреть* это вещество до 85 °C

85 °C was absolutely necessary.	было совершенно необходимо.

2) **частью сказуемого**; переводится существительным или неопределенной формой глагола:

One of the effects of heat **is turning** a solid into liquid.	Одним из действий тепла *является превращение* твердого вещества в жидкое.

3) **дополнением, прямым или предложным**; переводится существительным, неопределенной формой глагола или дополнительным придаточным предложением:

He likes **reading.**	Он любит *читать.*
Thank you for **coming.**	Благодарю вас за то, *что вы пришли.*

4) **определением.** Имеются два случая употребления герундия в функции определения:

а) герундий стоит перед определяемым словом (переводится прилага-тельным или существительным):

a smoking room — *курительная* комната (т. е. можно сказать *комната для курения)*

a boiling point — *точка кипения*

б) герундий с предлогом стоит после определяемого слова (переводится существительным):

The idea of **utilizing** the energy of oceans and seas for man's needs is not new.	Идея *(какая?) использования* энергии океанов и морей для нужд человека не нова,

5) обстоятельством (всегда с предлогом).

Герундий с предлогом	Перевод

in in designing the device	1. деепричастием настоящего времени: *проектируя прибор* 2. сочетанием предлога *при* + существительное: *при проектировании* прибора
on, upon on (upon) reaching 63°C	1. деепричастием прошедшего времени: *достигнув 63° С* 2. сочетанием *при (после)* + существительное: *при достижении 63 "С*
before, after before (after) compressing the gas	1. сочетанием *перед (после)* + существительное: *перед (после) сжатием (сжатия) газа* 2. придаточным обстоятельственным предложением: *до того (после того) как произойдет сжатие газа.*
by by creating new station	1. деепричастем: *создавая* новые станции 2. сочетанием *путем (с помощью)* + существительное: *путем создания новых станций*
without without preheating	1 сочетанием *не* + деепричастие:*не нагревая* предварител 2. сочетанием *без* + существительное: *без предварительного нагрева*

Особое внимание следует уделить переводу герундиальных оборотов с предшествующим притяжательным местоимением или существительным в притяжательном падеже. Герундиальный оборот в этом случае переводится придаточным предложением с союзами *что; то, что; о том, чтобы; в том, что,* причем герундий в русском предложении становится сказуемым этого придаточного предложения. Притяжательное местоимение (или существительное в притяжательном падеже) становится подлежащим придаточного предложения:

We all know of **their designing** a new type of semiconductor radio set.	Мы все знаем, *что они проектируют* новый тип радиоприемника на полупроводниках.

Smirnov's taking part in the development of the new cooling system was of great help to us.	*То, что Смирнов принял участие* в усовершенствовании новой охладительной системы, очень помогло нам.

Indefinite Gerund Passive *(being written*) обычно переводится глаголом в настоящем времени:

We knew nothing about **her being sent** to Moscow.	Мы ничего не знали о том, *что ее посылают* в Москву.

Perfect Gerund Active *(having written)* и **Perfect Gerund Passive** *(having been written)* обычно переводятся глаголом в прошедшем времени:

The **engineer** mentioned **his** having **tested** this material for **strength with** an entirely satisfactory result.	Инженер упомянул о том, *что он испытал* этот материал на прочность с вполне удовлетворительным результатом.
We knew nothing of **her having been** sent to Moscow.	Мы ничего не знали о том, *что ее послали* в Москву.

ОТГЛАГОЛЬНОЕ СУЩЕСТВИТЕЛЬНОЕ (THE VERBAL NOUN)

Отглагольное существительное образуется путем прибавления к форме инфинитива суффикса-окончания **-ing:** to meet *(встречать) — meeting (встреча, собрание, митинг)*. В отличие от герундия, отглагольное существительное обладает **только свойствами существительного** и поэтому: 1) употребляется с артиклем, 2) может иметь форму множественного числа и 3) может определяться прилагательным:

The **readings** of this device are correct	*Показания* этого прибора верны.

UNIT 4. THE PARTICIPLE

Причастие — это неличная форма глагола, имеющая признаки как **прилагательного**, так и **глагола**. Существуют **простые** и **сложные формы** причастия.

Participle I	Active	Passive	Выражает действие, одновременное с действием глагола-сказуемого
	building	being built	
Participle II	—	built	Выражает действие, одновременное с действием глагола-сказуемого или предшествующее ему.
Perfect Participle	having built	having been built	Выражает действие, предшествующее действию глагола-сказуемого.

Причастие с относящимися к нему словами образует причастный оборот.

Participle I Active (*building*) образуется путем прибавления **-ing** к основе глагола: *build + ing = building.*

1. Если глагол оканчивается на **-e**, то при добавлении –ing буква **e** отбрасывается: *to produce + ing = producing.*

2. Если глагол оканчивается на согласную с предшествующей краткой гласной, то конечная согласная удваивается, чтобы не изменилось чтение гласной: *put + ing = putting.*

3. Если глагол оканчивается на **-ie,** то буква **e** отбрасывается, буква **i** меняется на **y** и добавляется **-ing:** *to tie + ing = tying.*

В предложении Participle I может быть:

1) **определением**; переводится причастием действительного залога с суффиксами *-ущ, -ющ ,-ащ, -ящ, -вш, -ш* или определительным придаточным предложением. В функции определения Participle I может стоять перед определяемым словом или после него:

The **boiling** water changes into steam. — *Кипящая* вода превращается в пар.

The water **boiling** in the vessel changes into steam.	Вода, *кипящая* в сосуде, превращается в пар.

2) **обстоятельством;** переводится деепричастием с суффиксами *-а, -я, -ав, -ив* или обстоятельственным придаточным предложением:

Going into chemical combinations elements entirely change their properties.	*Вступая* в химические соединения (реакции), элементы полностью меняют свои свойства.
Copper is of great value, **being** a good conductor of electricity.	Медь представляет большую ценность, *являясь (так как она является)* хорошим проводником электричества.

Participle I с союзами **when** *когда и* **while** *в то время как* переводится а) деепричастием (или деепричастным оборотом), при этом союз опускается, б) придаточным предложением с союзами *когда, в время как*, в) *при* + существительное:

When combining chemically hydrogen and oxygen form water.	*Вступая* в химическую реакцию, водород и кислород образуют воду. *(Когда водород и кислород вступают в химическую реакцию,* они образуют воду.)
While making his experiment the lab assistant put down all the necessary data.	*Проводя* опыт, лаборант записывал все необходимые данные, *В то время как лаборант проводил* опыт, он записывал... *При проведении опыта...)*

3) частью сказуемого во временах группы Continuous и Perfcc Continuous; переводится глаголом в личной форме:

The builders **are applying**	Строители *применяют* самые

the most progressive methods of constructing houses.	прогрессивные методы строительства домов.
He has been working in the laboratory since early morning.	Он *работает* в лаборатории с раннего утра.

Итак, **Participle I Active** переводится:

1. причастием действительного залога (с суффиксами *-ущ, -ющ,-ащ, -ящ,-вш, -ш),*
2. деепричастием (с суффиксами *-а, -я, -ав, -ив),*
3. глаголом в личной форме в придаточном определительном или обстоятельственном предложении,
4. предлогом *при* + существительное.

Participle II **стандартных глаголов** образуется, подобно Past Indefinite, путем добавления **-ed** к основе глагола: to design — designed.

Participle II **нестандартных глаголов** даются в списке нестандартных глаголов (см. Приложение).

В предложении Participle II может быть:

1) **определением**; переводится причастием страдательного залога с суффиксами-окончаниями, *-нный, -емый, -имый, -тый, -щийся, -вшийся.* В функции определения Participle II может стоять перед определяемым словом или после него:

The fibres **produced** by our shop are of **improved** quality.	Волокна, *выпускаемые* нашим цехом, *улучшенного* качества.
Most of the laboratories **equipped** with the latest apparatus are housed in the main building.	Большинство лабораторий, *оборудованных* новейшей аппаратурой, находится в главном здании,

Обратите особое внимание на перевод предложений, в которых за подлежащим следуют два слова с окончанием **-ed**. Первое из них обычно является

определением в форме Participle II и при переводе ставится перед определяемым словом, второе является сказуемым в Past Indefinite:

Thedevice *invented***s howed** good performance.	*Изобретенный* прибор **показал** хорошую работу.
The engine *tested* **required** further improvement.	*Прошедший испытания* двигатель **потребовал** дальнейшего усовершенствования.

Однако первым словом может быть сказуемое в Past Indefinite, а вторым — Participle II в функции определения:

Yesterday the engineer *demonstrated* **improved** mechanisms.	Вчера инженер*показал* усовершенствованные механизмы.

2) **обстоятельством;** перед Participle II в функции обстоятельства обычно стоят союзы **when** *когда,* **if** *если,* **unless** *если не,* **as** *как.* Такой причастный оборот переводится, как правило, придаточным обстоятельственным предложением, а иногда — предлогом *при* + существительное:

As **seen** from the article these engines are produced in Minsk.	*Как видно* из статьи, эти двигатели изготавливаются в Минске.
Unless **tested** the machine must not be put into operation.	*Если* машина *не испытана (не прошла испытаний),* ее нельзя эксплуатировать.
When **heated** the polymer changed its properties completely.	*Когда* полимер *нагрели,* он полностью *изменил свои свойства.* *(При нагревании полимер....)*

3) **частью сказуемого в страдательном залоге и во временах группы Perfect;** переводится глаголом в личной форме:

I was **told** about this discovery only a few days ago.	Мне *сказали* об этом открытии только несколько дней назад.
They have considerably **developed** the engine.	Они значительно *усовершенствовали* двигатель.

Итак, **Participle II** переводится:

1. причастием страдательного залога (с суффиксами *-нн, -м, -т, -ш, -вш),*

2. глаголом в личной форме в обстоятельственном придаточном предложении,

3. *при* + существительное.

Participle I Passive *(being built)* в предложении может быть:

1) **определением**; переводится причастием страдательного залога с суффиксами-окончаниями *-щийся, -вшийся, -мый* или определительным придаточным предложением:

The plant **being built** in our district will produce radio sets.	*Завод, строящийся (который строится* в нашем районе, будет выпускать радиоприемники.

2) **обстоятельством времени или причины;** обычно переводится обстоятельственным предложением времени или причины (реже причастным оборотом со словом *будучи):*

Being built of coloured stone and plastics, the cinema will look fine.	*Так как* кинотеатр *строится* из цветного камня и пластмасс, он будет выглядеть очень красиво.

Perfect Participle Active *(having built)* и **Perfect Participle Passive** *(having been built)* в предложении являются только **обстоятельством** (времени или причины) и переводятся:

1) Perfect Participle Active — деепричастием совершенного вида с суффиксами *-ав, -ив* или придаточным предложением:

Having repaired the engine, the mechanic showed it to the engineer.	*Отремонтировав* мотор, механик показал его инженеру. *Или: После того как механик отремонтировал мотор,* он....

2) Perfect Participle Passive — придаточным предложением с союзами *так как, после того как, когда:*

Having been repaired, the engine began operating better.	*После того как мотор был отремонтирован*, он начал работать лучше.

Итак, **Perfect Participle** переводится:

1. деепричастием совершенного вида,

2. глаголом в личной форме в обстоятельственном придаточном предложении.

Независимый причастный оборот. Обстоятельственные причастные обороты могут быть зависимыми и независимыми. Когда обстоятельственный причастный оборот относится к подлежащему предложения, он называется **зависимым:**

Inspecting **the motor**, the engineer made some valuable remarks.	*Осматривая мотор,* инженер сделал несколько ценных замечаний.
Having done a given number of operations, the machine stopped automatically.	*Проделав заданное количество операций,* машина автоматически остановилась.

Когда причастие входит в состав **независимого причастного оборота,** оно выражает действие не подлежащего всего предложения, а существительного (или местоимения), стоящего перед ним. Таким образом, такой причастный оборот **не зависит** от подлежащего всего предложения.

Независимый причастный оборот в тексте можно узнать по следующим признакам: 1) перед причастием стоит существительное без предлога или местоимение в именительном падеже, 2) независимый причастный оборот всегда отделен запятой.

На русский язык независимый причастный оборот переводится:

1) **придаточным обстоятельственным предложением времени или причины с союзами** *когда, после того как, поскольку, так как* и др., когда он стоит в начале предложения:

Some new devices having been obtained, the researchers could make more complex experiments.	*После того как были получены новые приборы*, исследователи смогли делать более сложные опыты.
It being late, we decided to stop working.	*Так как было поздно, мы решили прекратить* работу.

2) **самостоятельным предложением бессоюзным или с союзами** *причем, а, и, но*, если причастный оборот стоит в конце предложения:

The average height of the Ural mountains is 800 metres, **the highest point being 1,500 metres above sea level.**	Средняя высота Уральских гор 800 метров, *а самая высокая точка находится на высоте 1500 метров над уровнем моря.*
The installation was automized last year, **its capacity rising by 25 per cent.**	Эта установка была автоматизирована в прошлом году, и *ее производительность увеличилась на 25%.*
The students wrote their English test-paper, **each doing his variant.**	Студенты писали контрольную работу по английскому языку, *причем каждый делал свой вариант.*

Примечание: Иногда независимый причастный оборот, стоящий в конце предложения, может переводиться придаточным предложением:

All machines have energy loss, **some energy being converted into useless heat due to friction.**	Все машины испытывают потери энергии, *так как некоторое количество энергии превращается в бесполезное тепло из-за **трения.***

СРАВНЕНИЕ ГЕРУНДИЯ И ПРИЧАСТИЯ

Формы герундия совпадают с формами причастия. Герундий от причастия отличается:

1) **по функции в предложении.** Герундий может быть любым членом предложения, причастие — только определением, обстоятельством или частью сказуемого.

Если предложение начинается словом с окончанием **-ing**, следует помнить, что оно может быть герундием в функции подлежащего (если за ним идет глагол-сказуемое) или причастием в функции обстоятельства (если за ним следует подлежащее):

Герундий перед глаголом-сказуемым	Причастие перед подлежащим
Testing the motor *was necessary.*	Testing the motor, *he saw...*
Испытать мотор было необходимо.	*Испытывая мотор,* он увидел...

2) **по наличию предлога.** Как герундий, так и причастие могут быть обстоятельством и определением. В отличие от причастия, перед герундием в этом случае, как правило, стоит предлог. Перед причастием может стоять союз **when** или **while**.

Герундий	**Причастие**
в функции обстоятельства	
After testing the motor they put down the results. *После испытания мотора* они записали результаты.	*(While)* testing the motor they put down the results.*Испытывая мотор*, они записывали результаты.
в функции определения	
1. There are several ways of producing electricity. Имеется несколько способов *производства электричества*.	The plant producing electricity is very powerful. Эта установка, производящая *электричество*, очень мощная.
2. Герундий может употребляться без предлога, если стоит перед	

определяемым словом:

operating principle — принцип действия

reading hall — читальный зал

Причастие перед определяемым словом означает, что действие выполняется самим предметом или лицом:

operating engine — работающий двигатель

reading man — читающий человек

3) **по наличию перед герундием притяжательного местоимения или существительного в притяжательном или общем падеже:**

We heard of **his going to London.**	Мы слышали, *что он едет в Лондон,*
We know of *copper and silver* **being the best conductors.**	Мы знаем, *что медь и серебро — самые лучшие проводники.*

UNIT 5. MODAL VERBS

Модальные глаголы **can, may, must** являются модальными глаголами; они не обозначают действия, а выражают отношение к нему, т. е. возможность, вероятность или необходимость совершения действия. Само действие выражается инфинитивом смыслового глагола без частицы **to**, следующим за модальным глаголом.

Глагол сап выражает возможность, способность и разрешение совершить действие и переводится на русский язык глаголами *могу (может, можешь* и т. д.), *умею (умеет, умеешь* и т. д. *), можете (вам разрешено)* и т. д.

Глагол **may** выражает **разрешение** или **предположение** и переводится *могу, можно, возможно.*

Глагол **must** выражает **необходимость, обязательность** или **вероятность** совершения действия и переводится словами *должен, нужно*, **на***до, вероятно.*

We **can** determine the pressure of our atmosphere with the help of a barometer.	Мы *можем* определить давление атмосферы с помощью барометра
You **may** use this instrument in your experiments.	Вы *можете* (вам *разрешено)* пользоваться этим прибором во время опытов.
They **must** provide us with all necessary data.	Они *должны* снабдить нас всеми необходимыми данными.

Для образования **отрицательной формы** после модального глагола ставится отрицательная частица **not.**

Примечание: Отрицание not с глаголом сап пишется слитно: **cannot**

Для образования **вопросительной формы** модальный глагол ставится перед подлежащим:

She **cannot** translate this text without a dictionary.	Она *не может* перевести этот текст без словаря.
Must you take part in this work?	Вы *должны* принимать участие

	в этой работе?
Yes, I **must**	*Да, должен.*
No, **I need not (needn't).**	*Нет, не должен (мне не нужно).*

Примечания: 1. Для выражения необходимости *(не нужно, не надо)* в отрицательной форме употребляется глагол needn't

2. В ответе на вопрос, начинающийся с **may**, употребляется глагол **mustn't** в значении ***запрещается****:*

May I take this book? — No, you **mustn't** I need it myself.	Можно мне взять эту книгу? — Нет. Она мне нужна самому.

Глагол **can** в прошедшем времени имеет форму **could**. Глагол **may** имеет форму прошедшего времени **might**, которая употребляется в соответствии с правилом согласования времен, а также для образования сослагательного наклонения. Глагол **must** не имеет формы прошедшего времени.

Эквиваленты модальных глаголов. У модальных глаголов **can**, **may** и **must** есть эквиваленты, которые употребляются наряду с соответствующими модальными глаголами и, кроме того используются взамен отсутствующих временных форм этих модальных глаголов.

Глаголы **should** и **ought** употребляются для выражения морального долга или совета и переводятся *должен, следует.* Являясь модальным глаголом, **should** употребляется со всеми лицами единственного и множественного числа.

Глагол **ought** употребляется во всех лицах единственного и множественного числа. Инфинитив смыслового глагола после глагола **ought** употребляется с частицей **to**:

Atom **should** serve peaceful purposes.	Атом *должен* служить мирным целям.
You **ought to** be careful when experimenting with this substance.	Вы *должны* быть осторожны, проводя опыты (экспериментируя) с этим веществом.

Модальные глаголы и их эквиваленты

Present Indefinite	Past Indefinite	Future Indefinite
I, he, she, it } **can** we, you, they	I, he, she, it } **could** we, you, they	—
I **am** he, she **is** it, we, you, they **are** **able to**	I, he, she, it **was** we, you, they **were** **able to**	I, we, he, she, it, you, they **will be able to**
I, he, she, it } **may** we, you, they	I, he, she, it } **might** we, you, they	—
I **am** he, she **is** it, we, you, they **are** **allowed to**	I, he, she, it **was** we, you, they **were** **allowed to**	I, we, he, she, it, you, they **will be allowed to**
I, he, she, it } **must** we, you, they	—	—
I, we, you, they **have to**	I, he, she, it **had to**	I, we, he, she, it, you, they **will have to**
he, she, it **has to**	we, you, they	

Глагол **should** в модальном значении часто употребляется в инструкциях:

These machines **should** be handled with great care.

С этими машинами *следует обращаться* с большой осторожностью

Когда речь идет о **необходимости** совершения действия **в силу предварительной договоренности или заранее намеченного плана или расписания**,

употребляется глагол **to be** с последующим инфинитивом основного глагола. Глагол **to be** в **модальном значении** употребляется в настоящем или прошедшем времени группы Indefinite; для выражения действия в будущем употребляется настоящее время глагола **to be**.

Old machinery **is** to be replaced next month.	Старые машины *должны* быть заменены в следующем месяце.
They **were** to discuss the plan of their research work at the last meeting.	Они *должны* были обсуждать план научно-исследовательской работы на прошлом заседании.

Итак, следующие глаголы выражают долженствование:

must — должен, нужно, необходимо

to have to —должен, вынужден, придется

to be to — должен, нужно

should – ought to } следовало бы, следует *(реже* должен)

Употребление модальных глаголов в сочетании с инфинитивом страдательного залога. Инфинитив страдательного залога Indefinite Passive после модальных глаголов **can, may, must** и **should** переводится неопределенной формой глагола:

Today lathes **can be found** in any shop.	В настоящее время токарные станки *можно найти* в любом цехе.
The plan of producing a new kind of poisoners **should be fulfilled** as soon as possible.	План выпуска новых полимеров *следует выполнить* как можно скорее.

В **отрицательной форме** модальные глаголы **can** и **may** с инфинитивом страдательного залога переводятся *нельзя,* **must, should** — *не следует.*

This device **may not be**	Этот прибор *нельзя* здесь

switched on here.	*включать.*
The batteries **should not be kept** uncharged.	Батареи *не следует держать* разряженными.

Употребление модальных глаголов в сочетании с перфектным инфинитивом (Infinitive Perfect).

Must в сочетании с перфектным инфинитивом выражает **предположение, относящееся к прошлому,** и переводится *должно быть, вероятно:*

Originally the Earth's temperature **must have been** extremely high.	Вначале температура Земли *была, вероятно,чрезвычайно* высокой.

May также выражает **предположение**, но переводится *возможно:*

He **may have finished** his experiment, but we don't know about it yet.	*Он, возможно, закончил* свой опыт, но мы еще ничего об этом не знаем.

Could, should, might, ought в сочетании с перфектным инфинитивом употребляются для выражения действия, которое **могло бы произойти, но не произошло:**

You could have done this work yourself.	*Вы могли бы сделать эту* работу сами (но *не сделали).*
They **should have tested** the new equipment.	Они *должны были проверить* новое оборудование (но *не проверит).*
The student **ought to have been** careful while working with this instrument.	Студенту *следовало быть* осторожным, работая с этим прибором.
Now the instrument is broken.	Теперь прибор сломан.

UNIT 6. THE SUBJUNCTIVE MOOD

Глаголы в английском языке имеют категории **наклонения, залога и времени.**

В английском языке три наклонения:

а) **изъявительное** наклонение выражает действие как **реальный** факт во всех временах:

Our studies begin in September and end in July	Наши занятия *начинаются* в сентябре и *заканчиваютсяв* июле.

б) **повелительное наклонение** выражает **побуждение** к действию, т. е. просьбу, совет, приказание, запрещение:

Measure the temperature of the water. *Измерьте* температуру воды.

в**) сослагательное наклонение** выражает действие не как реальный факт, а как **действие предполагаемое** или **желательное**:

If she **were** present at the conference, she **would take** part in the discussion.	Если *бы* она *присутствовала* на конференции, она *бы приняла* участие в дискуссии.

В русском языке **сослагательное** наклонение выражается сочетанием формы прошедшего времени глагола с частицей *бы* и имеет одну форму для настоящего, прошедшего и будущего времени:

Если *бы* у меня *было* больше времени, я *бы пошел* на эту выставку (*сегодня, вчера, завтра)*.

В английском языке сослагательное наклонение может выражаться **синтетически**, т. е. простыми глагольными формами, или **аналитически**, т. е при помощи сложных глагольных форм.

К **синтетическим формам** относятся:

1. Для глагола **to be**:

а) форма **be** для всех лиц единственного и множественного числа:

It is necessary that the engine be light and highly efficient.	Необходимо, *чтобы* двигатель*был* легким и очень эффективным.

б) форма **were** для всех лиц единственного и множественного числа:

I wish he were here.	Я хочу (хотел бы), *чтобы* он *был* здесь.

Форма **were** употребляется в придаточных предложениях, выражающих **желание, сравнение или условие**.

2. Для всех остальных глаголов — форма инфинитива без частицы **to** для всех лиц единственного и множественного числа: she **work**, he **study**, they **come**:

We suggested that he **inform** us about his work.	Мы предложили, *чтобы* он *проинформировал* нас о своей работе.

Синтетические формы, кроме формы **were**, употребляются довольно редко (за исключением языка художественной литературы); более обычным является употребление аналитических форм сослагательного наклонения.

Аналитические формы представляют собой сочетание глаголов **should** или **would с простым инфинитивом** (если предполагаемое действие относится к настоящему или будущему) или **с перфектным инфинитивом** (если действие относится к прошлому):

I **should like to** do it.	Мне *бы хотелось сделать*это.
He **would have come** here but he was busy.	Он *бы пришелсюда (раньше, тогда),* но он был занят.

В английском языке сослагательное наклонение употребляется:

1) **В простых предложениях**, выражающих предположение или пожелание. В этом случае вспомогательный глагол **should** употребляется с 1-м лицом единственного и множественного числа, а глагол **would** со всеми остальными

лицами. В простых предложениях наряду с should и would употребляются глаголы **might** и **could**, которые сохраняют свое лексическое значение и переводятся на русский язык *мог (-ла, -ло, -ли) бы.*

It **would be** interesting to make this experiment.	*Было бы* интересно сделать этот опыт.
I **should like** to take part in this research work.	Мне *бы хотелось* принять участие этой исследовательской работе.
Atomic energy **might be** used for this purpose.	Атомная энергия *могла бы быть спользована* для этой цели.

В лозунгах и призывах употребляется чаще синтетическая (простая) форма сослагательного наклонения:

Be it so!	*Пусть будет так!*
Long live our peace-lovingpeople!	*Да здравствует наш миролюбивый* народ!

2) **В сложноподчиненных предложениях.** В случаях а), б) и в) сослагательное наклонение выражается при помощи вспомогательного глагола **should** для всех лиц единственного и множественного числа и инфинитива смыслового глагола без частицы **to** или при помощи синтетической формы:

а) **в придаточных предложениях подлежащих**, начинающихся с союза **that** после оборотов типа: **it is required** *требуется***, it is necessary** *необходимо,* **it is important** *важно,* **it is possible** *возможно,* **it is desirable** *желательно,* **it is probable** *вероятно,* **it is improbable** *невероятно.*

It is necessary that the data received **should be** highly accurate.	*Необходимо, чтобы* полученные данные *были* очень точными.
It is necessary that the data received **be** highly accurate.	

б) **в дополнительных придаточных, начинающихся с союза *that,*** после глаголов, выражающих:

приказание

- to order — приказывать
- demand — требовать
- to insist — настаивать

предложение

- to suggest предлагать
- to propose
- to recommend рекомендовать

К. Е. Tsiolkovsky *suggested that* the rocket **should be** used for interplanetary travel. = К. Е. Tsiolkov sky *suggested* that the rocket **be used** for…

К. Э. Циолковский *предложил, использовать* ракету для межпланетных путешествий.

в) **в обстоятельственных придаточных предложениях цели после союзов *so that*** *для того чтобы* и ***lest*** *чтобы не.* В этом случае наряду с **should** употребляются также глаголы **might** и **could**, которые, как правило, сохраняют свое лексическое значение и переводятся на русский язык:

He must hurry *lest* he **should be late.**

Он должен торопиться, *чтобы не опоздать.*

The new alloy must be thoroughly tested *so that* we **might use** it in our design.

Новый сплав надо тщательно испытать, *чтобы* мы *могли использовать* его в нашей конструкции.

г) **в дополнительных придаточных предложениях после глагола** to *wish*

We *wish* our tests of this engine **would give** better results.

Нам *хотелось бы*, чтобы испытания этого двигателя *дали* лучшие результаты.

They *wish* this method **were used** in his work.

Им *хотелось бы, чтобы* этот метод *использовался* в его работе.

д**) в обстоятельственных придаточных предложениях, жающих нереальное сравнение, после союзов *as if*** *как если бы* ***as though*** *как будто бы.* В

этом случае сослагательное наклонение передается формами, совпадающими с Past Indefinite и Past Perfect:

The Earth behaves *as if* it **were** a large magnet.	Земля ведет себя так, *как если бы* она *была* огромным магнитом (как огромный магнит),
He looked at this building *as though (as if)* he **had** never **seen** it before.	Он смотрел на это здание, *как будто* никогда его раньше *не видел.*

е) **в сложноподчиненных предложениях с придаточным условия**.

Итак, сослагательное наклонение употребляется:

1. в **простых предложениях**, выражающих **предположение** или **пожелание**,

2. в **придаточных предложениях подлежащих** после оборотов типа **it is necessary, it is important,**

3. **в дополнительных придаточных предложениях** после глаголов, выражающих **приказанне, предложение, пожелание.**

4. **в обстоятельственных придаточных предложениях цели**
после союзов **so that, lest, as if, as though**.

5. **в сложноподчиненных предложениях** с придаточным **условия** (см. Unit 7. Conditionals).

UNIT 7. CONDITIONALS

Сложные предложения подразделяются на **сложносочиненные** и **сложноподчиненные** предложения.

Сложносочиненное предложение состоит из двух или нескольких простых, самостоятельных предложений, которые соединяются сочинительными союзами **and, but, or** и др. или бессоюзной связью:

Lomonosov was born in Russia,	Ломоносов родился в России,
he devoted all his life to Russia	он посвятил всю свою жизнь Россия
and to Russia he gave all	и отдал России всю свою энергию
his energy and knowledge.	и все свои знания.

Сложноподчиненное предложение состоит из главного предложения и одного или нескольких придаточных, которые поясняют главное. Придаточное предложение может соединяться с главным предложением подчинительными союзами и союзными словами или без союзов.

Любой член предложения может быть заменен придаточным предложением. Поэтому придаточные предложения подразделяются на придаточные подлежащие, сказуемые, дополнительные, определиусльные и обстоятельственные.

Придаточные подлежащие стоят перед сказуемым и вводятся союзами **that, what, who, where** и др.

What you say is not quite clear.	То, что вы говорите, не совсем ясно.
Where I lost my watch is a mystery.	Где я потерял часы, для меня загадrf

Придаточные сказуемые в предложении являются именной частью сказуемого главного предложения, поэтому всегда следуют за глаголом-связкой и вводятся союзами **that, what, who** и др.

Обратите внимание на способы перевода глагола-связки, который предшествует придаточному сказуемому:

The difficulty of extramural education is that it demands great effort from the students.	Трудность заочного образования заключается в том, что оно требует от студентов большого напряжения.

Придаточные дополнительные следуют за сказуемым и вводятся союзами **that, if, whether** и др.:

Everybody knows **that** one must work regularly to master a foreign language.	Всем известно, что надо работать регулярно, чтобы овладеть иностранным языком.
I am not sure **if (whether)** will take part in this conference.	Я не уверен, примет ли он участие в этой конференции.

Придаточные дополнительные могут соединяться с главным предложением и бессоюзной связью:

I think we will complete our research in time.	Я думаю, (что) мы завершим свое исследование вовремя.

Переводя сложноподчиненное предложение с придаточным дополнительным, необходимо помнить о правиле согласования времен. Правило согласования времен соблюдается, когда сказуемое главного предложения стоит в **прошедшем времени** (чаще всего в Past Indefinite). В этом случае сказуемое придаточного дополнительного тоже должно стоять в одном из прошедших времен:

1. Сказуемое придаточного стоит **в Past Indefinite** или **Past Continuous** и переводится на русский язык **настоящим временем**, если действия, выраженные сказуемыми главного и придаточного, одновременны:

My friend **said** that he **wanted** to become an engineer.	Мой друг *сказал,* что он *хочет* стать инженером.
I **heard** that this young engineer **was working out** a new type	*Я слышал*, что этот молодой инженер *разрабатывает* новый тип

of self-movingcrane.	самоходного крана.

2. Сказуемое придаточного предложения стоит в **Past Perfect** и переводится на русский язык **прошедшим временем**, если действие, выраженное сказуемым придаточного, **предшествует действию**, выраженному сказуемым **главного предложения**:

We **knew** that this student **had taken part** in the investigation and **had received** very interesting results.	Мы *знали,* что этот студент *принимал участие* в исследовании и *получил* очень интересные результаты,

3. Сказуемое придаточного предложения стоит во времени **Future-in-the-Past** и переводится на русский язык **будущим временем**, если действие, выраженное сказуемым придаточного, **следует за действием**, выраженным сказуемым **главного.**

Форма Future-in-the-Past образуется при помощи вспомогательных глаголов:

should/would (1-е л. ед. и мн. числа) would (2-е и 3-е лицо)	инфинитив смыслового глагола без to

Придаточные определительные могут служить определениями к любому члену предложения, выраженному существительным. Они вводятся союзными словами и союзами **who, whom whose, which, that, when, where, why:**

A number whose **value is to be** found is called an unknown numbe	Число, значение которого надо найти, называется неизвестным числом.
Aluminium, *which* **is preferable to steel for certain parts of electric** machinery is a very light metal.	Алюминий, который предпочитают стали для изготовления некоторых деталей электрооборудования, является очень легким металлом.

Придаточные определительные могут соединяться с главными предложениями и без союзного слова, если союзное слово не является подлежащим придаточного:

The text *(which)* **the student is reading** is about our Russian cosmonauts.	Текст*, который читает этот студент,*—это текст о наших российских космонавтах.
The heat *(which)* a body contains is the kinetic energy of its molecules.	*Тепло, которым обладает тело,* — это кинетическая энергия его молекул.

Если бессоюзное придаточное определительное предложение заканчивается предлогом, то при переводе на русский язык предлог ставится перед союзным словом, которое в русском предложении не может быть опущено:

The Institute **I go** *to* is one of the biggest educational institutions in our city.	*Институт, в котором я учусь,* — одно из самых крупных учебных заведений в нашем городе.
The method **we objected** *to* did not give good results.	*Метод, против которого мы возражали,* не дал хороших результатов.

Придаточные обстоятельственные указывают на обстоятельства, при которых совершается действие. Они подразделяются на придаточные **места, времени, причины, цели, условия** и т. д.:

Work is done *when* **a force is acting over a distance.**	Работа производится, *когда сила действует на каком-то расстоянии. (придаточное времени)*
We are building new blocks of flats *where* **there were only some small wooden houses a few years** ago.	Мы строим новый жилой массив там, *где несколько лет тому назад было лишь несколько маленьких деревянных домов. (придаточное места)*
He looked through his notes very	Он тщательно просмотрел свои

carefully, *as* **he was going to make a report at a conference.**	записи, *так как собирался делать отчет на конференции. (придаточное причины)*

Обстоятельственные придаточные предложения условия вводятся союзами **if** *если (бы),* **in case** *в случае*, **provided, providing** *при условии,* ***unless*** *если не,* ***but for*** *если бы не.*

Условные предложения подразделяются на три типа:

1. Предложения первого типа выражают **реальное (выполнимое) условие,** могут относиться к любому времени и переводятся **изъявительным наклонением.**

If the temperature is low, the reaction will proceed slowly.	*Если температура будет низкой,* реакция будет проходить медленно.
Our engineer always took part in the discussions **unless he was busy.**	Наш инженер всегда принимал участие в обсуждениях, *если не был занят.*

2. Предложения второго типа употребляются для выражения **нереального (невероятного)** или **маловероятного предположения,** относящегося к настоящему или будущему времени. Переводятся **сослагательным наклонением.**

Главное предложение	Придаточное предложение
Indefinite would (should) + Infinitive might (could) без to	Форма глагола, совпадающая с **Past Indefinite**
We **would test** the device Мы бы *проверили* этот прибор (сейчас или вскоре),	**if we** *got* **it.** *если бы получили* его (но это маловероятно).
He **could** complete the test	**if he** *had* time (today, tomorrow).

Он *бы мог закончить* проверку,	*если бы у него было время* (сегодня, завтра)

В условных предложениях второго и третьего типа могут употребляться глаголы **might** и **could.** Эти глаголы, в отличие от вспомогательных глаголов **should** и **would,** сохраняют свое значение *(***might***— вероятность,* **could** *— физическая возможность или умение) и переводятся как возможно, вероятно, мог бы.*

3. Предложения третьего типа употребляются для **выражения нереального (невыполнимого) предположения,** так как относятся к **прошедшему времени.** Переводятся **сослагательным наклонением**.

Главное предложение	Придаточное предложение
would (should) Perfect mihtg (could) Indefinite	Форма глагола, совпадающая с Past Perfect
He would have used the device Он *бы использовал этот прибор* (в прошлом)	if it *had been* in order. *если бы он был в порядке* (но он не был в порядке).
I might have come to the conference (last *Я, возможно, пришел бы на конференцию* (на прошлой неделе)	provided I *had been* in town. *если бы был в городе (но меня не было).*

Инверсия (обратный порядок слов) в придаточных предложениях условия. Во всех трех типах условных предложений союзы **if, provided** и другие могут быть опущены, если в придаточном предложении имеются глаголы **had, were, could, might** или **should.** В таких случаях эти глаголы ставятся перед подлежащим, т. е. имеет место обратный порядок слов. При переводе необходимо вставить союз *если (бы):*

Should he come, let him wait for me.	*Если он придет,* пусть подождет меня.
Should he have translated (= if he	*Если бы он перевел* эту статью,

translated) this article, he **would give** it to me.	он бы *дал* ее мне.
Were she a specialist (= if she were a specialist) in this field, **we would show** her the new installation.	*Если бы она была специалистом* в этой области, мы *бы показали* ей эту новую установку.
Had he been to England (= if he had been), **he would** have spoken English much better.	*Если бы он был* в Англии, он *бы говорил* по-английски значительно лучше.

GRAMMAR EXERCISES

UNIT 1. THE PASSIVE VOICE

1. Identify the passive structures and translate the sentences into Russian as shown in the following examples:

1.1 Example: The problem **was discussed** last week.

a) Эта проблема **была обсуждена** на прошлой неделе.

b) Эта проблема **обсуждалась** на прошлой неделе.

c) Эту проблему **обсудили** на прошлой неделе.

1. The statistical theory has been developed quite recently.

2. The entire industrial and agricultural structure of our life is determined by our scientific knowledge.

3. Much time and effort have been devoted to the development of electric driven equipment of light weight, small size and moderate cost.

4. In ordinary air the initial electrons and ions are continuously supplied by ionization due to cosmic rays and radioactive radiation.

5. Mathematics is loved by many, disliked by a few, admired and respected by all.

1.2 Example: Some words **may be added** about the course of the reaction.

Можно добавить несколько слов о ходе этой реакции.

1. In connection with these facts many pressing problems must be solved.

2. This less-well-known fact needs to be told and the average citizen should be informed about it.

3. Atomic energy finds such wide application that our age might be called the age of atom.

4. In view of the very large requirement for power no single supply authority can meet the entire demand.

5. This problem cannot be dealt with unless more precise experimental data are received.

1.3 Example: It **was found** that the substance was radioactive.

Было установлено, что это вещество радиоактивно.

1. It is assumed that the derivative has a constant value.
2. It was thought that the cells passed two main phases during their growth.
3. It is believed that in many instances the explanations have been clarified.
4. It has been discovered that some elements have isotopes – the forms in which the nucleus can have more than one mass.
5. It must be admitted that the problem of classification can be approached from different viewpoints.

1.4 Example: Reliable evidence **was obtained** to support the idea.

Были получены надежные доказательства в поддержку этой идеи.

1. The largest disagreement between the various data is discussed.
2. New technique has been developed.
3. The new data base has been created.
4. A new hypothesis concerning the mechanism of this reaction has been suggested.
5. Numerous classifications have been used.

2. Identify the passive structures followed by a preposition and translate the sentences into Russian as shown in the following examples

2.1 Example: Old traditions **cannot be** easily **done away with**.

От старых традиций **нельзя** легко **отказаться**.

1. This theory has been referred to.
2. The quality of the instruments used can be safely relied upon.
3. Many materials now in common use were not even thought of 30 years ago.
4. Some of the data obtained cannot be relied upon, others have not been published yet.

5. The two basic principles of selecting samples for the experiment were insisted on.
6. The molecules of even a good insulator are acted upon by an electric field.
7. With some phenomena of nature any precise quantitative data are impossible and the judgment of the observer must be relied on.
8. The astonishing observational results obtained by the international group of astronomers were spoken about at the conference.
9. For more detailed report the reader is referred to the preliminary notes on subject.
10. The starting date of the experiment should be agreed upon.

2.2 Example: The question **was alluded** at the conference.

Этого вопроса **коснулись** на конференции.

1. The experimental results cannot be improved by the existing theory.
2. This sequence of events was brought about by the discovery of radioactivity.
3. The changes taking place are not easily accounted for.
4. The significance of the experiment should be commented on and explained by the observer.
5. The working method of science may be dealt with in several ways.
6. The problem of pollution was not even touched on some fifty years ago.
7. There are fields which cannot be dealt with on a national scale only, such as environmental protection, space exploration and so on.
8. Rapid development of chemical technology has been called for by the needs of the national economy.
9. The samples of these three substances were subjected to the beam of X – rays to see what changes take place within them.
10. This approach, which is the basis for much current work, will be referred to as the standard quasi-particle theory of XAS.

2.3 Example: These questions **were answered** in a series of investigations both experimental and theoretical.

На эти вопросы **ответили** в ряде как экспериментальных, так и теоретических исследований.

The reaction **is followed** by temperature rise.

За реакцией **следует** повышение температуры.

1. The first discovery was succeeded by many others.
2. The performance of the device has been affected by many factors.
3. These questions were answered in a series of investigations both experimental and theoretical.
4. The Symposium was attended by twenty-seven astronomers.
5. The introduction of a new theory is always followed by a period of extended testing.
6. At the plenary section of the conference the participants were addressed by the Chairman of the Intergovernmental Panel on Climate Change.
7. In several areas of research the efforts of scientists are joined by those of philosophers and sociologists.
8. It must be admitted that the problem of classification can be approached from different viewpoints.
9. Under these conditions the question cannot be answered unambiguously.
10. The speed of the reaction was affected by the temperature rise.

3. Identify the passive structures and translate the sentences into Russian as shown in the following examples

3.1 Example: ***Care is to be taken*** **to remove** all the impurities.

Следует принять меры**, чтобы убрать** все примеси.

1. Special attention has been called to the research work.
2. Unfortunately no advantage was taken of the fast reaction rate.
3. An attempt was made to measure samples by immediately raising the temperature.

4. Special attention has been paid to the problem of direct conversion of energy into electricity.

5. No attempts have been made to list all the contributions in which one or another procedure has been used.

6. There is no doubt that in the course of further development of all sciences extensive use will be made of modern computing machines.

7. Particular attention is paid to some safety devices.

8. Advantage should be taken of the low melting point of this substance.

9. So far no notice has been taken of the obvious advantage in connection with a new space project.

10. Mention has already been made of the fact that gold is slowly attacked by these substances.

PROGRESS TEST

Task 1: Identify the passive structures and translate the sentences into Russian

1. Power is the rate at which energy is being spent, or the rate at which work is being done.

2. The advantage of this technique was recognized by many scientists.

3. Some properties of metals are dealt with in this chapter.

4. All forces occur in pairs, which may conveniently be spoken of as action and reaction.

5. Certain special steps were taken to reduce the weight of the mechanical part.

6. The results were affected by the presence of impurities.

7. In effort to overcome these difficulties a great deal of experimental work has been carried out by the specialists.

8. The analysis will be followed by a review of the experimental data.

9. These mixtures are referred to as gases.

10. Solar radiation is influenced by the Earth's magnetic field.

Task 2: While reading papers on the subject of your research, highlight the passive constructions and translate them into Russian.

UNIT 2. THE INFINITIVE

1. Identify the functions of infinitives and give Russian equivalents as shown in the following examples. Translate the sentences into Russian

1.1 Example: **To explain** this simple fact is not so very easy.

a) **Объяснить** этот простой факт не так легко.

b) **Объяснение** этого простого факта является не таким легким.

1. To give a true picture of the surrounding matter is the task of natural science.
2. To compare the theoretical data with the findings obtained in the series of experiments was necessary for further simulations of the process.
3. To consider the special properties of matter in the colloidal state would be outside the scope of this book.
4. To coordinate the work of many groups of scientists who do research in this field is a very difficult task.
5. To increase the amount of heat passing through the body is to increase the temperature difference.
6. It is impossible to say when electricity was first discovered.
7. To define the amplitude of a wave is to determine the maximum value of the displacement.
8. To heat a body is to bring it into a contact with a body at a higher temperature.
9. To make a choice between these two alternatives is not an easy task.
10. To make such a prognosis means to learn from the past experience and to extrapolate the knowledge into the future.

1.2 Example: **To solve** this problem you have to carry out a lot of experiments.

Для того чтобы решить эту проблему, вам придется провести много экспериментов.

1. To be able to forecast the future we must begin by a thorough analysis of the past course of events.
2. To understand the importance of this discovery we should know all the facts concerning the history of the problem.
3. It has become possible to modify the Periodic Table so as to bring out the structural features more clearly.
4. Experience shows that science can be put to many good uses, but also that it has been used to cause great harm.
5. To improve the accuracy of the device a number of investigations were made.

1.3 Example: The technique of collecting information will differ according to the problem **to be solved**.

a) Методика подбора информации будет различаться в зависимости от проблемы, **которую надо решить**.

b) Методика подбора информации будет различаться в зависимости от проблемы, **которую будут решать**.

1. The theory to account for these changes has not been developed yet.
2. An interesting distinction to be made here is between problems and techniques.
3. At that time the project, later to be taken over by another laboratory, was still in progress.
4. An important point to be dealt with in the next chapter is different techniques of data-processing.
5. There is not very much experimental data on which to base a decision between these two possibilities.

2. Identify the infinitive constructions with the "Complex Object" and give equivalents as shown in the example.

Example: Most scientists **expect** major development in the near future **to take** place in biology.

Большинство ученых **ожидает**, что основные открытия в ближайшем будущем **произойдут** в биологии.

1. We expect a successful scientist to be full of curiosity – he wants to find out how and why the universe works.
2. One can expect the scope of research to expand steadily.
3. Most scientists regard biology, rather than physics, to become a central ground of scientific advance in the near future.
4. An efficient laboratory head always knows how to make his people do their work properly and on time.
5. Nowadays we see many new areas of research to come into being as a result of unexpected breakthroughs.
6. Scientists don't consider this effect to be an experimental error of any kind.
7. We may assume the composition of the sun and stars to be similar to that of the earth.
8. They considered all water on the surface of this planet to have been liberated by volcanic action.
9. One can hardly expect a true scientist to keep within the limits of one narrow long-established field, leaving most fascinating problems out of the scope of his inquiry.
10. We expect entirely new properties to develop when these molecules or molecular aggregates interact with water, forming with it a new and unique system.

3. Identify the infinitive constructions with the "Complex Subject" and give equivalents as shown in the examples.

Examples: Nowadays science **is known to** contribute to every aspect of man's life.

а) **Известно**, что в наши дни наука вносит свой вклад во все аспекты нашей жизни.

b) **Как известно**, в наши дни наука вносит свой вклад во все аспекты нашей жизни.

c) В наши дни наука, **как известно**, вносит свой вклад во все аспекты нашей жизни. •

With the advent of nuclear weapon some people **seemed to** be disappointed in science.

С появлением ядерного оружия некоторые люди, **по-видимому,** разочаровались в науке. •

Molecular biology **is likely** to dominate science in the years to come. •

Весьма вероятно, что молекулярная биология займет в будущем доминирующее положение в пауке.

1. A yawning ozone hole is reported to have been identified over the Antarctic.
2. Harmful effects of pollution seem to have been in the news for a long time.
3. One more type of pollution proves to have appeared recently.
4. All of us are certain to know very well what environmental pollution is.
5. You seem to have taken advantage of the favourable conditions.
6. The research is supposed to lead to a better understanding of the progress.
7. Molecular biologists are known to borrow their techniques from other sciences, mainly from physics.
8. This phenomenon does not appear to be studied.
9. There does appear to be some correlations between these data.
10. This compound is sure to contain admixtures.

4. Identify the infinitive constructions with "for-phrases" and give equivalents as shown in the example.

Example: It is important **for the model to be accurate** but simple enough.

Важно, **чтобы модель была точной**, но достаточно простой.

1. For any scientific gathering to be a success, the organizing committee must be firm on more than one point.

2. For scientific development to be of benefit for man, scientists must study the problems that have direct bearing on our lives.

3. For an original idea to be a product of one man's genius is quite natural.

4. For an idea to be transformed into a product, many people's effort is required.

5. Some experiments prove that it is physically possible for the ground ice of Alaska to have been formed by a process of segregation.

PROGRESS TEST

Task 1: Identify the infinitive and infinitive constructions and translate the sentences into Russian

1. To understand this phenomenon is to understand the structure of atoms.

2. (In order) To understand the phenomenon the laws of motion should be considered.

3. There seems to be some confusion of terms in the paper.

4. In an effort to overcome these difficulties a great deal of experimental work has been carried out by both researchers and engineers.

5. This method was so accurate as to give reliable results.

6. He was considered to have a strong affinity for both chemistry and mathematics.

7. It required some more experiments for the scientist to prove the correctness of the results obtained.

8. There are many examples to illustrate the rule.

9. Science is known to affect the lives of people.

10. The terms to be insisted on are as follows.

Task 2: While reading papers on the subject of your research, highlight the infinitive constructions and translate them into Russian.

UNIT 3. THE GERUND

1.1 Identify the gerund in the function of the subject. Give Russian equivalents as shown in the following examples.

Example: **Solving** the problem is very important.

a) **Решение** этой проблемы очень важно.

b) **Решить** эту проблему очень важно.

1. Carrying out experiments is a must with every scientist.
2. Protecting the personnel against radioactive radiation holds an important place at the atomic power plant.
3. Taking into account individual components resulted in a radical change of entire system.
4. Forecasting the weather with great accuracy is no easy matter.
5. Programming a computer involves analysing the problem to be solved and a plan to solve it.
6. Arguing is a good way to make people believe you.
7. Dividing the total charge by the number of ions in the cloud gives the charge of each ion.
8. Applying powerful machinery and chemical fertilizers means achieving a tremendous growth of the total amount of agricultural products.
9. Making these calculations may be a very difficult and time-consuming procedure.
10. Increasing the proportion of fuel reduces the critical size of the reactor.

1.2 Identify the gerund in the function of the object. Give Russian equivalents as shown in the following examples.

A) Example: We suggest **discussing** the problem.

a) Мы предлагаем **обсудить** эту проблему.

b) Мы предлагаем провести **обсуждение** этой проблемы. •

He hates **being asked** to repeat experiments several times.

Он не любит, **когда его просят** повторять эксперименты несколько раз.

1. The ammeter stopped working because the coil was short-circuited.
2. Gases and liquids return to their original form as soon as the applied force has stopped acting.
3. There is hardly any person who likes being criticized.
4. He likes being reminded of things.
5. The ability of a solid to resist being altered in shape is termed rigidity.

B) Example: It **is worth considering** all the data obtained.

Стоит рассмотреть все полученные данные. •

It **is no good (no use) considering** all the obtained data.

Не имеет смысла (бесполезно) рассматривать полученные данные.

One cannot help considering all the obtained data.

Нельзя не рассмотреть все полученные данные.

1. We cannot help acknowledging the importance of this statement.
2. I couldn't help mentioning the results of our investigation at this meeting.
3. It is no use devoting too much time to this problem without specifying all the details of the procedure.
4. It is no use undertaking this research without initiating preliminary studies of the observational data.
5. It is worth proving the reliability of the data obtained.

C) Example: The scientist **succeeded in obtaining** reliable results.

Ученому **удалось получить** надежные результаты.

1. Archimedes is credited with applying huge lenses.
2. They were surprised at being informed of our experiments.
3. Catalysts aid in accelerating reactions.
4. Our success depends on being supplied with the necessary equipment.

5. It was James Clerk Maxwell who first succeeded in evolving a truly adequate theory of electricity and magnetism.

6. They objected to using greater voltage in this case.

7. The experiment resulted in obtaining valuable data.

8. A cure for the common cold may result from research analyzing the DNA of a family of viruses.

9. The scientists insisted on using this technique to get better results.

10. This software will prevent a virus from spreading.

D) Example: We **have a chance of solving** some important problems.

a) У нас есть **возможность решить** несколько важных проблем.

b) У нас есть **возможность решения** несколько важных проблем.

1. The device has the merit of being suitable for many purposes.

2. The way of avoiding these difficulties is unknown at present.

3. The idea of using this technique is new and somewhat unexpected.

4. There is some reason for questioning this assumption.

5. Scientists were looking for a way of converting solar energy and making it serve people directly

1.3 Identify the gerund in the function of adverbial modifies. Give Russian equivalents as shown in the following examples.

Examples: **In making** observations extreme care to avoid errors is necessary.

a) **При проведении** наблюдений необходимо быть предельно осторожным, чтобы избежать ошибок.

b) **Проводя** наблюдения необходимо …

c) Когда **проводят** наблюдения, надо быть ... •

On reaching the boiling point the water temperature no longer increases.

a) **После достижения** / **По достижению** точки кипения температура воды больше не повышается.

b) **Достигнув** точки кипения, температура воды больше не повышается. •

By using the calculus a mathematician can find out how these two quantities - whatever they are – are varying with each other.

a) **При помощи** вычисления математик может выяснить, как эти две величины, какими бы они ни были, влияют друг на друга.

b) **Используя** вычисления, математик может выяснить, как эти две величины, какими бы они ни были, влияют друг на друга. •

They could not start a new experiment **without verifying** the previous data.

Они не могли начать новый эксперимент, **не проверив** ранее полученные данные.

1. Without actually making calculations, we cannot deduce some general properties which the self-consistent model should have.
2. In considering the chemical properties of metals the first point which must be mentioned is that they vary widely in degree of chemical activity.
3. By having defined one's research objective one has already made the first, and the most important step towards the final success.
4. It is important to reemphasize this point by stating these ideas in a different way.
5. On being heated to a sufficient temperature any body becomes a source of light.
6. In studying the theory of semiconductors Joffe had in mind the direct conversion of solar energy into electricity.
7. On standing for some weeks the uranium solution gradually regains its initial activity.
8. Metals cannot be dissolved without being changed into new substances.
9. Astronomers get a fairly good idea of the chemical composition of the Universe by studying the light from the stars and the sun.
10. Superheating is a process of heating a liquid above its boiling point without converting it into vapor.

2. Identify the gerund construction and its function in the sentence. Give Russian equivalents as shown in the following examples.

Examples: • **Newton's having formulated** this law was of great importance.

То**, что Ньютон сформулировал** этот закон, имело огромное значение.

Their having obtained new data is of great interest.

То, что они получили новые данные, представляет большой интерес.

We know **of work and energy being closely related**.

Мы знаем, что **работа и энергия тесно связаны** между собой.

1. They rely on your having carried out the experiment.
2. Researchers' working together and their sharing ideas with one another is of great advantage for science.
3. The difference between the two values probably accounts for the measured sensitivity being higher than that predicted by theory.
4. Einstein's being awarded the Nobel Prize in physics soon become widely known.
5. Plants are useful sources of energy thanks to their storing the sun's radiation in chemical form.
6. In spite of its being called a dry cell, that cell is not really dry, everybody knows of its containing moisture.
7. Its being theoretically correct did not make it less cumbersome.
8. Scientists' constantly exploring the unknown, their looking for new knowledge and the answers to unsolved questions cannot be overestimated.
9. Mendeleev's having established a periodic law of nature has entered his name into the history book of the world science.
10. Immediate recognition of a discovery depends largely on its being made at a proper moment.

PROGRESS TEST

Task 1: Identify the gerund and gerund constructions. Translate the sentences into Russian.

1. Ice melting begins at zero degrees C.
2. In recent years man has succeeded in controlling chemical changes.
3. In performing the experiment they observed the change in the properties of the substance.
4. There is little probability of atmosphere being on that planet.
5. One cannot help recognizing the importance of the study.
6. These substances are alike in having high melting points.
7. In spite of not having any university education, Faraday made his great discoveries.
8. This phenomenon depends on the atomic weights of the substances being equal.
9. Computers gain an ever increasing application due to there being constantly improved.
10. Roentgen's having discovered X-rays contributed much to the world's science.

TASK 2: While reading papers on the subject of your research, high-light sentences with the gerund and gerund constructions and translate them into Russian.

UNIT 4. THE PARTICIPLE

1. Identify the forms of the participles in the function of attributes. Give Russian equivalents as shown in the following examples.

1.1 Examples: The device **using** the energy was rather powerful.

Прибор, **использующий** энергию, был довольно мощным. •

The device **used** in the experiment was rather powerful.

Прибор, **использованный** в этом эксперименте, был довольно мощным. •

The device **being used** in the experiment is rather powerful.

Используемый прибор в этом эксперименте довольно мощный.

1. Natural science is the main characteristic feature distinguishing the present civilization from the other civilizations in the past.
2. The latest model now being tested accounts for many of the previously unknown phenomena.
3. The scientist theoretically predicted complicated interaction between the components involved in the process.
4. The results obtained are consistent and may be summed up in one simple rule.
5. The paper being referred to is published in the journal.

1.2 Examples: The properties **of the substances involved/concerned** are not yet clear.

a) Свойства **рассматриваемых веществ**, до сих пор еще не ясны.

b) Свойства **веществ, о которых идет речь**, до сих пор еще не ясны.

1. The technique involved was quite new.
2. The phenomenon concerned is difficult to explain.
3. We have to consider all the factors involved.
4. The complexity of the technique involved increased considerably.
5. None of the authors concerned had based his experiment on the method discussed.

2. Identify the participles in the function of adverbial modifiers. Give Russian equivalents as shown in the following examples.

A) Examples: **Testing** the new device scientists used…

Тестируя новый прибор, ученые использовали… •

Having tested the new device, the scientists used…

Протестировав новый прибор, ученые использовали… •

Being tested in the laboratory, the new device demonstrated…

Когда (При/Будучи) новый прибор **тестируют (тестировании/тестируемым)** в лаборатории, он… •

Having been tested, the new device...-

После того, как новый прибор **протестировали**, он...

1. Recognizing the problem the scientist makes the first step to its solution.
2. Being separated from the sun by vacuum the earth receives its heat by radiation.
3. Having been seen in action the device was greatly modified.
4. The scientist is often interested in a problem, disintegrating possible consequences of its solution.
5. Every new idea is immediately taken up and developed further, forming the initial point of an avalanche-like process.
6. Having been tested the new equipment was installed in the laboratories.
7. Having changed the traditional approach, they succeeded in solving the problem.
8. Using radioactive isotopes, biologists are able to carry out new kinds of research.
9. Being influenced by temperature and pressure, the volume of any substance is not constant.
10. Having alloyed copper with tin Greeks and Romans formed a new alloy called "bronze".

B) Example: **(When/While) Working** at the laboratory he made many experiments.

Работая в лаборатории, он провел много экспериментов. •

Когда он работал…. •

При работе…

1. While designing new kinds of experiments we don't have to bear in mind the advantages of previous ones.
2. When dealing with gases it is common practice to consider them under a pressure of the atmosphere.
3. Calculating the weight of a body we have to multiply its specific gravity by its volume.
4. When studying a compound we have to know the chemical formulae and the valences of the elements involved.
5. Travelling in a curved path around the Earth, the Moon is continually changing the direction of its velocity.

C) Examples: **When/While heated** all substances expand.

a) **Нагреваясь**, все вещества расширяются.

b) **Когда вещества нагревают**, все они расширяются.

c) **При нагревании** все вещества расширяются.

d) **Будучи нагретыми**, все вещества расширяются. •

It is common observation that bodies expand **when heated**.

Общеизвестно, что тела расширяются **при нагревании (если их нагревают/ когда их нагревают)**.

1. A metal gives off free electrons when heated.
2. While arranged according to their atomic weights the elements exhibit an evident periodicity of properties.
3. When represented by arrows the forces can be easily computed.
4. This substance changes its properties when subjected to high temperature.
5. When properly insulated the wire may be used in conditions of excessive moisture.

3. Identify the Absolute Participle Constructions and give Russian equivalents as shown in the following examples.

A) Examples: **A new theory being suggested**, scientists will be able to use it.

После того как была предложена новая теория, ученые изменили методику проведения эксперимента. •

There **being no** atmosphere, the lunar surface is exposed to direct sunlight.

Так как (поскольку) на Луне **отсутствует** атмосфера, то её поверхность подвергается воздействую прямых солнечных лучей.

Weather **permitting**, the astronomer will proceed with his observation.

Если погода **позволит**, астроном продолжит свои наблюдения.

1. The sun being near the zenith, its rays are nearly vertical.
2. The Earth's orbit being an ellipse, the distance between the Earth and the sun constantly changes.
3. The temperature increasing, we may expect the resistivity of the material decreasing.
4. The new approach showing promise, we began to develop it.
5. The device being repaired, we shall be able to use it.

B) Example: The atmosphere always contains some moisture, the amount **varying** all the time.

Атмосфера всегда содержит какое-то количество влаги, **причем/ при этом, а, и/** это количество все время **изменяется**.

1. The astronomer proceeded his observation, the sky having cleared.
2. The term "speed" means the rate of motion, the term "velocity" meaning the speed in a definite direction.
3. Power is the basis of civilization, all, industry and transport being dependant upon power in some form.
4. The nucleus is made up of neutrons and protons, the number of protons being equal to the number of electrons.

5. Special cameras may be used to photograph the ocean bed, the photographs showing any rocks and living organisms at depths of more than three kilometers.

4. Identify the Absolute Participle Constructions preceded by the preposition "with". Give Russian equivalents as shown in the following examples.

Examples: **With** research **involving** more and more people the profession of a scientist has become one of the most popular nowadays.

> **По мере того**, **как** научное исследование **требует** участия все большего числа людей, профессия ученого стала одной из самых популярных в наши дни. •

The mixture of fuel and air prior to ignition is of heterogeneous nature, **with** atomization, vaporization and mixing **occurring** simultaneously.

> Смесь топлива и воздуха перед воспламенением имеет гетерогенный характер, **причем** распыление, испарение и смешивание **происходят** одновременно. •

With the experiments having been **carried out**, they started new investigations.

> **После того как** опыты были **закончены**, они начали новые исследования.

1. With highly accurate numerical predictions having been made, the experimental results were in good agreement with the theory.
2. With industrialization going on at its present rate, the world's fuel reserves will be exhausted within the near future.
3. With cell phone rates dropping, some people are disconnecting their old, wired phones in their homes and offices and using cellular phones for all of their calling needs.
4. With research involving more and more people the profession of a scientist has become one of the most popular nowadays.
5. The Moon is mainly responsible for the tides on the Earth, with the Sun also assisting simply by its direct attraction of the water.

PROGRESS TEST

Task 1: Identify the participle and participle constructions and translate the sentences into Russian

1. With the experiments having been carried out, we started new investigations.
2. Having made the measurements the experimenter then processed the data.
3. The work performed by this scientist showed good results.
4. This substance was more valuable than that obtained by the previous authors.
5. The substance being investigated contained some admixtures.
6. Having been weighed with insufficient accuracy the substance could not be used in quantitative analysis.
7. The equipment needed for the experiment was carefully checked.
8. The speed of light being extremely great, we cannot measure it by ordinary methods.
9. The article discussed at the lesson yesterday deals with the problem of geology.
10. The energy used per second is proportional to the frequency.

Task 2: While reading papers on the subject of your research, high-light sentences with the participle constructions and translate them into Russian

UNIT 5. MODAL VERBS

Translate the sentences into Russian:

Examples: You **should complete** your experiment by 5 p.m.

Вы **должны закончить** эксперимент к 5 часам.

You **should have completed** your experiment by 5 p.m.

Вы **должны были бы закончить** эксперимент к 5 часам **(но этого не сделали)**.

1. Not only must these questions be answered – someone must decide them.

2. According to some authors, intelligent life on any planet should develop exponentially, with all the curves going infinitely upwards.
3. Under such an assumption they ought to have arrived at completely different conclusions.
4. By that time the resources of the planet may have been completely exhausted.
5. The biggest problem in the world could have been solved when it was small.
6. They were to complete their research by the end of September, but they failed.
7. They needn't have carried out the test once more.
8. Important as this question may be in itself, the debate on the subject went far beyond its original bounds.
9. The program or the database does not have to be changed.
10. Every visible event in nature can be explained by previous events.

PROGRESS TEST

Task 1: Identify modal verbs and their equivalents and translate the sentences into Russian

1. The velocity of a particle is to be continuously changing if this particle has uniform motion. 2. However, they were confronted with pressing problems which they had to solve as well as they could. 3. You might have made the experiment more carefully. 4. To understand the importance of this discovery the student ought to know all the facts concerning the history of the problem. 5. They needn't use such complicated methods, there are some more simple and good ones. 6. They could have done it more carefully. 7. One should be very careful when working with strong acids. 8. He cannot have made such a serious mistake. 9. Some mistakes must have been made in the program. 10. Simplification as a method of understanding can and must be the method of understanding any science.

Task 2: While reading papers on the subject of your research, high-light sentences with modal verbs and their equivalents and translate them into Russian.

UNIT 6. THE SUBJUNCTIVE MOOD

Translate the following sentences into Russian:

A) Examples: **It is important (necessary/desirable/required/possible…)** that the substance **(would) be** pure.

Важно (необходимо/желательно/возможно…), чтобы вещество **было** чистым.

It is demanded (proposed/advised/suggested/insisted…) that the researcher (should) submit his paper on time.

Настаивают на том (предлагают/советуют…) чтобы исследователь **представил** свою статью вовремя.

We must keep this gas in a special vessel **lest** it **be evaporated.**

Мы должны содержать этот газ в специальном сосуде, **чтобы** он **не испарялся**.

1. It is desirable that this method should be used.
2. The engineer proposed that a new alloy be used in the device instead of a rare metal.
3. The scientist suggested that he would wait for a number of a new data obtained before making the experiment.
4. It is necessary that atomic energy be used only for industrial purposes.
5. The instruments were packed carefully lest they should be damaged during transportation.
6. It is essential that scientists meet regularly to exchange views and information.
7. They suggested that the new means of communication should be discussed at once.
8. It is important that the conference cover a wide range of questions concerning the advantages of satellite communication.
9. They required the sophisticated equipment, so that they could investigate these phenomena.
10. Make exact calculations lest you should fail with your experiment.

PROGRESS TEST

Task 1: Identify the subjunctive mood and translate the sentences into Russian

1. He demanded that the device should be carefully examined.
2. It is important that he should give his consideration on this subject.
3. It is important that modern means of communication meet the requirements of the national economy.
4. It is highly desirable that more radio-telescopes be applied for astronomical observation and measurements.
5. We demand that such data find application on further work.
6. It is necessary that the law should be observed.
7. He advised that the question be discussed immediately.
8. We insisted that such actions might provide some information about the event.
9. They applied new methods of work lest the productivity decrease.
10. The engineer demanded that the engine parameters be taken into consideration.

Task 2: While reading papers on the subject of your research, high-light sentences with the subjunctive mood and translate them into Russian.

UNIT 7. CONDITIONALS

Translate the following sentences into Russian:

A) Example: If the distance between the two points **is** the same, no further experiments **will be** necessary.

Если расстояние между этими двумя точками **будет** одинаковым, **не потребуется** никаких дальнейших экспериментов. •

If I **have time, I'll complete** the experiment.

Если у меня **будет** время, я **закончу** эксперимент.

Given/Provided the value of a, the velocity of a body **can** easily **be computed**.

Если/При условии, что **задана** величина a, **можно** легко **вычислить** скорость тела.

B) Example: If I **had time**, I **would complete** the experiment.

Если бы у меня **было** время, я бы **закончил** эксперимент (**возможно я еще успеваю)**.

If I were you, I would continue the work.

Если бы я был на вашем **месте**, то я **продолжил бы** работу **(возможно Вы так и сделаете)**.

Unless there **were** space meteorological stations, we **would not be able to observe** the formation of hurricanes.

Если бы не было космических метеостанций, мы **не смогли бы наблюдать** образование ураганов.

C) Example: If I **had had time** yesterday, I **would have completed** the experiment.

Если бы у меня вчера было время, я **бы закончил** опыт **(но его у меня не было и эксперимент остался незаконченным)**.

1. If the model fits well, the observed data will be correct.
2. A valuable contribution would be made, if considerable efforts were devoted to the theoretic examination.
3. He would have solved the problem, if he had read enough on the subject.
4. If it were not for their close cooperation with other laboratories, the task would not be accomplished in schedule.
5. If he had been given opportunity, the work might have been finished.
6. If the North Star ceased to exist, the Earth would continue to receive light for about half a century.
7. Unless computer technique had been developed, space research would have never made such great progress.
8. One will easily calculate the volume, if he knows the dimensions of a body.

9. If the entire Earth were covered by the ocean, high and low tides would follow one another at regular intervals in response to rotation of the Earth and the revolution of the Moon.

10.Provided one knows the rate of the emission, one can determine the range of the particles.

PROGRESS TEST

Tak 1: Identify conditionals and translate the sentences into Russian

1. Provided the acid was purified, the reaction would take place. 2. If he had used this formula, he would not have made this mistake. 3. We should not have been able to solve the equation, if we had not used the new technique. 4. If life existed on Venus, we would know this. 5. They could have done it, if they had obtained the necessary equipment. 6. If we don't raise the temperature, the pressure will not increase. 7. If he had not done well on the training course, he could not have helped the team to cope with the problem. 8. If there were no atmosphere, the temperature of the earth would raise to 200 F.˚9. Unless radio had been invented in the 19-th century, we couldn't have created television in the 20-th century. 10. If our laboratory has the laser equipment, we will be able to start the investigation in the near future.

Task 2: While reading papers on the subject of your research, highlight the sentences with conditionals and translate them into Russian.

SUPPLEMENTS

LIST OF IRREGULAR VERBS

Infinitive	*Past Indefinite*	*Participle II*	*Перевод*
to be	was, were	been	быть
to bear	bore	born	рождать
to beat	beat	beaten	бить
to become	became	become	становиться
to begin	began	begun	начинать(ся)
to blow	blew	blown	дуть
to break	broke	broken	ломать, разбивать
to bring	brought	brought	приносить
to broadcast	broadcast; ~ed	broadcast; ~ed	передавать по радио
to build	built	built	строить
to burn	burnt	burnt	гореть, жечь
to buy	bought	bought	покупать
to catch	caught	caught	ловить, хватать
to choose	chose	chosen	выбирать
to come	came	come	приходить, приезжать
to cost	cost	cost	стоить
to cut	cut	cut	резать
to deal (with)	dealt (with)	dealt (with)	иметь дело с
to do	did	done	делать
to draw	drew	drawn	рисовать, чертить
to dream	dreamt; ~ed	dreamt; ~ed	мечтать
to drink	drank	drunk	пить
to drive	drove	driven	везти, управлять
to eat	ate	eaten	есть (принимать пишу)
to fall	fell	fallen	падать
to feed	fed	fed	кормить, питать
to feel	felt	felt	чувствовать
to fight	fought	fought	бороться
to find	found	found	находить
to fly	flew	flown	летать
to foresee	foresaw	foreseen	предвидеть
to forget	forgot	forgotten	забывать

Продолж. табл.

Infinitive	*Past Indefinite*	*Participle II*	*Перевод*
to freeze	froze	frozen	замерзать, замораживать
to get	got	got	получать, становиться
to give	gave	given	давать
to go	went	gone	идти, ехать
to grow	grew	grown	расти, становиться
to hang	hung	hung	висеть, вешать
to have	had	had	иметь
to hear	heard	heard	слышать
to hold	held	held	держать, владеть
to keep	kept	kept	держать, хранить
to know	knew	known	знать
to lay	laid	laid	класть
to lead	led	led	вести
to learn	learnt; ~ed	learnt; ~ed	учиться, узнавать
to leave	left	left	оставлять, уезжать
to let	let	let	позволять, пускать
to lie	lay	lain	лежать
to light	lit lighted	lit lighted	зажигать, освещать
to lose	lost	lost	терять
to make	made	made	делать
to mean	meant	meant	значить, предполагать
to meet	met	met	встречать
to overcome	overcame	overcome	преодолевать
to pay	paid	paid	платить
to put	put	put	класть
to read	read	read	читать
to ring	rang	rung	звонить, звенеть
to rise	rose	risen	вставать
to run	ran	run	бежать
to say	said	said	говорить, сказать
to see	saw	seen	видеть
to sell	sold	sold	продавать
to send	sent	sent	посылать
to set	set	set	ставить, устанавливать
to shine	shone	shone	сиять, блестеть

Продолж. табл.

Infinitive	*Past Indefinite*	*Participle II*	*Перевод*
to show	showed	shown	показывать
to sit	sat	sat	сидеть
to sleep	slept	slept	спать
to speak	spoke	spoken	говорить
to spend	spent	spent	тратить, проводить
to split	split	split	расщеплять
to spread	spread	spread	распространять(ся)
to stand	stood	stood	стоять
to strike	struck	struck	ударять
to swim	swam	swum	плавать
to take	took	taken	брать
to teach	taught	taught	учить, обучать
to tell	told	told	рассказывать
to think	thought	thought	думать
to throw	threw	thrown	бросать
to undergo	underwent	undergone	подвергаться
to understand	understood	understood	понимать
to wake	woke; ~ed	woken; ~ed	будить, просыпаться
to wear	wore	worn	носить
to win	won	won	выигрывать
to withstand	withstood	withstood	противостоять
to write	wrote	written	писать

ТАБЛИЦА ВРЕМЕН АНГЛИЙСКОГО ЯЗЫКА

Infinitive	Indefinite Tenses		Continuous Tenses		Perfcct Tenses		Perfect Continuous Tenses
	to test	*to be tested*	*to be testing*	*to be being tested*	*to have tested*	*to have been tested*	*to have been testing:*
	Active	Passive	Active	Passive	Active	Passive	Active
Present	I test the devices regularly. Я испыты-ваю эти приборы регу-лярно	The de-vices are tested regularly. Эти прибо-ры испыты-ваются регу-лярно.	I am test-ing the device. Я испыты-ваю этот прибор (сейчас).	The de-vice is being tested. Этот прибор испыты-вается (сейчас).	I have al-ready tested the device. Я уже ис-пытал этот прибор	The de-vice has been tested al-ready. Прибор уже ис-пытан.	I have been testing the device for two hours. Я испыты-ваю прибор уже в тече-ние двух часов.
Past	I tested the device yesterday. Я испы-тал этот прибор вчера.	The de-vice was tested yesterday. Этот при-бор был испытан вчера.	I was testing the de-vice when you came. Я испыты-вал этот при-бор, когда вы при-шли.	The de-vice was being tested when you came. Прибор испыты-вали, ко-гда вы пришли.	I had tested the device before you came. Я испытал этот прибор до того, как вы пришли.	The de-vice had been tested be-fore you came. Прибор был ис-пытан до того, как вы при-шли.	I had been testing the device for two hours when you came. Я испыты-вал прибор уже два часа, когда вы пришли.
Future	They will test the device to-morrow. Они про-ведут ис-пытание этого прибора завтра.	The de-vice will be tested tomor-row. При-бор будет испы-тан завтра.	I will be testing the de-vice when you come. Я буду испы-тывать прибор, когда вы придете.		They will have tested the device before you come. Они ис-пытают прибор до того, как вы придете.	The de-vice will have been tested be-fore you come. При-бор будет испытан до того, как вы придете.	They will have been testing the device for two hours when you come. Они будут ис-пытывать прибор уже в течение двух часов, когда вы придете.

Вопросительная и отрицательная формы в Present Indefinite образуются посредством do (do not), does (does not) + инфинитив без частицы to. Do you test devices? I do not test devices

Вопросительная и отрицательная формы в Past Indefinite образуются посредством did (did not) + инфинитив без частицы to. Did you test the device yesterday? I did not test the device yesterday.

REFERENCES

1. Андрианова, Л. Н. Курс английского языка для вечерних и заочных технических вузов : Учеб./Л.Н. Андрианова, Н.Ю. Багрова, Э.В. Ершова. — 7-е изд., испр. М.: Высш. шк., 2007. — 463. с.
2. Аристова, Л. В. Machine-Building Automation. Автоматизация машиностроения : учеб. пособие / Л.В. Аристова, О.С. Воячек, Т.Н. Кондрашина, С.А. Кокурина; при участии Г. Б. Моисеевой, Ю. В. Шепелевой; под ред. Т. Н. Кондрашиной. — 3-е изд., стереотип. — М.: ФЛИНТА, 2016. — 142 с.
3. Кохан, О. В. Английский язык для технических направлений : учебное пособие для прикладного бакалавриата / О. В. Кохан. — 2-е изд., испр. и доп. — М. : Издательство Юрайт, 2018. — 185 с.
4. Рачков, М. Ю. Английский язык для изучающих автоматику (B1-B2) : учеб. пособие для СПО / М.Ю. Рачков. — 2-е изд., испр. и доп. — М. : Издательство Юрайт, 2018. — 268 с.
5. Семенов, В. А. Англо-русский словарь по релейной защите. / В. А. Семенов. — 2-е изд. испр. и доп. — ПЭИ, Минэнерго, 2000. — 57 с.
6. Трухан, Е. В. Английский язык для энергетиков : учеб. пособие / Е. В. Трухан, О. Н. Кобяк. — Минск : Вышэйшая школа, 2011. — 191 с.
7. Lambert, Valerie. Everyday Technical English. / Val. Lambert, Elaine Murray. — Harlow, Essex : Pearson Education, 2003. — 96 p.

Электронные ресурсы

1. Академик. Словари и энциклопедии на Академике. Режим доступа: http://dic.academic.ru
2. Energy update. – Online magazine. Режим доступа: http://www.energyupdate.com.pk/archives
3. Macmillan Dictionary. Режим доступа: http://www.macmillandictionary.com/

4. Oxford Dictionaries. Режим доступа: http://www.oxforddictionaries.com
5. Plant Automation Technology. Global B2B Industrial Automation Platform. Режим доступа: https://www.plantautomation-technology.com/articles
6. Thesaurus.com. Режим доступа: http://thesaurus.com
7. Voice of America. Режим доступа: http://www.voanews.com

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ENGLISH FOR STUDENTS STUDYING AUTOMATION TECHNOLOGY

Part II

Учебно-методическое пособие по английскому языку