

LESSON PLAN
Technical/Electronics

Name of school	Grup Școlar 'Radu Negru' Galați
Level	11 th form (English L1, Intermediate+)
Area	Technical/electronics
Time	200 min. (4 classes, 50 minutes each)
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The Teaching/Learning Unit: ELECTRIC MACHINES

Purpose of the unit: to familiarize the students with the basic principles, the notions and the English vocabulary that will enable them to tackle the subject successfully when they come to it, in the 12th grade.

Time allocated: The unit was devised for a two-hour class / unconventional lesson.

A. Basic Principles: Generators vs. motors

I. Prequestions

1. Do you know how electricity is produced?
2. Mention some conventional or/and alternative (non-conventional) sources of energy.
3. How important are electric motors in our everyday life? How do we use them?

II. Access to text

Read the definitions and try to answer the following questions:

1. What is the difference between AC (alternating current) and DC (direct current)?
2. Define 'electromagnetic induction'.
3. What's a dynamo?
4. What is an electric motor?
5. What is the difference between an electric motor and a generator?

Definitions:

1. **AC (alternating current)** = "an electric current that reverses its direction many times a second at regular intervals, typically used in power supplies".
2. **DC (direct current)** = "an electric current flowing in one direction only".
3. **motor - electric motor** = "a device that changes power into movement, used to make machines work"; a device that changes electric power into movement.
4. **electric generator** = "machine for producing electric energy / dynamo or similar machine for converting mechanical energy into electricity".
5. **electromagnetic** = "having both electrical and magnetic properties / of or relating to the interrelation of electric currents or fields and magnetic fields".
6. **induction** = the production of an electric or magnetic state by the proximity (with-out contact) of an electrified or magnetized body"/ " the production of an electric current in a conductor by varying the magnetic field applied to the conductor".

7. excitation = “current in a coil that gives rise to a m.m.f.(MagnetoMotive Force) in a magnetic circuit, especially in a generator or motor.”

8. magnetic field = “ region around a magnetic material or a moving electric charge within which the force of magnetism acts.”

III. Reading

Read the text below. Look up the words you don't know in the Mini Technical Dictionary (Electric generators and motors) at the end of the unit.

The 19th century witnessed a major scientific breakthrough: the discovery of the principles that later on were to lay the foundation for electrical engineering, the branch of science and technology concerned with the design, building and use of motors, machines and structures.

Two closely related physical phenomena are involved, magnetism and electricity, and the principles are the principle of electromagnetic induction and the principle of reversibility of electromagnetic movement and electromagnetic induction.

The first was discovered by the British physicist Michael Faraday in 1831; it states that “if a conductor is moved through a magnetic field or if the strength of a stationary conducting loop is made to vary, a current is set up or induced in the conductor; in other words, if a wire is passed so that it crosses the magnetic lines of force, an electric current will flow along the wire. This is the basic principle of how electricity is generated. The second had been discovered by the French physicist and mathematician Andre Marie Ampere in 1820. He noticed that “if a current is passed through a conductor located in a magnetic field, the field exerts a mechanical force on it”.

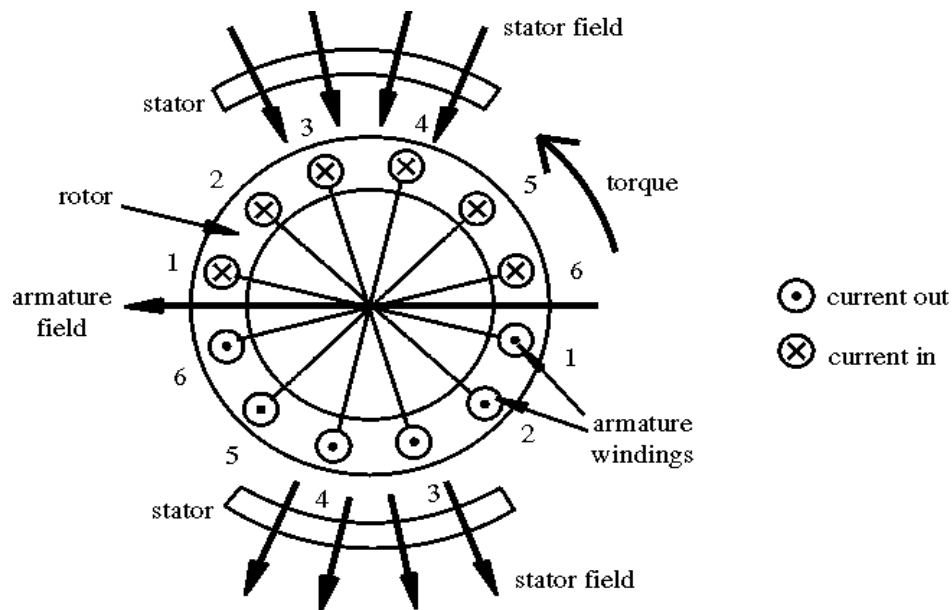
Later on other scientists developed this theory and formulated the principle of reversibility of electromagnetic movement and electromagnetic induction. This is the principle of reversibility of electric motors. In the motor, the current that flows through a coil of wire called an armature, which is mounted inside a magnetic field, will cause the coil to rotate.

Thus, electricity may be used to produce a magnetic field and a magnetic field can generate electricity. A machine that converts mechanical energy into electrical energy is called a generator, alternator, or dynamo. A machine that converts electrical energy into mechanical energy is called a motor.

A brief analysis reveals the fact that electric generators and electric motors are quite similar in construction; they both consist of two basic units:

- the electromagnet with its coils which generates the magnetic field;*
- the armature, which is the structure that supports the conductors which cut the magnetic field and carry the induced current (in a generator) or the exciting current (in a motor).*

(Source: Encarta 2000)



IV. Focus on vocabulary and content

Exercise A.1.

Fill in the gaps with the right word(s) from the text:

1. Electric generators are also known as _____ (DC) or _____ (AC).
2. The basic principle of how electricity is generated is called _____.
3. The principle of electromagnetic _____ was discovered by the British physicist Michael Faraday.
4. A machine that converts _____ energy into electrical energy is called a generator.
5. A machine that converts electrical energy into mechanical energy is called a _____.
6. In a generator, the conductors which cut the magnetic field carry the _____ current.
7. In a motor, the conductors that cut the electric field carry the _____ current.

Exercise A.2.

Find words in the text that mean: alternator, produce, induced, magnetic field, armature.

Exercise A.3.

Match two halves (one from column A, one from column B) to form correct sentences:

A

1. A motor is a machine that -
2. The principle of electromagnetic induction -
3. Electrical engineering -
4. Electricity may be used to -
5. A machine that converts mechanical energy into electrical energy –
6. If a wire is passed so that it crosses the magnetic lines of force, -

B

- a – is the basic principle of how electricity is generated.
- b – produce a magnetic field.
- c – converts electrical energy into mechanical energy.
- d – an electric current will flow along it.
- e – is a branch of science and technology.
- f – is called an generator.

V. Grammar**Special plurals: Latin or Greek nouns**

The language of science and technology often uses words that come into English from foreign languages. Many such words are of Latin or Greek origin and they retain their original plurals, according to the rules of the language they come from.

e.g. phenomenon (sg.) – phenomena (pl.) Greek ; line [5]

basis (sg.) – bases (pl.) Greek

analysis (sg.) – analyses (pl.) Latin ; line [30]

Exercise A.4.

Give the plural of the following nouns (look them up in a dictionary; G stands for Greek, L stands for Latin).

- 1) criterion [G] 2) formula [L] 3) hypothesis [G] 4) nucleus [L] 5) radius [L]
- 6) stimulus [L] 7) crisis [G]

The Passive Voice

We use the Passive Voice in English when we are more interested in stressing the action / thing done rather than the doer / agent of it or when the agent is not important or not known.

Each active tense in English has a passive equivalent; this is formed by putting the verb **to be** into the **appropriate tense** and adding the **Past Participle** of the main verb.

To be + Past Participle

e.g. is done, was sent, will be written, may be found, etc.

Sometimes, in a passive clause, we use a phrase beginning with **by** – thus we mention the person or the thing that does the action, or that causes what happens.

e.g. The former **was discovered by** the British physicist Michael Faraday...

The latter **had been discovered by** the French physicist A.M. Ampere

A larger number of phases may **be obtained by** increasing the number of the windings in the armature.

We often choose to use passive structures without mentioning the agent. Passives without agents are common in scientific writings.

e.g. Two closely related phenomena **are involved**...

...a current **is set up or induced** in the conductor...

...which **is mounted** inside a magnetic field...

...electricity may **be used** to produce a magnetic field...

Exercise A.5.

Use the verb in brackets in the right Passive Voice tense:

- 1) The alternating-current motors _____ to operate on alternating-current circuits. (to design)
- 2) Electricity may _____ to produce a magnetic field. (to use)
- 3) If a current _____ through a conductor located in a magnetic field, the field exerts a mechanical force on it. (to pass)
- 4) New electric machines _____ in the future. (to develop)
- 5) The generators which produce electricity for our daily use _____ to send out alternating-current. (to make)
- 6) Some generators _____ so that the current produced always flows in the same direction; this _____ direct-current. (to build/ to call)

Exercise A.6.

Translate into Romanian:

The first dynamo based on Faraday's principles was built in 1832 by Hippolyte Pixii, a French instrument maker. It used a permanent magnet which was rotated by a crank. The spinning magnet was positioned so that its north and south poles passed by a piece of iron wrapped with wire. Pixii found that the spinning magnet produced a pulse of current in the wire each time a pole passed the coil. Furthermore, the north and south poles of the magnet induced currents in opposite directions. By adding a commutator, Pixii was able to convert the alternating current to direct current.

(taken from Encarta 2000)

B. Electric Machines**I. Access to text:**

Read the definitions and try to answer the following questions:

1. What is the difference between a synchronous machine and an asynchronous machine?
2. What is the difference between rotor and stator?
3. How is the alternator also called?

Definitions

1. asynchronous machine = 'the electrical machine having each operation started only after the preceding operation is completed.'

2. synchronous machine = 'an alternating current machine in which the average speed of normal operation is exactly proportional to the frequency of the system to which it is connected.'

3. rotor = 'a rotating member of a machine'

4. stator = 'a portion of a machine which remains fixed with respect to rotating parts, especially the collection of stationary parts in the magnetic circuits of a machine.'

5. alternator = 'a generator of alternating current.'

6. hydraulic = 'operated by the pressure created by forcing water, oil or another liquid through a comparatively narrow pipe or orifice.'

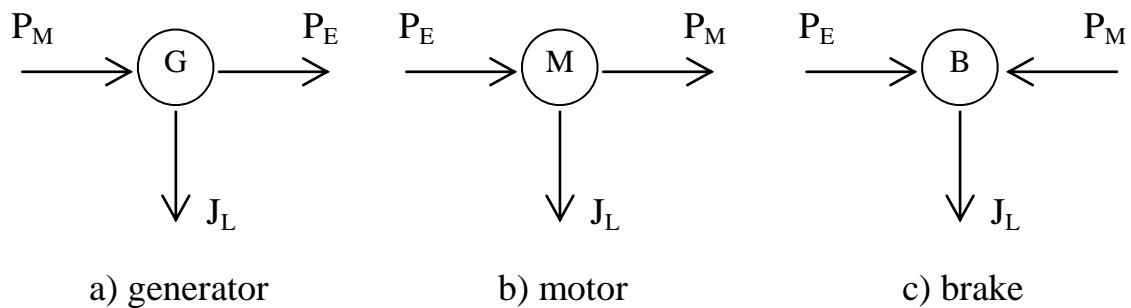
II. Reading

Read the text below. Look up the words you don't know in the Mini Technical Dictionary at the end of the unit.

People use electric machines in any field of activity. The electric machines represent the sources of electric energy or the operating elements which perform mechanical work by mechanisms and industrial devices.

Electric machines perform the electromechanical conversion of energy and they are reversible.

We use the symbols P_M for mechanical power, P_E for electric power and J_L for irreversible energy loss entailed by Joule's effect, friction and inside the magnetic core. The operating modes of electric machines can be symbolized as follows:



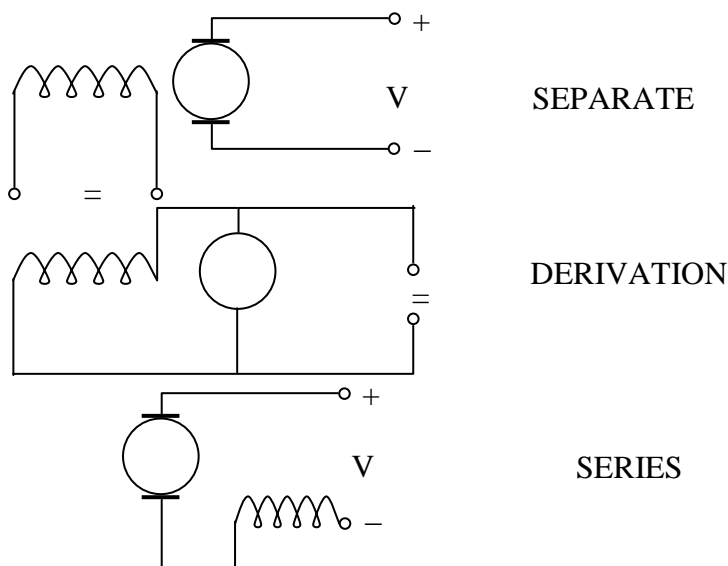
As you can notice there are irreversible energy losses which are transformed into heat.

Rotating electric machines are the most common electric machines. They have a fixed external armature called **stator** and an internal armature which can be rotated called **rotor**.

Electric machines can be classified according to the type of the electric current as follows:

- a) direct current electric machine
- b) alternating current electric machines

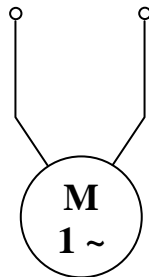
The direct current electrical machines have coils fixed on the stator and they are mounted on the main poles which provide the machine 'excitation'.



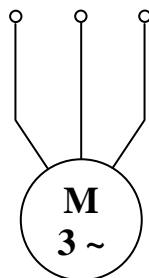
The alternating current electric machines can be: **synchronous** machines and **asynchronous** machines.

The **asynchronous** machines are robust and safe to be used, that's why they are the most used operating motors.

They can be single-phase motor and three-phase motor.



**ASYNCHRONOUS SINGLE-PHASE
MOTOR**



**ASYNCHRONOUS THREE-PHASE
MOTOR**

The **synchronous** machines are mainly used as synchronous generators which are also called **alternators**. They represent the alternating current source from the power plants.

A synchronous generator operated by a steam or gas turbine is called **turbo generator**, and if it is operated by a hydraulic turbine it is called **hydro-generator**. (taken from Encarta 2000)

III. Focus on vocabulary and content

Exercise B.1.

Decide whether the following sentences are true or false. Write **T/F** on the line at the end of each sentence:

1. The electric machines perform conversion of energy and they are reversible.
2. A synchronous machine is a generator of alternating current.
3. The synchronous machines are the most used operating motors.
4. A stator can be a single-phase motor or a three-phase motor.
5. A cause for the energy loss is the Joule effect.
6. A hydraulic turbine is a synchronous generator.
7. The asynchronous machine is an alternating current machine in which the average speed of normal operation is exactly proportional to the frequency of the system to which it is connected.
8. The synchronous machines can be also used as synchronous generators which are called alternators.
9. The external armature of the most common electric machines is called a stator.

10. The turbo generator is that asynchronous generator which has a hydraulic turbine.

Exercise B.2.

Choose the right word(s) from among those given to fill in the following sentences:

1. A.....is a portion of a machine which remains fixed with respect to rotating parts, especially the collection of stationary parts in the magnetic circuits of a machine.
 - a) rotor
 - b) alternator
 - c) stator
 - d) turbine

2. The electric machines perform the conversion of energy and they are reversible.
 - a) electromechanic
 - b) synchronous
 - c) asynchronous
 - d) generator

3. For the mechanical power we use the following symbol:
 - a) P_E
 - b) P_M
 - c) J_L
 - d) DC

4. The current electric machines can be: synchronous and asynchronous machines.
 - a) direct
 - b) alternating
 - c) single-phase
 - d) three-phase

5. A synchronous generator operated by a steam gas turbine is called
 - a) a hydro-generator
 - b) a turbo-generator
 - c) an atomic generator
 - d) a wind generator

IV. Listening comprehension

Listen to a fragment on tape; a native English speaker was interviewed by one of the members on the team. After listening carefully, try to answer the following questions:

1. What is the interviewee's educational background?
2. What does she do for a living in the United States?
3. In her opinion, what section of the project is excellent?
 - a) the texts
 - b) the exercises
 - c) the vocabulary
 - d) the interview
4. Why are school projects important?

C. Help pages

Key to exercises:

A.1.

1. dynamos; alternators; 2. electromagnetic induction; 3. induction; 4. mechanical; 5. motor; 6. induced; 7. exciting

A.2.

generator ; generate ; set up ; magnetic lines of force ; structure (that supports the conductors which cut the electric field)

A.3.

1. – c
2. – a
3. – e
4. – b
5. – f
6. - d

A.4.

criterion – criteria
formula – formulae
hypothesis – hypotheses
nucleus – nuclei

radius – radii
stimulus – stimuli
crisis – crises

A.5.

- | | |
|-----------------|--------------------------|
| 1. are designed | 4. will be developed |
| 2. be used | 5. are made |
| 3. is passed | 6. are built / is called |

B.1

- | | |
|------|-------|
| 1. T | 6. T |
| 2. T | 7. F |
| 3. F | 8. T |
| 4. F | 9. T |
| 5. T | 10. F |

B.2.

- c
- a
- b
- b
- b

Tapescript

Interviewer: "Will you..., will you, please, introduce yourself to our listeners and give your credentials."

D.H.: "My name is Dawn Harvey and I live in Connecticut in the United States of America. I have a degree in Sociology and Economics. And my husband has a degree in Electrical Engineering. We own and operate a computer company"

Interviewer: "You are familiar with our project. What do you think about it? Do you think it can help someone who studies electric motors to learn more about them?"

D.H.: "Absolutely! I think you guys did a terrific job. And I think the vocabulary section is excellent."

Interviewer: "How important are school projects in the United States?"

D.H.: "Very important; they teach us teamwork and effective communication skills."

Interviewer: "You were with us last year when we presented the first part of our project. What do you think about our team at Grupul Scolar Radu Negru?"

D.H.: "I think you guys have a GREAT team! And I think you did a great job last year and I'm sure you'll be equally great this year."

Interviewer: "Thank you very much!"

D.H.: "You're welcome!"

Mini Technical Dictionary (Electric generators and motors)

alternating current = *curent alternativ*

amount = *sumă, total, cantitate*

armature = *armătură*

to attain = *a atinge, a ajunge (la anumiți parametrii)*

automatic relay = *releu automat*

to brace = *a propti*

carbon brush = *perie de carbine*

circuit breaker = *întrerupător*
coil = *bobină*
coil of wire = *tobă de cablu*
collar thrust bearing = *cuplaj prin transformator*
commutator = *colector*
condenser = *condensator*
convert = *a transforma, converti*
core = *miez*
design = *plan, proiect*
direct current = *curent continuu*
distorsion = *distorsiune*
efficiency = *randament*
electric arc = *arc electric*
electric generator = *generator electric*
electric motor = *motor electric vs. engine*
electromotive force = *forță electromotoare*
to embed = *a introduce, a încorpora*
enamel = *email*
engineering = *inginerie, tehnică*
equidistantly = *echidistant*
fan = *ventilator*
fasten = *a fixa, lega*
flow = *a trece, a (se) scurge*
fractional = *de fracțiune*
frame = *schelet, structura, cadru*
frequency = *frecvență*
fuse = *siguranță*
ground = *legare la pământ*
induction = *inducție*
interwoven = *interdependent*
input current = *curent de alimentare*
to insulate = *a izola*
insulating brushing = *manșoane izolatoare*
internal faults = *avarii, defecțiuni*
interpole windings = *bobinaje de compensare*
lacquer = *smalt*
lead = *bornă*
to map out = *a trasa, a schița*
mount = *a monta*
non-pulsating current = *curent nepulsatoriu*
oil filled condenser = *condensator cu ulei*
output (power) = *putere de ieșire*
overload = *suprasarcină*
peak load = *sarcina de varf*
phase-to-phase = *scurt-circuit între faze*
phenomenon/ phenomena = *fenomen/fenomene*

pole = *pol*
polyphase = *polifazic*
relay = *releu*
reluctance = *reluctanță*
to remove = *a transfera (a îndepărta)*
ring = *inel*
series-wound = *infășurat în serie*
short-circuited turn = *spiră scurt circuitată*
shunt motor = *motor derivație*
single-phase motor = *motor monofazic*
to slide = *a glisa*
slot = *locas, nut*
solid dielectric condenser = *condensator cu dielectric solid*
sparking = *scânteie*
speed regulation = *reglarea vitezei*
split rings = *inele colectoare*
squirrel-cage = *colivie*
supply = *a alimenta, a furniza, a procura*
starting torque = *cuplu de pornire*
stationary = *staționar*
switching equipment = *echipament de comutație*
synchronous motor = *motor sincron*
torque = *cuplu*
trip coils = *miez mobil*
varnish = *lac*
voltage = *voltaj*
winding = *bobinaj*
wire-wound coil = *bobină de sârmă*
wound-rotor induction motor = *motor de inducție cu rotor bobinat*