T.C.
MİLLİ EĞİTİM BAKANLIĞI

RAYLI SİSTEMLER TEKNOLOJİSİ

TEKNİK YABANCI DİL(İNGİLİZCE) 2

ANKARA, 2014

- Bu modül, mesleki ve teknik eğitim okul/kurumlarında uygulanan Çerçeve Öğretim Programlarında yer alan yeterlikleri kazandırmaya yönelik olarak öğrencilere rehberlik etmek amacıyla hazırlanmış bireysel öğrenme materyalidir.
- Millî Eğitim Bakanlığınca ücretsiz olarak verilmiştir.
- PARA İLE SATILMAZ.

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EXPLANATIONS

ALAN	**RAYLI SİSTEM TEKNOLOJİSİ**
DAL	**Raylı Sistemler Teknolojisi Alanı Tüm Dallar**
MODÜL	**Teknik Yabancı Dil (İngilizce) 2**
MODÜLÜN TANIMI	Raylı sistem tafiği, sinyalizasyonu, haberleşmesi, elektriği, elektroniği ile ilgili terim ve elemanlar için kullanılan teknik İngilizceyi okuma, anlama, yazma ve konuşma becerisinin kazandırıldığı öğrenme materyalidir.
SÜRE	40 / 32
ÖN KOŞUL	10. ve 11. sınıf İngilizce derslerini başarmış olmak (Temel seviyede İngilizce yeterliğine sahip olmak)
YETERLİLİK	Demiryolu işletmesi ve demiryolu elektrik-elektroniği ilgili Teknik İngilizceyi kullanmak
MODÜLÜN AMACI	**Genel Amaç** Gerekli ortam sağlandığında raylı sistemişletmesi ve elektrik, elektroniği ile ilgili Teknik İngilizceyi, okuma, anlama, yazma ve konuşma düzeyinde öğrenebileceksiniz. **Amaçlar** **1.** Raylı sistem trafiği terimleri ile ilgili Teknik İngilizce' yi kullanabileceksiniz. **2.** Raylı sistem sinyalizasyonu ile ilgili Teknik İngilizceyi kullanabileceksiniz. **3.** Raylı sistemlerdeki haberleşme terimleri ile ilgili Teknik İngilizceyi kullanabileceksiniz. **4.** Raylı sistem elektriği ile ilgili Teknik İngilizceyi kullanabileceksiniz. **5.** Raylı sistem elektroniği ile ilgili Teknik İngilizceyi kullanabileceksiniz.
EĞİTİM ÖĞRETİM ORTAMLARI VE DONANIMLARI	**Ortam:** TCDD, Metro ve Hafif Raylı İşletmeleri, sınıf, kütüphane, dil laboratuarı, bilgi teknolojileri ortamı v.b. **Donanım:** TV, VCD, Video, Internet, projeksiyon, bilgisayar ve donanımları v.b. sağlanmalıdır.
ÖLÇME VE DEĞERLENDİRME	Modülün içinde her öğrenme faaliyetinden sonra yer alan ölçme araçları ile kazandığınız bilgi ve becerileri ölçerek kendi kendinizi değerlendireceksiniz. Öğretmen, modülün sonunda, size ölçme aracı (test, çoktan seçmeli, doğru-yanlış, vb.) kullanarak, modül uygulamaları ile kazandığınız bilgi ve becerileri ölçerek değerlendirecektir.

INTRODUCTION

Dear student;

Nowadays, knowing of foreign language is a fact that cannot be ignored. And everyone knows this fact. It has become an important part of people's daily lives. If people know a foreign language, they can find a job easily. In addition, It is possible to achieve better wages.

We live in the time period described as the information age. The information age has accelerated the development of technology. In addition, information life and of time the validity is short increasingly. Therefore, the information obtained must be kept up to date. At this point, you need to know a foreign language in order to be a step ahead.

Today, English has been adopted by the whole world and was accepted as a world language. All issued information are translated into English and are published.

The railway system sector is developing very fast. The highest using of technological developments has become an industry branch. Therefore, people working in this area need to know Technical English usage.

This module is about railway systems technology which includes English equivalents and usage patterns of the basic definition and terms. With this module you will be able to follow the developments in the field of railwat systems and will have the knowledge of technical English.

LEARNING ACTIVITY -1

AIM

At the end of this activity you will be able to express the terms about railway system traffic that are used in the field of railway systems and translate the basic texts related to this area

RESEARCH

- Visiting a foundation running in the field of railway systems search the the terms about railway system traffic and find the english equivalents of the terms.

- Prepare a feedbaack report and present it in the class to your instructor and your friends.

1. TERMS ABOUT RAILWAY SYSTEM TRAFFIC

1.1. Technical Terms About Traffic

Train traffic systems are quite important to fulfill modern railway carrying services. TGR enterprise is switching to more modern traffic systems day by day up to the necessities of century.

- **Telegraph Block (Walrus) System**

In this system, dispatchers on duty take and give way to one another to sned the trains. (Destination station (B) gives way, station where train is departing (A) takes way). These procedures are recorded to telegraph band up to Walrus (alphabet) system.

- **DRS System**

In this system; to send trains from station or to receive trains to the same station, dispatcher presses buttons on control console and he controls the switches and signals which are situated in entrance and exit of station.

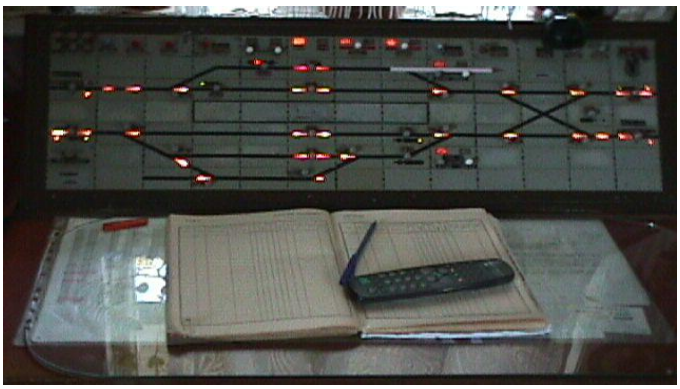


Figure 1.1: DRS system

- **TMİ System**

In this system, there is a control center where 20-25 stations are bound to. Senders talks on phone with dispatchers, one of whom is on departing station and another is on the arrival station. They decided on taking and giving way all together. At the end of these talks, dispatcher gives dispatch order. Talks are recorded on recording band in control center. At the same time, dispatcher draws the movement of train on train record chart. With the help of these chart, it is possible to know places of train and which station the train is. Also it is possible to learn arrival, pausing and departing hours of trains and to follow route programme. For this reason, dispatcher uses different pencils with different colors. Three colors represent the types pf train

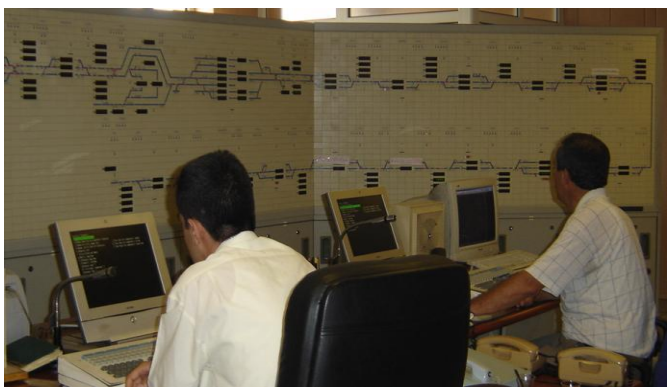


Figure 1.2:TMİ control console

- **CTC System**

With this system, traffic is directed automatically from the center with electrical signals. Dispatcher by pressing on buttons on control console organizes arrival and departing traffic. There are 20-25 stations that dispatcher controls. In this system, there is a signal nearly every 4 kms. As the block signals can be seen from control center, it is possible to know where the train is.

In case of failure, dispatcher makes the flow of traffic by giving orders on phone. (Close-circuit Telephone). Also, every movement of train is drawn on traingraph.

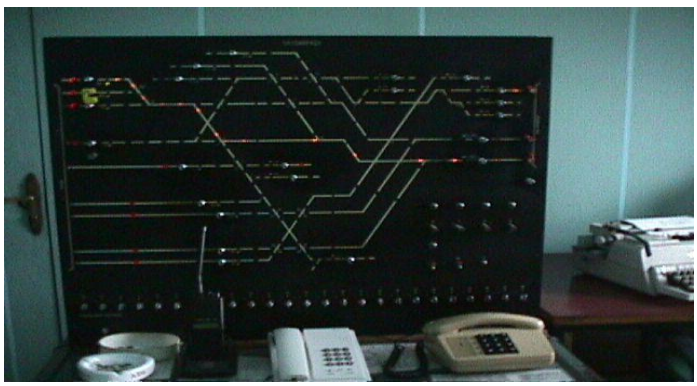


Figure 1.3:CTC desk

- **OBS System**

This system is the mixture of TMI and CTC systems. In region where there is little traffic TMI system is used, in other regions CTC system is used to make economy.

1.2. Technics about Wagon Loading

Some goods have some special difficulties about carrying resourced by their weight, volume, loading-unloading and transferring. These are special technics that are applied during the carriage of those special goods with speacial wagons.

- **Loadings that Exceeds the Lengtht of Wagons**

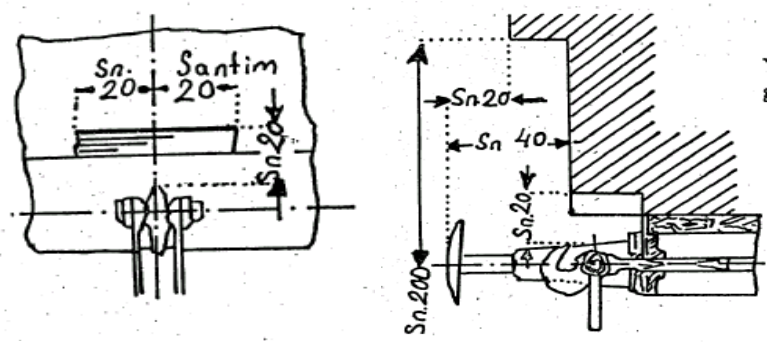
Following rules are applied when the load exceeds the length of wagon;

- If the length of an equipment is longer than the length of a wagon, it is loaded on two wagons which are connected to each other with iron sticks or load. Or it is loaded on two wagons with turning sleeper. There is a free wagon between those two wagons.
- Wagons with turning-axis can be used as intermediate wagon on the condition that the axis is put away. Intermediate wagons cannot be more than one.
- If the length of load exceeds the length of wagon , there must be one safety-coach.
- If the length of load doesn't exceeds the length of wagon too much, there will be no need for safety-coach.
- If the length of load is up to 2 meters when measured from the top of the rails, good can exceed back and front part of wagon as long as there is 40cm-openness between the top of loaded good and buffer panels.

Figure 1.4:Carring good that exceeds the lenght of

➢ **Measures of Space that Needs to Applied to Front Part of Wagon**

In order to connect wagons, it is necessary to put at least 20 cm. space at the tip of draw hook. Also there should be 20 cm space at the middle of draw hook at both right and left sides. If the height of loading exceeds 2 meters from top of rails, 40 cm-space can be reduced to 20 cm.



- **Safety Wagon**

Safety wagons canbe analysed in four parts:

1.If the load exceeds length of wagon, a safety wagon is placed between exceeding wagons and passenger wagons or between two exceeding wagons.

2. In heavy wagons, it is the loaded wagon or empty wagon which is placed between locomotive and passenger wagons.

3.In wagons loaded with flammables and explosives, a safety wagon is placed between those wagons and passenger coach and locomotive or to seperate two wagons loaded with those flammable and explosives.

4.For the safety of passengers, these wagon is placed between passenger coach and locomotive which arenot loaded with heavy flammable or explosives.

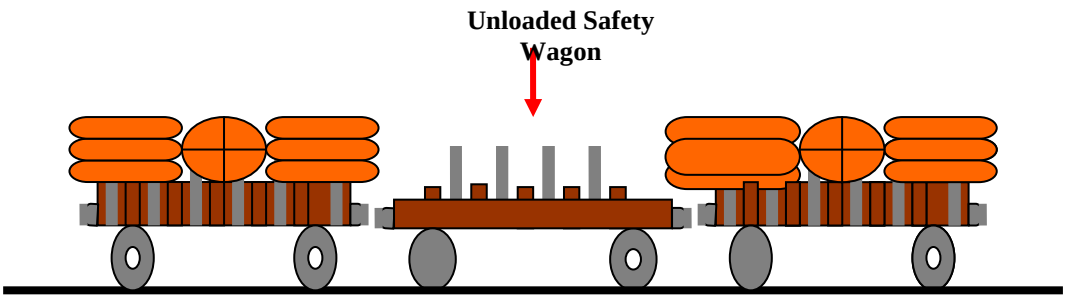


Figure1.5: Loading style when the load exceeds wagon length

➢ **Loading in Rotating-Axis Wagon**

The following rules are obeyed during loading process of wagons with rotating-axis:

If the good is loaded on two wagons, the good shouldn't prevent the running of axis.

If the good is loaded on more than two wagons with turning-axis, the tops of rotating axis are fastened by chain as they can rotate 10 cm for every direction. Trains with rotating-axis are not supported from the back.

Figure 1.6: Special wagon used because of the feature and weight or size of load

➢ **Loadings to Low-platformed Wagons**

In carrying heavy and high goods as sprocket gear and buffers of low-platformed heavy load wagons are on the bridges that disperse the load common chasis of bogies, when pushing or pulling wagons. Bogies are strained from the middle. In order to enable the security of travel and to prevent the damages in middle part of bogies and the parts they are connected, the following precautions should be taken;

- Only one low-platformed load wagon is connected to the back part of train.
- Trains with a low-platformed wagon in its row hasn't been supported from the back.
- Load wagons with low-platformed are not pushed severely. It is not possible to shunt with these wagons.
- When taking those wagons in border stations, bogies and the parts of bogies should be checked neatly whether there is damage on them or not. When heavy and high goods are loaded on low-platformed goods wagons, chief and technician should check them then the wagons are attached to the train.

Figure 1.7: Low-platformed Wagon

APPLICATION ACTIVITY

Steps of Process	Suggestions
Translate the text below into Turkish.	➢ Read the whole text. ➢ While reading try to predict the terms that you do not know. ➢ Find the english equivalents of the terms from tecnical dictionaries.that you can't predict. You can find detailed information about the terms from the text

INTEGRATED OPERATION SYSTEMS FOR MULTIPLE LINES

Integrated Operation Systems

Railway operators that operate multiple lines are making efforts to consolidate their facilities and improve their operating efficiency by combining together the train traffic management systems hitherto introduced individually for multiple lines intointegrated operator centers, thereby ensuring safe and stable transportation by making the dispatch operations faster and more efficient.

Besides being responsible for traffic dispatch, an integrated operation system is also linked with other functions such as electric power dispatch, rolling stock dispatch and facility dispatch to allow the entire railway system to be managed and operated more efficiently.

Integrated Traffic Management Systems

An integrated traffic management system improves the efficiency of dispatch operations by systematically managing the train traffic management system of each line so as to automate management operations across multiple lines.

Integrated traffic management systems are currentlyevolving by tying in with related systems and communication networks in addition to managing the traffic on multiple lines. There is also a trend towards the provision of information services in addition to traffic management. As a result, it will eventually become necessary to supplement the integrated traffic management system functions with control and information service functions and with cooperative control functions that span across lines based on themonitoring and observation functions of each line.

MEASURING AND EVALUTION

Choose the correct option

1. What is the name of the train traffic system that watchmen are taking and giving ways to each other in sending the trains?

   A) DRS System
   B) Telegraph Block (Mors) System
   C) TMİ System
   D) CTC System

2. What is the name of the train traffic system that is mixture of TMI and CTC systems?

   A) OBS Sistemi
   B) CTC Sistemi
   C) DRS Sistemi
   D) TMİ Sistemi

3. What is the name of the train traffic system which has one controlling center where 20-25 stations are attached?

   A) OBS System
   B) CTC System
   C) DRS System
   D) TMİ System

4. Which one is the train traffic system where traffic is controlled from the center by electricity signals with automatically and remote controls?

   A) TMİ System
   B) OBS System
   C) CTC System
   D) DRS System

5. To attached the wagons to each other there should be _____cm length at the top of draw hook and there should be at least _____cm space on both right and left sides of the middle of draw hook?

   A) 20-20
   B) 30-30
   C) 60-60
   D) 45-45

EVALUATION

Compare your answers with the answer key. Assess yourself by determining the number of correct answers. Hesitate to give the wrong answer, or where you live, answering questions, go back to again check the operational issues related to.

If you answered all questions correctly, please other activities.

LEARNING ACTIVITY -2

AIM

At the end of this activity you will be able to express the main definitions and terms about terms about railway system signalling technology that are used in the field of railway systems and translate the basic texts related to this area.

RESEARCH

- Visit a foundation running in the field of railway systems technology, search the main definitions and terms about terms about railway system signalling technology that are used in the field of railway systems and find the english equivalents of the terms.

- Prepare a feedbaack report and present it in the class to your instructor and your friends.

2. TERMS ABOUT RAILWAY SYSTEM SIGNALLING

2.1. Technical Terms about Signalling

Signal is a system that arranges the railway traffic by giving signs with various color. The signal has two, three or four different colors placed on steel pipe, desk or bridges.

- **Signals Categorised according to Their Outlook**

- **High Signals**

These signals has three or four lamps placed on 3 or 3.8 meters high pipes and they are placed on main road. If the area is not suitable or if there is a loading gauge, they are placed on consoles and bridges.

Figure 2.1: High Signals

- **Dwarf Signals**

These are the signals that are placed on short steel pipes and the exit of emergency roads

Figure 2.2: Dwarf Signals

➢ **Signals classified according to their usage**

- **Operated Signals**

Commanded signals are attached to control machine with electrical system and they are controlled by dispatcher. Also where there is a station control console, the signals commanded by cotrol console are called commanded signals.

- **Automatic Signals**

Apart from commmanded signals, the signals that gives color sign automatically according to the direction of traffic and situation of the following signal are called automatic signals

➢ **Signals According to their Function**

- **Arrival Signals**

They are the commanded signals with high four lamps placed at the entrance of station and sidings.

Figure 2.3: Arrival Signals

- **Departing signals**

They are the high and dwarf commanded signals placed at the exit of stations and siding roads. Exit signals from main roads are given with four-lamp high signals in three direction stations and multi-lined areas. In the areas with single-line, high signals with three lamps are used. At the exit of emergency roads, dwarf signals are used. .

Figure 2.4: Departing Signal

- **Automatic Block Signals**

They are the automatic signals with high three lamps that are placed on the entrance of blocks between stations and sidings.

Figure 2.5: Otomatic Block Signals

- **Approaching Signals**

These are automatic block signals that are placed on stations apart from terminal stations and that are placed just before arrival signal in sidings.

Figure **2.6: Approaching Block Signal**

- **Warning Signals**

They are commanded or semi-commanded signals just before arrival signal at terminal stations or in stations that have a lot of shunting.

- **Repeating Signals**

These are high signals that cannot be seen from certain distance, that gives colored sign according to the position of signals. Also they are two colored, there is a white round panel and there is “T” letter with black on that white color.

Figure2.7: Repeating Signal

- **The row and colors of lamps on signals**

  - Four-lamp high signal; from bottom to top; yellow, red, green and yellow
  - Three-lamp high signal red, green and yellow
  - Dwarf Signal, yellow, green and red
  - Repeating signal, green at top, white at bottom
  - Two-lamp dwarf signal yellow at bottom, red at top
  - In two-lamp dwarf signal as manouvre signal, green at bottom, red at top.

2.2. Technical Terms About Signs

- **Heard Signs**

It is a kind of communication style used to deliver concerned commands about train tarffic to authorized people

  - Whistle
  - Pulling vehicle whistle
  - Electric- Gong or Bell
  - Firecracker

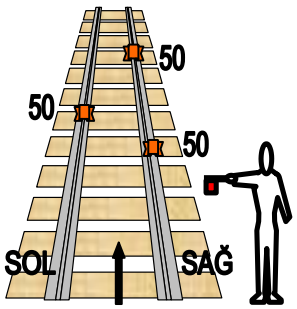


Figure 2.8: Placement of Firecracker

Firecrackers are used as stopping and warning signs and they are placed before signs. It informs the concerned staff the train approaching to the stopping or warning sign

- **Visible Signs**

There are two types of seen signs according to their use; signs used in day and signs used at nights.

1- Signs used on day are used from sun rise till sun set.

2- Signs used at night are used from sun set till sun rise.

In the following situations night sign used insted of day sign;

a) In foggy, snowy and similar weather and places where day sign is impossible to see.

b) In tunnels above 1000meters high or in tunnels where it is impossible to see entrance and exit

c) In places where informed with private command

- **Meanings Of Colors And Lights In Signs**

The meanings of colors and lights used in signs are as follows;

1- Red color and light means immediate stop

2- Yellow color and light means you are apporaching to a stop-sign, you should be more careful. Also up to the position of sign, it informs that you should speed down to stop when necessary.

3- Green color and light means that way is free to pass in TSI system. In TMI system it means that you should be more careful and speed down.

4- Daylight means the way is free.

5- White color and light has meaning according to shapes on signs.

Figure 2.9: Colors

- **Sign Flag**

Red and green sign flags are used only on day.
Red flag means that you should stop immediately.
Green flag means that you should be more careful and you can pass from junctions with permitted speed and from the rest 25 km/h. Super Express, blue train, Express, rail bus and engined-trains can speed up 40km/h with green flag sign.Flag in its cover means that it is free to pass.

Figure 2.10: Sign Flags

- **Round Signboards**

There are two kinds of round signboards which are used to give the sign of stopping and speeding down in daylight. Its diameter is 40cm and there is one more round shape in the signboard whose diameter is 27 cm.

1. One side is green in the center and white in border. Other side is white in middle and green in border.

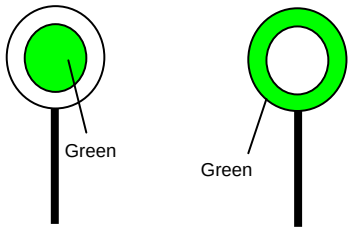


Figure 2.11. Green Round

If you see the signboard whose center is green and border is white, you should speed down to 25 km/h. If it is super express, blue train, express, rail bus and engined-train, you should speed down to 40 km/h and be more careful.

If you see the signboard whose center is white and border is green, it means that the way is free and you can travel on normal speed.

2.One side is red in center and white in border, the other side is white in center and green in border.

If you see the side with red in center and white in border, you must stop immediately.

If you see the side with white in center and green in border, it means that way is free and you can travel on normal speed

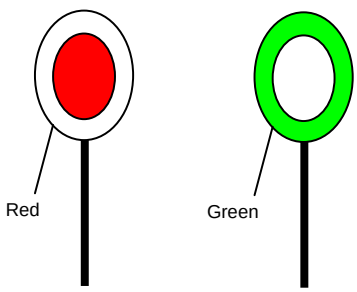


Figure 2.12. Green-Red Round Signboards

- **Signalling Lantern**

There are red, green and daylight signalling lantern which are ligthened with gas lamp or battery at nights.

With signallaing lantern;

a. If you see red, you must stop immediately.

b. If you see green, you must speed down 25 km/h,in super express, blue train, express, rail bus and engined trains, you must speed down 40 km/h and be more careful and you must pass from switches with permitted speed.

c. If you see daylight color, it means that the way is free.

d. Level crossing sign should be placed to the both sides of railway and to the right side of highway where drivers can see easily.

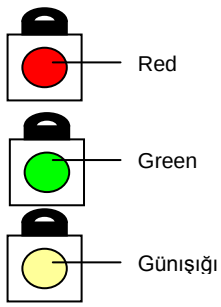
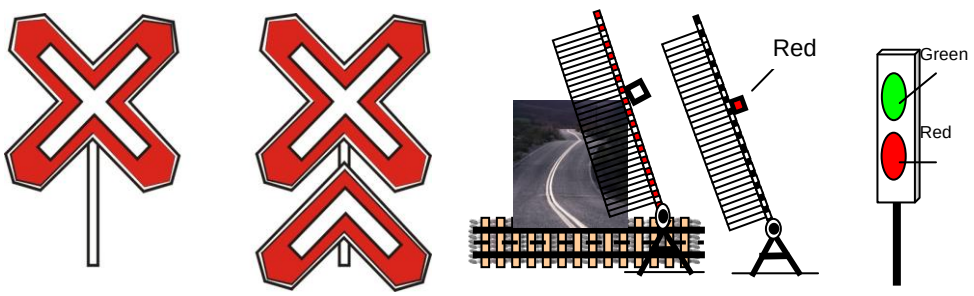


Figure 2.13: Signalling Lantern

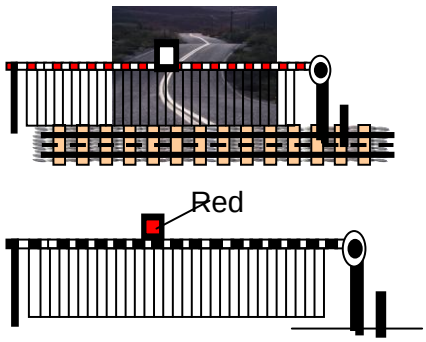
- **Level Crossing Sign and Signal**



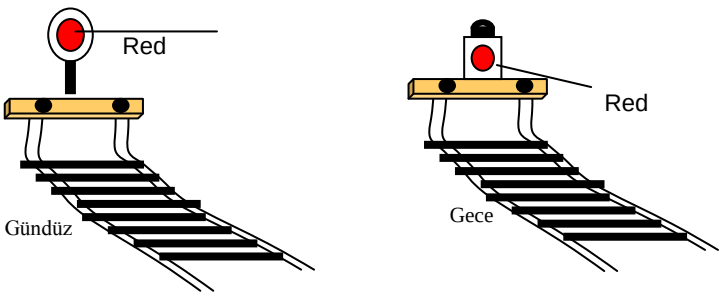
Level crossing sign is placed both sides of railway and right part of highway where drivers can see it easily.

➢ **Barrier Sign**

Barrier Sign is placed on level crossing points where railways meets highway and where the highway traffic is busy.



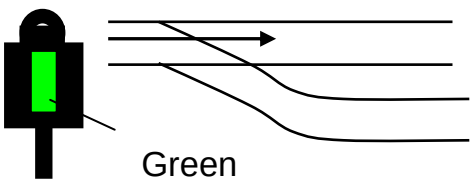
- **Road-End Signal**



It is the round signboard or light which is red in center and white in border. It is placed on buffer sleeper at the end of closed ways, if there is no buffer sleeper it is placed at the center of way.

- **Switch Lantern**

There is a switch lantern in all switches except from switches bound to TSI system. It shows which way the train is going to take

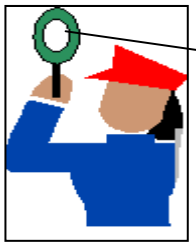


- **Switch signboard**

Junction signboard is used instead of lantern on switch at rarely used ways and where it is impossible to shunt at nights.

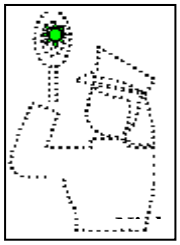
➢ **Dispatcher Disc**

Train dispatchers on duty use that round signboards. One side of that signboard is red in center and white in border, other side is white in center and green in border. They are lighted up at nights so that they give out red light one side and green light on the other side



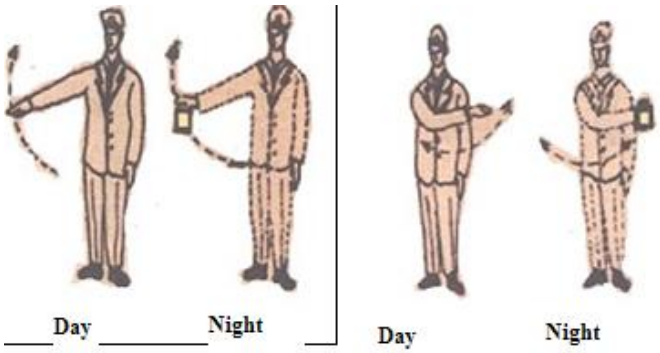
Gre

Day



➢ **Shunting Signs**

Shunting signs are given by taking locomotive's position into consideration with arm and hooter on daytime, with three-colored sign signalling lantern and whistle at nights. The side where locomotive or control part exist is front part and ahead, other side is back.



APPLICATION ACTIVITY

Steps of Process	Suggestions
Translate the text below into Turkish.	➢ Read the whole text. ➢ While reading try to predict the terms that you do not know. ➢ Find the english equivalents of the terms from tecnical dictionaries.that you can't predict. ➢ You can find detailed information about the terms from the text

Railway signalling is a system used to control railway traffic safely, essentially to prevent trains from colliding. Being guided by fixed rails, trains are uniquely susceptible to collision; furthermore, trains cannot stop quickly, and frequently operate at speeds that do not enable them to stop within sighting distance of the driver.

Most forms of train control involve movement authority being passed from those responsible for each section of a rail network (e.g, a signalman or stationmaster) to the train crew. The set of rules and the physical equipment used to accomplish this determine what is known as the method of working (UK), method of operation (US) or safeworking (Aus.). Not all these methods require the use of physical signals and some systems are specific to single track railways.

Entering and leaving a manually-controlled block

Before allowing a train to enter a block, a signalman must be certain that it is not already occupied. When a train leaves a block, he must inform the signalman controlling entry to the block. Even if the signalman receives advice that the previous train has left a block, he is usually required to seek permission from the next signal box to admit the next train. When a train arrives at the end of a block section, before the signalman sends the message that the train has arrived, he must be able to see the end-of-train marker on the back of the last vehicle. This ensures that no part of the train has become detached and remains within the section. The end of train marker might be a white disc by day or a steady or flashing red lamp. If a train has entered the next block before the signalman sees that the disc or lamp is missing, he will ask the next signal box to stop the train and investigate.

MEASURING AND EVALUTION

Choose the correct option

1. On switches at ways where it is impossible to shunt at nights or rarely used ways , instead of torch …… is used?

A) Switch Pannel
B) Shunting Sign
C) Switch Light
D) Road-end Sign

2. What is the name of the signal which are present in all switches except from switches bound to TSI system and that shows which way the train is going to take?

A) Barrier Sign
B) Road-end Sign
C) Switch Signboard
D) Switch Light

3. What is the name of the signal placed on level crossing where highway and railway meets and where the highway traffic is busy?

A) Road-end Sign
B) Barrier Sign
C) Switch Signboard
D) Shunting Sign

4. What is the name of the signal placed on short steel pipes and exit of emergency roads?

A) High Signals
B) Approaching Signals
C) Protecting Signals
D) Dwarf Signals

5. Which one below says that you are approaching to stopping sign?

A) Red Color
B) Green Color
C) Yellow Color
D) Daylight Color

EVALUATION

Compare your answers with the answer key. Assess yourself by determining the number of correct answers. Hesitate to give the wrong answer, or where you live, answering questions, go back to again check the operational issues related to.

If you answered all questions correctly, please other activities.

LEARNING ACTIVITY -3

AIM

➢ At the end of this activity you will be able to express terms about railway system communication technology that are used in the field of railway systems and translate the basic texts related to this area.

RESEARCH

➢ Visit a foundation running in the field of railway systems technology, search the terms about railway system communication technology that are used in the field of railway systems and find the english equivalents of the terms.

➢ Prepare a feedbaack report and present it in the class to your instructor and your friends.

3. TERMS ABOUT RAILWAY SYSTEM COMMUNICATION

3.1. Technical Terms about Radio and Telephones

Communication is very important in railway systems. Telephones are used to direct the traffic and to communicate inside the station. In directing traffic, traffic telephones are used between station and dispatcher. Service telephones are used to communicate inside the station and Mobile phones are used in emergency to communicate with dispatcher.

Figure 3.1: Telephone on local control console and telephone on dispatcher desk

➢ **Types of Telephones**

- **Service Telephones**

Station staff use service telephones to communicate with each other about issues apart from train traffic.

- **Automatic Telephones**

Automatic telephones are used to prevent delays caused by correspondence. Also it enables, when necessary, national and international communication, by connecting to other national telephone system.

- **Traffic Telephones**

Telephones used to direct train traffic are called traffic telephones. There are traffic telephones in traffic control center, in station control consoles, in control pannels, at crosses and next to signals.

- **Mobile Telephones**

Train, machine or travelling staff enters into telephone circuit with mobile phone by using the plug on communication poles. The staff listens to the line and when he is sure that there is no conversation on the line, he says "Hello" to traffic controler. After the traffic controler introduces himself, the staff on the way tells where he is, his occupation and his surname. He makes his speech. He repeats the order if he gets any from traffic controler. The conversation ends when the traffic controler says "OK".

- **Panel Telephones**

Like line telephones in junction area, it is inside steel box or inside the building.

Figure 3.2: Panel Telephone

- **Line Telephones**

Line telephones are at station control console, at junction area, and next to all approaching, protecting and block signals. Telephones are placed in boxes and attached to steel poles. They are locked with special locks and there is a key of them in each staff. These telephones enable the communication between staff dealing with traffic and traffic controler

Figure 3.3: Line Telephones

- **Switch Telephones**

Switch telephones and line telephones are placed in steel boxes similar to each other. What diffirientiates junction phone from line phone is the hunchback-like shape on telephone box

Figure 3.4: Switch Telephones

➢ **Radio Communication**

Stable and mobile radios are used by staff in charge in offices, control centers and trains to fulfill the services quickly which are not directly related to the train traffic but that completes traffic and increases security.

Figure 3.5. Mobile radios and stable telephones

The speech on radio is made as follows and the following patterns are used during talks.

To be able to communicate with radio, staff should turn the switch ON position and to arrange the volume, he should turn the switch.

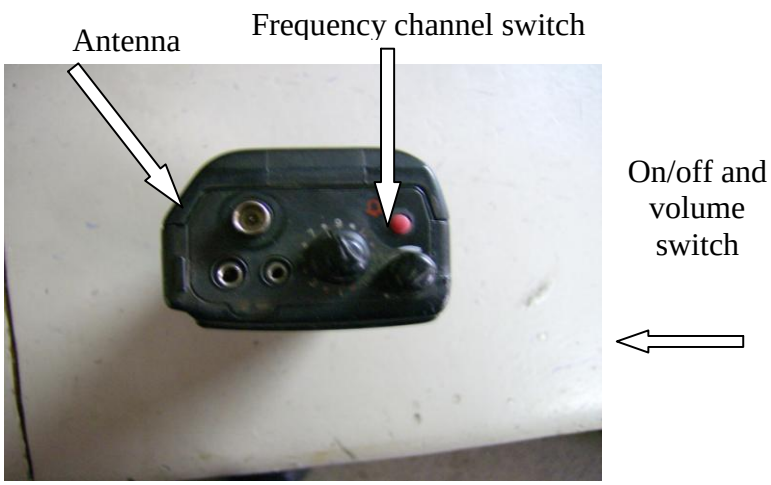


Figure 3.6: Radio Buttons

Approriate frequency is chosen. By pressing on speaking thumb of radio, staff talks. To listen, staff releases the thumb.

First the caller says his code or number and then he says the code or number where he calls and he ends his speech by saying "OK".

When authorised staff hears it, he says the code or number of caller, then he says his code or number and he says that he is listening.

So the caller speaks and ends his speech by saying "OK".Then he listens the speech and repeats it and at last he says " Got it, OK" and he finishes the conversation. When both parts says OK, the conversation ends. ,

If the command or speech is not understood properly, he says "the command is not understood " and he asks for repetation

While directing train traffic communicating by telephone is essential, but radio is also used in directing train traffic as long as all speech is recorded to recording unit in control center. The lines where radio can be used in directing train traffic are decided seperately.

While communicating with radio, as only radio is permitted instead of telephone, related regulations, general Orders and Orders in telephone use must be allowed during radio communication.

If you have hesitation whether you are talking to authorised person or not, you can ask some questions to introduce himself/herself to be sure of it.

Communication by radio is recorded on equipments at control center. The chief traffic controller checks periodically whether the talks are appropriate to regulations or not.

- **Radio Frequency Channels**

Authorised person makes the arrangement of frequency. Taking and giving frequencies have been taken from Telekom and tax is paid for it. In order to have good communication by radio, frequency of newly-bought radios should be arrange according to those values. The channels which will be used are decided in advance and they are given to the staff who is using the radio.

Figure 3.7: Radio Frequency Channel

- **Communicating with Radio in Train**

The staff in charge communicates with each other or with the cotrol center and station in the following procedures;

- Radio that staff in charge carries and that is in machine is always on position.
- Engine driver initially follows the signals or signs and conducts the train. Without ignoring his/her those duties, s/he communicates by radio both stopping and running.
- Train and machine staff communicates with each other in accordance with regulations.
- In any danger, train staff enables the prevention of that danger. Then s/he informs control center, station and staff in train by radio.
- In trains supported from back, both engine drivers warns each other before hand by radio not to cause any fault in stops and departures.

APPLICATION ACTIVITY

Steps of Process	Suggestions
Translate the text below into Turkish.	➢ Read the whole text. ➢ While reading try to predict the terms that you do not know. ➢ Find the english equivalents of the terms from tecnical dictionaries.that you can't predict. ➢ You can find detailed information about the terms from the text.

Train radio communication system

A train radio communication system includes a plurality of land communication equipments and a train communication equipment. The land communication equipments are arranged at predetermined intervals along a railroad on which a train travels and designed to output transmission signals having different frequencies. The train communication equipment is arranged in the train and designed to set a radio channel between the train communication equipment and one of the land communication equipments during travel of the train. The train communication equipment includes a plurality of antennas, an antenna switch, a receiver, and an antenna controller. The antennas respectively receive the transmission signals from the land communication equipments. The antenna switch selects one of the antennas. The receiver demodulates an output from the antenna selected by the antenna switch and outputs a reception signal. The antenna controller includes a current position detecting section for detecting a current traveling position of the train and controls the antenna switch in accordance with a current traveling position from the current position detecting section.

MEASURING AND EVALUTION

Choose the correct option

1. Which one following below is used to make talks inside the institutiton?

A) Automatic Telephone
B) Mobile Telephone
C) Panel Telephone
D) Shunting Telephone

2. Which one below enables communication about traffic control by entering into line with the plugs placed on line way with certain gaps?

A) Automatic Telephone
B) Mobile Telephone
C) Panel Telephone
D) Shunting Telephone

3. Which one below is the communication tool that enables the communication of station staff on issues apart from train traffic and that is not recorded?

A) Mobile Telephone
B) Automatic Telephone
C) Panel Telephone
D) Service Telephone

4. Which one below is the telephone that enables the communication from switch region with staff at station control console ?

A) Automatic Telephone
B) Mobile Telephone
C) Switch Telephone
D) Bakıcı Telephone

5. Which one below is the telephone that is placed at station control desk, switch region and next to all signals and that enables the talks of staff in charge about traffic control and traffic?

A) Mobile Telephone
B) Line telephone
C) ShuntingTelephone
D) AutomaticTelephone

EVALUATION

Compare your answers with the answer key. Assess yourself by determining the number of correct answers. Hesitate to give the wrong answer, or where you live, answering questions, go back to again check the operational issues related to.

If you answered all questions correctly, please other activities.

LEARNING ACTIVITY -4

AIM

At the end of this activity you will be able to express the terms about railway system electricity technology that are used in the field of railway systems and translate the basic texts related to this area.

RESEARCH

- Visit a foundation running in the field of railway systems technology, search the the terms about railway system electricity technology that are used in the field of railway systems and find the english equivalents of the terms.
- Prepare a feedbaack report and present it in the class to your instructor and your friends.

4. TERMS ABOUT RAILWAY SYSTEM ELECTRICITY

4.1. Main Terms and Definitions Used in Electrification

These are the electrical-traction air lines that supplies electrical energy to electrical vehicles in any weather condition, in any geometrical shape of railway, in maximum speed. These lines supplies enegry without any shortage, they also reduce the run-out in current receiving pantograph and in contact wire, without giving harm to people or equipment.

This system is called as "overhead" because of its geometrical shape.

- Overhead wires are as follows;
  - One carrier transistor (Porter Wire)
  - One contact Wire (Carrier Wire)
  - Pendulum that enables the hang of contact wire to carrier transistor.
  - Other connection wire.
- Poles and console hardware that carry overhead transistor
- Protecting equipments such as; grounding, warnings with signals, height – limiting portals etc.

- **Transformer(Substation) Centers**

These are the centers that supply energy to aerial line contact system. These centers are private stations, rectifier centers or transformator centers with industrial frequency up to the current type they are using.

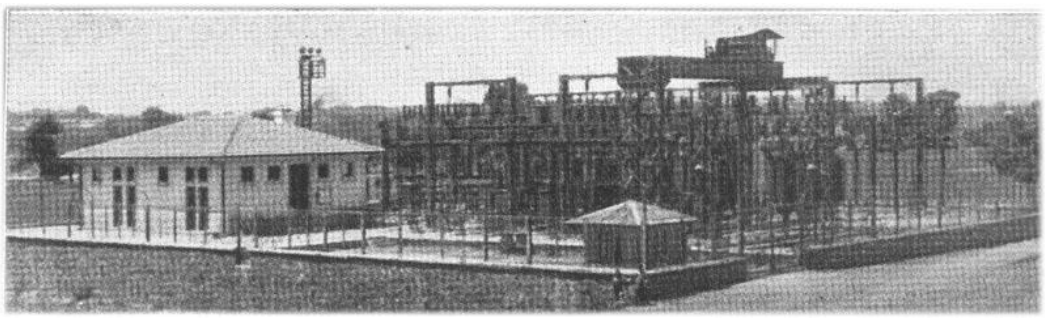


Figure 4.1: Substation

- **Traction Unit**

These are the units that will do the electrical shuntings which will be needed in running aerial line contact systems.

- **Energy Transfer Lines**

These are energy lines which supply energy to feed centers.

- **Telecommand (Remote Control) System**

These command facility is used to control and command all system from a center.

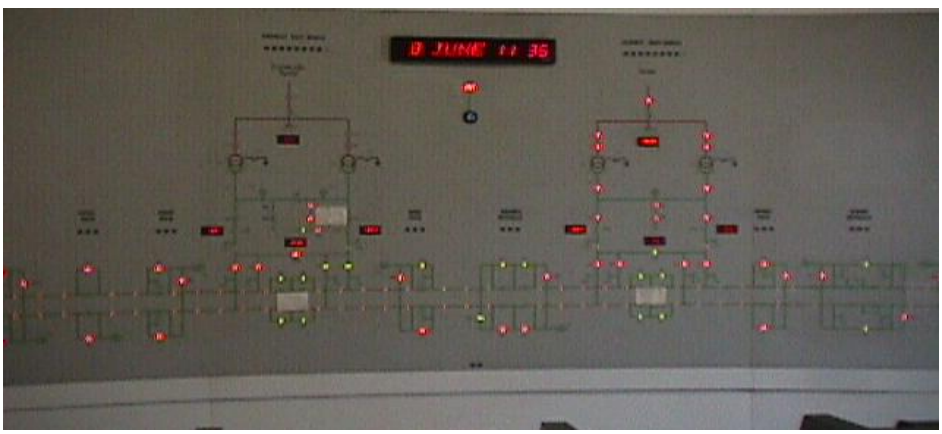


Figure 4.2: Telecommand Center

➢ **Communication System**

It is a communication system that is built speacially to operate and maintain stable electrification facilities.

➢ **Structural Types of Overhead**

In electrical traction, return current way is rail-soil circuit. This is all the same in all overhead systems. When the syetem below is analysed, it can be conucluded that overhead systems are changing up to the speed. When the speed increases, the structure of facility becomes more complicated.

Tram Overhead	Max Speed → 30 km/h
Overhead with Λ Rope	Max Speed → 90 km/h
Simple Overhead	Max Speed → 120 km/h
Simple Over head with Y Rope	Max Speed → 160 km/h
Compound Overhead	Max Speed → 180 km/h

➢ **Electrical Traction Current Types**

- 750 V DC → Current type used in subway lines.
- 1500 V DC → It is not used many of the countries any more.
- 3000 V DC → It is not used many of the countries any more.
- 15 KV 16 2/3 Hz AC → Current type used in Scandinavian countries
- 25 KV 50-60 Hz AC → It is frequently prefered.
- **25 KV–50 Hz AC → Current type used in our country**

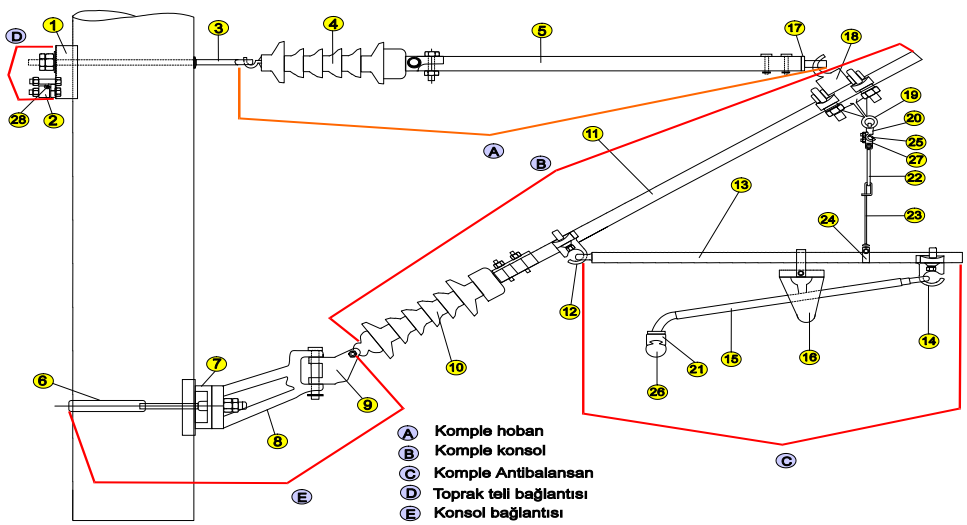
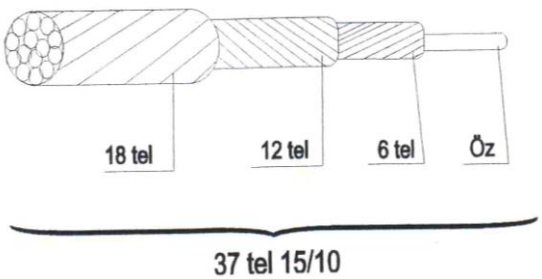


Figure 4.3: Overhead System

50 KV 50–60 Hz AC → It is used in lines where heavy load transportation is made

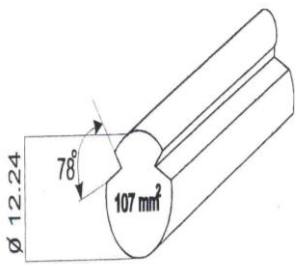
- **Conveyer Transistor (Porter Wire)**

It has 65 mm^2 cross-section and it is made from bronze (alloy of copper and stannum). This transistor is composed of 37 wires of 15/10 mm. It is % 60 more conductive when compared with etalon copper. There is a central wire and first layer has 6 wires that are wrapped in spiral-like to the core. On first layer, 12 wires are wrapped to the opposite direction. Lastly, 18 wires are wrapped in the same direction with first layer's. Out diameter is 10,5 mm and traction failure load is 4300 kg. The weight of a meter is 600 gr.



- **Carrier Wire**

Carrier wire is made from electrolyte hard copper. Its profile cahnges according to the current flowing from overhead. For example:107 mm^2. Weight of a meter is 950 gr. And its conductivity is %98. Diameter of that wire is 12.24 mm. It has two passages. Traction failure load is 3905 kg.



- **Pendulum**

It is kind of wire with 5mm diatemeter and made from either hard copper or stranded copper. By this wire, it is possible to hang route wire to porter wire. Its duty is to enable the hang of route wire without versine. The maximum distance between two pendulums are 9 meters.

- **Overhead Wire Mast**

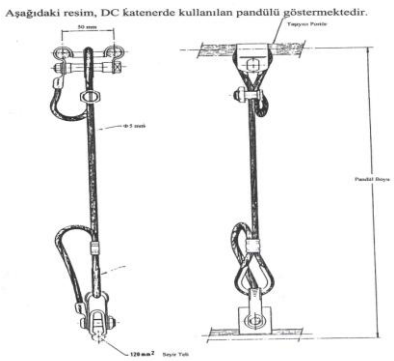


Figure 4.4: Overhead Poles

In TCDD, two types of poles are used; concrete poles and iron poles. Concrete poles are prefered as they are more economic, more long-lasting and and less expensive when maintenance is considered.

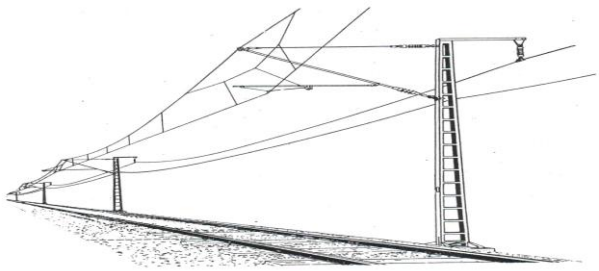


Figure 4.5: Overhead Wire Mast and Hardware

APPLICATION ACTIVITY

Steps pf Process	Suggestions
Translate the text below into Turkish.	➢ Read the whole text. ➢ While reading try to predict the terms that you do not know. ➢ Find the english equivalents of the terms from tecnical dictionaries.that you can't predict. You can find detailed information about the terms from the text

Overhead systems

Early electric systems used low-voltage DC. Electric motors were fed directly from the traction supply, and were controlled using a combination of resistors and relays that connected the motors in parallel or series.

The most common DC voltages are 600 V and 750 V for trams and metros, and 1500 V and 3000 V for railways. The lower voltages are often used with third or fourth rail systems, and voltages above 1000 V are normally limited to overhead wiring for safety reasons. The "S-Bahn" in Hamburg, Germany, has third rail with 1200 V, the French SNCF Culoz-Modane main line electrification in the Alps with 1500 V and third rail .

Through the middle 20th century, rotary converters or mercury arc rectifiers were used to convert utility (mains) AC power to the required DC voltage at the feeder stations. Today, this is usually done by semiconductor rectifiers after transforming the voltage down from the utility supply.

The DC system is quite simple, but it requires thick cables and short distances between feeder stations because of the heavy currents required, with significant resistive losses. In the UK, the maximum current that can be drawn by a train is 6800 A at 750 V[1]. The feeder stations require constant monitoring, and on many systems, only one train or locomotive is allowed per section. The distance between two feeder stations at 3000 V is about 25 km (15 miles).

If auxiliary machinery, such as fans and compressors, is powered by motors fed directly from the traction supply they may be larger because of the extra insulation required for the relatively high operating voltage. Alternatively, they can be powered from a motor-generator set, which was provided as an alternative way of powering incandescent lights which otherwise had to be connected as series strings (bulbs designed to operate at traction voltages being particularly inefficient). Now solid-state converters (SIVs) and fluorescent lights can be used.

Overhead catenary

A catenary is a system of overhead wires used to supply electricity to a locomotive, streetcar, or light rail vehicle which is equipped with a pantograph.

Unlike simple overhead wires, in which the uninsulated wire or cable is attached by clamps to closely spaced crosswires, themselves supported by line poles, catenery system use at least two wires. One wire, called the catenary wire or the messenger wire, is hung at a specific tension value in the shape of a mathematical catenary between line structures. A second wire is held in tension by the messenger wire, to which it is attached at frequent intervals by clamps and connecting wires. The second wire is straight and level, parallel to the rail tracks, suspended over it as the roadway of a suspension bridge is over water.

Simple wire installations are common in light rail applications, especially on city streets, while more expensive catenery systems are especially suited to high-speed operations.

MEASURING AND EVALUTION

Choose the Correct Option

1. What is the name of the center that supplies energy to aerial line contact system?

A) Transformer(Substation) Centers
B) Communication center
C) Signal center
D) Overhead center

2. What is the name of the energy linet hat supplies energy to feed centers?

A) Signal Line
B) Tram line
C) High voltage line
D) Energy transfer lines

3. What is the name of the wire made from hard copper or stranded copper and that enables the hang of route wire on pendulum?

A) Signal wire
B) Current wire
C) Pendulum
D) Overhead

4. Which overhead poles below are used in TCDD?

A) Wood-Concrete
B) Iron-Concrete
C) Wood-Iron
D) Steel-Concrete

5. Which current type below is used in overhead lines in our counrty?
Ülkemizdeki katener hatlarında kullanılan akım türü aşağıdakilerden hangisidir?

A) 25 KV–50 Hz AC
B) 50 KV 50–60 Hz AC
C) 750 V DC
D) 3000 V DC

EVALUATION

Compare your answers with the answer key. Assess yourself by determining the number of correct answers. Hesitate to give the wrong answer, or where you live, answering questions, go back to again check the operational issues related to.

If you answered all questions correctly, please other activities.

LEARNING ACTIVITY -5

AIM

➢ At the end of this activity you will be able to express the main definitions and terms about the main hardware of pulling vehicles technology that are used in the field of railway systems and translate the basic texts related to this area.

RESEARCH

➢ Visit a foundation running in the field of railway systems technology, search the main definitions and terms about the main hardware of pulling vehicles that are used in the field of railway systems and find the english equivalents of the terms.

➢ Prepare a feedbaack report and present it in the class to your instructor and your friends.

5. MAIN TERMS AND MATERIALS OF SUPERSTRUCTURE

5.1. Electricity and Electronics Terms

➢ **The Principles Of The Electricity**

Electrical current is a flow of electrons, and the more electrons in motion, the stronger the current is.

The greater the concentration of electrons in a battery or generator terminal, the higher pressure between the electrons. The greater this pressure, the greater the flow of electrons. There are three fundamental characteristics of an electrical circuit:

- Volts = Electrical Pressure
- Amps = The rate of current flow
- Ohms =Electrical Resistance

The flow of electrons through a conductor is called current and is measured in electrons per second or Amperes. The flow of current measured in amperes can be compared to the flow of water in a pipe measured in liter per second.

Voltage is the energy that moves the current (like the pressure that moves the water). Voltage is measured in volts. Voltage is described as the difference in potential charges between the positive and the negative terminals of a battery or alternator. Without voltage no current will flow.

Resistance describes the opposition to current flow. The unit of measurement is the Ohm (ω) which is defined as the resistance that will allow one ampere to flow when the potential is one volt.

There is a mathematical relationship between voltage, current and resistance (Ohm's law). The current flow in a circuit varies directly with the voltage and inversely with the esistance. In others words the pressure of 1Volt applied to 1 Ohm resistance will cause 1 Amp of current to flow. If voltage increases current will increase, if resistance increases current will decrease. If any two of the three terms (volt, amp and ohm) are known the missing one can be found.

$$Volts = Ampers \times Resistance$$

$$Amps = \frac{Volts}{Resistance}$$

$$Ohms = \frac{Volts}{Amps}$$

- **Electrical Circuits**

The term circuit means a cycle, an unbroken path beginning at a point and returning to the same point.

Basic requirements for an electrical circuit include:

- A voltage source (battery or alternator).
- Connecting wires (conductors).
- An electrical load (lamps, rotor, resisters etc.).

In order for a circuit to be complete there cannot be a break of circuit flow. If there is any sort of break, the circuit becomes an open circuit and will not function.

There are three types of circuits:

- Series is one in which there is only one path for the current to flow.
- Parallel is one which has more than one path in which the current can flow. In such a circuit the current divides to pass through of the devices forming the circuit.
- Series/parallel is a combination of series and parallel circuits. Same devices in the circuit are connected in series while others are in parallel. This is very common in automotive applications.

➢ **Electrical Work and Power**

The electrical unit for measuring work is known as Joule (1 Joule=1 Ampere flowing for 1 second under the pressure of 1 Volt). This is the result of the product of a force and the distance through which it acts in overcoming resistance. Power is the rate of doing work.

$$Power = \frac{Work}{Time}$$

$$Watts = \frac{Joules}{Seconds} = Volts \times Ampers$$

➢ **Basic Elements of Electricity**

Electricity is the flow of tiny subatomic particles, called electrons, from one place to another. Electrons contain a negative charge; they are attracted to particles of opposite (positive) charge and repulsed by particles with the same charge. It is this force that causes electrons to flow, thereby producing electrical power.

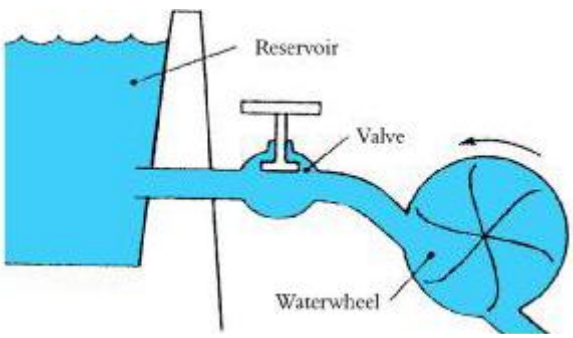


Figure 5.1: Create electric energy

The flow of electricity in a wire can be likened to the flow of water through a pipe. An example is water draining a reservoir to run a waterwheel. The reservoir is like a battery, the valve is like a switch, and the pipes are like wires. The wheel is like an electrical load, which can be a light bulb, an electric motor, an ignition system, or the like. A diagram of three basic electrical components is shown below. The diagram describes a circuit. The circuit includes a return wire from the load to the battery. All electrical circuits form closed loops; without a return, current could not flow.

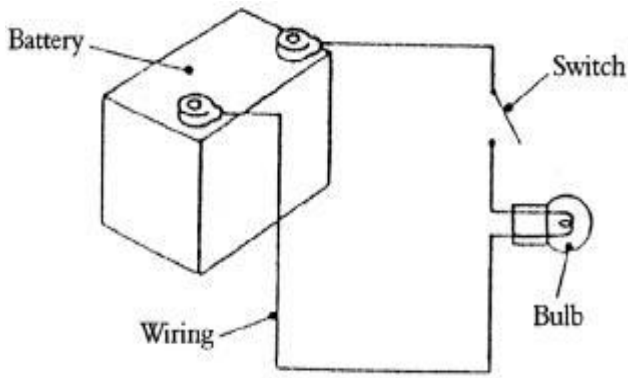


Figure 5.2 Components of basic electrical

The metal body and engine of a car are used as the return wire for all the electrical circuits. This is called grounding, and it reduces the actual amount of wire needed by half.

In a waterwheel system it is sometimes desirable to know the pressure of the water when it emerges from the pipe and how much water is flowing out. The same kind of information is often helpful when discussing electrical circuits.

Pressure in a reservoir system can be estimated simply by knowing how high the water is above the waterwheel. The amount of pressure in an electrical circuit, however, is not so easily seen. It is called voltage, and an instrument called a voltmeter is needed to measure it. The unit of measurement is a volt.

Likewise, the now of water can be seen, but a flow of electrons is invisible. In a circuit, electron flow is called a current. It is measured in amperes with an ammeter. The size of the load in electrical circuits can be measured, too. Load size is cal1ed resistance; it is measured in ohms with an ohmmeter.

These three quantities are connected arithmetically by Ohm's Law:

$$Current = \frac{Voltage}{Resistance}$$

If two of the three quantities are known, the third can be calculated.

For example, if the bulb in the circuit shown above has a resistance of 6 ohms and it is connected to a 12-volt battery, the current flowing through it will be 12 divided by 6, or 2 amperes.

The power consumed by a motor or a light is calculated in watts: wattage is current time voltage. A 15-ampere head-light operating at 12 volts consumes 180 watts of electrical power.

Coupled to the electric force that sends electron running through wires is a magnetic force that always exerts itself at right angles to the direction of the electron current. In most circuits this force is chaotic and negligible. However, if the electrons are made to flow many times in a spiral-as through many turns of wire wrapped around an iron bar-the forces are lined up and create a magnet:

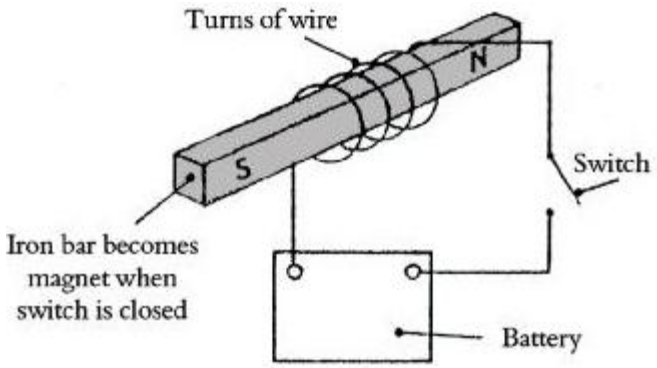


Figure 5.3: Create a magnet

Magnets exert mechanical pull. When oriented in a ring, as in an electric motor, they can be used to pull the motor's shaft continuously around. This is basically the way all electric motors work. It is also the principle behind the operation of solenoid switches; the magnetic pull from a coil of wire can move a rod that will close a door lock or engage the starter motor. When the principle operates in reverse, mechanical motion is converted into electricity, as in a car's alternator.

Because of the way alternators are built, they produce current that changes direction frequently; this is called alternating current (AC). A diode is used to convert this to one-way current, called direct current (DC). Diodes act like one-way valves in water pipes: they al1ow the current to flow in one direction but block flow in the other direction

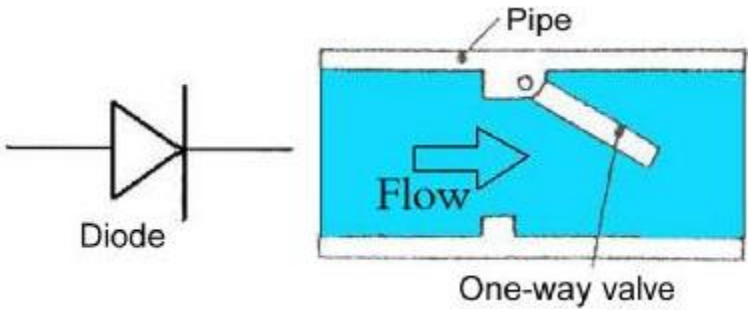
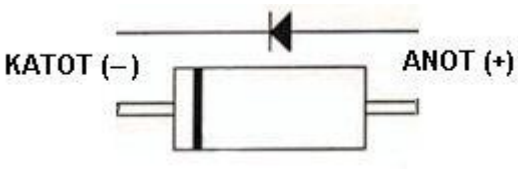


Figure 5.4: Function of diode

5.2. Electricity-Electronics Items

- **Diode**

In electronics, a diode is a two-terminal device (except that thermionic diodes may also have one or two ancillary terminals for a heater). Diodes have two active electrodes between which the signal of interest may flow, and most are used for their unidirectional current property. The varicap diode is used as an electrically adjustable capacitor.



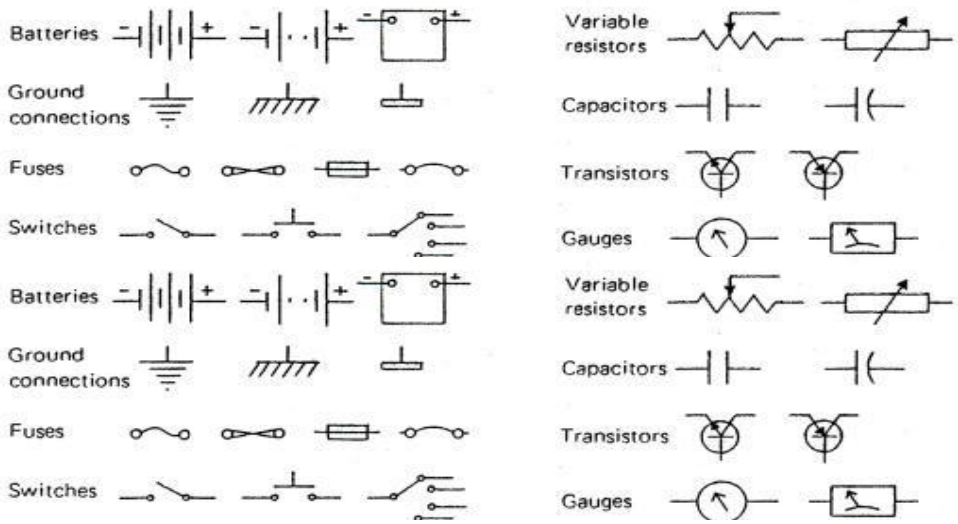
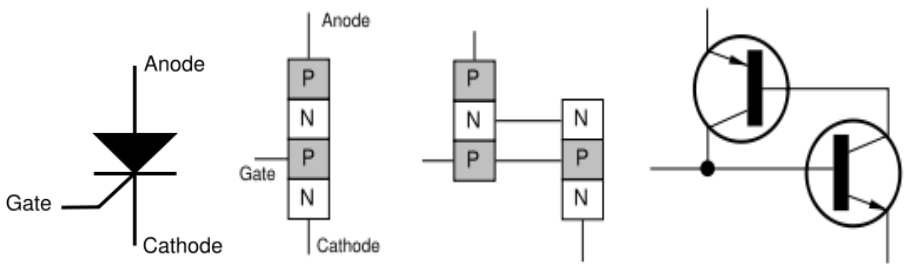


Figure 2.29: Electrical symbols

- **Thyristor**

The thyristor is a solid-state semiconductor device with four layers of alternating N and P-type material. They act as a switch, conducting when their gate receives a current pulse, and continue to conduct for as long as they are forward biased (that is, as long as the voltage across the device has not reversed

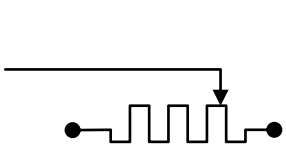


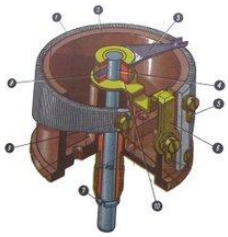
- **Resistor**

A resistor is a two-terminal electronic component that opposes an electric current by producing a voltage drop between its terminals in proportion to the current, that is, in accordance with Ohm's law: V = IR. The electrical resistance R is equal to the voltage drop V across the resistor divided by the current I through the resistor. Resistors are used as part of electrical networks and electronic circuits.

- **Potentiometer**

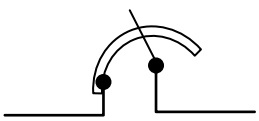
A potentiometer is a three-terminal resistor with a sliding contact that forms an adjustable voltage divider. If only two terminals are used (one side and the wiper), it acts as a variable resistor or rheostat. Potentiometers are commonly used as controls for electrical devices such as a volume control of a radio. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick.





- **Rheostats**

A rheostat is a two-terminal variable resistor. Often these are designed to handle much higher voltage and current.



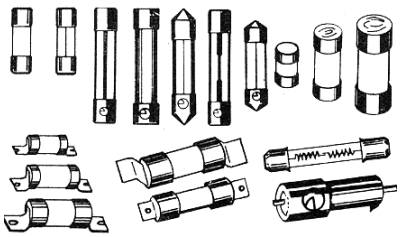
- **Contactor**

Contactors are the electro-magnetic switches which enable electrical circuits to connect, electrical receivers to run and power circuits to switch on and off.

A contactor is an electrically controlled switch (relay) used for switching a power circuit. A contactor is activated by a control input which is a lower voltage / current than that which the contactor is switching..

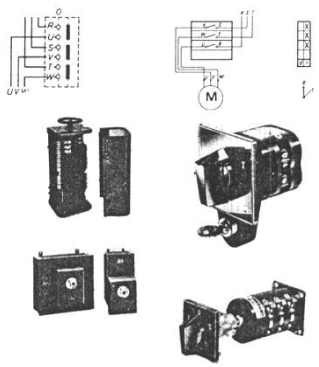
- **Fuse**

When too much current than desired flows through circuit, fuse opens the circuit and protects the elements and prevents damage. (thermic, wired, automatic fuses).



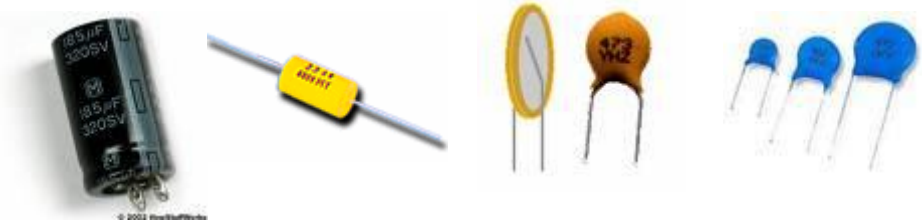
- **Switch**

It is a part that opens or shuts the electrical circuit when needed. Switches are classified according to arc switching off system. (dry, greasy, vacuum-operated and switches with gas etc.)



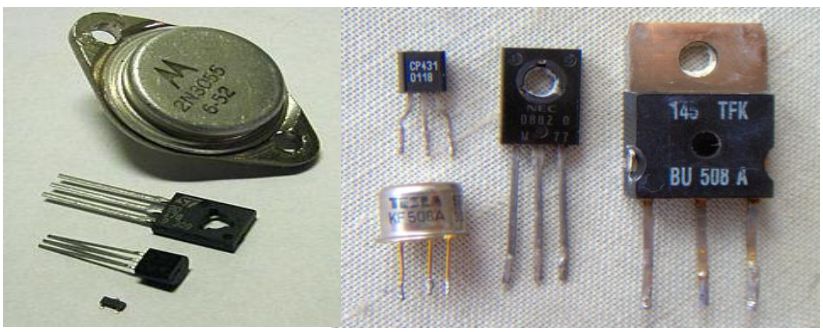
- **Capacitor**

A capacitor is an electrical/electronic device that can store energy in the electric field between a pair of conductors (called "plates"). The process of storing energy in the capacitor is known as "charging", and involves electric charges of equal magnitude, but opposite polarity, building up on each plate.



- **Transistor**

In electronics, a transistor is a semiconductor device commonly used to amplify or switch electronic signals. The transistor is the fundamental building block of computers, and all other modern electronic devices. Some transistors are packaged individually but most are found in integrated circuits.



APPLICATION ACTIVITY

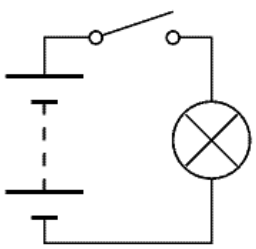
Steps of Process	Suggestions
Translate the text below into Turkish.	➢ Read the whole text. ➢ While reading try to predict the terms that you do not know. ➢ Find the english equivalents of the terms from tecnical dictionaries that you can't predict. ➢ You can find detailed information about the terms from the text.

The electron theory states that electricity is caused by a flow of electrons through a conductor. There is a shortage of electrons at one end of the conductor and a surplus at the other. Whenever this condition is present, current will flow.

An atom is made of neutrons, proton s and electrons. The electron is a negative charge of electricity, while the proton is positively charged. The neutron is neutral, electrically.

The free electrons in an atom are those that are relatively easy to "shake" out of orbit. The free electrons are those that cause the current flow. The pressure that causes current to flow is VOL TAGE. The amount of current flowing is measured in AMPERES. Every conductor will have some RESISTANCE to the movement of electrons.

What is electricity?



Electricity is the flow of charge around a circuit carrying energy from the battery (or power supply) to components such as lamps and motors.

Electricity can flow only if there is a complete circuit from the battery through wires to components and back to the battery again.

The diagram shows a simple circuit of a battery, wires, a switch and a lamp. The switch works by breaking the circuit.

With the switch open the circuit is broken - so electricity cannot flow and the lamp is off.

With the switch closed the circuit is complete - allowing electricity to flow and the lamp is on. The electricity is carrying energy from the battery to the lamp.

We can see, hear or feel the effects of electricity flowing such as a lamp lighting, a bell ringing, or a motor turning - but we cannot see the electricity itself, so which way is it flowing?

CHECKLIST

If you have behaviors listed below, evaluate yourself putting (X) in “Yes” box for your earned skills within the scope of this activity otherwise put (X) in “No” box.

Evaluation Criteria	Yes	No
Did you use technical english related to the upper structure and basic definitions and terms?		
Did you use technical english related to the tunnel, bridge, walkway etc. structures?		

EVALUATION

Please review your"No" answers in the form at the end of the evaluation. If you do not find yourself enough, repeat learning activity. If you give all your answers "**Yes**" to all questions, pass to the "Measuring and Evaluation

MEASURING AND EVALUTION

Choose the correct answer

1. Which one is energy (Electrical Pressure) that moves the current?

A) Voltage
B) Bridge Resistance
C) Amperes
D) None

2. Which on describes the opposition to current flow?

A) Voltage
B) Resistance
C) Amperes
D) None

3. Which one is used measuring unit as work for electrical equipments?

A) Pascal
B) Volt
C) Joule
D) None

4. Which one is a type of circuit?

A) Seri circuit
B) Parallel circuit
C) Combination (Seri/Parallel) circuit
D) All

5. Which one requires an electrical circuit?

A) A voltage source
B) Connecting wires
C) An electrical load
D) All

EVALUATION

Compare your answers with the answer key. Assess yourself by determining the number of correct answers. Hesitate to give the wrong answer, or where you live, answering questions, go back to again check the operational issues related to.

If you answered all questions correctly, please evaluation module.

MODULE EVALUATION

EVALUATION

Please compare the answers with the answer key. If you have wrong answers, you need to review the Learning Activity. If you give right answers to all questions, pass to the next learning activity.

Write " True or False" according to the knowledge

1. DRS is a system which aims to send trains from station or to receive trains to the same station. _____
2. In TMI system there is a control center where 40-50 stations are bound to. _____
3. Dwarf signals that are placed on very long steel pipes._____
4. Arrival signals are the commanded signals with high four lamps placed at the entrance of station and sidings. _____
5. When lanterns are used, if you see green lantern, you must speed down 25 km/h,in super Express. _____
6. Station staff use service telephones to communicate about train traffic. _____
7. Electrical current is a flow of electrons, and the more electrons in motion, the stronger the current is. _____
8. In electronics, a diode is a three-terminal device. _____
9. When too much current than desired flows through circuit, fuse opens the circuit and protects the elements and prevents damage. _____
10. Traction units are the units that will do the electrical shuntings which will be needed in running aerial line contact systems. _____

ANSWER KEYS

LEARNING ACTIVITY -1

QUESTIONS	ANSWERS
1	B
2	A
3	D
4	C
5	A

LEARNING ACTIVITY -2

QUESTIONS	ANSWERS
1	A
2	D
3	B
4	D
5	C

LEARNING ACTIVITY -3

QUESTIONS	ANSWERS
1	A
2	B
3	D
4	C
5	B

LEARNING ACTIVITY -4

QUESTIONS	ANSWERS
1	A
2	D
3	C
4	B
5	A

LEARNING ACTIVITY -5

QUESTIONS	ANSWERS
1	A
2	B
3	D
4	D
5	D

MODULE EVALUATION

QUESTIONS	ANSWERS
1	T
2	F
3	F
4	T
5	T
6	F
7	T
8	F
9	T
10	T

Assess yourself and compare your answers with the answer keys

SOURCES

- SOLTEKİN Hilmi, **Elektrik Bilgisi**, TCDD Eğitim Merkezi yayınlanmamış ders notları.
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- ÖREKÇİ M.Özgür, **Bitirme Tezi**, T.C. Osmangazi Üniversitesi MMF Makine Mühendisliği Bölümü.
- TCDD yayınlanmamış ders notları.