Ministerio de Educación

Gobierno de Chile

100 TOP
Electronics
WORDS TP BOOKLET
4° MEDIO

DEG
División Educación General

English Opens Doors Program

División de Educación General - Mineduc

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100 TOP

Electronics

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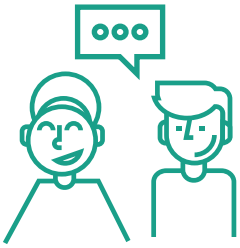
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Ministerio de Educación

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¡Bienvenido!

Welcome!

ES

A continuación, te presentamos un recurso elaborado para avanzar en uno de nuestros principales objetivos: mejorar la calidad y fortalecer la enseñanza Técnico-Profesional en el país.

La creación de este Booklet responde a la importancia de aprender el idioma inglés en el contexto de cada especialidad técnica, de manera que en el futuro puedas acceder a mayores oportunidades de especialización y en el mundo laboral.

Es por esta razón que creamos este recurso didáctico, donde proponemos tanto a docentes como estudiantes, las 100 palabras más utilizadas en cada especialidad aplicadas en contextos específicos, fundamentales para el dominio del idioma.

Dado que en el mundo de hoy es importante entregar todas las opciones para favorecer el aprendizaje del inglés, el trabajo continuo de las actividades que ofrece cada unidad te permitirá desarrollar habilidades lingüísticas como la lectura, audición, expresión escrita y oral, además de trabajar colaborativamente en los proyectos al término de cada unidad.

Esperamos que este 100 Top Words Booklet sea una contribución para el aprendizaje del idioma en la especialidad que has elegido.

EN

We are pleased to present you with this resource, which was created to advance one of our primary objectives- improving and strengthening the quality of technical professional education in Chile.

The creation of this booklet responds to the importance of learning the English language in the specific context of each technical specialty and aims to provide you with access to greater opportunities in your area of concentration, and in the labor market in general.

With that in mind we have created this educational resource, through which we propose to teachers and students alike – the 100 most commonly used words for specific contexts, fundamental to language mastery in each area of technical specialization.

Given the current importance of providing all possible opportunities to foment English language acquisition, the successive completion of the activities offered in each unit will facilitate the development of your linguistic abilities, including reading comprehension, written and oral expression, as well in collaborative learning projects provided at the end of each unit.

We hope that the "100 Top Words" Booklet will contribute to your English language learning, in the technical professional concentration that you have chosen.

Tus comentarios nos importan: escríbenos a TPenglish@mineduc.cl

Electronics Booklet Glossary

(A)

1. AC power (n.) Alternating Current power is standard electricity that comes out of power outlets and is defined as a flow of charge that exhibits a periodic change in direction.

2. Actuator (n.) A servomechanism that supplies and transmits a measured amount of energy for the operation of another mechanism or system.

3. Arc furnace (n.) A furnace in which heat is generated by an electric arc.

4. Assembly (n.) The putting together of parts, as of machinery, from parts of standard sizes.

(B)

5. Belt (n.) An endless band passing around pulleys, used to transmit motion or to convey objects.

6. Blower (n.) A machine for pushing or sending air through something.

7. Blueprint (n.) A process of photographic printing, used chiefly in copying architectural and mechanical drawings, which produces a white line on a blue background.

8. Bolt (n.) Any of several types of strong screws threaded to receive a nut and used to hold things together.

9. Breakout boards (n.) Common electrical components that take a bundled cable and "break out" each conductor to a terminal that can easily accept a hook-up wire for distribution to another device.

(C)

10. Check-up (n.) An examination or close scrutiny, as for verification, accuracy, or comparison.

11. Circuit breaker (n.) A device for stopping the flow of electricity through an electric circuit.

12. Compressor (n.) A transducer that produces an output with a range of voltages whose ratio is smaller than that of the range of the input signal.

13. Contactor (n.) A mechanically operated switch for continuously establishing and interrupting an electric power circuit.

14. Control panel (n.) A panel containing switches, dials, and other equipment for regulating electrical devices, lights, etc. Also called control board.

15. Conveyor (n.) A continuous belt or chain for carrying materials or objects short distances.

16. Cracks (n.) Breaks without separation of parts.

17. Crane (n.) A large device for lifting and moving very heavy objects.

18. Crusher (n.) A machine designed to reduce large rocks into smaller rocks, gravel, sand or rock dust.

19. Current (n.) The movement or flow of electric charge, measured in amperes.

(D)

20. DC power (n.) Direct Current power is a linear electrical current that moves in a straight line.

21. DIN rail (n.) A metal rail of a standard type widely used for mounting circuit breakers and industrial control equipment inside equipment racks.

22. Diode (n.) A device through which current can pass freely in only one direction.

23. Disassemble (v.) To take apart.

24. Disconnect switch (n.) Used to ensure that an electrical circuit is completely de-energized for service or maintenance. Not usually intended for normal control of the circuit, but only for safety isolation.

25. Doping (n.) A method of adding a dopant to a pure semiconductor to change its electrical properties.

E **26. Elevator** (n.) A moving platform or cage for carrying people or freight from one level to another, as in a building.

27. Ethernet switch (n.) Networking hardware that connects devices on a computer network by using packet switching to receive and forward data to the destination device.

F **28. FACTS** (n.) Flexible AC Transmission System is a system composed of static equipment used for the alternating current (AC) transmission of electrical energy.

29. Failure (n.) Cessation of normal operation; breakdown.

30. Fan (n.) A device for producing a current of air by the revolving movement of one or more blades.

31. Faults (n.) Defects or imperfections.

32. Feeder (n.) A conductor, or group of conductors, connecting primary equipment in an electric power system.

33. Filler (n.) A substance used to fill cracks.

34. Fixture (n.) Any of various devices for holding work in a machine tool or holding parts in certain positions during welding, assembly, etc.

35. Fluid (n.) A substance, such as a liquid or gas, that is capable of flowing and that changes its shape when acted upon by a force.

36. Fork-lift (n.) A vehicle having two power-operated horizontal prongs that can be raised or lowered for loading, transporting, and unloading goods.

37. Fuse (n.) A mechanical or electronic device for detonating an explosive charge.

G **38. Gear** (n.) A part, such as a disk, or wheel, having teeth of such form, size, and spacing that they mesh with the teeth from another part to carry or receive force and motion.

H **39. Handle** (n.) The part of an object, such as a bag or a tool, used to hold it or carry it.

40. HMI display (n.) A Human-Machine Interface (HMI) is a user interface or dashboard that connects a person to a machine, system, or device.

41. HVDC transmission (n.) A power transmission system that uses high-voltage direct current (HVDC) for the bulk transmission of electrical power.

42. Hydraulic (adj.) Operated by liquid moving under pressure.

I **43. I/O** (n.) Input/output.

44. Inrush current (n.) The maximal instantaneous input current drawn by an electrical device when first turned on.

45. Isolate (v.) To insulate.

K **46. Knob** (n.) A part, usually rounded, that forms a handle, as on a door or drawer, or forms a control device, as on a radio.

L **47. Layout** (n.) An arrangement or plan.

M **48. Machinery** (n.) An assemblage of machines or mechanical apparatuses.

49. Manufacturer (n.) A person, group, or company that owns or runs a manufacturing plant.

50. Mill (n.) A machine for grinding or crushing any solid substance.

51. Mixer (n.) Any machine that can blend, homogenize, or emulsify various types of materials into a single substance.

O **52. Overload** (n.) A component that protects electric motors from overheating and it usually monitors three-phase motors.

53. Overwork (v.) To make a machine to work too hard or too long.

P **54. P&ID device** (n.) A device in AutoCAD used for schematic representations of pipelines, equipment, instrumentation, and control systems found in process environments such as oil refineries, chemical plants, paper mills, and cement plants, etc.

55. Panelboard (n.) A compact pressboard for use in constructing sides of cabinets, paneling for walls, and in other nonstructural applications.

56. PLC (n.) Programmable Logic Controller.

57. Pneumatic (adj.) Filled with, operated by, or containing compressed air.

58. Pole (n.) Either of the two parts of an electric battery or magnet that are opposite in charge.

59. Power electronics (n.) The application of solid-state electronics to the control and conversion of electric power.

60. Power supply (n.) A device that provides power to electric machines, generators, etc.

61. Pump (n.) An apparatus or machine for raising, pushing in or out, or compressing fluid or gases.

R **62. Recalibrate** (v.) To make small changes to an instrument so that it measures accurately.

63. Relays (n.) Electrical devices that respond to a change of current or voltage in one circuit by making or breaking a connection in another.

64. Resistance (n.) The tendency of a conductor to oppose the flow of electrical current.

65. Rotary kiln (n.) A pyroprocessing device used to raise materials to a high temperature (calcination) in a continuous process.

S **66. Scoot** (v.) To slide.

67. Screw jack (n.) A jack for lifting consisting of a screw steadied by a threaded support and carrying a plate or other part bearing the load.

68. Seal (v.) To bring (a plug and jack or socket) into locked or fully aligned position.

69. Semiconductor (n.) A substance, such as silicon, that can conduct electricity with less efficiency than a true conductor.

71. Silicon (n.) A non-metallic element, occurring in minerals and rocks and making up more than one fourth of the earth's crust. Used in steelmaking, computer chips, etc.

72. Smart grid (n.) An electrical grid which includes a variety of operation and energy measures including smart meters, smart appliances, renewable energy resources and energy efficient resources.

73. Soft starter (n.) It protects an electric motor from possible damage and at the same time extends the lifespan of the motor and the whole system.

74. Solenoids (n.) Coils of wire that, when carrying current, magnetically attract a sliding iron core.

75. Splice (n.) A join between two pieces of something so that they form one long piece.

76. Spreadsheet (n.) A piece of computer software used for showing rows and columns of numbers or other data, and for doing calculations with this data.

77. Strain gauge (n.) A sensor whose resistance varies with applied force; It converts force, pressure, tension, weight, etc., into a change in electrical resistance which can then be measured.

78. Switch (n.) A device for turning on or off or directing an electric current.

T **79. Tear** (v.) To be pulled apart or in pieces by force.

80. Terminal blocks (n.) Insulated connections that fasten two or more wires together and have an insulating frame and a clamping system.

81. Terminal ground block (n.) A device mechanically and electrically connect wires to the DIN rail by using a metal clamping bar.

82. Three-phase motor (n.) A type of AC motor that is a specific example of a polyphase motor.

83. Thyristor (n.) A semiconductor device having two stable states, used as an electronic switch.

84. Tire (n.) A ring of rubber, place over the rim of a wheel on cars, trucks etc., to provide traction or resistance to wear.

85. Torque (n.) The measured ability of a twisting part of machinery, as of a shaft, to overcome resistance to such turning.

86. Track (n.) A pair of parallel lines of rails on which a railroad train, trolley, or the like runs.

87. Transducer (n.) A device, such as a microphone, that converts a signal from one form of energy to another.

88. Transformer (n.) A device that changes the voltage or other characteristics of electrical energy as it moves from one circuit to another.

89. Transistor (n.) A semiconductor device that amplifies, oscillates, or switches the flow of current between two terminals by varying the current or voltage between one of the terminals and a third.

90. Trim wire (n.) Used in AutoCAD to trim a wire back to an intersection with another wire, a component, or remove it completely.

91. Trolley (n.) A pulley traveling on an overhead track and serving to support and move an object hung from it or a small truck or car operated on a track, as in a factory.

U

92. UPS (n.) An Uninterrupted Power Supply is an electrical apparatus that provides emergency power to a load when the input power source fails.

V

93. VAC (n.) Volts Alternating Current.

94. VAR compensation (n.) A device which compensates for the reactive power of the load connected to a power system. Also known as SVC (Static VAR Compensation).

95. VFD (n.) Variable Frequency Drive is a type of motor drive used in electro-mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage.

W

96. Waveform (n.) The shape of a wave; a graph obtained by plotting the instantaneous values of a periodic quantity against time.

97. Wear (v.) To deteriorate by a constant or repeated action.

98. Weld (v.) To unite pieces of metal or plastic together by softening with heat and hammering or by fusion.

99. Wired duct (n.) Used to route, protect and/or organize electrical cables and wires, typically within a control panel.

100. Wiring (n.) A system of electric wires, as in a building or the aggregate of wires in a lighting system, switchboard, radio, etc.

Unit V: Maintenance and Operation of Electronic Power Control Equipment.

Learning Objectives:

LO1: Comprehend relevant information for a specific purpose in oral and written texts in contexts related to students' interests and concerns to know how other cultures address those contexts.

LO2: Produce clear oral and written texts in contexts related to students' interests and concerns in order to express a critical personal opinion that respects other opinions.

Skills: Listening, Reading, Speaking, and Writing.

Project: "Planned Maintenance Scheme"

☆ 27 KEY WORDS

AC power (n.)	FACTS (n.)	Silicon (n.)
Arc furnace (n.)	Fan (n.)	Smart grid (n.)
Blower (n.)	Forklift (n.)	Switch (n.)
Compressor (n.)	HVDC transmission (n.)	Thyristor (n.)
Crane (n.)	Mill (n.)	Transistor (n.)
DC power (n.)	Power electronics (n.)	Trolley (n.)
Diode (n.)	Pump (n.)	UPS (n.)
Doping (n.)	Rotary kiln (n.)	VAR compensation (n.)
Elevator (n.)	Semiconductor (n.)	Weld (v.)

Lesson I: Listening Comprehension

BEFORE YOU LISTEN

1. Look at the following picture and answer:

a. What do you think the audio will be about? I think the audio will be about...

_____

b. Name the power semiconductors you already know. The power semiconductors I know are...

_____

c. Now compare your answers with a classmate.

WHILE YOU LISTEN

Click here to listen:

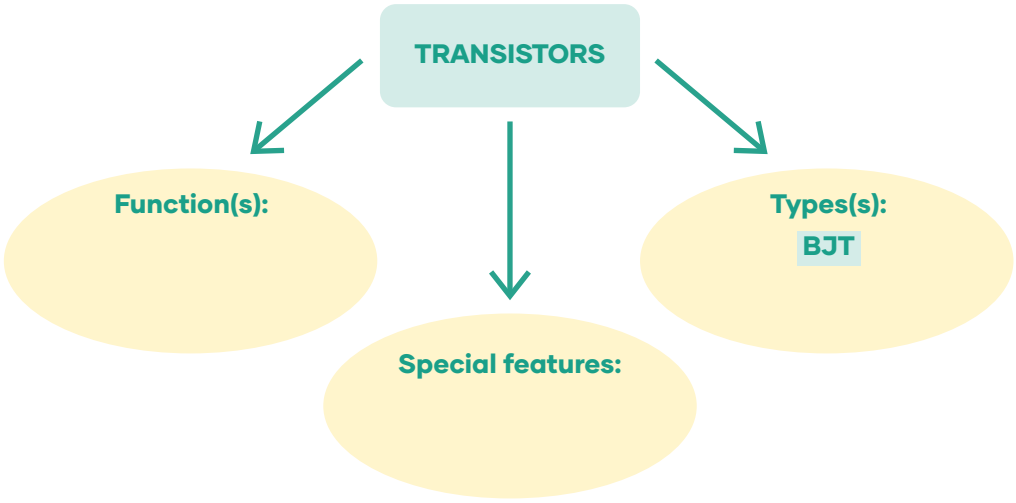
2. Listen to the audio to confirm your predictions.

a. What do you think the audio will be about? I think the audio will be about...

Main topic	
Power semiconductors	

b. Listen again to the description of transistors and complete the concept map with the information from the audio. ****You will listen twice.****

Example: Type(s):



AFTER YOU LISTEN

3. Write the main concepts mentioned in the audio.Example: The main concepts mentioned in the audio were...

Lesson II: Reading Comprehension

BEFORE YOU READ

1. Match the concepts with the corresponding category. Then, compare with a classmate.

A	Automotive & Traction
B	Daily life
C	Defense & Aerospace
D	Industries
E	Renewable Energy
F	Utility System

	SVC
	trolley
	pumps
	personal computer
	space shuttle
	solar cells
	FACTS
	cars
	rolling mills
	light dimmer

WHILE YOU READ

2. Read the text quickly and select the main idea of the text from the options below.

a) Current uses of power electronics.
b) Power electronics devices in the industry field.
c) Fields where power electronics devices are not available yet.

3. Read the text quickly and select the main idea of the text from the options below.

I.- Power electronics is part of some of the fields where electrical energy is in the picture.
2.- Air-conditioning is an example of power electronics applied to our daily life.
III.- Ships are an example where power electronics is not yet present.
IV.- Power electronics can be found in construction machinery and excavation.
V.- Renewable energy is a field where power electronics has not been applied.

APPLICATION OF POWER ELECTRONICS

It is literally impossible to list all the applications of power electronics today; it has penetrated almost all the fields where electrical energy is in the picture. This trend is an ever increasing one especially with present trends of new devices and integrated design of power semiconductor devices and controllers. The ease of manufacturing has also led to availability of these devices in a vast range of ratings and they have gradually appeared in high voltage and extra high voltage systems also. The day is not far when all of the electrical energy in the world will pass through power electronic systems.

Here is a list of the main categories where we can find power electronics applications:

- Our Daily Life: If we look around ourselves, we can find a whole lot of power electronics applications such as a fan regulator, light dimmer, air-conditioning, induction cooking, emergency lights, personal computers, vacuum cleaners, UPS (uninterruptible power supply), battery charges, etc.

- Automotive and Traction: Subways, hybrid electric vehicles, trolleys, fork-lifts, and many more. A modern car itself has so many components where power electronics is used such as ignition switch, windshield wiper control, adaptive front lighting, interior lighting, electric power steering and so on. Besides, power electronics are extensively used in modern traction systems and ships.

- Industries: Almost all the motors employed in the industries are controlled by power electronic drives, for example: Rolling mills, textile mills, cement mills, compressors, pumps, fans, blowers, elevators, rotary kilns etc. Other applications include welding, arc furnace, cranes, heating applications, emergency power systems, construction machinery, excavators etc.

- Defense and Aerospace: Power supplies in aircraft, satellites, space shuttles, advance control in missiles, unmanned vehicles, and other defense equipment.

- Renewable Energy: Generation systems, such as solar, wind, etc., need power conditioning systems, storage systems and conversion systems in order to become usable. For example: solar cells generate DC power, and for general application we need AC power, hence a power electronic converter is used.

- Utility System: HVDC transmission, VAR compensation (SVC), static circuit breakers, generator excitation systems, FACTS (Flexible AC Transmission Systems), smart grids, etc.

Text adapted from:
Application of Power Electronics. Electrical4U. (2020).
https://www.electrical4u.com/application-of-power-electronics/

AFTER YOU READ

4. My reflection. Complete the following statements about this lesson.

a. I am proud of myself today because

_____

_____

b. The most challenging thing about this lesson was

_____

_____

(Example: I am proud of myself today because *I learned about fields where power electronics is applied*. The most challenging thing about this lesson was *to understand specific words in the text such as rotary kilns*.)

Lesson III: Speaking

WARM UP

1. What do you think the steps involved in the preventive and/or corrective maintenance of a piece of equipment are? (Example: I think the steps involved in the preventive/corrective maintenance of a piece of equipment are...)

_____

_____

_____

_____

_____

_____

2. Compare your answer with a partner.

INPUT

3. Look at the following text about establishing a planned maintenance scheme.

ESTABLISHING A PLANNED MAINTENANCE SCHEME

1. Take inventory of all items to be maintained. Reference each item with a letter to indicate its location. A simple exercise book may be used with each item having its own page in the book, or a card system may be employed with each item having its own card. The entry should include all relevant technical details on the item.

2. Describe the maintenance tasks that are to be performed. This may be achieved by listing the tasks to be completed at each scheduled maintenance point. This is normally done in a maintenance Record Card.

3. Finally, wherever any maintenance is carried out on a piece of equipment a record of what has been done must be kept. This may be a form of job report specifying date, fault detected, cause.

Text adapted from:
Preventive Maintenance Plan in 5 Steps [2021] • Infraspeak Blog. Infraspeak Blog. (2021). https://blog.infraspeak.com/preventive-maintenance-plan/.

CONTROLLED PRACTICE

4. Look at the steps mentioned in the text, find a partner and discuss what you would do to establish a planned maintenance scheme for your school or for a local grocery store in your neighborhood.

You can use expressions such as:

First of all, we would need to....

After that, we.....

Next,.....

Finally,.....

Example:

Student A: First, we would need to take inventory of all electronic equipment. We would need to label them using a code designed by us.

Student B: Yes, and after that we would have to register in a notebook or laptop all relevant technical details of each piece of equipment.

Student A: Right. Next, we would have to describe the maintenance tasks to be performed, for example....

Student B: And finally, we need to record the maintenance of the equipment and make a report.

FREER PRACTICE

5. With your partner, write a summary of your discussion and present it orally to the rest of the class.

WRAP-UP

6. Write the main steps involved in a planned maintenance scheme.

Step 1: _____

_____

Step 2: _____

_____

Step 3: _____

_____

Lesson IV: Writing a maintenance report

PRE-WRITING

1. What information does a maintenance report have? Write the concepts in your notebook and then compare with a partner.

2. Now look at the following example and confirm your predictions.

Equipment Maintenance Report

Company name:	Softinar S.p.A.
Name of equipment:	Air conditioning
Label:	Aaa-2458-2020
Serial number:	AOE20001-55587-55531
Manufacturer:	Panasonic

Date	Maintenance Description	Maintenance performed by:	Validation
01/12/20	**1. Remove** brush and debris near the unit. **2. Clean** the condenser coils every spring. **3. Replace** any HVAC air filters. **4. Check** for loose contacts or electric connections. **5. Lubricate** motors and bearings. **6. Recharge** refrigerant. **7. Ensure** the condensate drain is clear.	Carlos Espinoza	María Salas (Operations Manager)

DRAFTING

3. In your notebook, write a draft of an equipment maintenance report. Look at the maintenance guide manual of a piece of electronic equipment of your choice, e.g.: car, personal computer, vacuum cleaner, motor, power supply, etc., to write the steps needed in the maintenance report.

REVISING

4. Use the following checklist to assess your classmate's draft. Once finished, return the draft and comments.

EQUIPMENT MAINTENANCE REPORT		
Equipment Maintenance Report	Tick if completed	Comments & Suggestions (*)
Name of company, equipment, label, serial number, manufacturer.		
All maintenance steps described.		
Correct use of grammar, sentence structure, word choice, punctuation, capitalization & spelling.		

(*) Comments & suggestions may provide reference to specific missing information, grammar, sentence structure, word choice, punctuation, capitalization & spelling errors.

EDITING

5. Using the following layout, re-write your proposal taking into account your classmate's feedback (re-check the criteria established in the checklist).

Equipment Maintenance Report

Company name:	
Name of equipment:	
Label:	
Serial number:	
Manufacturer:	

Date	Maintenance Description	Maintenance performed by:	Validation

PUBLISHING

6. Submit the final version to your teacher.

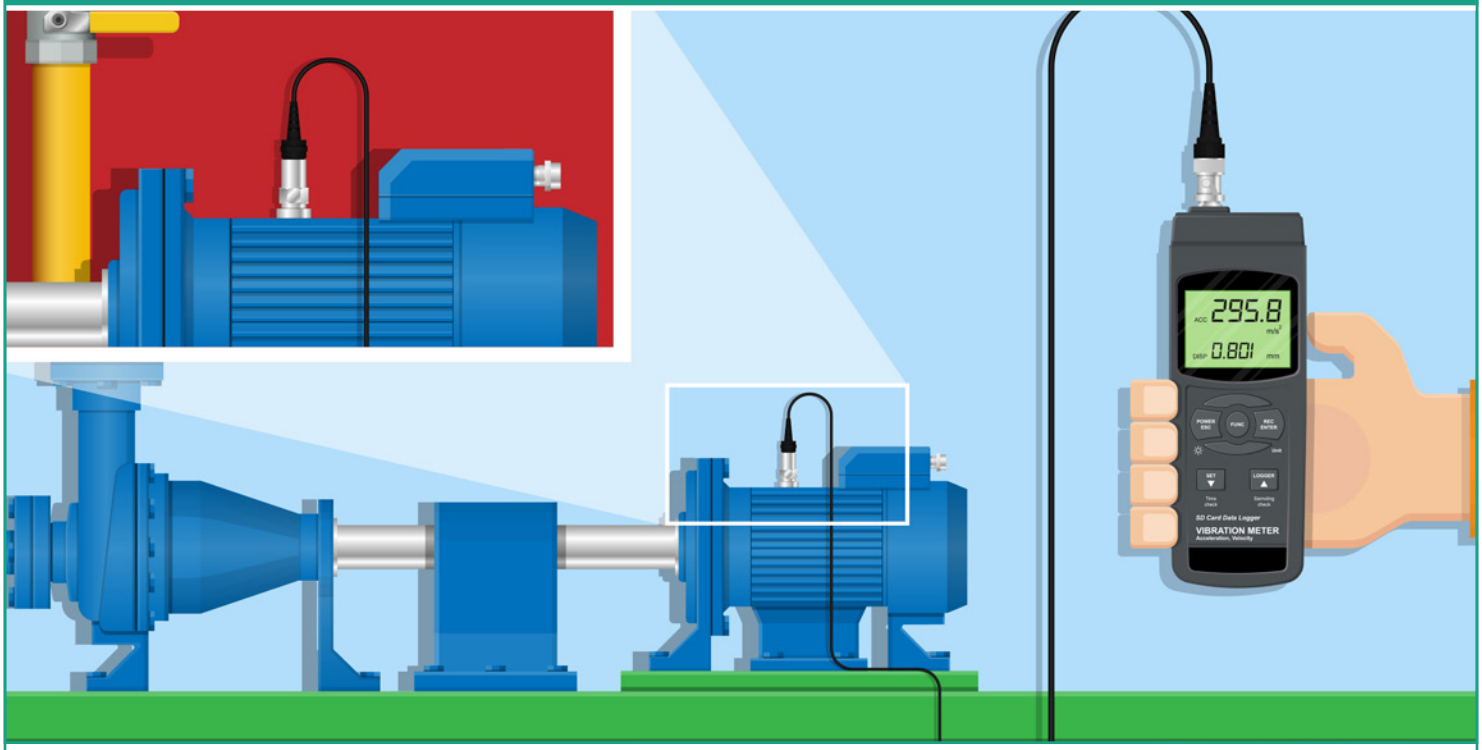
Project: Planned Maintenance Scheme



Name of the Project:	Planned Maintenance Scheme.
Level:	Elementary to intermediate.
Time:	90-135 minutes.
General aim (s):	Students will present a planned maintenance scheme orally.
Language aim(s):	Students will practice all four language skills, with a focus on the productive skills (speaking & writing).
Resources / Materials:	Cardboards, colored pencils/pens/markers, pictures, glue, scissors.
Teacher's role:	To provide the steps required to maintain electronic equipment, systems, devices, and components (preventive & corrective), as well as an example of a planned maintenance scheme. (Input from lesson III can be used).
Students' roles:	To collect material needed to create an infographic. To collect information about electronic equipment, systems, devices, and components available in a local store or at their school.

PROCEDURE	
1. Explain and provide examples of the process involved in designing a planned maintenance scheme. **2.** Divide the class into groups of 3-4. Allow time for a discussion about the local store/school selected as a group and the information needed to design a planned maintenance scheme. **3.** After selecting the store/school, each group works on the information needed and assigns roles to each member to collect the data and prepare an oral presentation. **4.** Each group practices their oral presentation according to the rubric criteria. **5.** Each group presents in front of the class.	
FOLLOW UP	The teacher or other groups can provide feedback about one or two aspects of a group's performance such as posture and pronunciation, or the planned maintenance scheme itself, emphasizing the positive instead of the negative.
VARIATION	Depending on the level of proficiency, other groups can take notes during oral presentations and ask questions after the presentation is finished in order to gather more specific information. After presenting, groups could develop the electronics project proposal with subject teachers.
RUBRIC	Rubric to assess planned maintenance scheme (self or peer assessment). Rubric to assess oral presentation (peer assessment). You will find it in the appendix section of this booklet.

Unit VI: Industrial Fault Detection



Learning Objective:

LO3 Use your knowledge of English to comprehend and produce clear oral and written texts in order to build a critical personal opinion in contexts related to your interests and concerns.

Skills: Listening, Reading, Speaking, and Writing.

Project: Fault detection & repair of industrial equipment

☆ 31 KEY WORDS

Assembly (n.)	Faults (n.)	Knob (n.)	Tear (v.)
Belt (n.)	Filler (n.)	Layout (n.)	Tire (n.)
Bolt (n.)	Fixture (n.)	Machinery (n.)	Torque (n.)
Check-up (n.)	Fluid (n.)	Manufacturer (n.)	Track (n.)
Cracks (n.)	Fuse (n.)	Overwork (v.)	Waveform (n.)
Current (n.)	Gear (n.)	Recalibrate (v.)	Wear (v.)
Disassemble (v.)	Handle (n.)	Resistance (n.)	Wiring (n.)
Failure (n.)	Isolate (v.)	Seal (v.)	

Lesson I: Listening Comprehension

BEFORE YOU LISTEN

1. Look at the picture and predict what the audio will be about.

a. I think the audio will be about

_____

_____

_____

_____

b. Now compare your answer with a classmate.

WHILE YOU LISTEN

Click here to listen:

2. Listen to the audio and confirm your predictions. Take notes about the number of speaker(s) and the main purpose of the audio.

PREDICTION	
PURPOSE	
N° OF SPEAKER(S)	

3. Listen again and select the best response or each question. ****You will listen twice. ****

I. Why is it important to provide maintenance to industrial equipment?

a) Because the government forces industrial companies to do it.
b) In order to make sure machinery lasts a long time.
c) Because industrial machinery is not frequently used.

II. How many tips does the person provide?

a) 4
b) 5
c) 6

III. Why should industrial companies prevent from the possibility of having broken equipment?

a) Because they would have to shut down the company.
b) Because they can't use any other working equipment.
c) Because it can be very expensive and unsafe.

IV. One tip mentioned is that operators should not only be well trained in the use of the machinery but also...

a) Know information from manuals.
b) Visit other companies.
c) Have extra holidays.

V. What can contribute to a breakdown of parts in industrial equipment?

a) Proper use of the equipment.
b) Fluids, tires, tracks and electrical systems.
c) Regular use, friction, and high temperatures.

AFTER YOU LISTEN

4. Complete the following concept map summarizing the maintenance tips provided.

Lesson II: Reading Comprehension

BEFORE YOU READ

1. Look at the title and write what you already know about causes of equipment failures. (e.g.: I know that equipment failures are caused due to improper use).

WHILE YOU READ

2. Read the text quickly and circle the unknown words. Write them in your notebook and look them up in your dictionary to find out their meaning. Then, compare with a classmate.

3. Read the text " Equipment failures: Cause and nature of falts", to complete the following chart.

EQUIPMENT FAILURES	
Categories	**Example(s)**

EQUIPMENT FAILURES: CAUSES AND NATURE OF FAULTS

The failure of a piece of equipment refers to its inability to perform its required function. There may be partial failures resulting from deviations in characteristics or parameters beyond the specified limits but not such as to cause a complete breakdown of the required function or complete failure if there is a complete breakdown.

The causes of equipment failures can be due to various reasons which can be classified into: (1) poor design, (2) production deficiencies, (3) careless storage & transport, and (4) inappropriate conditions during working life. Equipment failures due to poor design can be caused by improper choice of components, inadequate information on the stress and failure analysis of components, poor mechanical layout of components, assemblies, and panels, excessive development of heat inside the equipment and lack of cooling, and insufficient prototype testing for meeting both reliability and performance specifications.

If failures are categorized as production deficiencies it means there may be a lack of inward inspection of goods, sampling tests and inspection, unsuitable storage methods and unduly long storage period of components, poor motivation, lack of skill, and sense of involvement among staff members, absence of training programs for workers to properly use the equipment and most effective production techniques, use of sub-standard manufacturing equipment and tools, lack of proper working environment, ill-ventilated, poorly illuminated and dusty assembly shops, insufficient testing and inspection of finished products, and negligence in performing environmental tests like temperature cycling and operation of equipment at high temperatures for specified periods.

Unduly long storage of equipment before its dispatch to the customer, improper packaging which may fail to protect the equipment from corrosion and mechanical damage, and excessive vibrations and mechanical shocks during transportation of equipment from the manufacturer to the user are common causes categorized under careless storage & transport.

As for inappropriate conditions during working life, we can find hostile working environment conditions like lack of air-conditioned rooms and dust-free areas, carelessness in handling, operating and using the equipment without following the manufacturer's instructions, cautions & warnings, poor operability from operators, poor maintenance policy, wrong selection of equipment and provision of inadequate after-sales service by manufacturers, fluctuations in the main voltage, running the equipment beyond its prescribed lifetime, aging of the equipment, and lack of preventive maintenance.

As for the nature of faults occurring in different types of electronic equipment, it may vary from simple mechanical faults to complex faults in electronic circuitry. However, experience shows that about 30% of the faults are minor in nature, such as a blown-up fuse or a loose socket. About 20% are very common in nature which are mostly mechanical faults such as mechanical fixtures, knobs, handles, power sockets, or mounting of PCBs in connectors. Another 30% to 40% are not simple nor common in nature and can include burnt transformers, erratic performance due to instability and failure due to voltage fluctuations. The final 10% of the faults are chronic in nature and can become a headache for the service engineer and the user. They are repetitive faults and can occur due to poor designing or use of substandard components in its manufacture.

Text adapted from:

Khandpur, R. (2013). *Troubleshooting electronic equipment* (2nd ed.). McGraw Hill.

AFTER YOU READ

4. Write a brief summary (no more than 10 lines) of the most relevant information from the text. e.g.: Equipment failure can be classified into 4 causes which are...

Lesson III: Speaking

WARM UP

1. What steps do you have to follow to diagnose a fault?

INPUT

3. Look at the following dialogue between a senior electronic technician and a trainee.

Context of the dialogue: A senior electronic technician is training a new one on how to diagnose a fault. ST: Senior Technician / NT: New Technician.

ST: Hello **Carlos**, my name is **Christopher** and I will show you how to **diagnose a fault**.

NT: Hello sir, I brought some notes I took in class.

ST: Perfect! So, can you tell me what I have to do first?

NT: I know that before locating the fault it is good to talk to the operator about the history of the equipment, its function and any fault symptoms.

ST: Exactly! And what about after **locating the fault?**

NT: I would need to read the manual carefully and look for the test points suggested by the manufacturer.

ST: Indeed! **And don't forget to make measurements.**

NT: You're right! That's a key step.

CONTROLLED PRACTICE

4. Each student will choose a character to role-play the dialogue (i.e.: Student A is a Senior Technician, and student B is a New Technician).

5. Switch roles and repeat the dialogue again.

FREER PRACTICE

6. With your partner, create a similar dialogue naming the steps involved to **repair a fault** [1]**. Present it to the rest of the class.**

WRAP-UP

7. Summarize the steps involved in the procedure to diagnose and repair a fault.

[1] Ask your English/Subject teacher or look up the information on the internet in advance.

Lesson IV: Writing

PRE-WRITING

1. What information must a fault detection & repair protocol have? (**Example:** A fault detection & repair protocol must include all steps you have to take to diagnose a fault.)

2. Look at the following example and confirm your predictions.

- Make sure to have all necessary equipment, tools, and manual of the equipment available in advance.
- Discuss with the equipment operator the history of the equipment and his/her observations on its functioning and fault symptoms.
- Inspect the equipment from the most general to the specific, verifying power wiring, cracks, patchy spots, and odor.
- In case of no visible fault, disassemble the equipment.
- Study the service manual carefully and look for the test points suggested by the manufacturer.
- Make measurements (DC Voltage, current, resistance or waveform) and isolate the defective part or component.
- Once the fault is localized, prepare all necessary items to repair and replace the faulty component or correct the trouble or abnormal condition.
- Test the performance of the equipment and recalibrate, if necessary.
- Check for several hours before releasing the equipment to the user.

Text adapted from:
Khandpur, R. (2013). *Troubleshooting electronic equipment* (2nd ed.). McGraw Hill.

DRAFTING

Hypothetical situation: You are a technician working for a company that maintains and repairs industrial equipment.

3. Write a draft of a fault detection & repair protocol for a specific piece of industrial equipment of your choice following the example given in the previous activity.

REVISING

4. Use the following checklist to assess your classmate's draft. Once finished, return the draft and comments.

SPECIFIC FAULT DETECTION & REPAIR PROTOCOL		
Fault detection & repair protocol	Tick if completed	Comments & Suggestions (*)
Specific industrial equipment selected is stated in the title.		
Details of necessary equipment, tools & manual are provided in protocol.		
Details on measurements to be made are stated in protocol.		
All necessary steps for fault detection and repairing are provided.		

(*) Comments & suggestions may provide reference to specific missing information, grammar, sentence structure, word choice, punctuation, capitalization & spelling errors.

EDITING

5. Using the following layout, re-write your fault detection & repair protocol taking into account your classmate's feedback (re-check the criteria established in the checklist).

TITLE: _____

Steps:

1.

2.

3.

4.

-

-

-

-

-

-

-

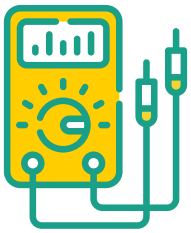
-

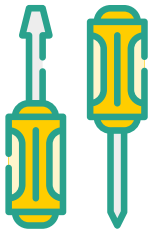
-

PUBLISHING

6. Submit the final version to your teacher.

Project: Fault detection & repair of industrial equipment





Name of the Project:	Fault detection & repair of industrial equipment
Level:	Elementary to intermediate.
Time:	90-135 minutes
General aim(s):	Students will record a video simulating fault detection and repairing of industrial equipment, presenting the process step by step (considering the protocol from lesson IV.)
Language aim(s):	Students will practice all four language skills, with focus on the productive skills (speaking & writing).
Resources / Materials:	Cell phones or video cameras, electronic components, equipment, tools, manuals to detect faults and repair industrial equipment, notebooks, and the protocol from lesson IV. If the industrial equipment chosen is not available for recording, students can draw it or show one taken from the internet.
Teacher's role:	To make sure students are able to collect all necessary resources, or to provide them if possible. To create a handout with guidelines for video recording.
Students' roles:	To collect material needed to simulate fault detection and repairing of industrial equipment. To use information from the protocol.

PROCEDURE	
1. Explain and provide examples of the process involved in detecting a fault and repairing industrial equipment according to protocols written in Lesson IV. 2. Divide the class into groups of 3-4. Allow time for a discussion about the materials needed and roles that each member will have in the recording and presentation of the video. 3. Each group works on simulating fault detection & repairing of industrial equipment, the steps involved in the procedure, and the recording of the video. 4. Once the video is finished, each group presents it to the rest of the class.	
FOLLOW UP	The teacher or other groups can provide feedback about one or two aspects of the video presentation such as assembly process explanation, proper functioning, etc.
VARIATION	Depending on the level of proficiency, other groups can take notes during video presentations and ask questions in order to gather more specific information.
RUBRIC	Rubric to assess video presentation (peer assessment). See appendix section.

Unit VII: Operation & Programming of Industrial Electrical Control Equipment.

Learning Objective:

LO3: Use your knowledge of English to comprehend and produce clear oral and written texts in order to build a critical personal opinion in contexts related to students' interests and concerns.

Skills: Listening, Reading, Speaking, Writing.

Project: Safety Instructions to operate industrial equipment.

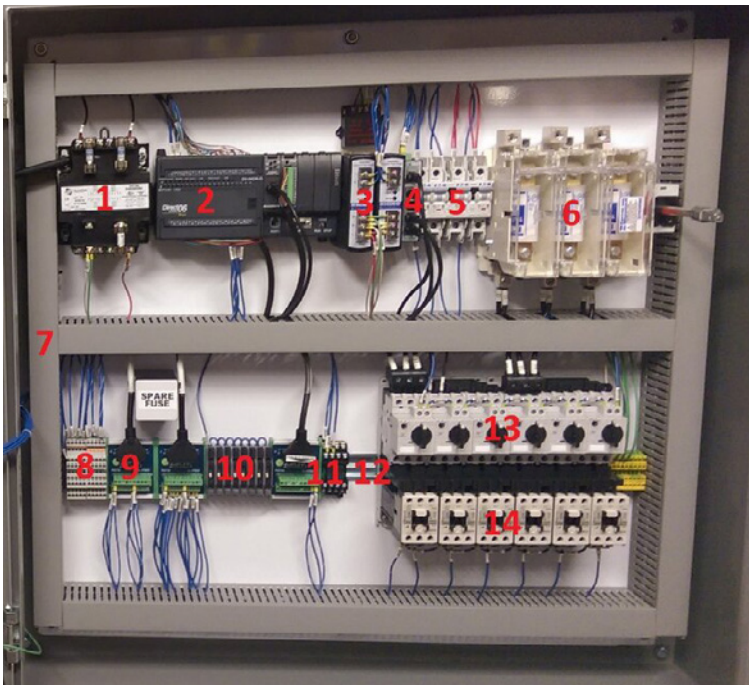
☆ 28 KEY WORDS

Blueprint (n.)	I/O (n.)	Spreadsheet (n.)
Breakout boards (n.)	Overload (n.)	Terminal blocks (n.)
Circuit breaker (n.)	P&ID device (n.)	Terminal ground block (n.)
Contactor (n.)	PLC (n.)	Three-phase motor (n.)
Control panel (n.)	Pneumatic (adj.)	Transformer (n.)
DIN rail (n.)	Pole (n.)	Trim wire (n.)
Disconnect switch (n.)	Power supply (n.)	VAC (n.)
Ethernet switch (n.)	Relays (n.)	Wired duct (n.)
HMI display (n.)	Scoot (v.)	
Hydraulic (adj.)	Solenoids (n.)	

Lesson I: Listening Comprehension

BEFORE YOU LISTEN

1. Which components of an electrical control panel can you recognize in the picture? Make a list from 1 to 14 and write the name of the components you know in your notebook. Example: 10. Fuses



1		8	
2		9	
3		10	
4		11	
5		12	
6		13	
7		14	

2. Compare your answer with a classmate.

WHILE YOU LISTEN

Click here to listen:

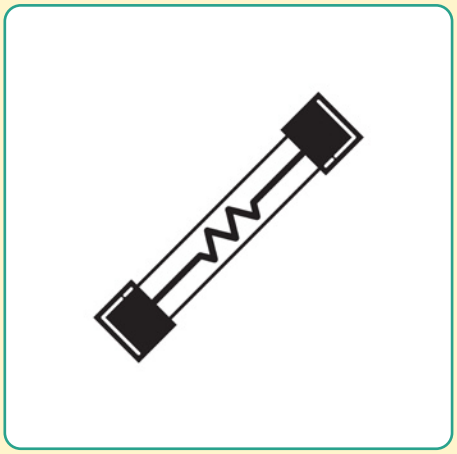
3. Using the list you wrote in the previous activity, tick the words you will hear in the audio.

1		8	
2		9	
3		10	
4		11	
5		12	
6		13	
7		14	

4. Listen again and write the components that you don't know.

AFTER YOU LISTEN

5. Choose one component from the list, draw it, and write at least one sentence related to the function of the component in an industrial control panel. Example:



1. Fuses are safety devices that protect an electric circuit from overloading.

Lesson II: Reading Comprehension

BEFORE YOU READ

1. Look at the title of the text. Complete the sentence with what you already know about this topic.

What I already know about AutoCAD & the Electrical toolset is :

_____

_____

_____

_____

WHILE YOU READ

2. Read the text quickly. Underline the concepts related to electrical toolset features, e.g.: schematic symbols.

3. Read the text again and complete the following chart.

	What is it?	Who uses it?	Main/Specific features
AutoCAD			
Electrical toolset			

AutoCAD and the Electrical toolset

AutoCAD is a computer-aided design software developed by the company Autodesk (hence the name AutoCAD). It allows you to draw and edit digital 2D and 3D designs more quickly and easily than you could by hand. The files can also be easily saved and stored in the cloud, so they can be accessed anywhere at any time. Before the age of computers, a designer would have to manually revise designs, creating an entirely new draft or editing the draft you had, which could become messy and difficult to interpret. With AutoCAD, you can easily change and manipulate designs as well as create a re-useable block library to replicate design parts and as it allows you to design down to fractions, it creates a more accurate design in all dimensions.

AutoCAD can be used across a variety of industries. In mechanical engineering, you might use it to create manufacturing processes as well as to design motor parts, robots and other innovative objects whereas in civil engineering, you might use it to help you design bridges and roads. Architects often use it to create blueprints and floor plans for houses and commercial buildings, and interior designers can use it to imagine the interior of a building, which can be an eating place for a restaurant or a living space in a house. Even artists can use AutoCAD to draft sculptures, wood carvings, engravings, and experimental art pieces.

Nowadays it includes an Electrical toolset to be used in the electrical field to map out electrical systems. Among specific features of the electrical toolset, we can find more than 2,000 standards-based schematic symbols. A simple, icon-menu-driven system for inserting electrical, pneumatic, hydraulic, and P&ID devices is provided, allowing you to quickly build standards-based control designs with a simple pick-and-place workflow. These are 'smart' symbols in many ways, one of which is that wiring automatically breaks and connects to them. This toolset also automatically places sequential or reference-based numbers on all wires and components based on the chosen configuration determining if an inserted wire will 'bump' into anything searching laterally along the wire for a clear spot to place the wire number. In addition, this toolset includes real-time error checking to help you avoid errors during the design process as well as many commands designed specifically for electrical schematic drafting. Specialized features such as Trim Wire, Scoot and Align Components make it easier to create drawings quickly. Other specific features are the ability to create PLC I/O drawings from spreadsheets and the creation of physical 'footprint' representations of

your panel layouts in your project drawings. Users can choose the panel location and install a 'footprint' of panel components, which, in turn, are then linked back to the schematic component symbols in their schematic drawings. Therefore, the panel drawing includes a panel door layout created from schematic data, with nameplates added to each operator. Balloons are also added to the pushbuttons and switches.

Text adapted from:
https://www.chartercollege.edu/news-hub/who-uses-autocad-and-why-it-important#:~:text=AutoCAD%20is%20a%20computer%2Daided,be%20accessed%20anywhere%20at%20anytime.
https://www.pccpolska.pl/wp-content/uploads/2019/07/Autocad_Electrical-Toolset_Productivity-Study-badanie-produktywnosci.pdf

AFTER YOU READ

4. What do you think about AutoCAD and the Electrical toolset? **Write at least two sentences.**

Example:

I believe AutoCAD and the Electrical toolset is a very useful software to design electronic circuits.

In my opinion, AutoCAD and the Electrical toolset...

Lesson III: Speaking

WARM UP

1. Answer this question.

What can happen when someone suffers an electrical shock?

_____

_____

_____

_____

_____

2. Compare your answer with a classmate.

INPUT

3. Read the following text.

Electrical Shock – Causes & Effects on the human body

The human body is an electrical conductor and has an electrical resistance of around 100 Kilo Ohm when dry and 1 Kilo Ohm when wet. When a person is standing on Earth, his/her feet are at the Earth potential, which is zero voltage. If they touch a voltage source, a current will flow through their body and they will receive an electrical shock. Three primary factors affect the severity of the shock a person receives when he or she is part of an electrical circuit: the amount of current flowing through the body (measured in Amperes), the path of the current through the body, and the length of time the body is in the circuit. Other factors that may affect the severity of the shock are the voltage of the current, the presence of moisture in the environment, the phase of the heart cycle when the shock occurs and the general health of the person prior to the shock.

Effects can range from a barely perceptible tingle to severe burns and immediate cardiac arrest. Although it is not known the exact injuries that result from any given amperage, there are probable effects related to them considering one second of duration of electrical shock:

CURRENT LEVEL (Milliamperes, mA)	PROBABLE EFFECT ON HUMAN BODY
1mA	Perception level, slight tingling sensation. Still dangerous under certain conditions.
5mA	Slight shock felt; not painful but disturbing. Average individual can let go. However, strong involuntary reactions to shocks in this range may lead to injuries.
6-16 mA	Painful shock, begin to lose muscular control. Commonly re-ferred to as the freezing current or 'let-go' range.
17-99 mA	Extreme pain, respiratory arrest, severe muscular contractions, individual cannot let go. Death is possible.
100 - 200	Ventricular fibrillation (uneven, uncoordinated pumping of the heart). Muscular contraction and nerve damage begin to occur. Death is likely.
> 2,000 mA	Cardiac arrest, internal organ damage, and severe burns. Death is probable.

Adapted from: Safety when operating inverters by Vijay Sharma
https://www.samlexamerica.com/support/documents/13003-0614_SafetyWhenOperatingInverters.pdf

CONTROLLED PRACTICE

4. **Group discussion.** In groups, discuss the causes and effects of an electrical shock and what an electronic technician would need to do in order to avoid suffering one.

FREER PRACTICE

5. **Oral presentation.** Each group gives a brief presentation summarizing the key aspects of their discussion.

WRAP-UP

6. In your notebook, write the steps that an electronic technician would need to take in order to avoid suffering from an electrical shock.

Lesson IV: Writing

PRE WRITING

1. Where can you find safety instructions to operate specific equipment/machinery?

2. Look at the following extract from a rework station user's manual.

Safety Instructions

⚠ **Warning**

Warning and cautions are placed at critical points in this manual to direct the operator's attention to significant items. They are defined as follows:

⚠ **Warning:** Failure to comply with a WARNING may result in serious injury or death.

⚠ CAUTION: Failure to comply with a CAUTION may result in injury to the operator or damage to the items involved. Two examples are given below.

NOTE: A NOTE indicates a procedure or point that is important to the process being described.

EXAMPLE: AN EXAMPLE is given to demonstrate a particular procedure, point or process.

Be sure to comply with the following WARNINGS and CAUTIONS for your safety.

⚠ **Warning**

Do not change or disassemble any components related to this product, it may cause product damaged.

When you need to replace the fuse, be sure turn off the power before operating.

During working period, do not turn off the power suddenly, the heat gun should be placed on the heat gun holder until cool off after power turn off, otherwise it will damage the product.

⚠ **CAUTION**

When the power is ON, the temperature of the hot air and the nozzle ranges from 100 to 450 °C (212 to 842 °F) To avoid injury to personnel or damage to the items in the work area, observe the following:

** Do not direct the hot air toward personnel or touch the metal parts near the nozzle.

** Do not use the product near combustible gases or flammable materials.

** Advise those in the work area that the unit can reach very high temperatures and should be considered potentially dangerous.

**Turn the power off when no longer using the Pro Skit SS-869 or when leaving it unattended.

** Before replacing parts or storing the unit, allow the unit cool and then turn the power OFF.

To prevent accidents and failures, be sure to take the following precautions:

** Do not strike the handpiece against hard surfaces or otherwise subject it to physical shock.

** Be sure the unit is grounded. Always connect power to a grounded receptacle.

** Do not Disassemble the machine.

** Do not modify the unit.

** Use Pro'skit provides replacement parts.

** Do not wet the unit or use the unit with wet hands.

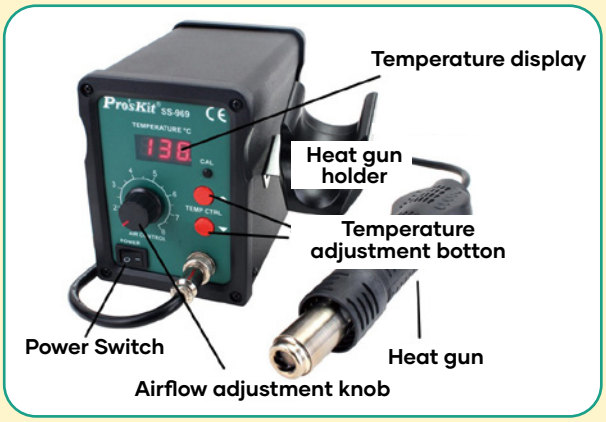
** Remove power cord by holding the plug-not the wires.

** Make sure the work area is well ventilated

** The Pro'skit SS-969 is not intended for use by children or infirm persons without supervision.

** Children should be supervised to ensure that they do not play with the SS-969.

Packing list and name of parts



Packing list: SS-969 SMD Rework Station (include holder) x 1/ Heat gun x 1/Air nozzle x 3/Power cord x 1/ User's manual x 1

DRAFTING

Hypothetical situation: You are asked to design a sign with the safety instructions to operate industrial electrical control equipment/machinery at the company where you work.

3. Choose a piece of industrial electrical control equipment/machinery and write a draft of the safety instructions to operate it including the name of the equipment/machinery, all necessary safety instructions to operate the equipment/machinery properly, and visual support for each instruction provided.

REVISING

4. In pairs, use the following checklist to assess your classmate's draft. Once finished, return the draft and comments.

SIGN WITH SAFETY INSTRUCTIONS		
Safety Instructions	**Tick if completed**	**Comments & Suggestions (*)**
Name of equipment/ machinery		
Safety instructions		
Visual support for each safety instruction		
Correct use of grammar, sentence structure, word choice, punctuation, capitalization & spelling		

(*) Comments & suggestions may provide reference to specific missing information, grammar, sentence structure, word choice, punctuation, capitalization & spelling errors.

EDITING

5. Using the following layout, re-write your sign with safety instructions taking into account your classmate's feedback (re-check the criteria established in the checklist).

_____

(Name of equipment/machinery)

SAFETY INSTRUCTIONS

(visual support)

1. _____

(visual support)

2. _____

(visual support)

3. _____

(visual support)

4. _____

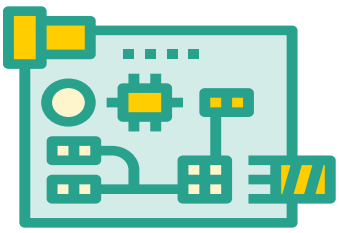
(visual support)

5. _____

PUBLISHING

G. Hand in your final version to your teacher.

Project: Safety Instructions to operate industrial equipment


Name of the Project:	Safety Instructions to operate industrial equipment
Level:	Elementary to intermediate
Time:	90-135 minutes
General aim(s):	Students will present a poster with safety instructions guidelines to operate industrial equipment.
Language aim(s):	Students will practice all four language skills, with a focus on the productive skills (speaking & writing).
Resources / Materials:	Poster paper, colored pencils/pens/markers, pictures or drawings, glue, scissors.
Teacher's role:	To make sure students are able to collect the materials and information needed. To create a handout with guidelines for poster making & presentation delivery.
Student preparation:	To collect the material needed to create a poster. To use information from Lesson IV.

PROCEDURE	
1. Explain and provide a handout with guidelines for poster making & presentation delivery. **2.** Divide the class into groups of 3-4. Allow time for a discussion about the materials needed, the industrial equipment selected, and the roles that each member will have during the project. **3.** Each group works on their poster for presentation. **4.** Once the poster is finished, each group practices their oral presentation according to the rubric criteria. **5.** Each group presents in front of the class.	
FOLLOW UP	The teacher or other groups can provide feedback about one or two aspects of a group's performance such as posture and pronunciation, or the steps mentioned, emphasizing the positive instead of the negative.
VARIATION	Depending on the level of proficiency, other groups can take notes during oral presentations and ask questions after the presentation is finished in order to gather more specific information. If they have access to technology, they could design a poster using PowerPoint, Canva or other electronic resources.
RUBRIC	Rubric to assess poster (peer assessment). Rubric to assess oral presentation. See the appendix section.

Unit VIII: Assembly of Industrial Equipment

Learning Objective:

LO1: Comprehend relevant information for a specific purpose in oral and written texts in contexts related to students' interests and concerns in order to know how other cultures address those contexts.

LO2: Produce clear oral and written texts in contexts related to students' interests and concerns in order to express a critical personal opinion that respects other opinions.

Skills: Listening, Reading, Speaking, Writing.

Project: Board assembly & installation project design.

☆ 14 KEY WORDS

Actuator (n.)
Conveyor (n.)
Crusher (n.)
Feeder (n.)
Inrush current (n.)
Mixer (n.)
Panelboard (n.)
Screw jack (n.)
Sensor (n.)
Soft starter (n.)
Splice (n.)
Strain gauge (n.)
Transducer (n.)
VFD (n.)

Lesson I: Listening Comprehension

BEFORE YOU LISTEN

1. Can you recognize the elements of this device from the picture? What are they?

2. Compare your answer with a classmate.

According to the picture, predict what the audio will be about. (e.g.: I think the audio will be about VFDs.)

WHILE YOU LISTEN

Click here to listen:

3. Listen to the audio and select the most suitable title:

a) VFDs and PLCs
b) The difference between VFDs and Soft Starters
c) Soft Starters and VFDs are the same

4. Listen again and complete the chart below with the information from the audio. Then, compare with a classmate. ****You will listen twice.****

	Variable Frequency Drive (VFD)	Soft Starter
Use		
Similarities		
Differences		

AFTER YOU LISTEN

5. Write one sentence about where a VFD can be used. Write another sentence about where a soft starter can be used. (e.g.: A VFD **can be used in** elevators.)

1. _____

_____

2. _____

_____

Lesson II: Reading Comprehension

BEFORE YOU READ

1. Look at the picture and predict the title of the text.

WHILE YOU READ

2. Read the text quickly and circle the unknown words. Write them in your notebook and look for their meaning in your dictionary (e.g.: transducer).

3. Read the text and complete the chart below.

	Definition	Types	Examples
Transducers			
Sensors			
Actuators			

Transducers, Sensors and Actuators

A transducer is a device that converts one form of energy into another. Transducers are used in all aspects of life to measure changes in the environment, to enhance everyday applications, and to learn more about the world around us. A microphone, a solar cell, and an incandescent light bulb are common examples of transducers. Transducers can be classified into electrochemical (e.g.: pH probe), electroacoustic (e.g.: loudspeaker), electromagnetic (e.g.: magnetic cartridge), electrostatic (e.g.: electrometer), electromechanical (e.g.: strain gauge), and photoelectric transducers (e.g.: laser diode).

An actuator is a device that converts energy into motion. Therefore, it is a specific type of transducer. We can find thermal actuators such as bimetallic strips, electric actuators like electric motors, and mechanical actuators like screw jacks.
When the output of the transducer is converted to a readable format, the transducer becomes a sensor. A sensor is a device that receives and responds to a signal. This signal must be produced by some type of energy, such as heat, light, motion, or chemicals. Once a sensor detects one or more of these signals, it converts it into an analog or digital representation of the input signal. What are some sensors that you are familiar with or use daily? Human beings are equipped with 5 different types of sensors. Eyes detect light energy, ears detect acoustic energy, a tongue and a nose detect certain chemicals, and skin detects pressures and temperatures. The eyes, ears, tongue, nose, and skin receive these signals and send messages to the brain, which outputs a response. For example, when you touch a hot plate, it is your brain that tells you it is hot, not your skin. Sensors can be classified into thermal, mechanical, electrical, chemical, optical, infrared, and acoustic, among others. Some common examples are thermometers, barometers, Ohmmeters, voltmeters, oxygen sensors, CO2 detectors, light sensors, and seismometers.

Transducers, sensors and actuators can be found in the macroscale (those visible to the naked eye) and the microscale (microscopic). Nanotechnology is enabling such devices in the nanoscale. Microsystems use micro transducers, such as temperature sensitive resistors and strain gauges, as elements in micro sensing devices, such as flowmeters and pressure sensors. Microsensors can be found in chemical sensor arrays, optical sensors and acoustical sensors. Micro actuators have been used for years in automobile airbags. These actuators sense a crash and actuate the airbag. Regardless of the scale, the operation of these devices remains the same. With all such devices, as the sensing elements shrink, so do the components for the output circuitry. The diaphragm micro pressure sensor is only a few micrometers square. The electronics that communicate with this device are also in the microscale. This allows a micro-sized package to be mounted in the smallest places. With nanotechnology, there are many transducers in the nanoscale. These nano transducers require nano to microscale components to complete the sensor or actuator.

Text adapted from:
http://www.ieec.uned.es/investigacion/Dipseil/PAC/archivos/More%20on%20Transducers%20Sensors%20and%20Actuators.pdf

AFTER YOU READ

4. How are transducers, sensors and actuators currently applied?

Lesson III: Speaking

WARM-UP

1. What do you know about current electrical regulations?

2. Compare your answer with a classmate.

INPUT

Click here to listen:

3. Listen to the following audio

CONTROLLED PRACTICE

4. Think about the final question in the audio. In your notebook, write the information that you know about panelboards according to NCh Elec. 4/2003. If you don't know anything, look for this information online or ask your teacher to assist you.

FREER PRACTICE

5. Find a partner and discuss the information that you both found.

WRAP-UP

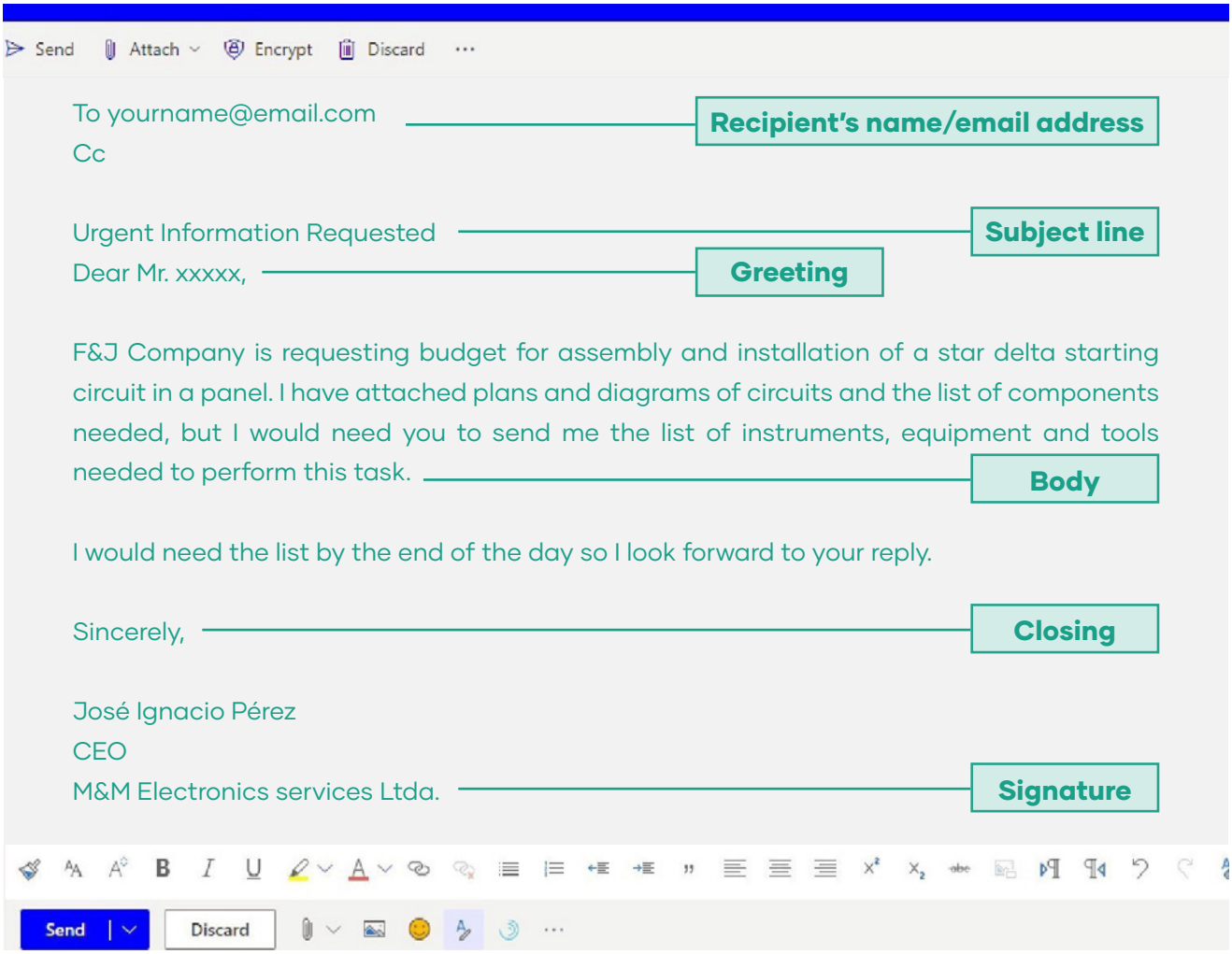
6. Write a brief summary of panelboards according to NCh Elec. 4/2003.

Lesson IV: Writing

PRE-WRITING

1. What information can you find in an email? (Example: An email has a subject line.)

2. Look at the following example and confirm your predictions.



DRAFTING

3. Write a draft of an email replying to the CEO of the company (considering the content presented in the example). Make sure to include all necessary information.

REVISING

4. Use the following checklist to assess your classmate's draft. Once finished, return the draft and comments.

EMAIL REPLY		
EMAIL	**Tick if completed**	**Comments & Suggestions (*)**
Recipient's name/email address		
Subject line		
Greeting		
Body		
Closing		
Signature		
Correct use of grammar, sentence structure, word choice, punctuation, capitalization & spelling.		

(*) Comments & suggestions may provide reference to specific missing information, grammar, sentence structure, word choice, punctuation, capitalization & spelling errors.

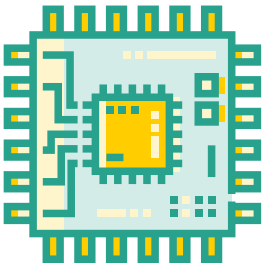
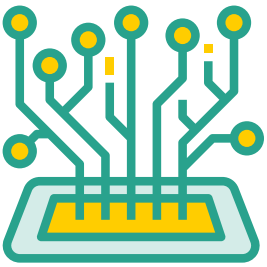
EDITING

5. Re-write your email reply taking into account your classmate's feedback (re-check the criteria established in the checklist).

PUBLISHING

6. Submit the final version to your teacher.

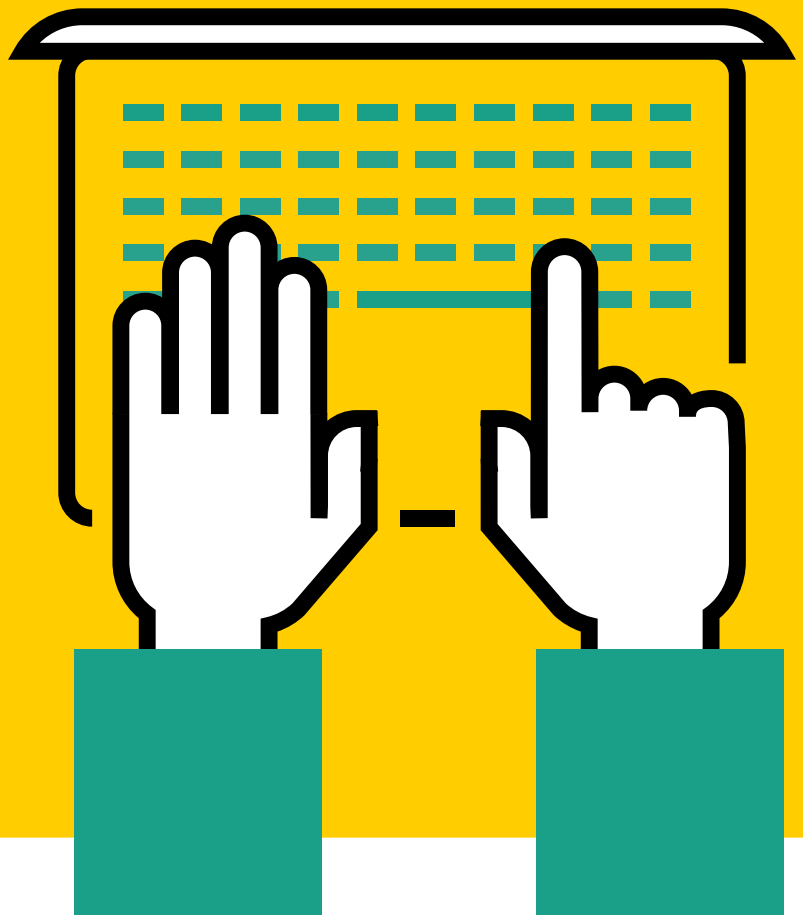
Project: Board assembly & installation project design


Name of the Project:	Board assembly & installation project design
Level:	Elementary to intermediate
Time:	90-135 minutes
General aim(s):	Students will present a project design to assemble and install a smooth start board of a single-phase motor.
Language aim(s):	Students will practice all four language skills, with a focus on the productive skills (speaking & writing).
Resources / Materials:	Computer access, pictures and/or videos.
Teacher's role:	To make sure students are able to collect the materials and information needed. To create a handout with guidelines for the project design and presentation.
Student preparation:	To collect the material needed to design their project and present it orally.

PROCEDURE	
1. Explain and provide a handout with guidelines for the project design and presentation. **2.** Divide the class into groups of 3-4. Allow time for a discussion about the materials and information needed, and the roles each member will have during the project design. **3.** Each group works on the design of the project and the visual support for the oral presentation. **4.** Once the project design and the visual support for the oral presentation are finished, each group practices their oral presentation according to the rubric criteria. **5.** Each group presents in front of the class and submits the written version of their project design.	
FOLLOW UP	The teacher or other groups can provide feedback about one or two aspects of a group's performance such as posture and pronunciation, or project design content, emphasizing the positive instead of the negative.
VARIATION	Depending on the level of proficiency, other groups can take notes during oral presentations and ask questions after the presentation is finished in order to gather more specific information. Project design can be later developed with their subject teacher in charge of the module on Assembly of industrial equipment's module.
RUBRIC	Rubric to assess oral presentation using visual support. Rubric to assess project design. (See appendix section).

Appendix

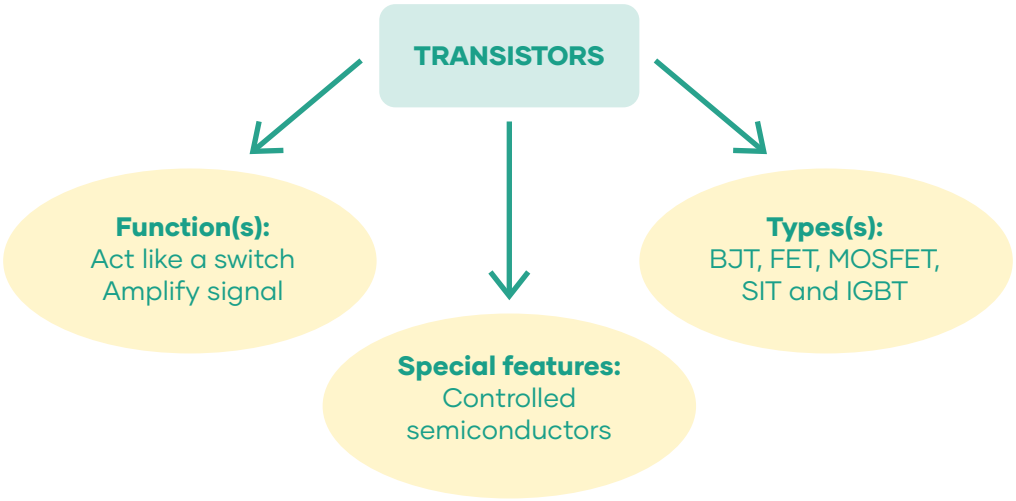


ANSWER KEY

UNIT V , Lesson I, WHILE YOU LISTEN (1)

Main topic:	**Transistor**
Power Semiconductors:	**Transistors, diodes and thyristors**

Lesson I, WHILE YOU LISTEN (2)



Lesson II, BEFORE YOU READ

(Answer key: F, A, D, B, C, E, F, A, D, B)

Lesson II, WHILE YOU READ

2. Read the text quickly and select the main idea of the text from the ones below.

a) Current uses of power electronics

b) Power electronics devices in the industry field

c) Fields where power electronics devices are not available yet

Lesson II, WHILE YOU READ

3. (Answer key: F, T, F, T, F)

ANSWER KEY Unit VI

Unit VI, Lesson I, While Listening

PREDICTION	**Student's own answers.**
PURPOSE	**Tips to maintain industrial equipment**
N° OF SPEAKER (S)	**1**

Lesson I, While Listening

3. Listen again and select the best response for each question.

I. Why is it important to provide maintenance to industrial equipment?
a) Because the government forces industrial companies to do it
b) In order to make sure machinery lasts a long time
c) Because industrial machinery is not frequently used

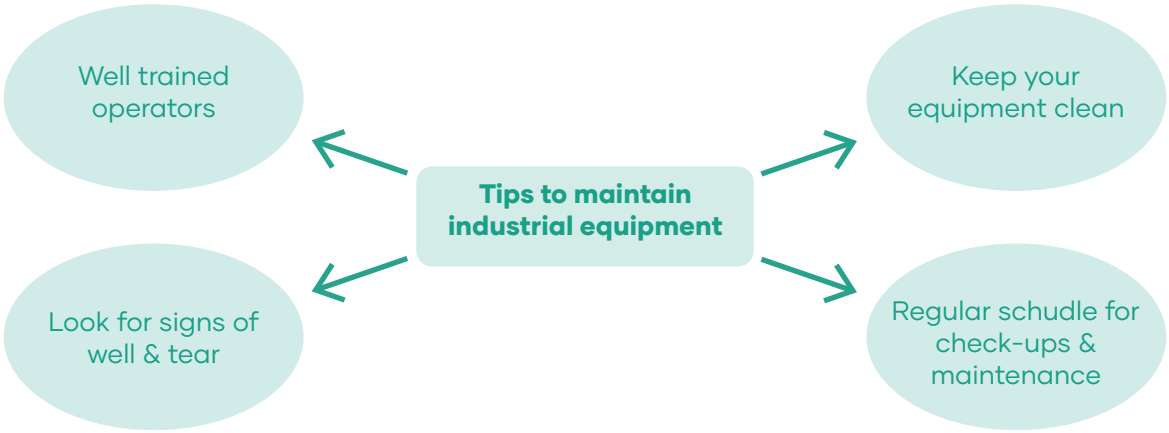
II. How many tips does the person provide?
a) 4
b) 5
c) 6

III. Why should industrial companies prevent from having broken equipment?
a) Because they would have to shut down the company
b) Because they can't use any other working equipment
c) Because it can be very expensive and unsafe

IV. One tip mentioned is that operators should not only be well trained in the use of the machinery but...
a) Know information from manuals
b) Visit other companies
c) Have extra holidays

V. What can contribute to a breakdown of parts in industrial equipment?
a) Proper use of the equipment
b) Fluids, tires, tracks and electrical systems
c) Regular use, friction, and high temperatures

Lesson I, After Listening



Lesson II, While you read (2)

EQUIPMENT FAILURES

Categories	Example
POOR DESIGN	Improper choice of components
PRODUCTION DEFICIENCIES	Sub-standard manufacturing equipment & tools
CARELESS STORAGE & TRANSPORT	Improper packaging
INAPPROPRIATE CONDITIONS DURING WORKING LIFE	Poor maintenance policy

ANSWER KEY Unit VII

Lesson I: Listening Comprehension
Before and while you listen (Activities 1,3,4)

List of components:
1. Transformer
2. Programmable Logic Controller (PLC)
3. Power Supply
4. Ethernet Switch
5. Circuit Breaker
6. Disconnect Switch
7. Wire Duct
8. Terminal Blocks
9. Breakout Boards
10. Fuses
11. Relays
12. DIN Rail
13. Overload
14. Contactor
15. Terminal Ground Blocks

Lesson II: Reading Comprehension

While you read

2. Read the text quickly. Underline the concepts related to Electrical toolset features, e.g.: schematic symbols.

electrical systems
schematic symbols
electrical
pneumatic
hydraulic
P&ID devices
wiring
sequential or reference-based numbers
'bump'
real-time error checking
commands
trim Wire
scoot
align components
PLC I/O drawings
spreadsheets
'footprint'
panel layouts
schematic drawings
panel door layout
schematic data
nameplates
balloons
pushbuttons
switches

3. Read the text again and complete the following chart.

	What is it?	Who uses it?	Main/Specific features
AutoCAD	A computer-aided design software developed by the company Autodesk	Mechanical engineers, civil engineers, architects, interior designers, artists, electrical/electronic engineers.	Draws and edits digital 2D and 3D designs more quickly and easily than you could by hand.
Electrical toolset	A specific component of AutoCAD used in the electrical field to map out electrical systems.	Electrical/electronic engineers or technicians.	Maps out electrical systems, inserting electrical, pneumatic, hydraulic, and P&ID devices. Places sequential or reference-based numbers on all wires and components. Does real-time error checking. Creates PLC I/O drawings from spreadsheets. Creates physical 'footprint' representations of your panel layouts.

ANSWER KEY Unit VIII

Lesson I: Listening Comprehension

Before you listen

1. Can you recognize the elements of this device from the picture? What are they?

Variable Frequency Driver and Soft Starter

While you listen

3. Listen to the audio and select the most suitable title:

a) VFDs and PLCs

b) The difference between VFDs and Soft Starters

c) Soft Starters and VFDs are the same

4. Listen again and complete the chart below with the information from the audio. Then, compare with a classmate. ****You will listen twice.****

	Variable Frequency Drive (VFD)	Soft Starter
Use	For motor torque-speed control and protection.	For a smooth start and stop of a motor.
Similarities	Semiconductor Start & stop motor	Semiconductor Start & stop motor
Differences	Control motor speed and torque Higher cost Best suited for elevators, escalators, crushers, mixers, or any other equipment where speed needs to be maintained in spite of load variations.	Lower cost No harmonics Best suited for conveyors, pumps and other belt-driven applications.

Lesson II: Reading Comprehension

While you read

3. Read the text and complete the following chart.

	Definition	Types	Examples
Transducers	Devices that convert one form of energy into another.	Electrochemical, electroacoustic, electromagnetic, electrostatic, electromechanical, and photoelectric.	pH probes, loudspeakers, magnetic cartridges, electrometers, strain gauges, laser diodes, light bulbs.
Sensors	Devices that receive and respond to a signal.	Thermal, mechanical, electrical, chemical, optical, infrared, and acoustic.	Thermometers, barometers, Ohmmeters, voltmeters, oxygen sensors, CO2 detectors, light sensors, and seismometers
Actuators	Devices that convert energy into motion.	Thermal, electric, mechanical.	Bimetallic strips, electric motors, screw jacks.

Unit V : Maintenance & Operation of Electronic Power Control Equipment
Lesson 1: Listening Comprehension

Audio Script
(Context: someone describing what transistors are and how they work)

Transistors, how do they work?

The invention of transistors revolutionized human civilization like no other technology. At the heart of a smartphone lies a processor, and this processor holds about 2 billion transistors. But, what do these incredibly tiny devices do? How do they work?
Transistors can act like a switch with no moving parts and they can amplify a weak signal. They are power semiconductors along with diodes and thyristors. While diodes are semi controlled and thyristors are no controlled, transistors are controlled semiconductors.
BJT, FET, MOSFET, SIT, and IGBT are common types of transistors. BJT stands for Bipolar Junction Transistor, FET stands for Field Effect Transistor; MOSFET stands for Metal Oxide Semiconductor Field Effect Transistor; SIT stands for Static Induction Transistor, and IGBT stands for Insulated Gate Bipolar Transistor. It will depend on the circuit you want to design and its application area which one would suit best. For example, it could be for motor control, power supply or audio amplifier. It also depends on the load power modulation, which means if it will have linear control, switching or static mode.
They can be made of semiconductors such as silicon. If pure silicon has to conduct electricity, the electrons have to absorb some energy and become free electrons causing pure silicon to have a low electrical conductivity. In this case, a technique called doping is used to improve the conductivity of semiconductors, which basically means introducing impurities into the semiconductor crystal to deliberately change its conductivity due to deficiency or excess of electrons.

Adapted from:
Transistors, how do they work?
https://www.youtube.com/watch?v=7ukDKVHnac4&t=4s
MOSFET, BJT and IGBT
https://www.youtube.com/watch?v=VlMdSCI29A0

Unit VI: Industrial Fault Detection
Lesson 1: Listening Comprehension

Audio Script

(Context: someone providing tips to maintain industrial equipment)

Tips to maintain industrial equipment

Industrial equipment in its many forms deserves plenty of attention when it comes to maintenance. Whether it's mining equipment, farming, or construction pieces, maintenance is important when trying to make machinery last a long time.
In the industry field, plenty of machinery run 24/7 and perform functions that are crucial to the production process. Repairing broken equipment can be rather expensive and could pose a risk to the safety of the personnel's or to the environment. or to the environment, which is why I will provide you with some maintenance tips to make sure your equipment lasts as long as it's meant to, and maybe even more.
The first tip would be to make sure operators are well trained and know information available on manuals. Any maintenance checklist should include overseeing the correct operation of the equipment itself.
Another tip is to look for signs of wear and tear. Vibration, high temperatures, regular use, and friction can all contribute to the breakdown of parts in industrial equipment. From extended use to bad gear and overworked belts, a lot of issues can come up with regular use of machinery, which is why it's good to keep an eye out for signs of harsh use since it will help to get out ahead of possible breakdowns and issues with maintenance.
A great tip I also provide is to keep your equipment clean. Seals and filters cover heavy machinery in order to keep parts clean and free of contamination. Seals should be inspected regularly and thoroughly to make sure they're in great condition and filters should be inspected and changed on a regular basis.
Finally, I would suggest you to keep a regular schedule for check-ups and maintenance as well as having up-to-date record keeping. Don't forget fluids, tires, tracks, and electrical systems in machinery need to be checked on a regular basis to prevent breakdowns so make sure notes are taken when inspections occurred and make sure to run torque checks on the bolts and lubricate gears frequently to avoid issues in the long-term.

Adapted from:
https://hilbgroupfl.com/4-maintenance-recommendations-for-industrial-equipment/

Unit VII: Operation & Programming of Industrial Electrical Control Equipment
Lesson 1: Listening Comprehension

Audio Script
(Context: an electronic technician explaining the key components of an industrial control panel in YouTube)

Hello everyone and welcome back to my channel. I'm sure you know how important it is to build, maintain and repair industrial control panels in order to function safely and reliably, so today I will talk about key control panel components and their main functions.
The first key component are transformers, which are used to reduce or increase AC voltages between circuits. A common application for an industrial control panel would be converting incoming 480VAC to 120VAC for creating control power. Next, we can find a Programmable Logic Controller or PLC which is the brain of the control panel since it controls equipment and processes by monitoring the status of sensor inputs to control outputs, such as motors, HMI displays, valves, lights, and solenoids.
Our third key component is the power supply, which converts alternating current (AC) voltage to direct current (DC) voltage. n a control panel, the power supply will typically be converting 480VAC or 120VAC to 24VDC. In number four we can find the Ethernet switch to connect PLCs, HMIs, networked I/O and information systems. Then we have a circuit breaker which protects an electrical circuit from becoming damaged by detecting when there is too much current and thus, opening or breaking the circuit to stop the flow. Our sixth key component is the disconnect switch which is used to disconnect the control panel from its electrical supply. It is useful to shut off power in order to repair or maintain it as well as for emergency stoppages. On the perimeter of the panel and in between rows of electrical components, we can find the wired duct that houses the wires that interconnect the electrical components and here we can find terminal blocks which are connection points to tie wires together. Some are for internal connections and some are for connecting field components to terminal blocks. Next to terminal blocks we can find breakout boards which are specialized terminal blocks that can be used to simplify wiring of components that have connectors that would normally need soldering or reduce the labor of internal wiring. In number 10 we can find fuses, which are protective devices that protects an electric circuit from becoming overloaded by a current that is too high. Once operated you must replace them.
Relays are electronically or magnetically operated switches that can make or break contact to turn on or off a device. Next to the relay, we can find a DIN rail wich allows the mounting of many industrial control components. The final key components are overload, contactor, and terminal ground blocks. An overload protects electric motors from overheating and it usually monitors three motor phases. A contactor is the same as a relay but is usually larger for a motor and consist of three poles. Finally, a terminal ground block is usually internally grounded to the panel and you can identify them because they are usually green or green/yellow.

Adapted from:
Identifying industrial control panels components: https://twcontrols.com/lessons/identifying-industrial-control-panel-components
The key components of industrial control panels: https://www.processsolutions.com/the-key-components-of-industrial-control-panels/

Unit VIII: Assembly of Industrial Equipment
Lesson 1: Listening Comprehension

Audio Script
(Context: podcast from an institution related to electronics)

Welcome to our electronics podcast edition. Today we will talk about the difference between Variable Frequency Drive (VFD) and Soft Starters.
VFD and soft starters are widely used in industrial motor control and pump control. Both of them are semiconductor devices but they are different from each other.
When a motor starts, it drains three to six times its full load current which can decrease the life motor so in order to control the inrush currents, and limit torque, which extend the life of a motor, VFDs and soft starters are used.
Variable frequency drives are semiconductor devices mainly used for motor torque-speed control and protection. It can start and stop a motor smoothly. Speed torque characteristics of a motor can be controlled throughout its operation based on the application by using a VFD. Motor speed can be controlled from zero to its rated speed by varying the frequency of the motor supply. Among the benefits of VFDs we can find: power savings; complete control over motor speed; they can be programmed to vary the speed of the motor based on factors such as flow or pressure; third quadrant operation is possible; dynamic torque control and perfect speed control; advanced overload protection; and best suited for elevators, escalators, crushers, mixers, or any other equipment where speed needs to be maintained in spite of load variations.
As the name indicates, soft starters offer a smooth start and smooth stop. They are usually bypassed by a contactor-overload circuit as the motor gradually reaches its full-speed and gets back into action when the motor stops. Soft start and stop are achieved by temporarily lowering the motor terminal voltage. Among the benefits of soft starters, we can find that they effectively reduce inrush current during motor start; no harmonics are generated unlike VFDs; lower cost compared to VFDs; and best suited for conveyors, pumps and other belt-driven applications.
In summary, soft starters are only used for starting and stopping a motor whereas VFDs can start, stop, and control speed and torque of a motor.

Adapted from:
https://www.electricalclassroom.com/difference-soft-starter-and-vfd/

Lesson 3: Speaking

Input

Audio Script

(Context: someone talking about one of our current electrical regulations in Chile)

NCh Elec. 4/2003 is the current regulation for low voltage consumer installations in Chile. Here you can find regulations related to splices, feeders, electrical conduit systems and materials as well as types of panelboards and their building specifications among others. For example, you can find specific information about electrical wiring color code which establishes that a phase 1 conductor is blue, a phase 2 is black, a phase 3 is red, neutral is white and protective ground is green or green/yellow.
Do you know what information does this regulation provide about panelboards?

Natacha Pardo (2021)

PROJECT RUBRIC UNIT V: PLANNED MAINTENANCE SCHEME

CRITERIA	EXCELLENT (7)	GOOD (5)	POOR (3)	NEEDS IMPROVEMENT (1)	SCORE
Format / Appearance	Infographic includes visual support related to the content presented. (i.e.: functioning, required materials & equipment, circuit scheme.)	Infographic includes visual support related to part of the content presented (i.e.: functioning or circuit scheme)	Infographic includes visual support but it doesn't relate to the content presented.	Infographic does not include visual support.	
Organization	Infographic includes title, and subtitles regarding content presented. (i.e.: name of project, functioning, required materials & equipment, circuit scheme)	Infographic includes title or subtitles regarding content presented (i.e.: name of project, functioning, required materials & equipment, or circuit scheme)	Infographic includes title or subtitles regarding content presented but they are not easy to read.	Infographic does not include title or subtitles regarding content presented.	
Content	All information needed about electronics project proposal is presented (i.e.: name of project, functioning, required materials & equipment, circuit scheme)	Most information needed about electronics project proposal is presented.	Some information needed about electronics project proposal is presented.	Few or no information needed about electronics project proposal is presented.	
Grammar & Mechanics	Correct use of grammar, punctuation and spelling. Minor or no mistakes.	Mostly correct use of grammar, punctuation and spelling. Some mistakes are made but they don't interfere with meaning.	Somewhat correct use of grammar, punctuation and spelling. Mistakes made interfere with meaning.	Incorrect use of grammar, punctuation and spelling. A lot of mistakes made that interfere with meaning.	
TOTAL					

PROJECT RUBRIC UNIT VI: FAULT DETECTION & REPAIR OF INDUSTRIAL EQUIPMENT

CRITERIA	EXCELLENT (7)	GOOD (5)	FAIR (3)	NEEDS IMPROVEMENT (1)	SCORE
Non-verbal skills	Student makes eye contact while presenting and stands up straight and still during presentation.	Student often makes eye contact while presenting and stands up straight and still most of the time during the presentation.	Student rarely makes eye contact while presenting and sways or fidgets during presentation.	Student doesn't make eye contact while presenting and slumps or leans during presentation.	
Oral skills	Student uses a clear voice, rhythm and tone and pronounces clearly and correctly during presentation.	Student uses a clear voice, rhythm and tone and pronounces clearly and correctly most of the time during the presentation.	Student's voice, rhythm and tone are not clear enough and makes mistakes in pronunciation during the presentation.	Student's voice, rhythm and tone are not clear and make mistakes in pronunciation which break down communication during presentation.	
Visual support	Infographic is visually attractive and contains images that relate to the presentation.	Infographic is somewhat visually attractive and contains images that relate to the presentation.	Infographic is somewhat visually attractive and contains some images that relate to the presentation.	Infographic is not visually attractive.	
TOTAL					

PROJECT RUBRIC UNIT VII: SAFETY INSTRUCTIONS TO OPERATE INDUSTRIAL EQUIPMENT

CRITERIA	EXCELLENT (7)	GOOD (5)	FAIR (3)	NEEDS IMPROVEMENT (1)	SCORE
Non-verbal skills	Student makes eye contact while presenting and stands up straight and still during presentation.	Student often makes eye contact while presenting and stands up straight and still most of the time during the presentation.	Student rarely makes eye contact while presenting and sways or fidgets during presentation.	Student doesn't make eye contact while presenting and slumps or leans during presentation.	
Oral skills	Student uses a clear voice, rhythm and tone and pronounces clearly and correctly during presentation.	Student uses a clear voice, rhythm and tone and pronounces clearly and correctly most of the time during the presentation.	Student's voice, rhythm and tone are not clear enough and makes mistakes in pronunciation during the presentation.	Student's voice, rhythm and tone are not clear and make mistakes in pronunciation which break down communication during presentation.	
Visual support	Poster is visually attractive and contains images that support each safety instruction provided.	Poster is somewhat visually attractive and contains images that support each safety instruction provided.	Poster is somewhat visually attractive and contains some images that support each instruction provided.	Poster is not visually attractive.	
TOTAL					

CRITERIA	EXCELLENT (7)	GOOD (5)	FAIR (3)	NEEDS IMPROVEMENT (1)	SCORE
Format/ Appearance	Poster includes visual support related to the content presented. (i.e.: industrial equipment, all safety instructions to operate equipment properly, visual aid for each instruction provided).	Poster includes visual support related to part of the content presented (i.e.: industrial equipment or some safety instructions/ visual aid).	Poster includes visual support but it doesn't relate to the content presented.	Poster does not include visual support.	
Organization	Poster includes title, and subtitles regarding content presented. (i.e.: name of industrial equipment, safety instructions guidelines).	Poster includes title or subtitles regarding content presented (i.e.: name of industrial equipment or safety instructions guidelines).	Poster includes title or subtitles regarding content presented but they are not easy to read.	Poster does not include title or subtitles regarding content presented.	
Content	All information needed about safety instructions guidelines is presented (i.e.: industrial equipment, all safety instructions).	Most information needed about safety instructions guidelines is presented.	Some information needed about safety instructions guidelines is presented.	Few or no information needed safety instructions guidelines is presented.	
Grammar & Mechanics	Correct use of grammar, punctuation and spelling. Minor or no mistakes.	Mostly correct use of grammar, punctuation and spelling. Some mistakes are made but they don't interfere with meaning.	Somewhat correct use of grammar, punctuation and spelling. Mistakes made interfere with meaning.	Incorrect use of grammar, punctuation and spelling. A lot of mistakes made that interfere with meaning.	
TOTAL					

PROJECT RUBRIC UNIT VIII: BOARD ASSEMBLY & INSTALLATION PROJECT DESIGN

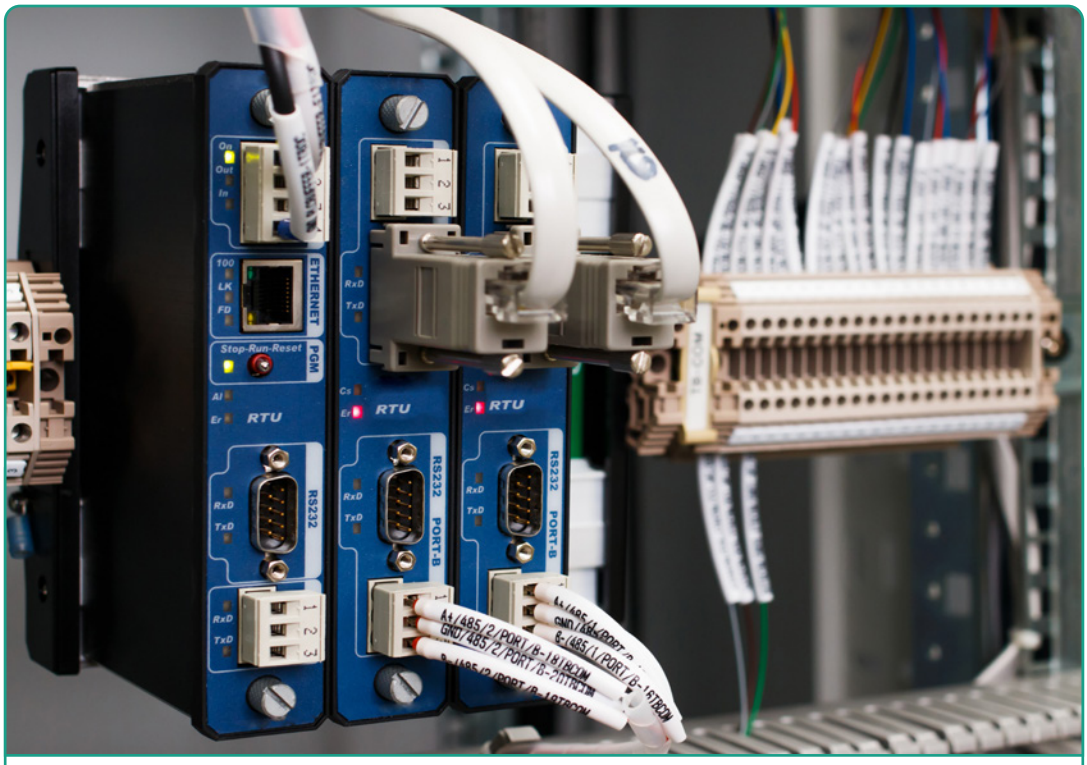
CRITERIA	EXCELLENT (7)	GOOD (5)	FAIR (3)	NEEDS IMPROVEMENT (1)	SCORE
Organization	Project design includes title, and subtitles regarding content presented. (i.e.: project name, diagram, hardware components, tools & equipment, procedure.)	Project design includes title and some subtitles regarding content presented.	Project design includes title or subtitles regarding content presented but they are not easy to read.	Poster does not include title or subtitles regarding content presented.	
Content	All information needed about project design is presented (i.e.: name of project, circuit diagram, list of hardware components needed, list of tools & equipment needed, explanation of procedure to be performed)	Most information needed about project design is presented.	Some information needed about project design is presented.	Few or no information needed about project design is presented.	
Grammar & Mechanics	Correct use of grammar, punctuation and spelling. Minor or no mistakes.	Mostly correct use of grammar, punctuation and spelling. Some mistakes are made but they don't interfere with meaning.	Somewhat correct use of grammar, punctuation and spelling. Mistakes made interfere with meaning.	Incorrect use of grammar, punctuation and spelling. A lot of mistakes made that interfere with meaning.	
TOTAL					

Flashcards

CONTROL PANEL

FUSES

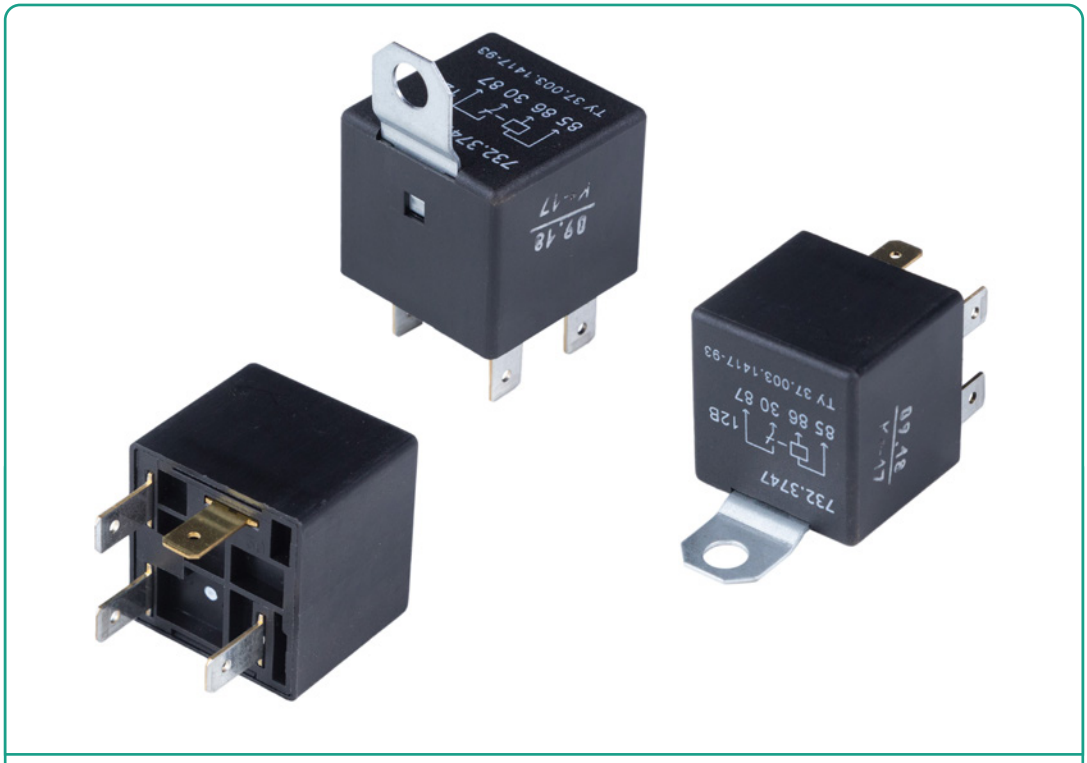
MILL



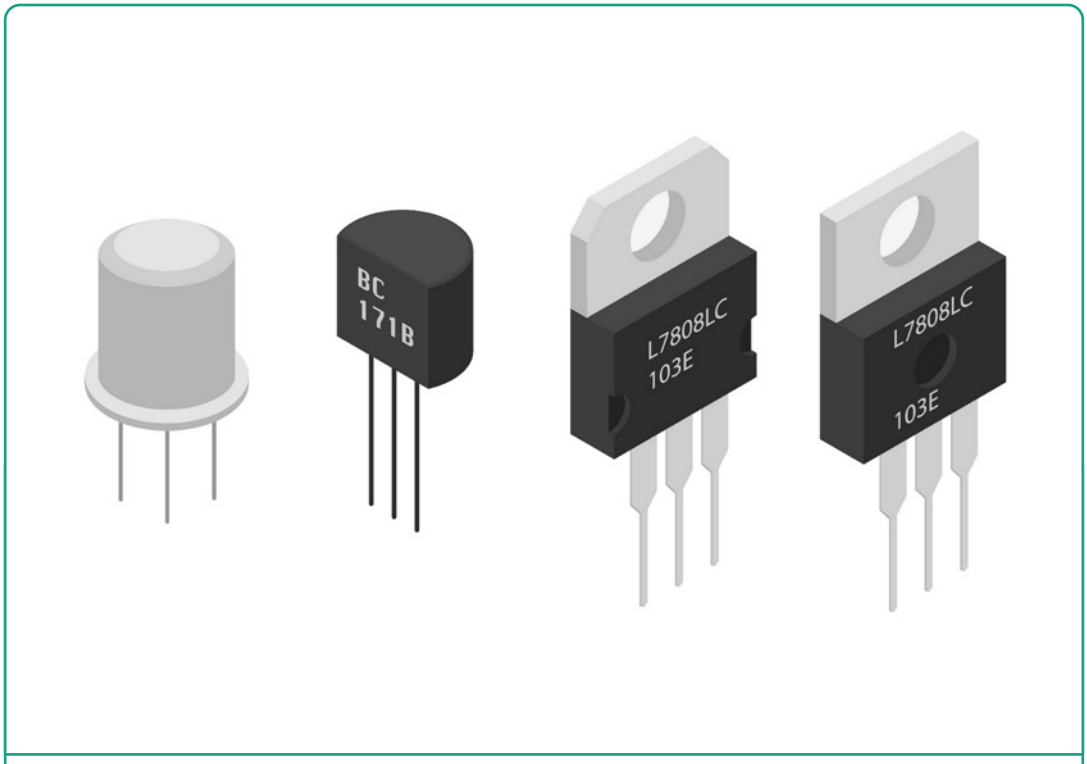
PROGRAMMABLE LOGIC CONTROLLER

PUMP

SOFT STARTER



RELAYS



TRANSISTORS

UNINTERRUPTED POWER SUPPLY

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Retrieved from http://www.sec.cl/sitioweb/electricidad_norma4/norma4_completa.pdf

UNIT V

Audio adapted from:
Transistors, how do they work?
https://www.youtube.com/watch?v=7ukDKVHnac4&t=4s
MOSFET, BJT and IGBT
https://www.youtube.com/watch?v=VlMdSCI29A0

Text adapted from:
https://www.electrical4u.com/application-of-power-electronics/

UNIT VI

Audio adapted from:
https://hilbgroupfl.com/4-maintenance-recommendations-for-industrial-equipment/

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