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Кафедра Иностранные языки

ПРОФЕССИОНАЛЬНО-ОРИЕНТИРОВАННЫЙ АНГЛИЙСКИЙ ЯЗЫК

Методические указания по развитию навыков чтения и перевода научно-технических текстов для студентов специальности 5В071600

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СОСТАВИТЕЛЬ: К.Е. Молдабаева Профессионально ориентированный английский язык Методические указания по развитию навыков чтения и перевода научно-технических текстов для студентов специальности 5В071600.

Данные методические указания предназначены для студентов специальности 5В071600. В методической разработке содержатся научно-технические тексты по специальности и лексико-грамматические задания для закрепления основного материала.

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Lesson One
Text A. General Concept of Instrumentation
Text B. Examples of usage of Instrumentation
Passive Voice
Must, can, have to

Exercise 1. Find out the translation of words and word combinations

Instrumentation, a physical variable, the measurement, a digital control system, a standard system of units, simple instrument model, management information, to provide for positive fail-safe operation, accounting systems, the pneumatic, electronic instrumentation, functional design specifications, more compatible with computer, advantage of pneumatic system, logical and conditional moves, fast signal transit time, the monitoring and controlling process variables.

Контроль и управление переменными процесса, предусмотреть положительную предохранительную операцию, преимуществопневматической системы, функциональные технические требования дизайна, более совместимый с компьютером, время быстрой транспортировки сигнала, пневматическая, электронная инструментовка, логические и условные шаги, цифровая система контроля, информация об управлении, приборостроение, простая модель инструмента, стандартная система единиц, системы учета, измерение, физические переменные

Exercise 2. Much the words with definitions

Temperature, length, pressure, velocity, capacity, elimination.

The longest extent of anything as measured from end to end: the length of a river.

The state of being pressed or compressed.

The ability to receive or contain, actual or potential ability to perform, yields, or withstand.

A measure of the warmth or coldness of an object or substance with reference to some standard value.

Destruction.

Rapidity of motion or operation; swiftness; speed.

Exercise 3. Read the text and translate it

Text A. General Concept of Instrumentation

An instrument is a device that transforms a physical variable (temperature, length, pressure, velocity, capacity, etc) of interest (the measurand) in to a form that is suitable for recording (the measurement). In order for the measurement to have broad and consistent meaning, it is common to employ a standard system of units by which the measurement from one instrument can be compared with the measurement of another. An example of a basic instrument is a ruler.

In this case the measurand is the length of some object and the measurement is the number of units (meters, inches, etc.) that represent the length. Simple instrument model, physical measurement variable is measure by measurand as input to sensor; sensor has a function to convert the input to signal variable; signal variables have the property that they can be manipulated in a transmission system, the signal is transmitted to a display or recording device where the measurement can be read by a human observer.

Simple Instrument Model Instruments used are important for control of process variable (temperature, pressure, level, flow and etc). Objectives of process control are to achieve the safe production, lowest cost of process, improving product quality, lowering labor costs, reducing or eliminating human error, reducing energy consumption, elimination of product giveaway, and products off-spec. Instrumentation for today industrial normally are equipped with a digital control system (DCS) that provides advanced control capabilities and interfaces to other systems, including management information and accounting systems and read-only interface to protective systems. Function of the process control can be class into basic functions and corollary functions.

Generally basic functions are needed for plant operability and corollary functions come after plant operability is established. Basic functions consist of maintaining stability of operating conditions at key points in the process and providing the operator with information of suitable operating condition and the means for adjusting them. Mean while corollary functions are automating operations which to reduce the demand for continuous operator attention as dictated by economics; insuring that operations are safe for personnel and equipment to met all regulatory requirements; and maintaining product quality while minimizing operating costs. Instrumentation is usually comprised of a system of pneumatic or electronic devices for measurement and control of all the process variables. Both type of the pneumatic or electronic instrumentation have advantages and disadvantages.

Generally advantage of pneumatic system is intrinsically safe (no electrical circuits), compatible with valves, reliable during power outage for short period of time; and disadvantage are subject to air contaminants, air leaks, mechanical part may fail due to dirt or water, subject to freezing with moisture present and control speed is limited to velocity of sound. Advantage of electronic system are greater accuracy, more compatible with computer, fast signal transit time, no signal integrity loss if current loop is used, and disadvantage are contacts subject to corrosion, must be air purged, explosion proof, or intrinsically safe to be used in hazardous areas, subject to electrical interference, and more difficult to provide for positive fail-safe operation.

Instrumentation systems perform the following major functions:

-on-line mathematics, which establishes the monitoring and controlling process variables that cannot be measured directly but may be computed from other measurable variables, determining set points, and setting limits for variables and signals representing variables, selecting variables, and performing programmed operations for control and decision-making purposes, and logical and conditional moves.

Exercise 4. Answer the questions to the text

What is an instrument?

Why are Simple Instrument Model Instruments playing an important role in instrumentation engineering?

What are objectives of process control?

Which advantages and disadvantages does the pneumatic or electronic instrumentation have?

Which factors do Instrumentation systems take into consideration by designing?

Which major functions do Instrumentation systems perform?

Exercise 5. Translate the sentences paying attention to the Passive voice

Instrumentation for today industrial normally is equipped with a digital control system.

Instrumentation systems are designed by taking the following factors into consideration.

The signal is transmitted to a display or recording device where the measurement can be read by a human observer.

Instrumentation is usually comprised of a system of pneumatic or electronic devices for measurement and control of all the process variables.

Exercise 6. Replace modal verbs with equivalents

It is common to employ a standard system of units by which the measurement from one instrument can be compared with the measurement of another.

And disadvantage are contacts subject to corrosion, must be air purged, explosion proof, or intrinsically safe to be used in hazardous areas, subject to electrical interference

Function of the process control may be class into basic functions and corollary functions.

Exercise 7. Read the text and tell about the fields of activity of Instrumentation

1. Household.

A very simple example of an instrumentation system is a mechanical thermostat, used to control a household furnace and thus to control room temperature. A typical unit senses temperature with a bi-metallic strip. It displays temperature by a needle on the free end of the strip. It activates the furnace by a mercury switch. As the switch is rotated by the strip, the mercury makes physical (and thus electrical) contact between electrodes.

Another example of an instrumentation system is a home security system. Such a system consists of sensors (motion detection, switches to detect door openings), simple algorithms to detect intrusion, local control (arm/disarm) and remote monitoring of the system so that the police can be summoned. Communication is an inherent part of the design.

2. Kitchen appliances use sensors for control.

A refrigerator maintains a constant temperature by measuring the internal temperature. A microwave oven sometimes cooks via a heat-sense-heat-sense cycle until sensing done. An automatic ice machine makes ice until a limit switch is thrown. Pop-up bread toasters can operate by time or by heat measurements.
Some ovens use a temperature probe to cook until a target internal food temperature is reached. A common toilet refills the water tank until a float closes the valve. The float is acting as a water level sensor.

3. Automotive

Modern automobiles have complex instrumentation. In addition to displays of engine rotational speed and vehicle linear speed, there are also displays of battery voltage and current, fluid levels, fluid temperatures, distance traveled and feedbacks of various controls (turn signals, parking brake, headlights, transmission position). Cautions may be displayed for special problems (fuel low, check engine, tire pressure low, door ajar, seat belt unfastened). Problems are recorded so they can be reported to diagnostic equipment. Navigation systems can provide voice commands to reach a destination. Automotive instrumentation must be cheap and reliable over long periods in harsh environments. There may be independent airbag systems which contain sensors, logic and actuators. Anti-skid braking systems use sensors to control the brakes, while cruise control affects throttle position. A wide variety of services can be provided via communication links as the On Star system. Autonomous cars (with exotic instrumentation) have been demonstrated.

4. Aircraft

Early aircraft had a few sensors. "Steam gauges" converted air pressures into needle deflections that could be interpreted as altitude and airspeed. A magnetic compass provided a sense of direction. The displays to the pilot were as critical as the measurements.

A modern aircraft has a far more sophisticated suite of sensors and displays, which are embedded into avionics systems. The aircraft may contain inertial navigation systems, global positioning systems, weather radar, autopilots, and aircraft stabilization systems. Redundant sensors are used for reliability. A subset of the information may be transferred to a crash recorder to aid mishap investigations. Modern pilot displays now include computer displays including head-up displays.

Air traffic control radar is distributed instrumentation system. The ground portion transmits an electromagnetic pulse and receives an echo (at least). Aircraft carry transponders that transmit codes on reception of the pulse. The system displays aircraft map location, an identifier and optionally altitude. The map location is based on sensed antenna direction and sensed time delay. The other information is embedded in the transponder transmission.

Lesson two
Text A. Instruments and measuring devices
Text B. Измерительный прибор
Text C. The latest standards for defining the physical units
Modal verbs, Participle, Conjunctions

Exercise 1. Translate international words

Instruments, principles, micrometer, amplitude, mechanical, electrical, optical, acoustical, pneumatic devices, industrialized production techniques.

Exercise 2. Much the words and word combinations with translation

Displacement-measuring instruments and devices, the mechanical dial gauge, static load, amplitude oscillation, molarity, mass flow rate, conductivity, frequency,

Колебание амплитуды, измерительные приборы и устройства перемещения, моляльность, статический заряд, частота, удельная проводимость, механический индикатор, интенсивность течения массы.

Exercise 3. Much the words with definitions

Accuracy, displacement, distance, extension, viscosity, measurement, resistance, acceleration,

An enlargement in scope or operation, the ability to prevent something from having an effect, the ability to work or perform without making mistakes, a size, length, or amount known by measuring something, the amount of space between two places or things, the difference between the initial position of something (as a body or geometric figure) and any later position, the act or process of moving faster or happening more quickly, the property of resistance to flow in a fluid or semi fluid.

Exercise 4. Read the text and translate it

Instruments and devices may be classified according to many different principles, but the first-order division will be based on the quantity which has to be measured, i.e. a displacement, a load, etc., and the second-order division will be based on the design characteristic, i.e. mechanical, electrical, optical, etc.

Displacement-measuring instruments and devices;, may be defined as changes of distance between two points belonging to different objects, whereas “strains”, which will be the subject of the subsequent section, may be defined as changes of distance between two points belonging to the same solid body. One of the points in a displacement is a moving point and the other is a fixed reference point. An example of such a displacement of interest in fatigue testing is the extension of a coil spring, where one end is displaced and the other is fixed to the framework. Another quantity of interest is the amplitude of vibration. The amplitude is, in fact, a difference between two displacements of the same point at different times in relation to a fixed point, and may be obtained as the result of two displacement measurements, but there are also methods of eliminating the fixed point and measuring the amplitude directly without defining a reference point. Displacements and amplitudes of vibration may be measured by means of mechanical, electrical, optical, acoustical, and pneumatic devices.

Mechanical Instruments and Devices are frequently used, simple instrument for measuring displacements .The mechanical dial gauge with ranges from 5 to 50 mm and an accuracy of from 1 to 20 >< l0~ mm is referred to mechanical Instruments Another simple device is the micrometer screw.

It may be mentioned that the accuracy of this simple tool can be considerably improved by indicating electrically the contact between the anvil of the screw and the metallic object to he measured by means of a micro-ammeter or a neon lamp which glows when a circuit is completed. The reed gauge, designed primarily for determining static loads by means of the proving ring, may also be used for recording the peak response to a transient motion of systems of single degrees of freedom an upper bound to the maximum structural response can be obtained by summing the peak responses in each of the modes. The error thus introduced is in many cases of small significance. The micrometer can be used not only to measure displacements and amplitudes of vibrations bitt also for pre-setting and maintaining constant amplitudes of vibrations within narrow limits, as has been successfully practiced by DOLAN (1951).

Exercise 5. Answer the questions to the text

How can Instruments and devices be classified?
Can you describe Displacement-measuring instruments and devices?
What is the amplitude?
What are Mechanical Instruments and Devices used for?
What is the reed gauge for?
Where can we use the micrometer?

Exercise 6. Replace modal verbs with equivalents

Instruments and devices may be classified according to many different principles.

The first-order division will be based on the quantity which has to be measured.

It may be mentioned that the accuracy of this simple tool can be considerably improved by indicating electrically the contact between the anvil of the screw.

The micrometer can be used not only to measure displacements.

Exercise 7. Translate the sentences paying attention to Participle

The reed gauge, designed primarily for determining static loads by means of the proving ring, may also be used for recording the peak response to a transient motion of systems of single degrees of freedom an upper bound to the maximum structural response can be obtained by summing the peak responses in each of the modes.

One of the points in a displacement is a moving point and the other is a fixed reference point.

Exercise 8. Read the text and translate it into English

Измерительный прибор-это средство измерений, предназначенное для получения значений измеряемой физической величины в установленном диапазоне. Часто измерительным прибором называют средство измерений для выработки сигнала измерительной информации в форме, доступной для непосредственного восприятия оператора.

По способу представления информации приборы делятся на следующие группы: показывающие или регистрирующие.

Показывающий измерительный прибор — измерительный прибор, допускающий только отсчитывание показаний значений измеряемой величины
Регистрирующий измерительный прибор — измерительный прибор, в котором предусмотрена регистрация показаний. Регистрация значений может осуществляться в аналоговой или цифровой формах. Различают самопишущие и печатающие регистрирующие приборы.

По методу измерений.

Измерительный прибор прямого действия — измерительный прибор, например, манометр, амперметр, в котором осуществляется одно или несколько преобразований измеряемой величины и значение её находится без сравнения с известной одноимённой величиной.

Измерительный прибор сравнения — измерительный прибор, предназначенный для непосредственного сравнения измеряемой величины с величиной, значение которой известно.

По форме представления показаний.

Аналоговый измерительный прибор — измерительный прибор, показания которого или выходной сигнал являются непрерывной функцией изменений измеряемой величины

Цифровой измерительный прибор — измерительный прибор, показания которого представлены в цифровой форме и.т.д.

Для измерительных приборов характерен следующий ряд параметров:
Диапазон измерений — область значений измеряемой величины, на которую рассчитан прибор при его нормальном функционировании (с заданной точностью измерения).

Порог чувствительности — некоторое минимальное или пороговое значение измеряемой величины, которое прибор может различить.

Чувствительность связывает значение измеряемого параметра с соответствующим ему изменением показаний прибора.

Точность — способность прибора указывать истинное значение измеряемого показателя (предел допустимой погрешности или неопределённость измерения).

Exercise 9. Read given text and memorize the latest standards for defining the units used for measuring a range of physical variables

Measurement techniques have been of immense importance ever since the start of human civilization, when measurements were first needed to regulate the transfer of goods in barter trade to ensure that exchanges were fair. The industrial revolution during the nineteenth century brought about a rapid development of new instruments and measurement techniques to satisfy the needs of industrialized production techniques. Since that time, there has been a large and rapid growth in new industrial technology. This has been particularly evident during the last part of the twentieth century, encouraged by developments in electronics in general and computers in particular. This, in turn, has required a parallel growth in new instruments and measurement techniques.

The massive growth in the application of computers to industrial process control and monitoring tasks has spawned a parallel growth in the requirement for instruments to measure, record and control process variables. As modern production techniques dictate working to tighter and tighter accuracy limits, and as economic forces limiting production costs become more severe, so the requirement for instruments to be both accurate and cheap becomes ever harder to satisfy. This latter problem is at the focal point of the research and development efforts of all instrument manufacturers. In the past few years, the most cost-effective means of improving instrument accuracy has been found in many cases to be the inclusion of digital computing power within instruments themselves. These intelligent instruments therefore feature prominently in current instrument manufacturers' catalogues.

The latest standards for defining the units used for measuring a range of physical variables are given in Table 1.1.

Definitions of standard units

Table
1.2 Fundamental and derived SI u
(a) Fundamental units

Physical *Quantity*	*Standard unit*	*Symbol* Definition
Length Mass	metre kilogram	m kg

Time Electric current	second ampere	s A
Temperature Luminous intensity	kelvin candela	K cd
Matter	mole	mol

(b)Supplementary fundamental uni

Quantity	*Standardunit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

(c) Derived units

Quantity	*Standard unit*	*Symbol*	*Derivation formula*
Area Volume Velocty Acceleration	square metre cubic metre metre per second metre per second squared	m^2 m 3 metre s m/s^2	
Angular velocity Angular acceleration Density Specific volume	radian per second radian per second squared kil per cubic metre cubic met kilogram	rad/s rad/s^2 kg/m^3 m^3/k	$kg\ m/s^2$
Mass flow rate Volume flow rate Force Pressure	kilogram per second cubic metre per second newtc newton per square metre	kg/s m^3/s N N/m^2	
Torque	newton metre	N m	
Momentum Moment of inertia Kinematic vis Dynamic viscosity	kilogram metre per second kilogram metre squared metre per second newton second per square me	kg m/s kg m^2 m^2/s N s/	
Work, energy, heat Specific energy	joule joule per cubic metre	J J/m^3	Nm
Power	watt	W	J/s
Thermal conductivity	watt per metre kelvin	W/m K	
Electric charge	coulomb	C	A s

Voltage, e.m.f., pot. diff.	volt	V	W/A
Electric field strength	volt per metre	V/m	
Electric resistance	ohm	*K*	V/A
Electric capacitance	farad	F	A s/V
Electric inductance	henry	H	V s/A
Electric conductance	siemen	S	A/V
Resistivity	ohm metre	*K*m	
Permittivity	farad per metre	F/m	
Permeability	henry per metre	H/m	
Current density	ampere per square metre	A/m^2	

Table 1.2 (*continued*)
(c) Derived units

Quantity	*Standard unit*	*Symbol*	*Derivation formula*
Magnetic flux Magnetic flux density	weber tesla	Wb T	V s Wb/m
Magnetic field strength	ampere per metre	A/m	
Frequency Luminous flux Lum Illumination Molar volume	hertz lumen candela per square metre lu cubic metre per mole	Hz lm cd/m^2 lx m^3/mol	$s^{Ð1}$ cd sr lm/m^2
olarity	ole per kilogram	ol/kg	
olar energy	ule per mole	mol	

Lesson three
Text A. Automatic control systems
Text B Types of Controlling System
Conditional sentences

Exercise 1. Translate international words and word combinations

Automatic control systems, TV, Cassette, air conditioner, biological, economical and physical systems, analog controllers, mechanical, aerospace and power engineering, bioengineering, and robotics.

Exercise 2. Much the words with definitions

Analog controllers, manufacture, microprocessor, phenomena, reliable, tolerance, simulation, manual control.

Something that is made to look, feel, or behave like something else especially so that it can be studied or used to train people , the process of making products especially with machines in factories, able to be trusted to do or provide what is needed : able to be relied on, something (such as an interesting fact or event) that can be observed and studied and that typically is unusual or difficult to understand or explain fully, the ability to accept, experience, or survive something harmful or unpleasant, operated or controlled with the hands or by a person, the device in a computer that manages information and controls what the computer does, kind of controllers which are based on electronic cards, electronic timers, electronic counters.

Exercise 3. Read the text and translate it

Automatic control systems are widespread in nature, home, and industry. Many applications can be encountered in our daily life such as TV, Cassette, air conditioner, refrigerator, washing machine, mobile phone, cars, computers … etc. For example, your body temperature remains almost constant (≈ 37o) regardless of whether you are in a cold or hot environment. To maintain this constancy your body has a temperature control system. If your temperature begins to increase above the normal you sweat, if it decreases you shiver.

Both these are mechanisms which are used to restore the body temperature to its normal value. Another example, if you go to pick up a pencil from a bench there is a need for you to use a control system to ensure that your hand actually ends up at the pencil. This is done by observing the position of your hand relative to the pencil and making adjustments in its position as it moves towards the pencil. This control system is controlling the positioning and movement of your hand.

Developments in various fields of engineering have resulted in very sophisticated machines, devices and manufacturing processes. Successful operation of these devices and process requires: very short response time, large amount of complexity, repetitious analytical and mechanical operations, and low tolerance to errors that are well beyond human abilities. Automation became the only alternative for continuing the technical progress. While design of a particular automatic control, it was found that all control systems operate according to the same principle known as the negative feedback.

Negative feedback mechanisms can be easily detected in many biological, economical and physical systems capable of maintaining equilibrium.

Analog controllers based on electronic cards, electronic timers, electronic counters, and control relays were used widely in the early control applications. In the beginning of 1970s, the digital microprocessor is created and changed completely the control design concepts. Thereafter, digital controllers have taken the increasing attention to replace old analog controllers by advanced digital controllers such as micro-controllers, programmable logic controllers, and computers. The sophisticated hardware functions are replaced by software programs to carry out a high reliable design approach within low cost.

Computers became the beginning of the new era in control engineering. First, computers allowed for full-scale implementation of powerful mathematical tools provided by numerical analysis and matrix theory in analysis and design. Second, computers allowed for numerical simulation of control and dynamic systems, providing the most accurate and thorough analytical and design tools. Third, a computer became a part of a control system, implementing in software the most sophisticated algorithms for monitoring, data logging, and control. Modern age controls became one of the most mathematical and computer-saturated fields of engineering. Interdisciplinary by nature, control engineering offers its services and general methods to electrical, mechanical, aerospace and power engineering, as well as metallurgy, biology, material science, etc.

Control theory provides a foundation for such new disciplines as intelligent (smart) machines, bioengineering, and robotics. In fact, instrumentation and process control is found in almost every device or process you will ever encounter, on or off the job. An example of a task demonstrating simple process control and instrumentation concepts would be someone filling a container with water from a faucet (simple valve) to some preset level. The instrumentation part of this task would be the container with markings on its side indicating volume. The process control part of the task would be the control of water flow from the faucet. As the level of the water reaches some predetermined point on the container, commonly called the set point, the flow of the water is gradually decreased and ultimately stopped. Another example would be someone maintaining a certain speed on a speedometer in an automobile. The instrumentation part of this process would be the speedometer. The process control part of this task would be the operation of the accelerator pedal, which controls the flow of gasoline to the engine. The driver pushes down or lets off the accelerator pedal to maintain the speedometer setting at a predetermined speed.

In both of these examples, a person acts as a controller in the process. The person visually gathers information about the flow rate of water or the speed of the automobile and performs a controlling action.

Exercise 4. Answer the questions to the text

Where can automatic control are used? Give examples.

What do successful operation of devices and manufacturing processes require?

In what systems can negative feedback mechanisms be easily detected?

What are analog controllers based on?

What part did computers take at the beginning of the new era in control engineering?

Exercise 5. According the text mark the sentences true or false, correct the false sentences

The process control part of this task would be the container with markings on its side indicating volume.

The instrumentation part of the task would be the control of water flow from the faucet.

Analog controllers based on negative feedback.

The driver pushes up or lets on the accelerator pedal to maintain the speedometer setting at a predetermined speed.

Developments in various fields of engineering have not resulted in very sophisticated machines, devices and manufacturing processes.

Exercise 6. Translate the sentences paying attention to Conditional sentences

If your temperature begins to increase above the normal you sweat, if it decreases you shiver.

Another example, if you go to pick up a pencil from a bench there is a need for you to use a control system to ensure that your hand actually ends up at the pencil.

With the thermostat example, if the door of the house were opened on a cold day, the house would cool down.

For instance, if a window were opened that was not being measured; the feed-forward-controlled thermostat might still let the house cool down.

Exercise 7. Read the text and tell about the types of Controlling System

In control theory there are two basic types of control. These are feedback and feed-forward. The input to a feedback controller is the same as what it is trying to control - the controlled variable is "fed back" into the controller. The thermostat of a house is an example of a feedback controller. This controller relies on measuring the controlled variable, in this case the temperature of the house, and then adjusting the output, whether or not the heater is on. However, feedback control usually results in intermediate periods where the controlled variable is not at the desired set-point. With the thermostat example, if the door of the house were opened on a cold day, the house would cool down.

After it fell below the desired temperature (set-point), the heater would kick on, but there would be a period when the house was colder than desired.

Feed-forward control can avoid the slowness of feedback control. With feed-forward control, the disturbances are measured and accounted for before they have time to affect the system. In the house example, a feed-forward system may measure the fact that the door is opened and automatically turn on the heater before the house can get too cold. The difficulty with feed-forward control is that the effect of the disturbances on the system must be accurately predicted, and there must not be any unmeasured disturbances. For instance, if a window were opened that was not being measured; the feed-forward-controlled thermostat might still let the house cool down.

To achieve the benefits of feedback control (controlling unknown disturbances and not having to know exactly how a system will respond to disturbances) and the benefits of feed-forward control (responding to disturbances before they can affect the system), there are combinations of feedback and feed-forward that can be used.

Some examples of where feedback and feed-forward control can be used together are dead-time compensation, and inverse response compensation. Dead-time compensation is used to control devices that take a long time to show any change to a change in input, for example, change in composition of flow through a long pipe. A dead-time compensation control uses an element (also called a Smith predictor) to predict how changes made now by the controller will affect the controlled variable in the future. The controlled variable is also measured and used in feedback control. Inverse response compensation involves controlling systems where a change at first affects the measured variable one way but later affects it in the opposite way. An example would be eating candy. At first it will give you lots of energy, but later you will be very tired. As can be imagined, it is difficult to control this system with feedback alone; therefore a predictive feed-forward element is necessary to predict the reverse effect that a change will have in the future.

Unit four
Text A. Automatic control
Text B. The Advanced Control Methods
Attribute
Abbreviations
Exercise 1. Translate international words and word combinations

The mathematical basis of control theory, designing a system, electrical or mechanical energy, the control algorithm, metrics, stochastic, computation, psychology, sociology, criminology and the financial system.

Exercise 2. Much the words with definitions

Sensor, controller, actuator, detector, metrics,tansducer, tansmitter,cmputation

- which measure some physical state such as temperature or liquid level.
- which may be from simple physical components up to complex special purpose digital controllers or embedded computers;
- which effect a response to the sensor(s) under the command of the responder, for example, by controlling an energy input, as e.g. a gas flow to a burner in a heating system or electricity to a motor in a refrigerator or pump;

-a device that detects the presence of something;

-a device that is actuated by power from one system and supplies power usually in another form to a second system;

-a device that sends out radio or television signals;

-a standard of measurement;

-the act or process of computing or calculating something.

Exercise 3. Read the text and translate it

Automatic control is the application of control theory for regulation of processes without direct human intervention. In the simplest type of an automatic control loop, a controller compares a measured value of a process with a desired set value, and processes the resulting error signal to change some input to the process, in such a way that the process stays at its set point despite disturbances. This closed-loop control is an application of negative feedback to a system. The mathematical basis of control theory was begun in the 18th century, and advanced rapidly in the 20th.

Designing a system with features of automatic control generally requires the feeding of electrical or mechanical energy to enhance the dynamic features of an otherwise sluggish or variant, even errant system. The control is applied by regulating the energy feed.

A central concept with automatic control is that of the system to be controlled, such as a rudder and its engine, a propeller and its motor or a ballistic missile with its jet or rocket engine and the feedback of control information from the measured speed, direction and heading in a closed loop to enable proper feed forward of propelling energy.

Functions of Automatic control are: Control, Sensing, Metrics, Measurement, Comparison, Computation and Correction.

Control theory is a theory that deals with influencing the behavior of dynamical systems, an interdisciplinary subfield of science, which originated in engineering and mathematics, and evolved into use by the social sciences, such as psychology, sociology, criminology and in the financial system.

Control systems may be thought of as having four functions: Measure, Compare, Compute, and Correct. These four functions are completed by five elements: Detector, Transducer, Transmitter, Controller, and Final Control Element. The measuring function is completed by the detector, transducer and transmitter. In practical applications these three elements are typically contained in one unit. A standard example of a measuring unit is a resistance thermometer. The compare and compute functions are completed within the controller, which may be implemented electronically by proportional control, a PI controller, PID controller, bitable, hysteretic control or programmable logic controller. Older controller units have been mechanical, as in a centrifugal governor or a carburetor. The correct function is completed with a final control element. The final control element changes an input or output in the control system that affects the manipulated or controlled variable.

Exercise 4. Answer the questions to the text

What is an automatic control?
What is closed-loop control?
When was the mathematical basis of control theory started?
What are the Functions of Automatic controls?
What are the elements of Automatic control?

Exercise 5. Find out attributes in given sentences and translate them

Modern day control engineering (also called control systems engineering) is a relatively new field of study that gained a significant attention during 20th century with the advancement in technology.

Control engineering has an essential role in a wide range of control systems, from simple household washing machines to high-performance F-16 fighter aircraft.

A system can be mechanical, electrical, fluid, chemical, financial and even biological, and the mathematical modeling, analysis and controller design uses control theory in one or many of the time, frequency and complex-s domains, depending on the nature of the design problem.

Exercise 6. Read the text and tell about the Advanced Control Methods such us: Adaptive Control, Predictive Control, Robust Control, Optimal Control, Intelligent Control

Advanced process control (APC) is a broad term within the control theory. It is composed of different kinds of process control tools, for example, model predictive control (MPC), statistical process control (SPC), Run2Run (R2R), fault detection and classification (FDC), sensor control and feedback systems. APC is often used for solving multivariable control problems or discrete control problems.

Overview of Advanced Control Methods

Adaptive Control

An adaptive control system can be defined as a feedback control system intelligent enough to adjust its characteristics in a changing environment so as to operate in an optimal manner according to some specified criteria.

Generally speaking, adaptive control systems have achieved great success in aircraft, missile, and spacecraft control applications. It can be concluded that traditional adaptive control methods are mainly suitable for:

-Mechanical systems that do not have significant time delays; and

-Systems that have been designed so that their dynamics are well understood.

In industrial process control applications, however, traditional adaptive control has not been very successful.

Robust Control

Robust control is a controller design method that focuses on the reliability (robustness) of the control algorithm. Robustness is usually defined as the minimum requirement a control system has to satisfy to be useful in a practical environment. Once the controller is designed, its parameters do not change and control performance is guaranteed.

Robust control methods are well suited to applications where the control system stability and reliability are the top priorities, process dynamics are known, and variation ranges for uncertainties can be estimated. Aircraft and spacecraft controls are some examples of these systems.

Predictive Control

Predictive control, or model predictive control (MPC), is one of only a few advanced control methods used successfully in industrial control applications.The essence of predictive control is based on three key elements:

-Predictive model.

-Optimization in range of a temporal window, and

-Feedback correction.

These three steps are usually carried on continuously by computer programs online. Predictive control is a control algorithm based on the predictive model of the process. The model is used to predict the future output based on the historical information of the process as well as the future input. It emphasizes the function of the model, not the structure of the model.

Predictive control is an algorithm of optimal control. It calculates future control actions based on a penalty function or performance function. The optimization of predictive control is limited to a moving time interval and is carried on continuously online. The moving time interval is sometimes called a temporal window. This is the key difference compared to traditional optimal control that uses a performance function to judge global optimization

Optimal Control.

Optimal control is an important component in modern control theory. Its great success in space, aerospace, and military applications has changed our lives in many ways. The statement of a typical optimal control problem can be expressed in the following: «The state equation and its initial condition of a system to be controlled are given. The defined objective set is also provided."

Find a feasible control such that the system starting from the given initial condition transfers its state to the objective set, and minimizes a performance index. In practice, optimal control is very well suited for space, aerospace, and military applications such as the moon landing of a spacecraft, flight control of a rocket, and the missile blocking of a defense missile.

Intelligent Control

Intelligent control is another major field in modern control technology. There are different definitions regarding intelligent control, but it is referred to as a control Para diagram that uses various artificial intelligence techniques, which may include the following methods:

-Learning control.

-Expert control.

-Fuzzy control, and

-Neural network control.

Learning Control: Learning control uses pattern recognition techniques to obtain the current status of the control loop; and then makes control decisions based on the loop status as well as the knowledge or experience stored previously.

Expert Control: Expert control, based on the expert system technology, uses a knowledge base to make control decisions. The knowledge base is built by human expertise, system data acquired on-line, and inference machine designed. Since the knowledge in expert control is represented symbolically and is always in discrete format, it is suitable for solving decision making problems such as production planning, scheduling, and fault diagnosis. It is not well suited for continuous control issues.

Fuzzy Control: Fuzzy control, unlike learning control and expert control, is built on mathematical foundations with fuzzy set theory. It represents knowledge or experience in a mathematical format that process and system dynamic characteristics can be described by fuzzy sets and fuzzy relational functions. Control decisions can be generated based on the fuzzy sets and functions with rules.

Neural Network Control: Neural network control is a control method using artificial neural networks. It has great potential since artificial neural networks are built on a firm mathematical foundation that includes versatile and well understood mathematical tools. Artificial neural networks are also used as one of the key elements in the model-free adaptive controllers.

Exercise 7. Find out abbreviations from the text and give their definition

Lesson five
Text A sensors
Text B Magnetic Displacement Sensors
Text C Optical Encoder Displacement Sensors
Modal verbs
Degrees of comparison of adjectives

Exercise 1. Translate international words and word combinations

Thermal sensors, physical quantity, voltage, transducer, accelerometer, flow meter, tachometer, digital sensors, prognostic/diagnostic system, piezoelectric force sensors.

Exercise 2. Much given words with synonyms and antonyms

To measure, quantity, maintenance, convenience, suspension, exhibit.

Synonyms- display, preservation, abundance, accommodation, continuation, expedient.

Antonyms- glimmer, deviation, decrement, destruction, millstone, obscure.

Exercise 3. Read the text and translate it

A sensor is a hardware device that measures a physical quantity and produces a signal which can be read by an observer or by an instrument. For example, a thermocouple converts temperature to an output voltage, which can be read by a voltmeter. For accuracy, all sensors are calibrated against known standards. A transducer is a device that is actuated by power from one system and supplies power usually in another form to a second system. For example, a loudspeaker is a transducer that transforms electrical signals into sound energy. A standard definition for a sensor or transducer does not exist and the words sensor and transducer are used synonymously, specific names being given depending on the application. Also, suffixed derivatives ending in -meter such as accelerometer, flow meter and tachometer are used. For convenience, the basic sensor will be used in this chapter to describe these units.

Analog sensors produce a continuous output signal or voltage, which is generally proportional to the quantity being measured. Physical quantities such as temperature, velocity, pressure and displacement are all analog quantities, as they tend to be continuous in nature. For example, the temperature of a liquid can be measured using a thermometer or thermocouple, which continuously responds to temperature changes as the liquid is heated up or cooled down. Digital sensors produce a discrete output signal or voltage that is a digital representation of the quantity being measured. Digital sensors produce a discrete (non-continuous) value, which may be outputted as a single bit or a combination of the bits to produce a single byte output.

One of the important newer applications of sensors to system reliability is prognostics and diagnostics. A prognostic/diagnostic system uses sensors to monitor operational and environmental conditions and translates any changes to component remaining life using the equations in this Handbook embedded in the prognostic/diagnostic processor. As pre established threshold values are exceeded, the embedded reliability models calculate component overstress and cumulative damage and provide maintenance personnel of impending malfunctions and the next best maintenance action to be performed.

Exercise 4. Answer the questions to the text

What is a sensor?
What are its functions?
Where can they be used?
What does sensor's sensitivity indicate?
How do they need to be designed?
How are the most of transformers built?

Exercise 5. Read the sentences and replace modal verbs with equivalents

Sensors need to be designed to have a small effect on what is measured.

Technological progress allows more and more sensors to be manufactured on a microscopic scale.

Both linear and rotary encoders can, in principle, be absolute or incremental.

Unfortunately, a loss of count may not be detected until a reference point is recessed.

A sensor (also called detector) is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an (today mostly electronic) instrument.

It never needs to be reset to a reference location in order derive the measured location.

The reference point can also be mechanical. Should power be lost or a signal transmission error occur, then the absolute position is lost and the encoder must return to one or more reference points in order to reset its counters.

Exercise 6. Read the sentences paying attention to the degrees of comparison in adjectives

This is more important in some industrial machinery.

Sensitivity is greatest when the magnetic field is perpendicular to the current flow.

In most cases, a micro sensor reaches a significantly higher speed

Longer sensors become more difficult to manufacture, and are expensive.

Multilayered structures of exotic materials have enabled development of materials that exhibit much greater magneto resistive effect, and saturate at larger applied fields.

Exercise 7. Read the text and tell about kinds of sensors such us Thermal Sensors, Force Sensors, Positional Sensors, Fluid Sensors, Optical Sensors, Motion Sensors, Presence Sensors, Environmental Sensors

Thermal sensors vary from simple ON/OFF thermostatic devices that control a domestic hot water system to highly sensitive semiconductor types that control complex processing facilities. Temperature sensors measure the amount of heat energy within an object and detect any physical change to that temperature. There are many different types of thermal sensors and all have different characteristics depending upon their actual application. Typical thermal sensors include the following:

-Resistance Temperature Detector: Same as a power resistor.

-Thermistor: A thermistor is a passive resistive device that changes its physical resistance with temperature producing a measurable voltage depending on the current through the device. A thermistor is generally made from ceramic type semiconductor materials such as oxides of nickel, manganese or cobalt coated in glass. Thermistors are generally connected in series with a suitable biasing resistor to form a potential divider network and the choice of resistor gives a voltage output at some pre- determined temperature point or value.

-Thermocouple: A thermocouple converts thermal energy into electrical energy. It consists of two junctions of dissimilar metals, such as copper and constantan that are welded or crimped together. A thermocouple is created whenever two dissimilar metals touch and the contact point produces a small thermoelectric voltage as a function of temperature (Seebeck voltage). The thermocouple is a commonly used temperature sensor because of its simplicity, small size, ease of application and speed of response to changes. A thermopile is composed of thermocouples connected in series.

Force sensors are used to obtain an accurate determination of pulling and/or pressing forces. The force sensor creates an electrical signal which corresponds to the force measurement to be used for further evaluation or process control. Force sensors are commonly used in automotive vehicle assemblies such as brakes, suspension units and air-bag systems.

A force sensor generally measures the applied force from the proportional deformation of a spring element; the larger the force, the more this element deforms. Many force sensors employ the piezoelectric principle exhibited by quartz. Under load, quartz crystals produce an electric charge proportional to the mechanical load applied; the higher the load, the higher the charge. Thus, in piezoelectric force sensors, quartz serves as both the spring element and the measurement transducer.

A strain gauge is a device used to measure the strain of an object. The strain gauge is the fundamental sensing element for many types of sensors, including pressure sensors, load cells, torque sensors and position sensors. The majority of strain gauges are foil types. They consist of a pattern of resistive foil which is mounted on a backing material and as the foil is subjected to stress, the resistance of the foil changes. This results in a signal output, related to the stress value.

A positional sensor is one that permits a linear or angular position measurement. It can either be an absolute positional sensor or a relative one (displacement sensor). A conventional potentiometer is an analog device that can be used as a positional sensor to vary, or control, the amount of current that flows through an electronic circuit. The potentiometer can be either angular (rotational) or linear (slider type) in its movement providing an electrical signal output that has a proportional relationship between the actual wiper position and its resistance change. A digital potentiometer consists of resistor arrays, switches, logic gates, multiplexers, and data converters. Digital potentiometers have excellent setability, better resolution, and lower noise levels than conventional potentiometers. They are more stable over time and their resistance drifts minimally. They are more reliable and exhibit a lower temperature coefficient of resistance than analog potentiometers.

Fluid Sensors.

A fluid pressure sensor detects a pressure difference between a detecting pressure and reference pressure and converts the difference into an electric signal. Pressure sensors are used to measure pressures of gases or liquids. Pressure measurements typically are made as absolute, gauge, or differential measurements. Absolute pressure sensors measure a pressure relative to a vacuum, gauge sensors measure a pressure relative to atmospheric pressure, and differential sensors measure a pressure difference between two inputs.

Generally, a pressure sensor for sensing a gas or liquid pressure has a diaphragm that acts as a pressure sensing element and is configured such that deflection (pressure deformation) of a diaphragm under a fluid pressure applied through a pressure port is converted to an electrical signal, thereby enabling the fluid pressure to be measured.

A fluid flow sensor is a device for sensing the rate of fluid flow. Typically a flow sensor is the sensing element used in a flow meter or data logging device to record the flow of fluids. There are various kinds of flow sensors and flow meters including some that have a vane that is pushed by the fluid and can drive a rotary potentiometer or similar device. Other flow sensors are based on sensors which measure the transfer of heat caused by the moving medium.

The flow sensor can normally measure velocity, flow rate or totalized flow. Flow sensors are sometimes related to sensors called velocimeters that measure speed of fluids flowing through them. The flow sensor technology can be based on such things as light, heat, electromagnetic properties, ultrasonic and many other technologies in a wide spectrum. A flow sensor can work by direct measurement or inferential measurement. Several types of flow sensors are non-mechanical and normally work by the inferential method. As is true for all sensors, accuracy of a fluid sensor measurement requires a calibration applicable to the sensor function.

Optical sensors are passive devices that convert radiant light energy into an electrical signal output. The most common type of photoconductive device is the photo resistor which changes its electrical resistance in response to changes in the light intensity. Photo junction devices are PN-Junction light sensors or detectors made from silicon semiconductors that can detect both visible light and infrared light levels. This class of photoelectric light sensors includes the photodiode and the phototransistor. Phototransistor light sensors operate the same as photodiodes except that they can provide current gain and are much more sensitive than the photodiode.

Photo detectors, also known as proximity sensors, are used to determine if a moving object enters the range of a sensor. The most commonly found photo detector is the “electric eye”. This type of sensor works by projecting a beam of light from a transmitter to a receiver across a specific distance. As long as the beam of light maintains a connection with the receiver, the circuit remains closed. If an object passes through the beam of light, the continuity of the circuit is lost, and the circuit opens. An example of this type of sensor is a garage door opener safety sensor that will halt the closing of the door if an object breaks the beam.

Fiber optic sensors can be used to measure a wide range of physical phenomena, depending on the configuration of the sensor. Optical fibers can be coated with materials that respond to changes in strain, temperature, or humidity. Optical gratings can be etched into the fiber at specific intervals to reflect specific frequencies of light. As the fiber is strained, the distances between the gratings change, allowing the physical strain to be measured.

Motion sensors are designed to measure the rate of change of position, location, or displacement of an object that is occurring. If the position of an object is changing as a function of time the first derivative gives the speed of the object and if the speed of the object is also changing, then the first derivative of the speed gives the acceleration.

Displacement sensors measure the distance an object moves and they can also be used to measure object height and width. Optical and magnetic displacement sensors are used to detect the amount of a linear displacement. Linear and angular displacement sensors are used for high-precision machining and measuring, for manufacturing and testing components with very tight dimensional tolerances. Magnetic displacement sensors consist of one or more magnets producing an induction field and typically measure linear or rotational displacement providing an output proportional to absolute linear or rotary position displacement of the elements.

Velocity sensors measure the linear velocity of an object using either contact or non-contact techniques. In cable-extension linear velocity sensors, the moving object is attached to a cable, which is typically connected to a potentiometer. As the object moves, the potentiometer's resistance value changes. Magnetic induction sensors are non-contact linear velocity sensors that use an induced current from a magnetic field to measure the linear velocity. Microwave sensors use microwave technology to determine speed, whereas fiber optic sensors use fiber optics or laser technology to determine speed. Piezoelectric linear velocity sensors utilize a piezoelectric material that is compressed generating a charge that is measured by a charge amplifier. Often, piezoelectric sensors are used in vibration velocity measurement applications.

Vibration sensors are sensors for measuring, displaying and analyzing linear velocity, displacement and proximity, or acceleration. They can be used on a stand- alone basis, or in conjunction with a data acquisition system. Vibration sensors are available in many forms. They can be raw sensing elements, packaged transducers, or as a sensor system or instrument, incorporating features such as local or remote display, and data recording. The primary elements of importance in shock measurements are that the device has a natural frequency that is greater than 1 kHz and a range typically greater than 500 g. The primary accelerometer that can satisfy these requirements is the piezoelectric type.

Presence Sensors.

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic or electrostatic field, or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. For example, a capacitive or photoelectric sensor might be suitable for a plastic target while an inductive proximity sensor requires a metal target.

Proximity sensors can have a high reliability and long functional life because of the absence of mechanical parts and lack of physical contact between sensor and the sensed object. A proximity sensor is divided in two halves and if the two halves move away from each other, then a signal is activated. An example application of a proximity sensor is for window security. When the window opens an alarm is activated.

Environmental sensors include those used to measure temperature, humidity, wind speed, barometric pressure, etc. They are often connected in a network. An analog humidity sensor gauges the humidity of the air relatively using a capacitor-based system. The sensor is made out of a film usually made of either glass or ceramics. The insulator material which absorbs the water is made out of a polymer which takes in and releases water based on the relative humidity of the given area. This changes the level of charge in the capacitor of the electrical circuit.

Exercise 8. Match given types of Sensors with definitions

Velocity sensors, Motion sensors, Vibration sensors, Environmental sensors, A proximity sensor, A thermistor, Thermocouple, Pressure sensors, Force sensors, A strain gauge.

-a passive resistive device that changes its physical resistance with temperature producing a measurable voltage depending on the current through the device.

-converts thermal energy into electrical energy.

-used to obtain an accurate determination of pulling and/or pressing forces.

-a device used to measure the strain of an object. A positional sensor is one that permits a linear or angular position measurement.

-used to measure pressures of gases or liquids.

-include those used to measure temperature, humidity, wind speed, barometric pressure

- a sensor able to detect the presence of nearby objects without any physical contact.

-are sensors for measuring, displaying and analyzing linear velocity, displacement and proximity, or acceleration.

- measure the linear velocity of an object using either contact or non-contact techniques.

-designed to measure the rate of change of position, location, or displacement of an object that is occurring. Displacement sensors measure the distance an object moves and they can also be used to measure object height and width.

Lesson six

Text A the Electromechanical Relay
Text B The Solid State Relay.
Conditional sentences
Abbreviation

Exercise 1. Translate international words and word combinations

Relay, a control signal, electromechanical relay, opto-coupler type, the construction of electromechanical relay.

Exercise 2. Match words with synonyms and antonyms

Connection, resistance, damage, emits, humidity, a flux. Syn-change, moistness, linkage, affliction, defiance, discharge.

Ant- disconnection, absorb, fix, outflow, acquiescence, dehydration.

Exercise 3. Match the abbreviations with definitions

EMR, AC, DC**, NO**, NC, SSR, EMI, CPU GMR, MR, CVD.

Chemical Vapor Deposition, Normally Closed**,** The electromechanical relay, Normally Open, Solid State Relay, Giant Magneto Resistance, Alternative current, Direct current, electromagnetic interference, Magneto Resistance.

Exercise 4. Read the text and translate it

The term Relay generally refers to a device that provides an electrical connection between two or more points in response to the application of a control signal. The most common and widely used type of electrical relay is the electromechanical relay or EMR.

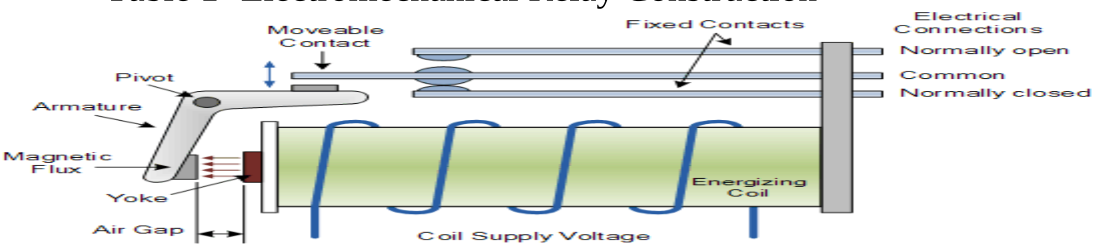
The most fundamental control of any equipment is the ability to turn it "ON" and "OFF". The easiest way to do this is using switches to interrupt the electrical supply. Although switches can be used to control something, they have their disadvantages. The biggest one is that they have to be manually (physically) turned "ON" or "OFF". Also, they are relatively large, slow and only switch small electrical currents.

Electrical Relays however, are basically electrically operated switches that come in many shapes, sizes and power ratings suitable for all types of applications. Relays can also have single or multiple contacts with the larger power relays used for high voltage or current switching being called "contactors".

As their name implies, electromechanical relays are *electro-magnetic* devices that convert a magnetic flux generated by the application of a low voltage electrical control signal either AC or DC across the relay terminals, into a pulling mechanical force which operates the electrical contacts within the relay. The most common form of electromechanical relay consists of an energizing coil called the "primary circuit" wound around a permeable iron core.

This iron core has both a fixed portion called the yoke, and a moveable spring loaded part called the armature, that completes the magnetic field circuit by closing the air gap between the fixed electrical coil and the moveable armature. The armature is hinged or pivoted allowing it to freely move within the generated magnetic field closing the electrical contacts that are attached to it. Connected between the yoke and armature is normally a spring (or springs) for the return stroke to "reset" the contacts back to their initial rest position when the relay coil is in the "de-energized" condition.

Table 1- Electromechanical Relay Construction



In our simple relay above, we have two sets of electrically conductive contacts. Relays may be "Normally Open", or "Normally Closed". One pair of contacts is classed as Normally Open, (NO) or make contacts and another set which are classed as Normally Closed, (NC) or break contacts. In the normally open position, the contacts are closed only when the field current is "ON" and the switch contacts are pulled towards the inductive coil.

In the normally closed position, the contacts are permanently closed when the field current is "OFF" as the switch contacts return to their normal position. These terms *Normally Open, Normally Closed* or *Make and Break Contacts* refer to the state of the electrical contacts when the relay coil is "de-energized", i.e, no supply voltage connected to the inductive coil.

The relays contacts are electrically conductive pieces of metal which touch together completing a circuit and allow the circuit current to flow, just like a switch. When the contacts are open the resistance between the contacts is very high in the Mega-Ohms, producing an open circuit condition and no circuit current flows.

When the contacts are closed the contact resistance should be zero, a short circuit, but this is not always the case. All relay contacts have a certain amount of "contact resistance" when they are closed and this is called the "On-Resistance». This arcing or sparking across the contacts will cause the contact resistance of the tips to increase further as the contact tips become damaged. If allowed to continue the contact tips may become so burnt and damaged to the point were they are physically closed but do not pass any or very little current. If this arcing damage becomes to severe the contacts will eventually "weld" together producing a short circuit condition and possible damage to the circuit they are controlling.

Exercise 5. Answer the questions to the text

What does the term Relay mean?
What are the functions of Electrical Relays?
What are electromechanical relays?
Describe the construction of electromechanical relay according to the table.
How many electrically conductive contacts are there in simple relay, describe them.

Exercise 6. Read the Text again and find out Conditional sentences in it

Exercise 7. Read the text and speak about the Solid State Relay

While the electromechanical relay (EMR) are inexpensive, easy to use and allow the switching of a load circuit controlled by a low power, electrically isolated input signal, one of the main disadvantages of an electromechanical relay is that it is a "mechanical device", that is it has moving parts so their switching speed (response time) due to physically movement of the metal contacts using a magnetic field is slow.

Over a period of time these moving parts will wear out and fail, or that the contact resistance through the constant arcing and erosion may make the relay unusable and shortens its life. Also, they are electrically noisy with the contacts suffering from contact bounce which may affect any electronic circuits to which they are connected.

To overcome these disadvantages of the electrical relay, another type of relay called a Solid State Relay or (SSR) for short was developed which is a solid state contact less, pure electronic relay. It has no moving parts with the contacts being replaced by transistors, thyristors or triacs. The electrical separation between the input control signal and the output load voltage is accomplished with the aid of an opto-coupler type Light Sensor.

The Solid State Relay provides a high degree of reliability, long life and reduced electromagnetic interference (EMI), (no arcing contacts or magnetic fields), together with a much faster almost instant response time, as compared to the conventional electromechanical relay.

Exercise 8. Read the text again and translate the sentences with suffixes dis, in, due to, over, un

Exercise 9.Translate the text into English

Слово “реле” возникло от английского relay, что означало смену уставших почтовых лошадей на станциях или передачу эстафеты (relay) уставшим спортсменом. Как самостоятельное устройство реле впервые упомянуто в патенте на телеграф Самюэля Морзе.

Приборы, осуществляющие в устройствах автоматики и телемеханики прерывистую скачкообразную связь между входными параметрами в одном процессе и выходными параметрами в другом, носят название реле.

Реле (франц. relais, от relayer — сменять, заменять) — устройство для автоматической коммутации электрических цепей по сигналу извне.

Реле являются одним из основных приборов (элементов) систем автоматики и телемеханики, при помощи которых осуществляются процессы автоматического управления, регулирования и контроля, а также различные схемные зависимости и требуемая последовательность в работе отдельных частей систем автоматики и телемеханики.

Существует много конструктивных разновидностей и типов реле, работающих на различных принципах.

В зависимости от физической природы явлений, на которые реле предназначено реагировать реле разделяются на следующие: электрические, механические, тепловые, пневматические, оптические, акустические, газовые, жидкостные и др.

Электрические реле по принципу действия делятся на электромагнитные, магнитоэлектрические, электродинамические, индукционные и пр.

Основным самым простым по конструкции и наиболее распространенным в автоматике и телемеханике является электромагнитное реле.

Первое реле было изобретено американцем Джозефом Генри в 1831 г. и базировалось на электромагнитном принципе действия. Следует отметить, что реле Дж. Генри было не коммутационным.

Lesson seven
Text A. A digital instrument and a analogue instrument
Text B. Structure of digital systems
Text C. Microelectronics and integrated circuits
Gerund
Participle I, II
Suffixes able, ible, tion, al

Exercise 1. Translate international words and word combinations

Methods to minimize logic functions, combinational systems, sequential systems, a simulation, Synchronous, Asynchronous, the minimum and maximum time, periodically, to construct, the arithmetic logic unit.

Exercise 2. Much the words with definitions

Transistors, capacitors, inductors, resistors, diodes, insulators, conductors, nanometers.

-a solid-state electronic device that is used to control the flow of electricity in electronic equipment.

-a device that has electrical resistance and that is used in an electric circuit for protection, operation, or current control.

-one billionth of a meter.

-a device that is used to store electrical energy.

-an electronic device that allows an electric current to flow in one direction only.

-a material or object that allows electricity or heat to move through it.

-a part of an electrical apparatus that acts upon another or is itself acted upon by induction.

-a material that allows little or no heat, electricity, or sound to go into or out of something.

Exercise 3. Read the text and tell about the differences between an analogue instrument and a digital instrument

An analogue instrument gives an output that varies continuously as the quantity being measured changes. The output can have an infinite number of values within the range that the instrument is designed to measure. The deflection-type of pressure gauge described earlier in this chapter (Figure 2.1) is a good example of an analogue instrument. As the input value changes, the pointer moves with a smooth continuous motion. Whilst the pointer can therefore be in an infinite number of positions within its range of movement, the number of different positions that the eye can discriminate between is strictly limited, this discrimination being dependent upon how large the scale is and how finely it is divided.

A digital instrument has an output that varies in discrete steps and so can only have a finite number of values. The rev counter sketched in Figure 2.4 is an example of a digital instrument. A cam is attached to the revolving body whose motion is being measured, and on each revolution the cam opens and closes a switch. The switching operations are counted by an electronic counter. This system can only count whole revolutions and cannot discriminate any motion that is less than a full revolution. The distinction between analogue and digital instruments has become particularly important with the rapid growth in the application of microcomputers to automatic control systems.

Any digital computer system, of which the microcomputer is but one example, performs its computations in digital form. An instrument whose output is in digital form is therefore particularly advantageous in such applications, as it can be interfaced directly to the control computer. Analogue instruments must be interfaced to the microcomputer by an analogue-to-digital (A/D) converter, which converts the analogue output signal from the instrument into an equivalent digital quantity that can be read into the computer. This conversion has several disadvantages. Firstly, the A/D converter adds a significant cost to the system. Secondly, a finite time is involved in the process of converting an analogue signal to a digital quantity, and this time can be critical in the control of fast processes where the accuracy of control depends on the speed of the controlling computer. Degrading the speed of operation of the control computer by imposing a requirement for A/D conversion thus impairs the accuracy by which the process is controlled.

Exercise 4. Read the text Structure of digital systems and answer the following questions to the text

What systems do digital systems divide into?

What are differences between combinational and sequential systems?

What two subcategories do Sequential systems divide into? Describe them.
What is the most general-purpose register-transfer logic machine?

Structure of digital systems

Engineers use many methods to minimize logic functions, in order to reduce the circuit's complexity. When the complexity is less, the circuit also has fewer errors and less electronics, and is therefore less expensive. To choose representations, engineers consider types of digital systems. Most digital systems divide into "combinational systems" and "sequential systems." A combinational system always presents the same output when given the same inputs. It is basically a representation of a set of logic functions, as already discussed.

A sequential system is a combinational system with some of the outputs fed back as inputs. This makes the digital machine perform a "sequence" of operations. The simplest sequential system is probably a flip flop, a mechanism that represents a binary digit or "bit".

Sequential systems are often designed as state machines. In this way, engineers can design a system's gross behavior, and even test it in a simulation, without considering all the details of the logic functions.

Sequential systems divide into two further subcategories. "Synchronous" sequential systems change state all at once, when a "clock" signals changes state. "Asynchronous" sequential systems propagate changes whenever inputs change. Synchronous sequential systems are made of well-characterized asynchronous circuits such as flip-flops, that change only when the clock changes, and which have carefully designed timing margins.

In comparison, asynchronous systems are very hard to design because all possible states, in all possible timings must be considered. The usual method is to construct a table of the minimum and maximum time that each such state can exist, and then adjust the circuit to minimize the number of such states, and force the circuit to periodically wait for all of its parts to enter a compatible state (this is called "self-resynchronization"). Without such careful design, it is easy to accidentally produce asynchronous logic that is "unstable", that is, real electronics will have unpredictable results because of the cumulative delays caused by small variations in the values of the electronic components.

The most general-purpose register-transfer logic machine is a computer. This is basically an automatic binary abacus. The control unit of a computer is usually designed as a micro program run by a micro sequencer. A micro program is much like a player-piano roll. Each table entry or "word" of the micro program commands the state of every bit that controls the computer. The sequencer then counts, and the count address the memory or combinational logic machine that contains the micro program. The bits from the micro program control the arithmetic logic unit, memory and other parts of the computer, including the micro sequencer itself.

In this way, the complex task of designing the controls of a computer is reduced to a simpler task of programming a collection of much simpler logic machines.

Exercise 5. Read the text again and find out sentences with suffixes able, ible, tion, al in it, and translate them

Exercise 6. Find out the Gerund from the text B and translate them

Exercise 7. Read the text and speak about Microelectronics and integrated circuits and find out Participle I, II, and define their functions

Microelectronics is a subfield of electronics. As the name suggests, microelectronics relates to the study and manufacture (or micro fabrication) of very small electronic designs and components. Usually, but not always, this means micrometer-scale or smaller. These devices are made from semiconductor materials. Many components of normal electronic design are available in a microelectronic equivalent. These include transistors, capacitors, inductors, resistors, diodes and (naturally) insulators and conductors can all be found in microelectronic devices. Unique wiring techniques such as wire bonding are also often used in microelectronics because of the unusually small size of the components, leads and pads. This technique requires specialized equipment and is expensive.

Integrated circuits can be classified into analog, digital and mixed signal (both analog and digital on the same chip).

Digital integrated circuits can contain anything from one to millions of logic gates, flip-flops, multiplexers, and other circuits in a few square millimeters. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration.

Digital integrated circuits (ICs) consist mostly of transistors. Analog circuits commonly contain resistors and capacitors as well. Inductors are used in some high frequency analog circuits, but tend to occupy large chip area if used at low frequencies; gyrators can replace them in many applications.

An integrated circuit or monolithic integrated circuit (also referred to as an IC, a chip, or a microchip) is a set of electronic circuits on one small plate ("chip") of semiconductor material, normally silicon. This can be made much smaller than a discrete circuit made from independent components.

Integrated circuits are used in virtually all electronic equipment today and have revolutionized the world of electronics. Computers, mobile phones, and other digital home appliances are now inextricable parts of the structure of modern societies, made possible by the low cost of producing integrated circuits.

ICs can be made very compact, having up to several billion transistors and other electronic components in an area the size of a fingernail. The width of each conducting line in a circuit (the line width) can be made smaller and smaller as the technology advances; in 2008 it dropped below 100 nanometers and in 2013 it is expected to be in the tens of nanometers.

Lesson eight
Text A. Encoders and Decoders
Text B Magnetic Encoders
Passive voice
Modal verbs
Conjunctions

Exercise 1. Translate international words and word combinations

Digital electronics, logic circuit, segment display, transducer, standardization, magnetized and non magnetized areas, the position information.

Exercise 2. Much the words with definitions

A decoder, an encoder, multiplexing, circuit, transducer, software, algorithm, demultiplexer.

- an electronic device that changes signals for a radio, television, etc., to a form that can be heard or seen correctly.
- the complete path that an electric current travels along.
- a set of steps that are followed in order to solve a mathematical problem or to complete a computer process.
- to convert (as a body of information) from one system of communication into another; *especially* **:** to convert (a message) into code.
- a device that changes power from one system into another form for another system.
- being or relating to a system of transmitting several messages or signals simultaneously on the same circuit or channel.
- an electronic device that separates a multiplex signal into its component parts.
- the entire set of programs, procedures, and related documentation associated with a system and especially a computer system; *specifically* **:** computer programs.

Exercise 3. Read the text Encoders and Decoders and answer the questions to it

What is the difference between encoders and decoders?
What kind of process is Multiplexing?
What is the reverse function of multiplexing?
Where Multiplexing and demultiplexing are used?

A decoder is a device which does the reverse operation of an encoder, undoing the encoding so that the original information can be retrieved. The same method used to encode is usually just reversed in order to decode. It is a combinational circuit that converts binary information from input lines to a maximum of 2^n unique output lines.

In digital electronics, a decoder can take the form of a multiple-input, multiple-output logic circuit that converts coded inputs into coded outputs, where the input and output codes are different. Enable inputs must be on for the decoder to function, otherwise its outputs assume a single "disabled" output code word. Decoding is necessary in applications such as data multiplexing, segment display and memory address decoding.

An encoder is a device, circuit, transducer, software program, algorithm or person that converts information from one format or code to another, for the purposes of standardization, speed, secrecy, security, or saving space by shrinking size.

Multiplexing is defined as the process of feeding several independent signals to a common load, one at a time. The device or switching circuitry used to select and connect one of these several signals to the load at any one time is known as a multiplexer.

The reverse function of multiplexing, known as demultiplexing, pertains to the process of feeding several independent loads with signals coming from a common signal source, one at a time. A device used for demultiplexing is known as a demultiplexer.

Multiplexing and demultiplexing, therefore, allow the efficient use of common circuits to feed a common load with signals from several signal sources, and to feed several loads from a single, common signal source, respectively.

In digital circuits, the term 'multiplexing' is also sometimes used to refer to the process of encoding, which is basically the generation of a digital code to indicate which of several input lines is active.

On the other hand, the term 'demultiplexing' in digital electronics is also used to refer to 'decoding', which is the process of activating one of several mutually-exclusive output lines, based on the digital code present at the binary-weighted inputs of the decoding circuit, or decoder. A decoder or demultiplexer is therefore a digital IC that accepts a digital code consisting of two or more bits at its inputs, and activates or enables one of its several digital output lines depending on the value of the code.

Multiplexing and demultiplexing are used in digital electronics to allow several chips to share common signal buses. In demultiplexers, for instance, the output lines may be used to enable memory chips that share a common data bus, ensuring that only one memory chip is enabled at a time in order to prevent data clashes between the chips.

Exercise 4. Read the text again and find out the sentences in Passive voice and translate them

Exercise 5. Read the text again and find out the sentences with Modal verbs and replace them with equivalents

Exercise 6. Read the text again and find out conjunctions on the other hand, in order to, otherwise and translate them

Exercise 7. Read the text and retell it

Magnetic encoders use a strip or disk of magnetic media onto which digital information is stored. This information is recorded at the location it describes, and is in the form of a collection of magnetized and no magnetized areas. A magnetic encoder includes this sensing element, as well as one or more read heads, electronics, and a mechanical enclosure with input shaft and bushings. The input shaft moves in and out for a linear sensor. It has wipes to prevent ingestion of foreign material, and bushings designed to accept side-loading. An angular sensor has a shaft that rotates, and includes bushings to withstand thrust and side-loading. The encoded media is implemented as either a strip in a linear sensor, or as a disk in an angular sensor.

As a read head passes above the encoded area, it picks up the magnetic variations and reads the position information. The information, digital ones and zeroes, will usually be encoded in several parallel tracks to represent the binary digits of the position information. A standard binary code presents a problem for encoders in that some numbers require the changing of several of the bits at one time to indicate a single increment of the number represented. If all the changing bits are not perfectly aligned with each other, instantaneous erroneous readings will result. To avoid this problem, a special adaptation of the binary code called “Gray code” is used.

Magnetic encoders can be incremental or absolute. In an incremental configuration, equally spaced pulses encoded on the magnetic media are read from one or more tracks. The pulses are collected by an up/down counter, and the counter output represents the position. Quadrature outputs can be coded to tell the direction of displacement, as described above. The zero position is set by resetting the counter.

Absolute magnetic encoders have the digital code representing the position encoded directly at that position. No counter is needed. The Gray code can be interpreted to yield the position in engineering units. Nonlinear coding, such as sine or cosine, is sometimes used.

Lesson nine

Text A. microprocessor
Text B. История микропроцессоров
Passive voice
Modal verbs
Suffixes able, ible, tion, al

Exercise 1. Translate international words and word combinations

Management systems, environmental control systems, microlithography, silicon chip, miniaturization techniques.

Exercise 2. Much Abbreviation with their definitions

CPU, RAM, ROM, I/O, VLSI, LSI, ALU,
Input/output, read-only memory, random access memory, algebraic and logical operations, central processor unit, very-large-scale integration, arithmetic logic unit, large-scale integration.

Exercise 3. Much words with synonyms and antonyms

Arrangement, random, external, reduce, permanent, generate, transfer, storage.
Syn-degrade, eternal, depository, alien, plan, bring about, accidental, arbitrary,
Ant-raise, inherent, systematic, impede, temporary, confusion, accept, give away.

Exercise 4. Read the text and answer the questions to it

What is a Microprocessor?
What functions does The CPU perform?
What is microlithography?
When was the first microprocessor system developed? Describe it.
What devices does the central processing unit consist of?

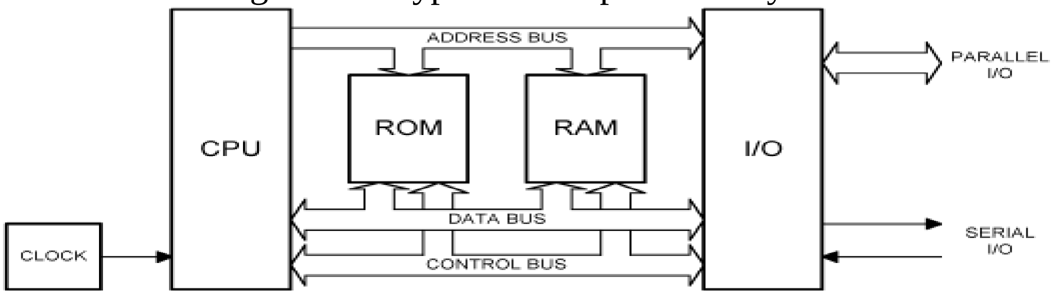
Microprocessor is a single chip of silicon that performs all of the essential functions of a computer central processor unit (CPU) on a single silicon chip. Microprocessors are found in a huge variety of applications including engine management systems, environmental control systems, domestic appliances, video games, fax machines, photocopiers, etc.

The CPU performs three functions: it controls the system's operation; it performs algebraic and logical operations; and it stores information (or data) whilst it is processing. The CPU works in conjunction with other chips, notably those that provide random access memory (RAM), read-only memory (ROM), and input/output (I/O).

The key process in the development of increasingly powerful microprocessor chips is known as microlithography. In this process the circuits are designed and laid out using a computer before being photographically reduced to a size where individual circuit lines are about 1/100 the size of a human hair. Early miniaturization techniques, which were referred to as large-scale integration (LSI), resulted in the production of the first generation of 256K-bit memory chip (note that such a chip actually has a storage capacity of 262,144-bits where each bit is a binary 0 or 1). Today, as a result of very-large-scale integration (VLSI), chips can be made that contain more than a million transistors.

The first microprocessor systems were developed in the early 1970's. These were simple and crude by today's standards but they found an immediate application in the automotive industry where they were deployed in engine management and automatic braking systems. Today, microprocessor systems are found in a huge variety of applications from personal computers to washing machines!

The block diagram of a typical microprocessor system is shown below.



The central processing unit (CPU) is generally the microprocessor chip itself. This device contains the following main units:

-storage locations (called registers) that can be used to hold instructions, data, and addresses during processing.

-an arithmetic logic unit (ALU) that is able to perform a variety of arithmetic and logical function (such as comparing two numbers).

-a control unit which accepts and generates external control signals (such as read and write) and provides timing signals for the entire system.

In order to ensure that all the data flow within the system is orderly, it is necessary to synchronize all of the data transfers using a clock signal. This signal is often generated by a clock circuit (similar to the clock in a digital watch but much faster). To ensure accuracy and stability the clock circuit is usually based on a miniature quartz crystal.

All microprocessors require access to read/write memory in which data (e.g. the results of calculations) can be temporarily stored during processing. Whilst some microprocessors (often referred to as microcontrollers) contain their own small read/write memory, this is usually provided by means of a semiconductor random access memory (RAM).

Microprocessors generally also require more permanent storage for their control programs and, where appropriate, operating systems and high-level language interpreters. This is usually provided by means of semiconductor read-only memory (ROM).

To fulfill any useful function, a microprocessor system needs to have links with the outside world. These are usually supplied by means of one, or more, VLSI devices which may be configured under software control and are therefore said to be programmable. The input/output (I/O) devices fall into two general categories; parallel (where a byte is transferred at a time along eight wires), or serial (where one bit is transferred after another along a single wire).

The basic components of a microprocessor system (CPU, RAM, ROM, and I/O) are linked together using a multiple connecting arrangement known as a bus. The address bus is used to specify memory locations (i.e. addresses), the data bus is used to transfer data between devices, and the control bus is used to provide timing and control signals (such as read and write, reset and interrupt) throughout the system).

Exercise 5. Read the text again and find out sentences in passive voice, translate them

Exercise 6. Read the text again and find out sentences with modal verbs

Exercise 7. Read the text again and find out sentences with suffixes able, ible, tion, al in it, and translate them

Exercise 8. Read the text and translate it. Speak about the history of Microprocessors

История микропроцессоров началась в 1971 году. Именно в начале 70-х годов появился первый микропроцессор от компании Intel, который был 4-х разрядный. Микропроцессор носил кодовое название 4004. Он содержал около 2300 транзисторов. В дальнейшем микропроцессоры пытались многократно модифицировать, тем самым увеличивая их производительность. Для того времени появление микропроцессора было настоящим техническим прогрессом. Счетные машинки ушли на второй план, а первое место заняли новые калькуляторы, которые хоть и имели большие габариты, но отлично справлялись со своими задачами. В дальнейшем были созданы процессоры более высокой разрядности.

Микропроцессоры j8080 и j8086 имели 8 и 16 разрядность соответственно. Также стоит отметить микропроцессор от компании Zilok z-80, который в дальнейшем и был положен в основу создания персональных компьютеров. Первые модели процессоров появились в нашей стране только под конец 80-х годов. Первым процессором на территории СССР был КР580. С этого момента компьютерная индустрия начала развиваться с небывалой скоростью. Персональные компьютеры, собранные на основе микропроцессоров, были маленькими по габаритам и довольно производительными (на тот период времени).

Стоимость компьютера была очень высокой, сравнимой с покупкой нового авто, поэтому спрос на новенькое «чудо техники» оказался маленьким. На основе процессоров j8080 и j8086 были созданы два первых компьютера от компании IBM (IBM XT и IBM AT). Различие в моделях было лишь одно – это разрядность микропроцессора. В дальнейшем были созданы более дешевые персональные компьютеры, на основе микропроцессора z-80 которые стоили в пределах 200$, однако они имели ограниченную функциональность.

Lesson ten.
Text A. Fiber optic communication.
Text B. Optical fibers.
Text C. The advantages of optical fiber communication

Adverbs
Conjunction due to

Exercise 1. Translate international words and word combinations

Electromagnetic interference, reflection, coaxial cables, communication, laser, audio signal, video signal, radiation, illumination, text and data from computers, metal conductor.

Exercise 2. Much words with their definitions

Fiber, ray, amplification, flexible, core, refraction, value, copper, splice.

-a thin thread of natural or artificial material that can be used to make cloth, paper, etc.

-deflection from a straight path undergone by a light ray or energy wave in passing obliquely from one medium (as air) into another (as glass) in which its velocity is different

-a central and often foundational part usually distinct from the enveloping part by a difference in nature.

-a beam of radiant energy (as light) of small cross section.

-able to change or to do different things.

-usefulness or importance.

-the particulars by which a statement is expanded.

-to join ropes, wires, etc., by weaving or twisting them together.

-a common reddish metallic element that is ductile and malleable and is one of the best conductors of heat and electricity.

Exercise 3. Read the text and translate it

Fiber optic communication uses light signals guided through a fiber core. Fiber optic cables act as waveguides for light, with all the energy guided through the central core of the cable. The light is guided due to the presence of a lower refractive index cladding around the central core. Little of the energy in the signal is able to escape into the cladding and no energy can enter the core from any external sources. Therefore the transmissions are not subject to any electromagnetic interference.

The core and the cladding will trap the light ray in the core, provided the light ray enters the core at an angle greater than the ‘critical angle’. The light ray will then travel through the core of the fiber, with minimal loss in power, by a series of total internal reflections. Given figure illustrates this process.

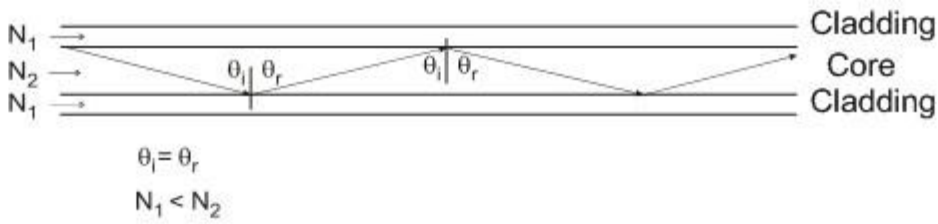


Figure 1- Light ray traveling through an optical fiber

Applications for fiber optic cables

Fiber optic cables offer the following advantages over other types of transmission media:

-Light signals are impervious to interference from EMI or electrical crosstalk.

-Light signals do not interfere with other signals.

-Optical fibers have a much wider, flatter bandwidth than coaxial cables and equalization of the signals is not required.

-The fiber has a much lower attenuation, so signals can be transmitted much further than with coaxial or twisted pair cable before amplification is necessary.

-Optical fiber cables do not conduct electricity and so eliminate problems of ground loops, lightning damage and electrical shock.

-Fiber optic cables are generally much thinner and lighter than copper cables.

-Fiber optic cables have greater data security than copper cables.

Fiber optic cable components.

The major components of a fiber optic cable are the core, cladding, coating (buffer), as shown in Figure 5. 6. Some types of fiber optic cable even include a conductive copper wire that can be used to provide power to a repeater.

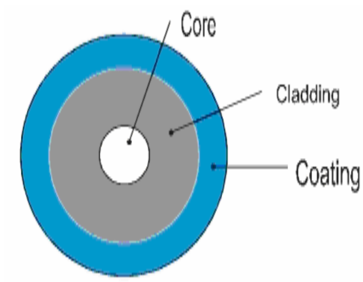


Figure 2- Fiber optic cable components

The fiber components include:

-Fiber core.

-Cladding.

-Coating (buffer).

-Strength members.

-Cable sheath.

There are four broad application areas into which fiber optic cables can be classified: aerial cable, underground cable, sub-aqueous cable and indoor cable.

Exercise 4. Read the text and answer the questions to it

Give the description to the optical fibers.
Where optical fibers are used?
What materials are replaced by optical fibers?
What are they consisting of?
What are their functions?

Exercise 5. Read the Text and retell it

An optical fiber (or optical fibre) is a flexible, transparent fiber made of high quality extruded glass (silica) or plastic, slightly thicker than a human hair. It can function as a waveguide, or "light pipe", to transmit light between the two ends of the fiber. The field of applied science and engineering concerned with the design and application of optical fibers is known as fiber optics.

Optical fibers are widely used in fiber-optic communications, which permits transmission over longer distances and at higher bandwidths (data rates) than other forms of communication.

Fibers are used instead of metal wires because signals travel along them with less loss and are also immune to electromagnetic interference. Fibers are also used for illumination, and are wrapped in bundles so that they may be used to carry images, thus allowing viewing in confined spaces. Specially designed fibers are used for a variety of other applications, including sensors and fiber lasers.

Optical fibers typically include a transparent core surrounded by a transparent cladding material with a lower index of refraction. Light is kept in the core by total internal reflection. This causes the fiber to act as a waveguide.

Fibers that support many propagation paths or transverse modes are called multi-mode fibers (MMF), while those that only support a single mode are called single-mode fibers (SMF). Multi-mode fibers generally have a wider core diameter, and are used for short-distance communication links and for applications where high power must be transmitted. Single-mode fibers are used for most communication links longer than 1,000 meters (3,300 ft).

Joining lengths of optical fiber is more complex than joining electrical wire or cable. The ends of the fibers must be carefully cleaved, and then spliced together, either mechanically or by fusing them with heat. Special optical fiber connectors for removable connections are also available.

Exercise 6. Read the text again and find out Adverbs and translate them

Exercise 7. Find out Adjectives from the Text and define their degrees of comparison

Exercise 8. Read given text and tell about the advantages of optical fiber communication with respect to copper wire systems

The advantages of optical fiber communication with respect to copper wire systems are: - 1. Broad Bandwidth

Broadband communication is very much possible over fiber optics which means that audio signal, video signal; microwave signal, text and data from computers can be modulated over light carrier wave and demodulated by optical receiver at the other end. It is possible to transmit around 3,000,000 full-duplex voices or 90,000 TV channels over one optical fiber.

2. Immunity to Electromagnetic Interference

Optical fiber cables carry the information over light waves which travel in the fibers due to the properties of the fiber materials, similar to the light traveling in free space. The light waves (one form of electromagnetic radiation) are unaffected by other electromagnetic radiation nearby. The optical fiber is electrically non-conductive, so it does not act as an antenna to pick up electromagnetic signals which may be present nearby. So the information traveling inside the optical fiber cables is immune to electromagnetic interference e.g. radio transmitters, power cables adjacent to the fiber cables, or even electromagnetic pulses generated by nuclear devices.

3. Low attenuation loss over long distances

There are various optical windows in the optical fiber cable at which the attenuation loss is found to be comparatively low and so transmitter and receiver devices are developed and used in these low attenuation region. Due to low attenuation of 0.2dB/km in optical fiber cables, it is possible to achieve long distance communication efficiently over information capacity rate of 1 T bit/s.

4. Electrical Insulators

Optical fibers are made and drawn from silica glass which is nonconductor of electricity and so there are no ground loops and leakage of any type of current. Optical fibers are thus laid down along with high voltage cables on the electricity poles due to its electrical insulator behavior.

5. Lack of costly metal conductor

The use of optical fibers does not require the huge amounts of copper conductor used in conventional cable systems. In recent times, this copper has become a target for widespread metal theft due to its inherent value on the scrap market.

Exercise 9. Read the text again and find out Participle I, II from it. Translate them

Exercise 10. Find out from the Text sentences with conjunction due to and translate them

Lesson eleven
Text A. Overview of Wireless Communications
Text B. Advantages and disadvantages of Wireless communication
Infinitive

Adjective

Exercise 1. Translate international words and word combinations

Radio, television, millions of kilometers, telecommunication, telecommunications systems, photo phone, Internet, telemedicine, segment, cordless telephones, a critical business tool, networking infrastructure.

Exercise 2. Much words with their definitions

Wireless, Internet, cellular, signal, laptop, proliferation, utilities, exponential.

- Something useful or designed for use.
- Not using wires to send and receive electronic signals.
- relating to a system that uses radio waves instead of wires to send telephone signals.
-something (such as a sound, a movement of part of the body, or an object) that gives information about something or that tells someone to do something.
-An electronic communications network that connects computer networks and organizational computer facilities around the world.
- Very fast: increasingly rapid.
-To grow by rapid production of new parts, cells, buds, or offspring.
-A portable microcomputer having its main components (as processor, keyboard, and display screen) integrated into a single unit capable of battery-powered operation.

Exercise 3. Read the text Overview of Wireless Communications and translate it

Wireless communications is, by any measure, the fastest growing segment of the communications industry. As such, it has captured the attention of the media and the imagination of the public. Cellular systems have experienced exponential growth over the last decade and there are currently around two billion users worldwide. Indeed, cellular phones have become a critical business tool and part of everyday life in most developed countries, and are rapidly supplanting antiquated wire line systems in many developing countries.

In addition, wireless local area networks currently supplement or replace wired networks in many homes, businesses, and campuses. Many new applications, including wireless sensor networks, automated highways and factories, smart homes and appliances, and remote telemedicine, are emerging from research ideas to concrete systems. The explosive growth of wireless systems coupled with the proliferation of laptop and palmtop computers indicate a bright future for wireless networks, both as stand-alone systems and as part of the larger networking infrastructure. However, many technical challenges remain in designing robust wireless networks that deliver the performance necessary to support emerging applications. The gap between current and emerging systems and the vision for future wireless applications indicates that much work remains to be done to make this vision a reality.

Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor. The most common wireless technologies use radio. With radio waves distances can be short, such as a few meters for television or as far as thousands or even millions of kilometers for deep-space radio communications. It encompasses various types of fixed, mobile, and portable applications, including two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Other examples of applications of radio *wireless technology* include GPS units, garage door openers, wireless computer mice, keyboards and headsets, headphones, radio receivers, satellite television, broadcast television and cordless telephones.

Somewhat less common methods of achieving wireless communications include the use of other electromagnetic wireless technologies, such as light, magnetic, or electric fields or the use of sound.

Wireless operations permit services, such as long-range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems (e.g. radio transmitters and receivers, remote controls etc.) which use some form of energy (e.g. radio waves, acoustic energy, etc.) to transfer information without the use of wires. Information is transferred in this manner over both short and long distances.

The world's first wireless telephone conversation occurred in 1880, when Alexander Graham Bell and Charles Sumner Tainter invented and patented the photo phone, a telephone that conducted audio conversations wirelessly over modulated light beams (which are narrow projections of electromagnetic waves). In that distant era, when utilities did not yet exist to provide electricity and lasers had not even been imagined in science fiction, there were no practical applications for their invention, which was highly limited by the availability of both sunlight and good weather. Similar to free-space optical communication, the photo phone also required a clear line of sight between its transmitter and its receiver. It would be several decades before the photo phone’s principles found their first practical applications in military communications and later in fiber-optic communications.

The term "wireless" came into public use to refer to a radio receiver or transceiver (a dual purpose receiver and transmitter device), establishing its usage in the field of wireless telegraphy early on; now the term is used to describe modern wireless connections such as in cellular networks and wireless broadband Internet. It is also used in a general sense to refer to any type of operation that is implemented without the use of wires, such as "wireless remote control" or "wireless energy transfer", regardless of the specific technology (e.g. radio, infrared, ultrasonic) used. Guglielmo Marconi and Karl Ferdinand Braun were awarded the 1909 Nobel Prize for Physics for their contribution to wireless telegraphy.

Exercise 4. Answer the questions to the text

What does the term wireless mean?
What means of wireless communication do you know?
When did the first wireless telephone conversation occur?
Which scientists contributed to the development of this technology?
What can you say about the Influence of wireless on our society?

Exercise 5. Find out Infinitive constructions from the Text and translate them

Exercise 6. Read the Text again and find out Adjectives from it

Exercise 7. Read the Text Advantages and disadvantages of Wireless communication and make Annotation to it

Wireless communication is among technology's biggest contributions to mankind. Wireless communication involves the transmission of information over a distance without help of wires, cables or any other forms of electrical conductors. The transmitted distance can be anywhere between a few meters (for example, a television's remote control) and thousands of kilometers (for example, radio communication).

Some of the devices used for wireless communication are cordless telephones, mobiles, GPS units, wireless computer parts, and satellite television.

There are both Advantages and disadvantages of Wireless Communication
Wireless communication has the following advantages:

Communication has enhanced to convey the information quickly to the consumers.

Working professionals can work and access Internet anywhere and anytime without carrying cables or wires wherever they go. This also helps to complete the work anywhere on time and improves the productivity.

Doctors, workers and other professionals working in remote areas can be in touch with medical centers through wireless communication. Urgent situation can be alerted through wireless communication. The affected regions can be provided help and support with the help of these alerts through wireless communication.

Wireless networks are cheaper to install and maintain.

Disadvantages

The growth of wireless network has enabled us to use personal devices anywhere and anytime. This has helped mankind to improve in every field of life but this has led many threats as well.

Wireless network has led to many security threats to mankind. It is very easy for the hackers to grab the wireless signals that are spread in the air. It is very important to secure the wireless network so that the information cannot be exploited by the unauthorized users. This also increases the risk to lose information. Strong security protocols must be created to secure the wireless signals like WPA and

WPA2. Another way to secure the wireless network is to have wireless intrusion prevention system.

Exercise 8. Find out modal verbs from the text and give their equivalents

Lesson 12
Text A Wireless data communications
Text B. Cellular Telephone Systems
Present Perfect
Suffixes –ance, -ly,-al

Exercise 1. Translate international words and word combinations

Mobile telephone site, Wi-Fi, monitor and collect data, fundamental methods, electromagnetism and magnetic fields, Bluetooth, minimum value, service, mobile terminals, characterization of signal propagation.

Exercise 2. Much words with their definitions

Software, access, Wi-Fi, a cell, compute, interface.

-The entire set of programs, procedures, and related documentation associated with a system and especially a computer system.

- A single unit in a device for converting radiant energy into electrical energy or for varying the intensity of an electrical current in accordance with radiation.

-Used to certify the interoperability of wireless computer networking devices.

- A system that controls the way information is shown to a computer user and the way the user is able to work with the computer.

- To determine especially by mathematical means; *also* **:** to determine or calculate by means of a computer.

- Permission or the right to enter, get near, or make use of something or to have contact with someone.

Exercise 3. Read the Text and translate it

One of the best-known examples of wireless technology is the mobile phone, also known as a cellular phone, with more than 4.6 billion mobile cellular subscriptions worldwide as of the end of 2010. These wireless phones use radio waves to enable their users to make phone calls from many locations worldwide. They can be used within range of the mobile telephone site used to house the equipment required to transmit and receive the radio signals from these instruments.

Wireless data communications are an essential component of mobile computing. The various available technologies differ in local availability, coverage range and performance, and in some circumstances, users must be able to employ multiple connection types and switch between them. To simplify the experience for the user, connection manager software can be used, or a mobile VPN deployed to handle the multiple connections as a secure, single virtual network. Supporting technologies include:

Wi-Fi is a wireless local area network that enables portable computing devices to connect easily to the Internet. Standardized as IEEE 802.11 a,b,g,n, Wi-Fi approaches speeds of some types of wired Ethernet. Wi-Fi has become the de facto standard for access in private homes, within offices, and at public hotspots. Some businesses charge customers a monthly fee for service, while others have begun offering it for free in an effort to increase the sales of their goods.

Mobile Satellite Communications may be used where other wireless connections are unavailable, such as in largely rural areas or remote locations. Satellite communications are especially important for transportation, aviation, maritime and military use.

Wireless Sensor Networks are responsible for sensing noise, interference, and activity in data collection networks. This allows us to detect relevant quantities, monitor and collect data, formulate meaningful user displays, and to perform decision-making functions.

Wireless energy transfer is a process whereby electrical energy is transmitted from a power source to an electrical load that does not have a built-in power source, without the use of interconnecting wires. There are two different fundamental methods for wireless energy transfer. They can be transferred using either far-field methods that involve beam power/lasers, radio or microwave transmissions or near-field using induction. Both methods utilize electromagnetism and magnetic fields

Wireless Medical Technologies.

New technologies such as mobile body area networks (MBAN) have the capability to monitor blood pressure, heart rate, oxygen level and body temperature, all with wireless technologies. The MBAN works by sending low powered wireless signals to receivers that feed into nursing stations or monitoring sites. This technology helps with the intentional and unintentional risk of infection or disconnection that arise from wired connections.

Computer interface devices.

Answering the call of customers frustrated with cord clutter, many manufacturers of computer peripherals turned to wireless technology to satisfy their consumer base· Originally these units used bulky, highly limited transceivers to mediate between a computer and a keyboard and mouse; however, more recent generations have used small, high-quality devices, some even incorporating Bluetooth. These systems have become so ubiquitous that some users have begun complaining about a lack of wired peripherals. Wireless devices tend to have a slightly slower response time than their wired counterparts; however, the gap is decreasing.

Exercise 4. Answer the questions to the Text

What is one of the best-known examples of wireless technology?
Give the definition to wireless data communications.
What is Wi-Fi? Define its functions.

What kind of process is wireless energy transfer?
Give examples of wireless Medical Technologies.

Exercise 5. Read the Text again and find out sentences in Present Perfect. Translate them

Exercise 6. Read the Text "Cellular Telephone Systems" and retell it

Cellular telephone systems are extremely popular and lucrative worldwide: these are the systems that ignited the wireless revolution. Cellular systems provide two-way voice and data communication with regional, national, or international coverage. Cellular systems were initially designed for mobile terminals inside vehicles with antennas mounted on the vehicle roof. Today these systems have evolved to support lightweight handheld mobile terminals operating inside and outside buildings at both pedestrian and vehicle speeds.

The basic premise behind cellular system design is frequency reuse, which exploits the fact that signal power falls off with distance to reuse the same frequency spectrum at spatially-separated locations. Specifically, the coverage area of a cellular system is divided into no overlapping cells where some set of channels is assigned to each cell. This same channel set is used in another cell some distance away. Operation within a cell is controlled by a centralized base station, as described in more detail below. The interference caused by users in different cells operating on the same channel set is called intercell interference.

The spatial separation of cells that reuse the same channel set, the reuse distance, should be as small as possible so that frequencies are reused as often as possible, thereby maximizing spectral efficiency. However, as the reuse distance decreases, intercell interference increases, due to the smaller propagation distance between interfering cells. Since intercell interference must remain below a given threshold for acceptable system performance, reuse distance cannot be reduced below some minimum value. In practice it is quite difficult to determine this minimum value since both the transmitting and interfering signals experience random power variations due to the characteristics of wireless signal propagation. In order to determine the best reuse distance and base station placement, an accurate characterization of signal propagation within the cells is needed.

Initial cellular system designs were mainly driven by the high cost of base stations, approximately one million dollars apiece. For this reason early cellular systems used a relatively small number of cells to cover an entire city or region. The cell base stations were placed on tall buildings or mountains and transmitted at very high power with cell coverage areas of several square miles. These large cells are called macro cells. Signal power was radiated uniformly in all directions, so a mobile moving in a circle around the base station would have approximately constant received power if the signal was not blocked by an attenuating object. This circular contour of constant power yields a hexagonal cell shape for the system, since a hexagon is the closest shape to a circle that can cover a given area with multiple no overlapping cells.

Cellular systems in urban areas now mostly use smaller cells with base stations close to street level transmitting at much lower power. These smaller cells are called microcells or picocells, depending on their size. This evolution to smaller cells occurred for two reasons: the need for higher capacity in areas with high user density and the reduced size and cost of base station electronics. A cell of any size can support roughly the same number of users if the system is scaled accordingly. Thus, for a given coverage area a system with many microcells has a higher number of users per unit area than a system with just a few macro cells. In addition, less power is required at the mobile terminals in microcellular systems, since the terminals are closer to the base stations. However, the evolution to smaller cells has complicated network design. Mobiles traverse a small cell more quickly than a large cell, and therefore handoffs must be processed more quickly. In addition, location management becomes more complicated, since there are more cells within a given area where a mobile may be located.

Exercise 7. Find out words with suffixes –ance, -ly,-al from the text and translate them

Exercise 8. Find out sentences in Passive voice and make them Active, where is possible.

Exercise 9. Find out sentences with must and have to from the Text and translate them

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Содержание

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ПРОФЕССИОНАЛЬНО-ОРИЕНТИРОВАННЫЙ АНГЛИЙСКИЙ ЯЗЫК

Методические указания по развитию навыков чтения и перевода научно-технических текстов студентов для специальности 5B071600

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