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وزارة التعليم العالي و البحث العلمي
Ecole Supérieure en Génie Electrique et Energétique – Oran
المدرسة العليا في الهندسة الكهربائية و الطاقة – وهران



Anglais pour Formation d'Ingénieur en Génie Electrique

2^{ème} Cycle – 1^{ère} année

Cours et Exercices Résolus

Unités 1 et 2

1^{er} Semestre

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Unit one

Introduction to Electrical Engineering

Unit one: Introduction to Electrical Engineering

Time-length: 11h45mn

Objectives:

- 1- To acquaint students with the different branches of engineering and the meaning of the engineering activity;
- 2- To introduce students to the concerns of electrical engineering and engineers including the tasks and skills required in this field;
- 3- To increase students' knowledge about the development of the electrical engineering field throughout time;
- 4- To introduce students to certain educational terms used in the engineering course;
- 5- To motivate students, future engineers, to review, improve and extend their knowledge of English grammar they need in the specialist field.

The approach:

Based on:

- 1- Developing students' key English mastery of academic skills by focusing on receptive skills (reading and understanding technical texts, and listening and comprehension) to trigger productive skills (speaking in technical English and technical writing);
- 2- Providing practice in the writing styles that are required in science and engineering such as explanation, persuasion, and critical analysis;
- 3- Providing opportunity for verbal communication throughout class discussion.

Outline

Topic one: Branches of Engineering (3h15)

Topic two: Electrical Engineering (4h)

Topic three: Engineering Student (4h)

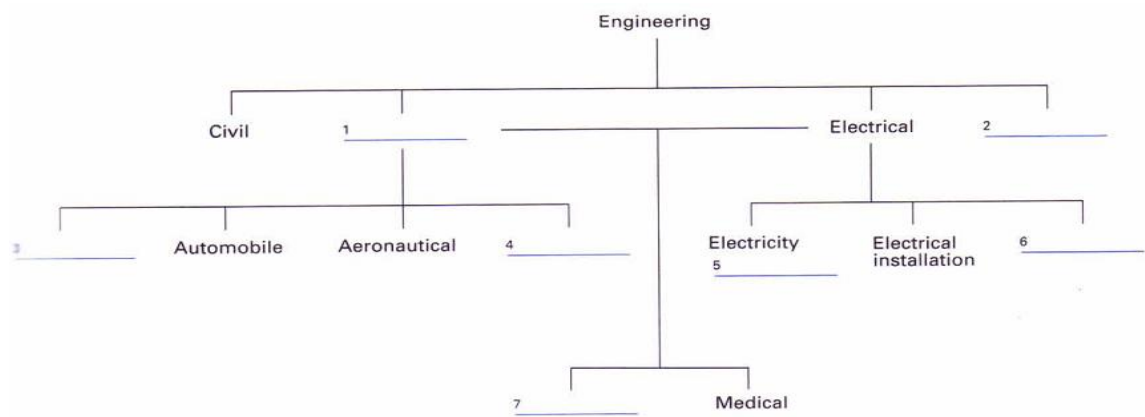
<i>Language Skills (6h35mn)</i>	<i>Language Knowledge (4h40mn)</i>
<p><i>Listening & Speaking: (3h)</i></p> <ul style="list-style-type: none"> - Listening to short extracts for collecting specific information and note taking - Listening to interviews for completing missing information - Listening for general ideas and for details - Comparing answers and sharing ideas <p><i>Reading and comprehension (2h)</i></p> <ul style="list-style-type: none"> - Understanding meaning from context - Completing diagrams. - Reading equations and formulas <p><i>Guided Writing: (1h35)</i></p> <ul style="list-style-type: none"> - Sentence building - Paragraph building 	<p><i>Grammar: (2h30)</i></p> <ul style="list-style-type: none"> - The present simple tense - Deal with / to be concerned with - Similarities and differences - Past participles as adjectives <p><i>Vocabulary: (1h40)</i></p> <ul style="list-style-type: none"> - Names of branches of engineering - Words related to electrical engineering <p><i>Pronunciation: (30mn)</i></p> <ul style="list-style-type: none"> - Word stress

Topic one: Branches of Engineering

Time allotted: 3h15mn

I- Discussion

- 1- List the main branches of engineering?
- 2- Listen to your teacher reading a text about the main branches of engineering and then complete the diagram below.



II- Language Study: “to deal with / to be concerned with”

- Study the table below and express the link between columns A–B and columns B-C using “to deal with” / “to be concerned with” and “to be the concern of”

A	B	C
Mechanical engineering	machines	Mechanical engineers
Electrical engineering	electricity	Electrical engineers

Exercise: Match each item in column **A** with an appropriate item from column **B** and link the two in a sentence.

- | A | B |
|----------------------------|---------------------------------|
| 1) marine | a- air-conditioning |
| 2) aeronautical | b- roads and bridges |
| 3) heating and ventilating | c- body scanners |
| 4) electricity generating | d- cables and switchgear |
| 5) automobile | e- communications and equipment |
| 6) civil | f- ships |
| 7) electronic | g- planes |
| 8) electrical installation | h- cars and trucks |
| 9) medical | i- power stations |

III- Pronunciation : “word stress”

Words are divided into syllables. For example: engine: **en.gine** /engineer: **en.gin.eer** /
engineering: **en.gin.eer.ing**.

Each syllable is pronounced separately, but normally only one syllable is stressed. That means it is said more slowly and clearly than the other syllables. We say “‘engine” but “engin'eer”. A good dictionary will show the stressed syllables.

Exercise: Listen to these words. Try to mark the stressed syllables.

*machinery / mechanical / machine / install / installation / electricity / electrical / electronics /
aeronautical / ventilation*

IV- Writing

Fill in the gaps in the following description of the different branches of engineering using information from the diagram and language you have studied in this lesson.

The main branches of ¹ _____ are civil, ² _____, ³ _____, and electronic. Mechanical engineering is ⁴ _____ ⁵ _____ machinery of all kinds. This ⁶ _____ of engineering includes ⁷ _____, automobile, ⁸ _____, and heating and ventilating. The first three ⁹ _____ ¹⁰ _____ with transport: ¹¹ _____, cars and planes. The last ¹² _____ with air- conditioning, refrigeration, etc.

Electrical engineering ¹³ _____ with ¹⁴ _____ from generation to use. Electricity ¹⁵ _____ is concerned with ¹⁶ _____ stations. Electrical ¹⁷ _____ deals ¹⁸ _____ cables, switchgear, and connecting up electrical equipment.

Two branches of engineering include both ¹⁹ _____ and ²⁰ _____ engineers. These are mining and ²¹ _____ engineering. The former deals with mines and mining equipment, the latter with hospital ²² _____ of all kinds.

V- Listening

- 1- Listen to these short extracts. To which branch of engineering do these engineers belong?
- 2- Listen again. This time note the words which helped you decide on your answers.

VI- Speaking

- 1- Discuss in groups the following questions.
 - a- What field of engineering are you studying?
 - b- How would you describe your branch of engineering to a non-specialist?
 - c- What kind of work would you like to do within your field?
 - d- In what kinds of situation do you / other people in your field need to use English at work?

- 2- Figure 1.1 and table 1.1 introduce the different electrical engineering disciplines. In groups, comment both of them. Can you say what each discipline is concerned with. Use language you have studied in this lesson.

Table 1.1 Electrical engineering disciplines

Circuit analysis
Electromagnetics
Solid-state electronics
Electric machines
Electric power systems
Digital logic circuits
Computer systems
Communication systems
Electro-optics
Instrumentation systems
Control systems

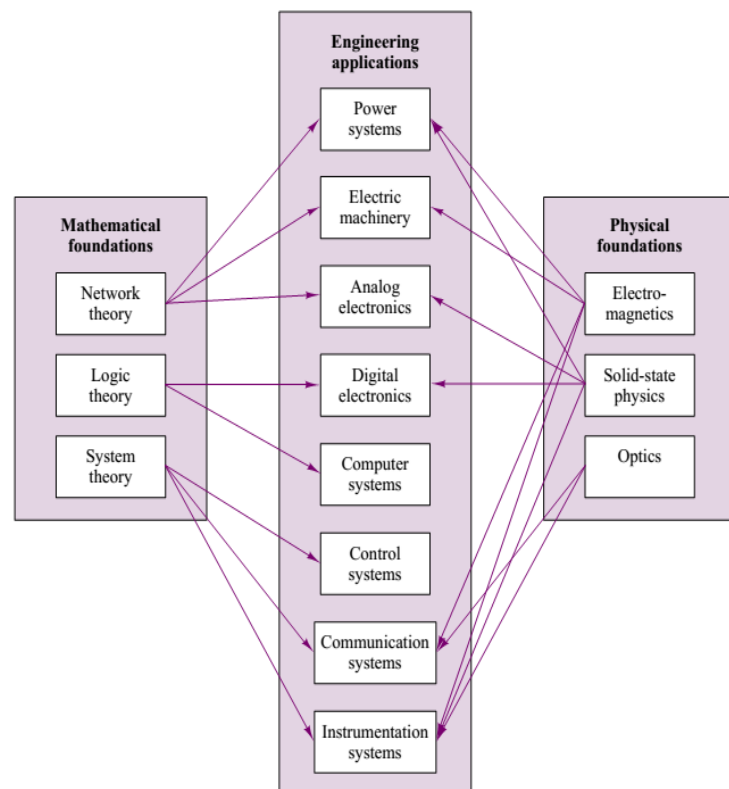


Figure 1.1 Electrical engineering disciplines

Key answer

I- Discussion

1- List the main branches of engineering?

These are some examples that can be listed by the students:

- *Mechanical engineering – electrical engineering – electronics – civil engineering – architecture – medical engineering – computer science – information technology – metallurgy – hydraulics - etc.*
- 2- Listen to your teacher reading a text about the main branches of engineering and then complete the diagram below.

The text:

Engineering is largely a practical activity. It is about putting ideas into action. Civil engineering is concerned with making bridges, roads, airports, etc. Mechanical engineering deals with the design and manufacture of tools and machines. Electrical engineering is about the generation and distribution of electricity and its many applications. Electronic engineering is concerned with developing components and equipment for communications, computing, and so on.

Mechanical engineering includes marine, automobile, aeronautical, heating and ventilating, and others. Electrical engineering includes electricity generating, electrical installation, lighting, etc. Mining and medical engineering belong partly to mechanical and partly to electrical.

¹Mechanical
⁵generating

²Electronic
⁶Lighting

³Marine
⁷Mining

⁴Heating and ventilating

II- Language Study:

- Expressing the link between columns A–B and columns B-C using “*to deal with*” / “*to be concerned with*” and “*to be the concern of*”

- 1) *Mechanical engineering deals with machines.*
- 2) *Mechanical engineers deal with machines.*
- 3) *Mechanical engineering is concerned with machines*
- 4) *Mechanical engineers are concerned with machines.*
- 5) *Machines are the concern of mechanical engineers.*

Exercise: Match each item in column A with an appropriate item from column B and link the two in a sentence.

- 1) f
- 2) g
- 3) a
- 4) i
- 5) h
- 6) b
- 7) e, c
- 8) d

Examples:

- 1) *Marine deals with ships. / Ships are the concern of marine.*
- 6) *Civil engineering is concerned with roads and bridges. / Roads and bridges are the concern of civil engineers.*

III- Pronunciation : “word stress”

Exercise: Listen to these words. Try to mark the stressed syllables.

*Ma'chinery / me'chanical / ma'chine / in'stall / insta'llation / elec'tricity / e'lectrical / elec'tronics
/ aero'nautical / venti'lation*

IV- Writing

¹ engineering	² mechanical	³ electrical	⁴ concerned	⁵ with	⁶ branch
⁷ marine	⁸ aeronautical	⁹ are	¹⁰ concerned	¹¹ ships	¹² deals
¹³ deals	¹⁴ electricity	¹⁵ generating	¹⁶ power	¹⁷ engineering	
¹⁸ with	¹⁹ mechanical	²⁰ electrical	²¹ medical	²² equipment	

V- Listening

- 1- *Electricity generating (power station, turbine, shifts)*
- 2- *Medical engineering (body scanners, x-rays)*
- 3- *Aeronautical (jet engines, onboard, take-offs)*
- 4- *Marine (sea, refit)*
- 5- *Heating and ventilating (working environment, comfortable, heating, ventilation)*
- 6- *Electrical engineering (safety, earthed, shock)*
- 7- *automobile (fuel consumption, engine emission)*

Extracts:

- 1) *I work in a power station. I'm responsible for turbine maintenance. I work shifts: midnight to eight o'clock this month.*
- 2) *I design body scanners. They give doctors far more information than x-rays and there's no risk to the patient.*
- 3) *I work on jet engines on board computers record readings every five hours and every twenty-five take-offs. This information allows us to carry out servicing before defects or reduction in performance, occur.*
- 4) *The best thing about my job is that I get to go on sea trials after the refit is finished.*
- 5) *I'm working with the architects of a new hospital. Getting the heating and ventilation right is important. I have to make sure that the working environment will be comfortable for the patient and staff.*
- 6) *Safety is very important in my job. Everything must be earthed to make sure that no one gets a shock.*
- 7) *My main areas of expertise are fuel consumption and engine emission. International pressures are really making things difficult for us.*

Topic two: Electrical Engineering

Time length: 4h

I- Reading Comprehension

1- Before reading the articles, in group discuss these questions.

- a- What is Electrical Engineering concerned with?
- b- What is the concern of electrical engineers?
- c- Do you know these names: *Michael Faraday, Thomas Edison, George Westinghouse, Nikola Tesla, Guglielmo Marconi* and *Philo T. Farnsworth*?
- d- Match their names with the following inventions?
Electric light bulb – TV- Alternating current - Induction motor – Radio - Law of Induction

2- Now read the articles to check your answers and learn more about electrical engineering and electrical engineers' concerns.

What Is Electrical Engineering?

Electrical engineering is one of the newer branches of engineering, and dates back to the late 19th century. It is the branch of engineering that deals with the technology of electricity. Electrical engineers work on a wide range of components, devices and systems, from tiny microchips to huge power station generators.

Early experiments with electricity included primitive batteries and static charges. However, the actual design, construction and manufacturing of useful devices and systems began with the implementation of *Michael Faraday's Law of Induction*, which essentially states that the voltage in a circuit is proportional to the rate of change in the magnetic field through the circuit. This law applies to the basic principles of the electric generator, the electric motor and the transformer. The advent of the modern age is marked by the introduction of electricity to homes, businesses and industry, all of which were made possible by electrical engineers.

Some of the most prominent pioneers in electrical engineering include *Thomas Edison* (electric light bulb), *George Westinghouse* (alternating current), *Nikola Tesla* (induction motor), *Guglielmo Marconi* (radio) and *Philo T. Farnsworth* (television). These innovators turned

ideas and concepts about electricity into practical devices and systems that ushered in the modern age.

Since its early beginnings, the field of electrical engineering has grown and branched out into a number of specialized categories, including power generation and transmission systems, motors, batteries and control systems. Electrical engineering also includes electronics, which has itself branched into an even greater number of subcategories, such as radio frequency (RF) systems, telecommunications, remote sensing, signal processing, digital circuits, instrumentation, audio, video and optoelectronics.

The field of electronics was born with the invention of the thermionic valve diode vacuum tube in 1904 by *John Ambrose Fleming*. The vacuum tube basically acts as a current amplifier by outputting a multiple of its input current. It was the foundation of all electronics, including radios, television and radar, until the mid-20th century. It was largely supplanted by the transistor, which was developed in 1947 at AT&T's Bell Laboratories by *William Shockley, John Bardeen* and *Walter Brattain*, for which they received the 1956 Nobel Prize in physics.

What does an electrical engineer do?

"Electrical engineers design, develop, test and supervise the manufacturing of electrical equipment, such as electric motors, radar and navigation systems, communications systems and power generation equipment." Electronics engineers design and develop electronic equipment, such as broadcast and communications systems — from portable music players to global positioning systems (GPS)."

If it's a practical, real-world device that produces, conducts or uses electricity, in all likelihood, it was designed by an electrical engineer. Additionally, engineers may conduct or write the specifications for destructive or nondestructive testing of the performance, reliability and long-term durability of devices and components.

Today's electrical engineers design electrical devices and systems using basic components such as conductors, coils, magnets, batteries, switches, resistors, capacitors, inductors, diodes and transistors. Nearly all electrical and electronic devices, from the generators at an electric power plant to the microprocessors in your phone, use these few basic components.

Critical skills needed in electrical engineering include an in-depth understanding of electrical

and electronic theory, mathematics and materials. This knowledge allows engineers to design circuits to perform specific functions and meet requirements for safety, reliability and energy efficiency, and to predict how they will behave, before a hardware design is implemented. Sometimes, though, circuits are constructed on breadboards, or prototype circuit boards made on computer numeric controlled (CNC) machines for testing before they are put into production.

Electrical engineers are increasingly relying on computer-aided design (CAD) systems to create schematics and lay out circuits. They also use computers to simulate how electrical devices and systems will function. Computer simulations can be used to model a national power grid or a microprocessor; therefore, proficiency with computers is essential for electrical engineers. In addition to speeding up the process of drafting schematics, printed circuit board (PCB) layouts and blueprints for electrical and electronic devices, CAD systems allow for quick and easy modifications of designs and rapid prototyping using CNC machines.

Written by Jim Lucas, Live Science contributor / August 26th, 2014

3- Now, answer the following questions using your own words.

- a-** How did Faradays' Law of Induction improve Electrical Engineering? Write the formula.
- b-** In which field is the thermionic valve diode vacuum tube used?
- c-** What skills are needed from the electrical engineer?

4- What do these abbreviations stand for:

- a-** GPS
- b-** RF
- c-** CNC
- d-** CAD
- e-** PCB

5- Find out in the articles words that mean the following.

- a-**: a constellation of approximately 30 well-spaced satellites that orbit the Earth and make it possible for people with ground receivers to pinpoint their geographic location.
- b-**: a branch of electronics that overlaps with physics. The field concerns the theory, design, manufacture, and operation of hardware that converts electrical signals to visible or infrared radiation (infrared) energy, or vice-versa. The components include photocells, solar cells, etc.
- c-**: a glass or metal enclosure in which electrons move through the vacuum or gas from one metal electrode to another.
- d-**: the representation of an integrated circuit.
- e-**: the electricity supply in a country.

6- Write the circuit symbols of the following components.

<i>Component</i>	<i>Symbol</i>
Battery	
Generator	
Electric motor	
Transformer	
Diode	

Coil	
Switch	
Resistor	
Capacitor	
Transistor	

II- Word Study

1- Parts of speech

Task: Classify these words in the table below.

Electrical – actual - rapid – newer – branch – engineering - increasingly - construction - manufacturing – useful – create – simulate- modification – develop - test - supervise – national – include- power- additionally – communication –implementation – transmission – perform- tiny – wide – destructive- reliability – skill- efficiency – safety – predict – production

<i>Noun</i>	<i>Verb</i>	<i>Adjective</i>	<i>Adverb</i>

2- Word Formation using Suffixes

- Study the tables below and then complete with the missing words.

a- Noun Formation from Verbs

<i>Verb</i>	<i>Suffix =</i>	<i>Meaning</i>	<i>Noun</i>
To manufacture To test	ing	<i>The activity of</i>	...............
To construct To produce To add To implement To modify To include To emit	ion tion ition ation cation sion ssion	<i>The action or state of</i>	..... ..... Addition
To equip	ment	<i>The action or result of</i>	equipment
To perform To differ	ance ence	<i>The action or state of</i>	.....
To refuse	al	<i>A process or state of</i>	Refusal

Exercise: Derive the nouns of these verbs by adding the right suffix from the table above.

<i>Verb</i>	<i>Noun</i>
Reduce	
Resist	
Alter	
Deduce	
Convert	
Exist	
Prefer	
Realize	
Amplify	
Improve	
Compete	
Distribute	

Propose	
Admit	
Replace	
Arrive	
Apply	
Discuss	
Explain	
Decide	
Move	
Accept	
Assist	
Tolerate	

b- Adjective Formation from Verbs

<i>Verb</i>	<i>Suffix</i>	<i>Meaning</i>	<i>Adjective</i>
Produce	<i>ive</i>	<i>Tending to; Having the nature of</i>	Productive
Realize	<i>able</i>	<i>Can or must be; Having the quality of</i>	Realizable
Change			Changeable
Comprehend	<i>ible</i>		.....
Resist	<i>ant</i>	<i>That is /does something</i>	Resistant
Differ	<i>ent</i>		.....

- Some past participles of verbs can be used as adjectives, they occur before a noun such as the **measured** current, the **transferred** energy, the **converted** current, etc.

Exercise: Derive the adjectives of these verbs by adding the right suffix from the table above.

<i>Verb</i>	<i>Adjective</i>
Explode	
Impress	
Count	
Recognize	
Accept	
Describe	
Signify	

III- Writing

- **Building sentences (Rephrasing and Paraphrasing)**

Pick up from the text five sentences describing the skills needed from an electrical engineer. Re-write the sentences using your own words. The first is done for you.

a- An electrical engineer must be able to understand deeply electrical and electronic theory, mathematics and materials.

b-

c-

d-

e-

Key answer

I- Reading Comprehension

1- Before reading: Possible answers:

- *Electrical Engineering is concerned with the technology of electricity.*
- *Electricity generating, electrical machines and networks are the concern of electrical engineers.*
- *Michael Faraday: Law of Induction , Thomas Edison: Electric light bulb, George Westinghouse: Alternating current, Nikola Tesla, Induction motor, Guglielmo Marconi : Radio, Philo T. Farnsworth: TV*

2- Reading:

3- Post-reading:

- *Faradays' Law of Induction improved the design of electric devices, especially the generator, the electric motor and the transformer. The law states that the voltage in a circuit is proportional to the rate of change in the magnetic field through the circuit, which means*
$$E = -\frac{d\phi}{dt}$$
- *The thermionic valve diode vacuum tube is used in the field of electronics.*
- *The skills needed from the electrical engineer include the possession of an in-depth understanding of electrical and electronic theory, mathematics and materials besides the mastery of computer-aided design (CAD) systems.*

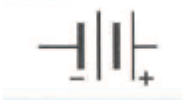
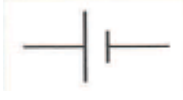

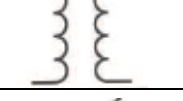


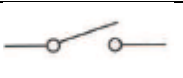
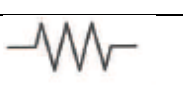
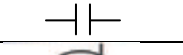

4- What do these abbreviations stand for:

- GPS : global positioning systems
- RF: radio frequency
- CNC : computer numeric controlled
- CAD: computer-aided design
- PCB: printed circuit boards

5- Find out in the articles words that mean the following.

- a- GPS
- b- Optoelectronics
- c- The thermionic valve diode vacuum tube
- d- Drafting schematics / layouts circuits
- e- a national power grid

6- Write the circuit symbols of the following components.

<i>Component</i>	<i>Symbol</i>
Battery	
Generator	
Electric motor	
Transformer	
Diode	
Coil	
Switch	
Resistor	
Capacitor	
PNP Transistor	

II- Word Study

1- Parts of speech

Task: Classify these words in the table below.

<i>Noun</i>	<i>Verb</i>	<i>Adjective</i>	<i>Adverb</i>
<i>branch – engineering – construction – manufacturing – modification – test – power – communication-implementation – transmission - reliability – skill- efficiency – safety- production</i>	<i>– simulate- – develop - create - supervise – include- test - perform - predict</i>	<i>Electrical - actual rapid – newer – useful – national - tiny – wide – destructive -</i>	<i>increasingly - additionally</i>

2- Word Formation using Suffixes

a- Noun Formation from Verbs

Verb	Suffix =	Meaning	Noun
To manufacture To test	ing	<i>The activity of</i>	Manufacturing Testing
To construct To produce To add To implement To modify To include To emit	ion tion ition ation cation sion ssion	<i>The action or state of</i>	Construction Production Addition Implementation Modification Inclusion Emission
To equip	ment	<i>The action or result of</i>	equipment
To perform To differ	ance ence	<i>The action or state of</i>	Performance Difference
To refuse	al	<i>A process or state of</i>	Refusal

Exercise: Derive the nouns of these verbs by adding the right suffix from the table above.

Verb	Noun
Reduce	Reduction
Resist	Resistance
Alter	Alteration
Deduce	Deduction
Convert	Conversion
Exist	Existence
Prefer	Preference
Realize	Realization
Amplify	Amplification
Improve	Improvement
Compete	Competition
Distribute	Distribution

Propose	Proposal
Admit	Admittance
Replace	Replacement
Arrive	Arrival
Apply	Application
Discuss	Discussion
Explain	Explanation
Decide	Decision
Move	Movement
Accept	Acceptance
Assist	Assistance
Tolerate	Tolerance

b- Adjective Formation from Verbs

Verb	Suffix	Meaning	Adjective
Produce	ive	<i>Tending to; Having the nature of</i>	Productive
Realize Change Comprehend	able ible	<i>Can or must be; Having the quality of</i>	Realizable Changeable Comprehensible
Resist Differ	ant ent	<i>That is /does something</i>	Resistant Different

Exercise: Derive the adjectives of these verbs by adding the right suffix from the table above.

Verb	Adjective
Explode	Explosive
Impress	Impressive
Count	Countable
Recognize	Recognizable
Accept	Acceptable
Describe	Descriptive

Signify	Significant
Tolerate	Tolerant
Corrode	Corrodible /corrosive
Result	Resultant
Destruct	Destructive
Transfer	Transferable
Measure	Measurable

III- Writing

- Building sentences (Rephrasing and Paraphrasing)

- 1- *An electrical engineer must be able to understand deeply electrical and electronic theory, mathematics and materials.*
- 2- *It is important for electrical engineers to master computers.*
- 3- *The design, development, testing and supervision of electrical equipment fabrication such as electric motors, radar and navigation systems, communications systems and power generation equipment are the concern of electrical engineers.*
- 4- *The drafting of electrical devices and systems occurs by means of basic components.*
- 5- *Engineers are likely required to conduct or write the specifications of devices and components for testing their performance, reliability and long-term durability*

Topic three: Engineering Student

Time length: 4h

I- Speaking Practice

- 1- List some of the subjects studied by engineering students.
- 2- Use a dictionary to find out what these terms mean in education:
course – certificate – diploma - pass – resit exam – assessment – fail - drop out – period - full-time – part-time – module

II- Listening Comprehension

You are going to hear an interview with David, a student of electrical engineering at a Scottish college of further education. He is a mature student with previous service in the Navy.

- 1- Listen to *part 1* of the interview and find whether these statements are *true, false* or *not mentioned*. Correct the *wrong* statement.
 - a- David's course is named a National Diploma in Electrical Engineering.
 - b- It lasts for one year – full time.
 - c- David is 23 years old.
 - d- He was in the navy for six years to have a military career.
 - e- There are four types of submarines.
 - f- He left the submarine service because of his weak eyesight.
- 2- Now, listen to *part 2* of the interview and answer these questions.
 - a- How many weeks of teaching are they left?
 - b- How is the course assessed?
 - c- What happens if you fail the tests once?
 - d- Does he have any problems? What kind of problems are they?
- 3- This is David's weekly timetable. Listen to *part 3* of the interview and try to complete the timetable.

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8.45-10.15	Design and make 150	_____	_____	Technology 138	Technology 051
B r e a k					
10.30-12.00	Design and make 150	_____	Tutorial 063	_____	_____
L U N C H B R E A K					
13.00-14.30	_____	Maths 510	Communications 606	_____	Maths 510
B r e a k					
14.45-16.15	Technology 053	Principles 138	Technology 039	Principles 051	Self-study

4- Listen to the last part of the interview and find the questions for these answers.

a- Yes, I do. At lunch breaks in the Sports Hall.

b- A diploma in electronics and electrical engineering.

c- I want to be a manager.

III- Discussion

1- What do you think of David's course?

2- Could you make a comparison between his course and yours in terms of modules, assessment and hobbies?

IV- Writing: *Comparing and Contrasting*

1- Write your own timetable in English.

	Sunday	Monday	Tuesday	Wednesday	Thursday

2- Write sentences comparing and contrasting your timetable and David's. These expressions may be useful:

Example: I have **more** classes than he has but he has **more** maths classes than I do.

- more time / hours / classes / than
- less time / maths / physics than
- fewer hours / classes than
- not as much time / maths / physics as
- not as many hours/classes as
- start/finish earlier / later than

- Note that **less** and **much** are used for things which cannot be counted.

Key answer

I- Speaking Practice

Using the dictionary or research websites, students try to find out the meaning of the following terms in education:

Source: Oxford Advanced Learners' Dictionary, new 8th edition (2010)

Assessment (n) [U] (syn. evaluation): the act of judging or forming an opinion about somebody: written exams and other forms of assessment. (p77)

Certificate (n): an official document proving that you have completed a course of study or passed an exam; a qualification obtained after a course of study or an exam: a Postgraduate Certificate in Education (= a British qualification for teachers). (p237)

Course (n): 1. a series of lessons or lectures on a particular subject: A French / chemistry course. 2. a period of study at a college or university that leads to an exam or a qualification: A two-year postgraduate course leading to a master's degree. (p348)

Diploma (n): 1. a course of study at a college or university: A two-year diploma course. 2. a document showing that you have completed a course of study or part of your education: A high school diploma. (p425)

Drop out (v): to leave school, college, etc. without finishing your studies: She started a degree but dropped out after only a year. (p468)

Full-time (adj., adv.): for all the hours of a week during which people normally work or study, rather than just for a part of it: Students in full-time education. (p629)

Module (n): a unit that can form part of a course of study, especially at a college or university in Britain: The course consists of ten core modules and five optional modules (p987)

Part-time (adj., adv.): to study on a part-time basis. (p1108)

Pass (v) (opp. fail): 1. to achieve the required standard in an exam, a test, etc, e.g. I'm not really expecting to pass first time. 2. To pass somebody: to test somebody and decide that they are good enough, according to an agreed standard: The examiners passed all the candidates. (p1109)

Period (n): 1. length of time. 2. lesson, any of the parts that a day is divided into at a school, college, etc. for study: "what do you have next period?" "French." (p1128)

Resit (v) (also retake): to take an exam or a test again, usually after failing in the first time.(p1301)

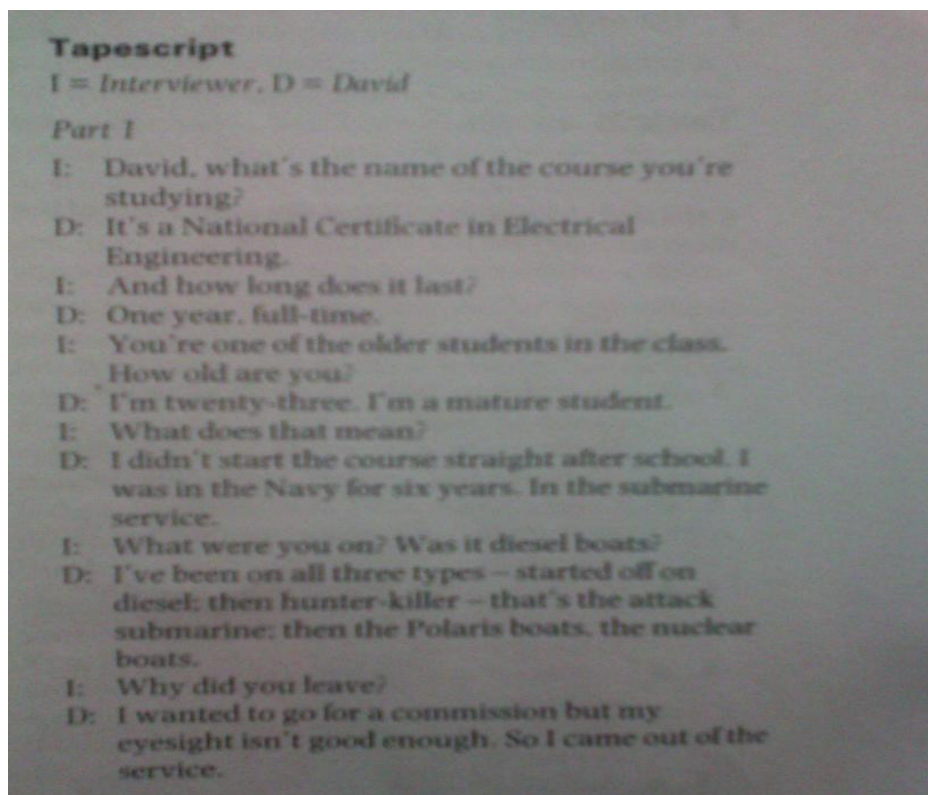
II- Listening Comprehension

You are going to hear an interview with David, a student of electrical engineering at a Scottish college of further education. He is a mature student with previous service in the Navy.

1- Listen to *part 1* of the interview and find whether these statements are *true, false* or *not mentioned*. Correct the *wrong* statement.

- a- **F**: David's course is named a National ~~Diploma~~ **certificate** in Electrical Engineering.
- b- **T**: It lasts for one year – full time.
- c- **T**: David is 23 years old.
- d- **NM**: He was in the navy for six years to have a military career.
- e- **F**: There are ~~four~~ **three** types of submarines.
- f- **T**: He left the submarine service because of his weak eyesight.

The script of part 1



2- Now, listen to *part 2* of the interview and answer these questions.

- a- Ten weeks.
- b- Continuous assessment.
- c- The student has a chance to resit the test.
- d- Yes he does. He has financial problems.

The script of part two:

Part 2

I: And what stage are you at with your studies?

D: Currently we're about to finish *second term*.
Only about ten weeks of actual *teaching* to go.

I: And then examinations?

D: No, it's *continuous assessment*.

I: Oh, I see. So you're assessed by *projects, class work*?

D: Class tests. In each subject you have on average one test per week. You must achieve a correct response in at least *four out of five* questions.

I: What happens if you don't?

D: Then you have a chance to *resit the test*, er ... in some cases you might get a chance to sit it again if you fail the resit but then you're getting into sticky water.

I: How many are in your group?

D: At the moment there are *nine* in my class. There were *twelve*.

I: So people have dropped out?

D: Yes.

I: Did they drop out because they weren't passing the examinations?

D: Yes, one of them was having trouble. And a couple of others basically felt that they didn't enjoy college, they wanted to work.

I: How has it been for you? Being a student again, to be behind a desk rather than working? How have you found it?

D: Apart from financial problems, I've found it very easy. I didn't enjoy school because I didn't feel I wanted to be there, but I really wanted to do this course.

3-

	Monday	Tuesday	Wednesday	Thursday	Friday
8.45-10.15	Design and Make 150	Technology 053	Self study 063	Technology 138	Technology 051
a.m. break					
10.30-12.00	Design and Make 150	PSD 140	Tutorial 063	Communications 406	Principles 051
Lunch break					
13.00-14.30	Maths 510	Maths 510	Communications 606	Maths 510	Maths 510
p.m. break					
14.45-16.15	Technology 053	Principles 138	Technology 038	Principles 051	Self-study

The script of part three:

Tapescript
Part 3

I: Can I turn to the timetable? It looks like a very full day. You're starting at 8.45 and going through to 4.15 each day. How do you start the week?

D: Monday morning. Design and Make. At the start of the course it was Computing but now we're doing Design and Make. We've got to design a circuit.

I: And what have you chosen to do?

D: I'm designing a sensor that will tell me when to bring the washing in if it's raining. An alarm will go off.

I: Uhuh. So there's some kind of sensing device out in the garden?

D: Yes.

I: And that reacts to the rain-water?

D: Yes, everybody's doing various things ...

I: And does it ring a bell?

D: A buzzer. It's really very simple.

I: Back to Monday morning.

D: We have Maths after the lunch break. Now ... Maths - we're in various streams; basically, we're split up into three different groups.

I: Is the maths the toughest element in the course?

D: I'd say it was. It's a lot of work. We have four periods a week after lunch.

I: Technology?

D: Technology, last thing on a Monday. Now this is the bread and butter of the engineering course: we do the more practical things like learning how to wire houses.

I: We're on to Tuesday now. Is that more of the same?

D: Yes. Technology again on Tuesday morning and then PSD - Personal and Social Development. There are three modules - Life and Work, Local Investigations and Job-Seeking Skills.

I: Job-Seeking Skills, is that interview skills and that sort of thing?

D: Yes, we're about to start that next week.

I: Do you find PSD quite helpful?

D: I find it a burden rather than helpful. Most of the guys on the course are going for at least the Diploma. So we find this a bit of a nuisance.

I: Maths again.

D: Yes and last thing we have Principles. That's the Physics side of electrics - Ohm's Law, Kirchoff's Law. We've got Principles again on a Thursday last thing and on Friday before lunch.

I: Is that as difficult as the Mathematics?

D: Er, you need the maths to keep up with the principles. A lot of people find it quite sticky.

I: Wednesday morning?

D: Self-study. It's a lie-in!

I: But theoretically you could use the library?

D: Yes, that's the library period. We also have one on Fridays last thing.

I: Is the library busy? If you wanted to go to the library could you find a space?

D: It's very busy at lunch times but other times are OK. There are no books that you actually need for the course. It's all hand-outs.

I: Do the lecturers give a lot of hand-outs?

D: Yes, especially in Principles and Maths.

I: After the break you have a tutorial. What happens there?

D: It's Principles. But if you're having problems in any subject you can use that class to sort them out. You get more individual help.

I: I see you have Communications next and again on Thursday before lunch.

D: Basically it's English, Business English.

I: Which bit do you enjoy most of the timetable?

D: I would say the technology side of it.

I: Why is that?

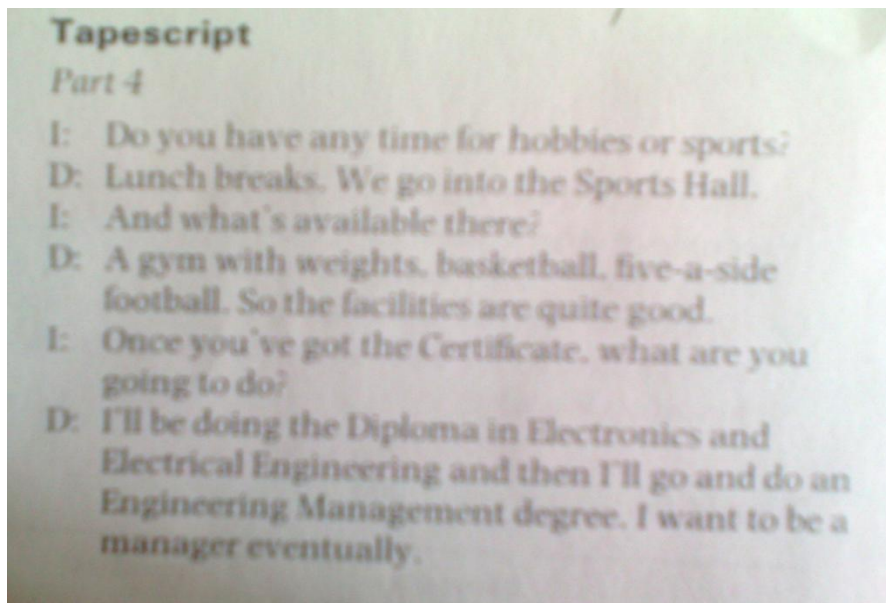
D: Because, having been out working for a living, I can now relate to a lot of the stuff I was doing. It's interesting and I don't find it too difficult.

4- Listen to the last part of the interview. And find the questions for these answers.

a- Do you have any time for hobbies or sports?

b- and c- What are you going to do once you've got the certificate?

The script of part four:



References

Topic one

Discussion, Language Study, Pronunciation, Writing and Listening, adapted from

GLENDINNING, Eric. H and GLENDINNING, Norman. Oxford English for Electrical and Mechanical Engineering. Oxford: Oxford University Press (unit one pp11-15) (pronunciation & listening CD1 Tasks 6 and 8) (5th impression), 2001

Speaking, adapted from

RIZZONI, [Giorgio](#) and KEARNS, James A. Principles and Applications of Electrical Engineering 6th edition. McGraw Hill Higher Education (p2), 2007

Topic two

Articles:

Jim Lucas, Live Science contributor / August 26th, 2014 , www.livescience.com

Reading Comprehension / task 5 (Definitions) and word formation (suffix meanings)

Oxford Advanced Learner's Dictionary, 2010

Topic three

Speaking Practice (word definitions)

Oxford Advanced Learners' Dictionary, new 8th edition (2010)

Listening Comprehension, adapted from

GLENDINNING, Eric. H and GLENDINNING, Norman. Oxford English for Electrical and Mechanical Engineering. Oxford: Oxford University Press (unit 7 pp 42-5, CD1), 2001

Unit two

Fundamentals of Electricity

Unit two: Fundamentals of Electricity

-Time: 11h45mn

Objectives:

- 1- To provide students the specific electrical engineering language, both written and spoken in the form of visual, audiovisual materials (i.e. texts, tables, diagrams, recordings, etc);
- 2- To equip students with the specialist electrical engineering language they need to read and understand articles and magazines with focus on the key electrical engineering vocabulary;
- 3- To provide students the fundamental terms excerpted from the electrical engineering context to show them how these terms and constructions function in this register of English;
- 4- To motivate students, future engineers, to review, improve and extend their knowledge of English grammar they need in the specialist field.

The approach:

Based on:

- 1- Developing students' key English mastery of academic skills by focusing on receptive skills (reading and understanding technical texts, and listening and comprehension) to trigger productive skills (speaking in technical English and technical writing);
- 2- Providing practice in the writing styles that are required in science and engineering such as explanation, persuasion, and critical analysis;
- 3- Providing opportunity for verbal communication throughout class discussion.

Outline

<p>Topic one: Current, Voltage and Resistance (4h30mn)</p> <p>Topic two: Electrical Supply (3h)</p> <p>Topic three: Circuits and Components (4h)</p>	
<i>Language Skills (6h35)</i>	<i>Language Knowledge (4h40mn)</i>
<p><i>Listening & Speaking (3h)</i></p> <ul style="list-style-type: none"> - Labeling and drawing circuit diagrams - Matching items with their specifications - Noting values - Discussing about fundamentals of electricity - Describing different types of circuit diagrams <p><i>Reading and comprehension: (1h35mn)</i></p> <ul style="list-style-type: none"> - Rephrasing, contextual reference and checking facts and ideas - Reading and summarizing <p><i>Writing: (1h30mn)</i></p> <ul style="list-style-type: none"> - Describing a diagram - Describing component values 	<p><i>Grammar: (2h30mn)</i></p> <ul style="list-style-type: none"> - The present tenses - Location / Position - Conditional clauses - Function / purpose / means - Relative clauses - Qualifications <p><i>Vocabulary: (1h40mn)</i></p> <ul style="list-style-type: none"> - System of units - Electrical symbols, terms and abbreviations - Names of electrical components <p><i>Pronunciation: (30mn)</i></p> <ul style="list-style-type: none"> - Reading component values

Topic one: Current, Voltage and Resistance

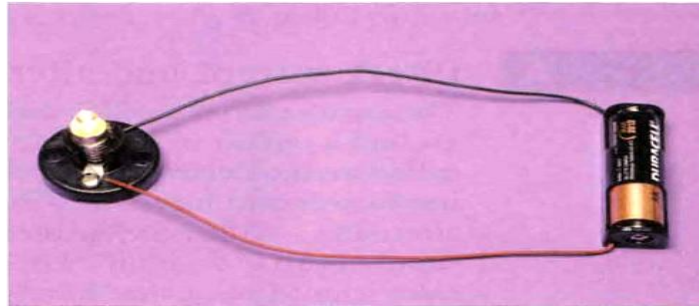
Lesson time-length: 4h30

I- Vocabulary Bank

1- Electric current

Task 01: Discuss the following

- a- What does the picture show?
- b- How does it work?



Task 02: Use the words from the given list to complete the passage below. Some words are used more than once.

rate - components - atoms - supply – wires - charge carriers - electric current - cell - charge - devices - electric circuit – electricity – amperes or amps – electrons – flow - amperage or ampage- conductor

The photo shows a simple _____. A _____ provides an _____. This flows through _____, which conduct the _____. The _____ is used to light a lamp. So, like all circuits, the example includes:

- An electrical _____ - in this case, the _____.
- An electrical _____ - an electrical path-in this case, _____.
- One or more electrical _____ - electrical _____ (in this case, the lamp) which have a function.

_____ -measured in _____ (A) -is the _____ of _____ of electric _____. Electric _____ is carried by _____ - particles with a negative charge (-), which are normally attached to _____. When an electric current flows through a conductor; the electrons move from one atom to another - in the case of a copper wire, from one copper atom to the next. If the number of electrons flowing through a conductor increases, the _____ _____ (current) increases. When electrons flow, carrying a current, they can be called _____.

2- Voltage and Resistance

Task 03: Match the terms with their definitions.

Term	Definition
a- <i>Electromotive force (EMF)</i>	1/ The metal wire inside a bulb.
b- <i>Resistance</i>	2/ Materials with very high resistance, such as plastics.
c- <i>Electrical insulators</i>	3/ The greatest potential difference that can be generated by a particular source of electric current measured in volts (V) and is generally called voltage.
d- <i>Filament</i>	4/ It has a value in ohms (Ω) which is a measure of how easily current can flow through the conductors and components in a circuit.
e- <i>Live conductor</i>	5/ Electric wire without plastic insulation.

3- *Electric Power*

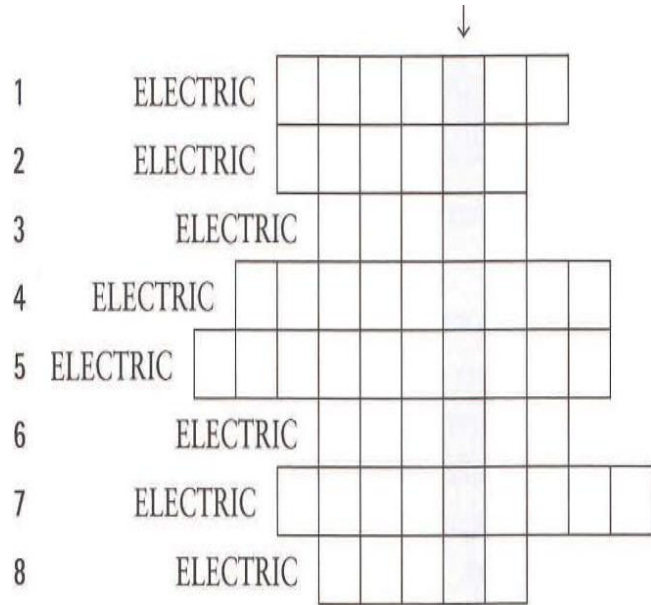
The text below, about electrical power, is from a home improvements magazine. Read it to focus on the key words in bold type, and then do the tasks below.

The amount of current, in amps, required by an **electrical appliance** – such as a TV or an electric kettle – depends on the **power** of the appliance. This number – expressed in **watts (W)** – will be marked somewhere on the appliance. To calculate the required current, simply take the **wattage** and divide it by the voltage of the electrical supply in your home – around 230 volts in most of Europe. Therefore, for an electric kettle with a **power rating** of 2,000 watts (as specified by the manufacturer), the current required is:

$$\frac{2,000 \text{ watts}}{230 \text{ volts}} = 8.7 \text{ amps}$$

Task 04: Complete the word puzzle and find the word going down using vocabulary you learned from 1, 2 and 3.

- 1/- another term for amperage
- 2/- provided by a battery, for example
- 3/- measured as a wattage
- 4/- allows current to flow through it
- 5/- have very high electrical resistance
- 6/- carried by moving electrons
- 7/- another term for an electrical 'device'
- 8/- the consequence of a person touching a live conductor



Task 05: Complete the extract about current and power calculations using the words in the box. Look at 1, 2 and 3 (pages 1 & 2) to help you.

amps	conductor	current	resistance	voltage	wattage
components	circuit	ohms	supply	volts	watts

In electrical calculations, electromotive force is expressed by the letter E, resistance by the letter R, and current by the letter I (which comes from the word 'intensity').

According to Ohm's Law: $I = E/R$.

In other words, the (1) flowing through a (2), measured in (3), equals the (4) of the electrical (5), measured in (6), divided by the total (7), measured in (8), To work out the value of R, it is necessary to calculate the total resistance of all the (9) and connecting lengths of (10) that make up the circuit. Once both the voltage and amperage are known, it is possible to work out the power, measured in (11), that will be consumed. Power (P) can be calculated using the equation $P = EI$. Therefore (12) equals voltage multiplied by amperage.

II- Technical Reading

CONDUCTORS, INSULATORS AND SEMICONDUCTORS

1- Re-order the cards to have a complete coherent text.

A material which does not easily release electrons is called an insulator. Rubber, nylon, porcelain and air are all insulators. All insulators will allow some flow of electrons, however this can usually be ignored because the flow they permit is so small.

If we connect a battery across a body, there is a movement of free electrons towards the positive end. This movement of electrons is an electric current. All materials can be classified into three groups according to how readily they permit an electric current to flow. These are: conductors, insulators and semiconductors.

Semiconductors are midway between conductors and insulators. Under certain conditions they allow a current to flow easily but under others they behave as insulators. Germanium and silicon are semiconductors. Mixtures of certain metallic oxides also act as semiconductors. These are known as thermistors. The resistance of thermistors falls rapidly as their temperature rises. They are therefore used in temperature-sensing devices.

In the first category are substances which provide an easy path for an electric current. All metals are conductors, however some metals do not conduct well. Manganin, for example, is a poor conductor. Copper is a good conductor, therefore it is widely used for cables. A non-metal which conducts well is carbon. Salt water is an example of a liquid conductor.

2- Now, read the text and do these activities.

A- **Paraphrasing:** Rewrite the following sentences, replacing the *words* in **bold** with expressions from the passage which have similar meanings.

- a- The **flow** of free electrons is an electric current.
- b- Materials in the first **group** are called conductors.
- c- *Materials* which provide a **path** for an electric current are conductors.
- d- All insulators **permit** some flow of electrons.
- e- Germanium sometimes **acts** as an insulator and sometimes as a conductor.

B- **Checking facts and ideas:** Decide if these statements are *true* or *false*. **Quote** from the passage to support your decisions.

- a- Electrons flow positive to negative.
- b- Copper provides an easy path for an electric current.
- c- All metals are good conductors.
- d- All good conductors are metals.
- e- Air is not a perfect insulator.
- f- Rubber readily releases electrons.
- g- The resistance of a thermistor is higher at low temperatures than at high temperatures.

3- *Use of language:* Sentence connectors

A- **Reason and Result**

- Study these sentences

a- Copper is used for cables. **b-** Copper is a good conductor

- Sentence **(b)** provides a **reason** for sentence **(a)**. We link a **statement** and a **reason** using '*because*', so **a + b** = Copper is used for cables *because it is a good conductor*.

- When the reason is a noun or a noun phrase, we use '*because of*', for example: The motor is overheated *because of dirt in the air gap*.

Noun phrase

- Now study this pair.

b- The flow of electrons through an insulator is very small. **c-**The flow can be ignored.

- Sentence **(d)** is the **result** of sentence **(c)**. We can link a **statement** and a **result** using '*therefore*', so **c + d** = the flow of electrons through an insulator is very small, *therefore it can be ignored*.

- Suggest other connectors such as because and therefore.

Exercise: Link these ideas using **because** or **therefore**.

1- Soft iron is used in electromagnets.

- Soft iron can be magnetized easily.

2- The voltage is 250V and the current 5A.

- The resistance is 50Ω.

3- PVC is used to cover cables.

- PVC is a good insulator.

4- Transistors can be damaged by heat.

- Care must be taken when soldering transistors.

5- Capacitance is usually measured in microfarads or picofarads.

- The farad is too large a unit.

6- It is easy to control the speed of dc motors.

- Dc motors are used when variable speeds are required.

B- Relative clauses

a- Starter motor brushes are made of carbon.

b- The carbon contains copper.

- Both these sentences refer to carbon. We can link them by making sentence **(b) a relative clause**, so **a + b** = Starter motor brushes are made of carbon **which contains copper**.

- Study these other pairs of sentences and note how they are linked.

c- Consumers are supplied at higher voltages than domestic consumers.

d- These consumers use large quantities of energy.

c + d = Consumers, **who use large quantities of energy**, are supplied at higher voltages than domestic consumers.

e- 33kV lines are fed to intermediate substations.

f- In the intermediate substations the voltage is stepped down to 11kV.

e + f = 33kV lines are fed to intermediate substations **where the voltage is stepped down to 11kV**.

Exercise: Link these pairs of sentences. Make relative clauses.

1- The coil is connected in series with a resistor.

- The resistor has a value of 240 ohms.

2- Manganin is a metal.

- This metal has a comparatively high resistance.

3- The signal passes to the detector.

- The signal is rectified by the detector.

4- A milliammeter is an instrument.

- The instrument is used for measuring small currents.

5- Armored cables are used in places.

- There is a risk of mechanical damage in these places.

6- Workers require a high degree of illumination.

- The workers assemble very small precision instruments.

III- Reading Tables

1- Units of measurement: SI based units

The International System of Units also called SI, from the French “Système International des Unités” includes units which are based on six fundamental quantities, listed in Table 1. All other units may be derived in terms of the fundamental units of table 1.

Table 1 SI units

Quantity	Unit	Symbol
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Electric current	Ampere	A
Temperature	Kelvin	K
Luminous intensity	Candela	cd

Note: 0 kelvin (K) = -273 degrees Celsius (°C). 0 K is the lowest possible temperature - often called absolute zero.

- See other examples of units in tables 2 and 3.

Table 2 SI Derived Units

Quantity	Unit	Abbreviation	Notes
Length	millimetre	mm	1mm = 0.001m
	centimetre	cm	1cm = 0.01m
	kilometre	km	1km = 1,000m
Area	square metre	m ²	1 m ² = 1m x 1m
	square millimetre	mm ²	1 mm ² = 1mm x 1mm
Volume	cubic metre	m ³	1 m ³ = 1m x 1m x 1m
	cubic centimetre	cc	1cc = 1cm x 1cm x 1cm
Volume of liquid	litre	l	1l = 0.001 m ³
Mass	gram	g	1g = 0.001kg
	tonne	T	1T = 1,000kg
Force	newton	N	1 N = the force exerted by the earth's gravity on a mass of approximately 0.1 kg.
Density	kilograms per cubic metre	kg/ m ³	If a volume of 1 m ³ of a material has a mass of 1kg, its density = 1kg / m ³
Pressure & Stress	Pascal	Pa	1Pa = 1 N/ m ²
Speed / velocity	metres per second	m/s	If an object travels 1metre in 1second, its speed or velocity is 1m/s
	kilometre per hour	Km/h	If an object travels 1kilometre in 1hour, its speed or velocity is 1km/h
Acceleration	metres per second squared	m/s ²	If the speed or velocity of an object increases by 1m/s every second, it has a rate of acceleration of 1m/s ²
Moments and torque	Newton metres	Nm	1 Nm=1N of force exerted at a distance of 1m from a fulcrum or axis rotation
Temperature	Degree Celsius	°C	Temperature in °C = temperature in kelvin (K) + 273 (see note above, table 1)
Frequency	hertz	Hz	1 Hz = 1 cycle per second
Angular movement	radian	rad	2 π rad = 360 degrees

Table 3 SI units for electricity

Term	Unit	Abbreviation
<i>Electromotive force</i>	<i>volt</i>	V
<i>Electrical resistance</i>	<i>ohm</i>	Ω
<i>Electrical conductance</i>	<i>siemens</i>	S
<i>Electrical charge</i>	<i>coulomb</i>	C
<i>Capacitance</i>	<i>farad</i>	F
<i>Inductance</i>	<i>henry</i>	H
<i>Magnetic flux</i>	<i>weber</i>	Wb
<i>Magnetic flux density</i>	<i>tesla</i>	T

2- Unit Prefixes

The prefixes below can be written in front of units to multiply them or divide them by a specific number. For example, 1 milliamp (mA) = 0.001 amps, and 1 kilonewton (kN) = 1,000 newtons.

Table 4 standard prefixes

Prefix	Symbol	Power
tera	T	10^{12}
Giga	G	10^9
Mega	M	10^6
Kilo	k	10^3
Hecto	h	10^2
Deka	da	10
Deci	d	10^{-1}
Centi	c	10^{-2}
Milli	m	10^{-3}
Micro	μ	10^{-6}
Nano	n	10^{-9}
Pico	p	10^{-12}
Femto	f	10^{-15}
Atto	a	10^{-18}

3- Terms, Symbols, Units, and Abbreviations used in Electrical Engineering and Electronics

- Read the table below and complete the missing information.

Table 5

Term	Symbol	Unit	Abbreviation
Admittance	Y	Siemens (mho)	S ($\overline{\Omega}$)
Capacitance	C	Farad	F
Charge	Q	Coulomb	C
Conductance	G	Siemens (mho)	S ($\overline{\Omega}$)
Conductivity	σ (sigma) / γ (gamma)	Siemens per metre	S/m
Current	I	Ampere	A
Electric field strength	E	Volt per metre	V/m
Electric flux	Q	Coulomb	C
Electric flux density	D	Coulomb per square metre	C/m ²
Electromotive force	E	Volt	V
Frequency	f	Hertz	Hz
Frequency angular	ω (omega)	Radian per second	rad/s
Frequency resonant	fr	Hertz	Hz
Inductance	.....	Henry	.....
Inductance mutual	.....	.....	.....
Impedance	.....	Ohm	Ω
Magnetic field strength	H	.....	At/m
Magnetic flux	.....	.....	Wb
Magnetic flux density	B	Tesla	.....
Magnetomotive force	F	Ampere turn	.....
Permeability	μ (mu)	.....	H/m
Permittivity	ϵ (epsilon)	.....	F/m
Phase, angle	.....	.....	.....
Power, apparent	S	Volt-Ampere	.....
Power, reactive	Q	var	vars
Reactance	.....	Ohm	Ω
Reactance capacitive	.....	Ohm	Ω
Reactance inductive	X _L	.....	.....
Resistance	R	Ohm	Ω
Resistivity	.....	.....	Ω /m
Voltage	V	Volt	V

- Now, using the table above write out these equations and formulas in full.

$$1- I = \frac{V}{R}$$

$$5- E=IR$$

$$8- \gamma = \frac{1}{\rho}$$

$$2- P= I^2 \times R = 40W$$

$$6- Z = \frac{100 \times 10^4}{200 \times 10^{-5}}$$

$$9- \frac{V}{Z} = I = VY$$

$$3- \frac{1}{R_{tot}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$7- Z = \sqrt{R^2 + (X_L - X_C)^2} = 330 \Omega$$

$$4- X_L = \sqrt{Z^2 - R^2}$$

$$10- B \propto H$$

Key answer

I- Vocabulary Bank

1- Electric current

Task 01:

- a- The picture shows an electric circuit. It consists of a battery, a lamp and connecting copper wires.
- b- The current flows from the battery to the lamp through the wires.

Task 02:

electric circuit – cell – electric current – wires – electricity – electric current – supply – cell – conductor – wires – components - devices – electric current – amperes or amps – ate – flow – charge – charge – electrons – atoms – amperage or ampage – charge carriers.

4- Voltage and Resistance

Task 03:

- a- 3
b- 4
c- 2
d- 1
e- 5

5- Electric Power

Task 04:

1	ELECTRIC	C	U	R	R	E	N	T		
2	ELECTRIC	S	U	P	P	L	Y			
3	ELECTRIC	P	O	W	E	R				
4	ELECTRIC	C	O	N	D	U	C	T	O	R
5	ELECTRIC	I	N	S	U	L	A	T	O	R
6	ELECTRIC	C	H	A	R	G	E			
7	ELECTRIC	A	P	P	L	I	A	N	C	E
8	ELECTRIC	S	H	O	C	K				

Task 05:

- (1) Current – (2) circuit – (3) amps – (4) voltage – (5) supply – (6) volts – (7) resistance – (8) ohms – (9) components – (10) conductor – (11) watts – (12) wattage

1- The text

If we connect a battery across a body, there is a movement of free electrons towards the positive end. This movement of electrons is an electric current. All materials can be classified into three groups according to how readily they permit an electric current to flow. These are: conductors, insulators and semiconductors.

In the first category are substances which provide an easy path for an electric current. All metals are conductors, however; some metals do not conduct well. Manganin, for example, is a poor conductor. Copper is a good conductor, therefore it is widely used for cables. A non-metal which conducts well is carbon. Salt water is an example of a liquid conductor.

A material which does not easily release electrons is called an insulator. Rubber, nylon, porcelain and air are all insulators. All insulators will allow some flow of electrons, however; this can usually be ignored because the flow they permit is so small.

Semiconductors are midway between conductors and insulators. Under certain conditions they allow a current to flow easily but under others they behave as insulators. Germanium and silicon are semiconductors. Mixtures of certain metallic oxides also act as semiconductors. These are known as thermistors. The resistance of thermistors falls rapidly as their temperature rises. They are therefore used in temperature-sensing devices.

2- Now, read the text and do these activities.

A- Paraphrasing: Rewrite the following sentences, replacing the words in **bold** with expressions from the passage which have similar meanings.

- a- The **movement** of free electrons is an electric current.
- b- Materials in the first **category** are called conductors.
- c- Materials which provide **a way** for an electric current are conductors.
- d- All insulators **allow** some flow of electrons.
- e- Germanium sometimes **behaves** as an insulator and sometimes as a conductor.

B- Checking facts and ideas:

- a- **F** "If we connect a battery across a body, there is a movement of free electrons towards the positive end."
- b- **T** "Copper is a good conductor."
- c- **F** "some metals do not conduct well"
- d- **F** "A non-metal which conducts well is carbon. Salt water is an example of a liquid conductor."
- e- **F** "All insulators will allow some flow of electrons."
- f- **F** "Rubber, nylon, porcelain and air are all insulators."
- g- **T** "the resistance of thermistors falls rapidly as their temperature rises."

III- *Use of language:* Sentence connectors

A- Reason and Result

Exercise:

- 1- *Soft iron is used in electromagnets because it can be magnetized easily.*
- 2- *The voltage is 250V and the current 5A, therefore the resistance is 50Ω.*
- 3- *PVC is used to cover cables because it is a good insulator.*
- 4- *Transistors can be damaged by heat therefore care must be taken when soldering transistors.*
- 5- *Capacitance is usually measured in microfarads or picofarads because the farad is too large a unit.*
- 6- *It is easy to control the speed of dc motors therefore DC motors are used when variable speeds are required.*

B- Relative clauses

Exercise:

- 1- *The coil is connected in series with a resistor which has a value of 240 ohms.*
- 2- *Manganin is a metal which has a comparatively high resistance.*
- 3- *The signal, which is rectified, passes to the detector.*
- 4- *A milliammeter is an instrument which is used for measuring small currents.*
- 5- *Armored cables are used in places where there is a risk of mechanical damage.*
- 6- *Workers, who assemble very small precision instruments, require a high degree of illumination.*

IV- Reading Tables

- Terms, Symbols, Units, and Abbreviations used in Electrical Engineering and Electronics

Table 5

Inductance	<i>L</i>	Henry	<i>H</i>
Inductance mutual	<i>M</i>	<i>Henry</i>	<i>H</i>
Impedance	<i>Z</i>	Ohm	Ω
Magnetic field strength	<i>H</i>	ampere turn per minute	At/m
Magnetic flux	<i>φ (phi)</i>	<i>Weber</i>	Wb
Magnetic flux density	B	Tesla	<i>T</i>
Magnetomotive force	F	Ampere turn	<i>At</i>
Permeability	<i>μ (mu)</i>	<i>Henry per metre</i>	H/m
Permittivity	<i>ε (epsilon)</i>	<i>Farad per metre</i>	F/m
Phase, angle	<i>φ (phi)</i>	<i>Radian</i>	<i>rad</i>
Power, apparent	S	Volt-Ampere	<i>VA</i>
Reactance	<i>X</i>	Ohm	Ω
Reactance capacitive	<i>X_c</i>	Ohm	Ω
Reactance inductive	<i>X_L</i>	<i>Ohm</i>	Ω
Resistance	R	Ohm	Ω
Resistivity	<i>ρ (rho)</i>	<i>Ohm per metre</i>	Ω/m

- Writing equations and formulas in full

A- *Current equals voltage over resistance*

B- *Power equals current squared times resistance. This equals forty watts.*

C- *One over total resistance equals one over resistance one plus one over resistance two plus one over resistance three*

D- *Reactance inductive equals the square root of impedance squared minus resistance squared.*

E- *Electromotive force equals current times resistance.*

F- *Impedance equals one hundred times ten to the power four over two hundred times ten to the power minus five.*

G- *Impedance equals the square root of resistance squared plus, open brackets, reactance inductive minus reactance capacitive, close brackets, squared. This equals three hundred and thirty ohms.*

H- *Conductivity equals one over resistivity.*

I- *Voltage over impedance equals current which is equal to voltage times admittance.*

J- *Magnetic flux density is proportional to Magnetic field strength.*

Topic two: Electrical Supply

Time length: 3h

I- Technical Reading

- Read these definitions (A, B and C) then do the activities below.

A- Direct Current and Alternating Current

The current from a cell is **direct current (DC)** – a constant flow of electricity which travels around a circuit in one direction. The electricity supplied to homes and other buildings – called **mains electricity** – is **alternating current (AC)**. Unlike a **DC supply**, an **AC supply** flows backwards and forwards – its direction continually **alternates**. The rate at which the current alternates – called the **frequency** – is measured in **hertz (Hz)**. For example, in the UK, AC supply is 50 Hz – it alternates 50 times per second. On a graph, the AC supply of mains electricity forms a **sine wave**.

The current supplied to most homes is **single-phase** – it forms one sine wave. In factories and large buildings, which have powerful electrical equipment, the supply is often **three-phase** – effectively three currents, each with a different **phase** (timing). This provides a smoother supply as it reduces the gaps between the voltage peaks.

Note: The term **mains electricity** is not used in American English – terms like **supply** are used.

B- AC Generation and Supply

Mains electricity is **generated** (produced) at sites called **power stations**, which use large **generators**. A generator converts mechanical energy to electrical energy. A generator rotates a magnet within an iron surround. The iron – called an **armature** – has coils of wire around it, called **field coils** (or **field windings**). As the magnet rotates, it causes current to flow through the field coils, due to **electromagnetic induction**.

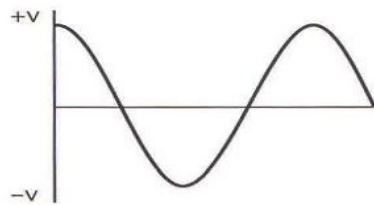
Current from the generators leaves the power station and enters the **power grid** (or **grid**) – the network of **power lines** (cables) which transmit it around the country. At the point where it enters the grid, the electricity flows through **transformers** – specifically **step-up transformers**, which increase voltage and decrease amperage. This reduces the energy lost from the power lines over long distances, as **high-voltage (HV)** supplies flow more efficiently than **low-voltage (LV)** supplies. Before the supply is used by homes and other buildings, it passes through several **step-down transformers**, which reduce its voltage and increase its amperage.

The supply may be **stepped up** to over 400,000 volts at the point where it enters the large **transmission lines** (long-distance power lines) leaving the power station. It is normally then **stepped down** in stages, first passing through a wider network of lower-voltage transmission lines, and finally through the small **distribution lines** which supply streets and houses – in many countries at around 230 volts.

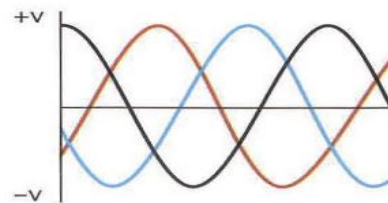
C- DC Generation and Use

- The extract below is from a consumer magazine

Photovoltaic cells (PVs) – or solar cells – are an effective way of generating your own electricity from sunlight. The current they produce can be used immediately, may be stored in **rechargeable batteries** (like the ones in cars), or can be fed into the power grid and sold to the electric company. But PVs produce direct current. This is fine for **charging** batteries, but is not suitable for powering household appliances, which require alternating current. For this, the DC supply from PVs and batteries needs to go through an **inverter** – a device which converts DC to AC.



A single-phase AC supply

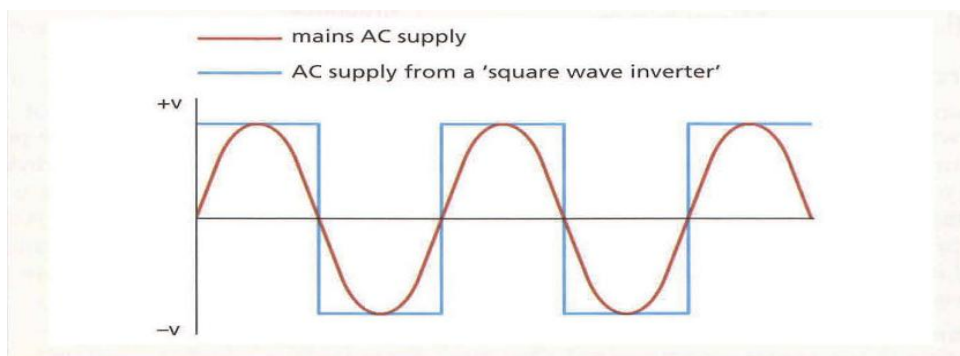


A three-phase AC supply

Task 1: Complete the text about inverters using words from **A** (page 1). Look at **A, B** and **C** (pages 1 & 2) to help you.

Inverters convert (1) to (2)

If an inverter is used to supply electrical appliances in a home, it must copy the supply of (3) Electricity produced by the generators at power stations. Most inverters can produce a current which alternates precisely at the required (4) - for example, 50 (5) (50 cycles per second). However, not all types are able to produce current which follows the pattern of a (6), like that of the (7) AC supply used in homes. So-called 'square wave inverters' only produce a very approximate copy of this wave, which can affect the functioning of many electrical appliances.



Task 2: Choose the correct words from the brackets to complete the descriptions of different stages of AC generation and supply (a-f). Then, put the stages in the correct order. Look at B (page 1) to help you.

- a-* After the step-up transformer, the current enters a (*distribution / transmission*) line.
- b-* Current is produced, by electromagnetic induction, in the (*magnet / field coils*) of a generator.
- c-* The current goes from the last step-down transformer to a (*distribution / transmission*) line.
- d-* The current leaves the power (*grid / station*) and enters the home.
- e-* Amperage is reduced and voltage is increased by a (*step-up / step-down*) transformer.
- f-* The current is stepped (*up / down*) from a higher voltage to a lower voltage, in stages.

Task 3: Decide whether these sentences are true or false and correct the false sentences.

- a-* Photovoltaic cells produce direct current.
- b-* The electricity supply from PVs can be used to charge rechargeable batteries.
- c-* Rechargeable batteries supply electricity as alternating current.
- d-* Inverters convert sunlight to alternating current.

II- Speaking

Think of some large and small electrical appliances you're familiar with. Explain their electrical supply requirements. What type of current is required, and how is it supplied and / or converted?

Key answer

I- Technical Reading

Task 1:

- (1) Direct current – (2) alternating current – (3) mains – (4) frequency – (5) hertz – (6) sine wave – (7) single-phase

Task 2:

- a- After the step-up transformer, the current enters a **transmission** line.
- b- Current is produced, by electromagnetic induction, in the **field coils** of a generator.
- c- The current goes from the last step-down transformer to a **distribution** line.
- d- The current leaves the power **grid** and enters the home.
- e- Amperage is reduced and voltage is increased by a **step-up** transformer.
- f- The current is stepped **down** from a higher voltage to a lower voltage, in stages.

Order: 1b – 2e – 3a – 4f – 5c – 6d

Task 3:

- a- T
- b- T
- c- F – rechargeable batteries supply electricity as direct
- d- F – Inverters direct current to alternating current.

Topic three: Circuits and Components

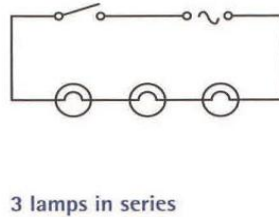
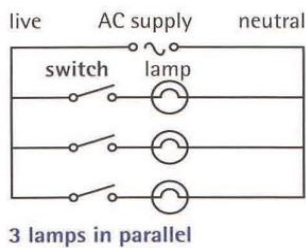
Time length: 4h

I- Vocabulary Study

1- Simple Circuits

- Read the passage and use the circuit diagrams below to fill in the gaps with the correct term.

The circuit diagrams below show lamps connected in a _____ circuit and in a _____ circuit. The supply has _____ and _____ conductors. On an _____ supply, the difference between _____ and _____ is that conductors on the neutral side of appliances are earthed-that is, connected to earth (the ground).



BrE: live; AmE: phase
 BrE: earth, earthed; AmE: ground, grounded

2- Mains AC Circuits and Switchboards

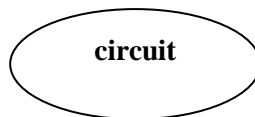
- Read the passage to do the task below.

Where an AC supply enters a building, it is connected to a switchboard. This has a number of switches to allow different circuits in the building to be switched on and off. Circuits include power circuits. These supply the power sockets (or sockets) for the plugs on appliances. Usually, a circuit-breaker is fitted to each circuit. This is a safety switch that switches off automatically if there is a problem. This may happen if a person touches a live conductor, or if there is a short circuit. A short circuit is when current flows directly from a live conductor to a neutral conductor – for example, due to damaged insulation. Circuit breakers also allow circuits to be switched off manually, to isolate them (switch them off safely) – for example, before maintenance work.

Note: The equipment in switchboards is often called switchgear.

Task: Make word combinations using words from 1 and 2 above. Then match the combinations with the descriptions.

- a
- a
- a
- a
- a
- an

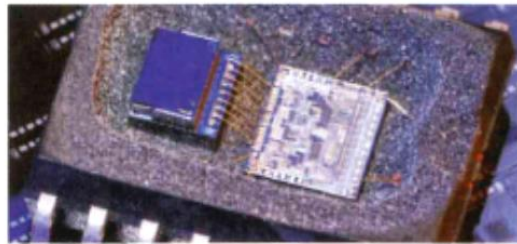
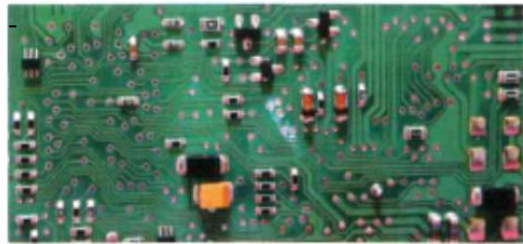


- a-** A circuit containing one or more sockets
- b-** A simple circuit where all the components are placed one after the other along the same conductor
- c-** A microchip- a very small, often complex circuit
- d-** What happens if live and neutral conductors touch while a current is flowing, and there is no component or appliance between them
- e-** A circuit which allows different components to be controlled independently by separate switches
- f-** A circuit that can be populated with a large number of components.

3- Printed and integrated circuits

- Read the passage below and label the pictures below

The circuits in electrical appliances are often **printed circuits**, on **printed circuit boards (PCBs)**. These are **populated** with (fitted with) electrical components. Many appliances also contain small, complex **integrated circuits** – often called **microchips** (or **chips**) – made from **silicon wafers** (very thin pieces of silicon). They act as **semiconductors**, which can be positively charged at certain points on their surface and negatively charged at other points. This principle is used to make very small circuits.



4- Plugs and Sockets

- Erin, an engineer in a firm that manufactures *electrical plugs* and *sockets*, is describing different electrical plug and socket formats. Read and match the descriptions (1-6) to the pictures

1 / On this one, there are *circular pins* for **live** and **neutral**. There's no earth pin. This is quite a common format in Europe and Russia. It's also quite widely used in India.

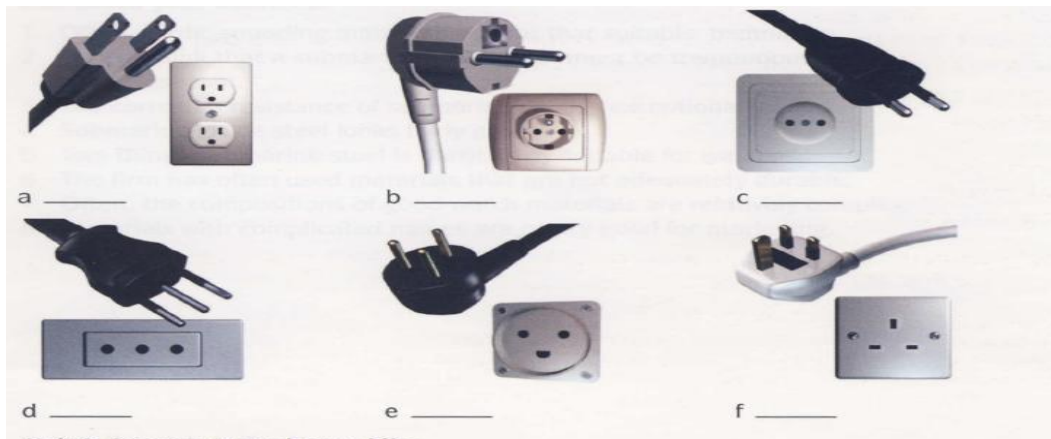
2 / Here, you've got *circular slots* for **live** and **neutral**. And the **earth slot's** got a **flat base** with **one side rounded** over to form a semi-circle. This type's only used in a few places.

3 / This one has *rectangular blades* for **live**, **neutral** and **earth**, in *triangular* configuration. This is the standard in the UK and Ireland, and a few other places, Malaysia and Singapore, for instance.

4 / This **plug** has got *circular pins* for **live** and **neutral**, and it has a *cylindrical slot* to receive the earth pin. It's quite common in continental Europe, and in parts of Africa.

5 / As you can see, there are *circular pins* for **live**, **neutral** and **earth**, and **the pins** are arranged in *linear* configuration. This is not a very commonly used format.

6 / This is the standard in North America, and quite common in Central and South America. Used in Japan, as well. There are *flat blades* for **live** and **neutral**, and a *round pin* for **earth**, and they're laid out in *triangular* configuration, so an extremely widely used format.

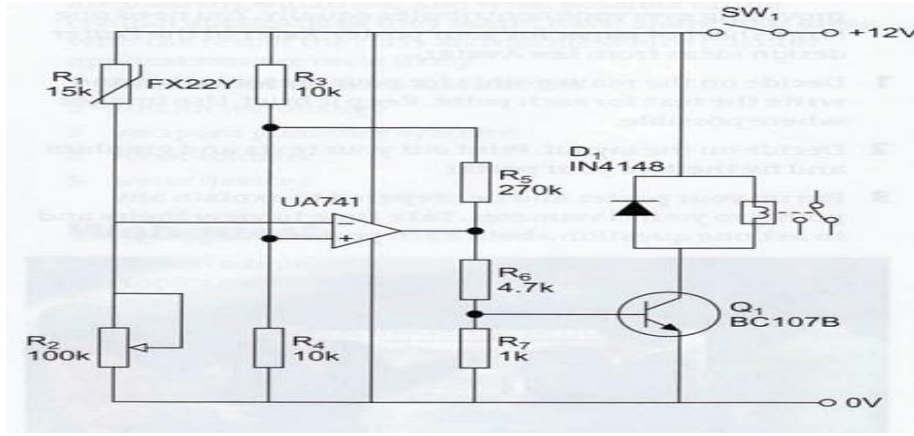


5- Components and Symbols

- Read this table and do the task on the next page.

Component	Symbol	Component	Symbol	Component	Symbol
ammeter		Schottky diode		single pole, single throw (SPST) switch	
amplifier		tunnel diode		single pole, double throw (SPDT) switch	
antenna		Zener diode		double pole, single throw (DPST) switch	
battery		fuse		double pole, double throw (DPDT) switch	
fixed capacitor		air-core inductor		momentary contact switch, normally open (NO) / push-to-make switch	
feed-through capacitor		bifilar inductor		momentary contact switch, normally closed (NC) / push-to-break switch	
polarized capacitor		iron-core inductor		bipolar NPN (negative, positive, negative) transistor	
variable capacitor		tapped inductor		bipolar PNP (positive, negative, positive) transistor	
cell		variable inductor		field-effect N-channel (negative channel) transistor	
circuit-breaker		lamp		field-effect P-channel (positive channel) transistor	
light-emitting diode (LED)		microphone		voltmeter	
PIN diode		motor		wattmeter	
photodiode		ohmmeter			
fixed resistor		oscilloscope			
variable resistor (rheostat)		air-core transformer			
speaker / loudspeaker		iron-core transformer			

- Study this circuit. Make a component list with the numbers, names, and values of each component. Say what the circuit is used for.



Component	Type	Value/reference number
R1		
R2		
R3		
R4		
R5		
R6		
R7		
D1		
Q1		
SW1		
	Operational amplifier	UA741

II- Pronunciation: Reading Component Values

- Listen to the recording and note the values of these components.

Symbol	Component and value

- Practice saying the component values aloud

III- Technical Reading: Combinational Logic

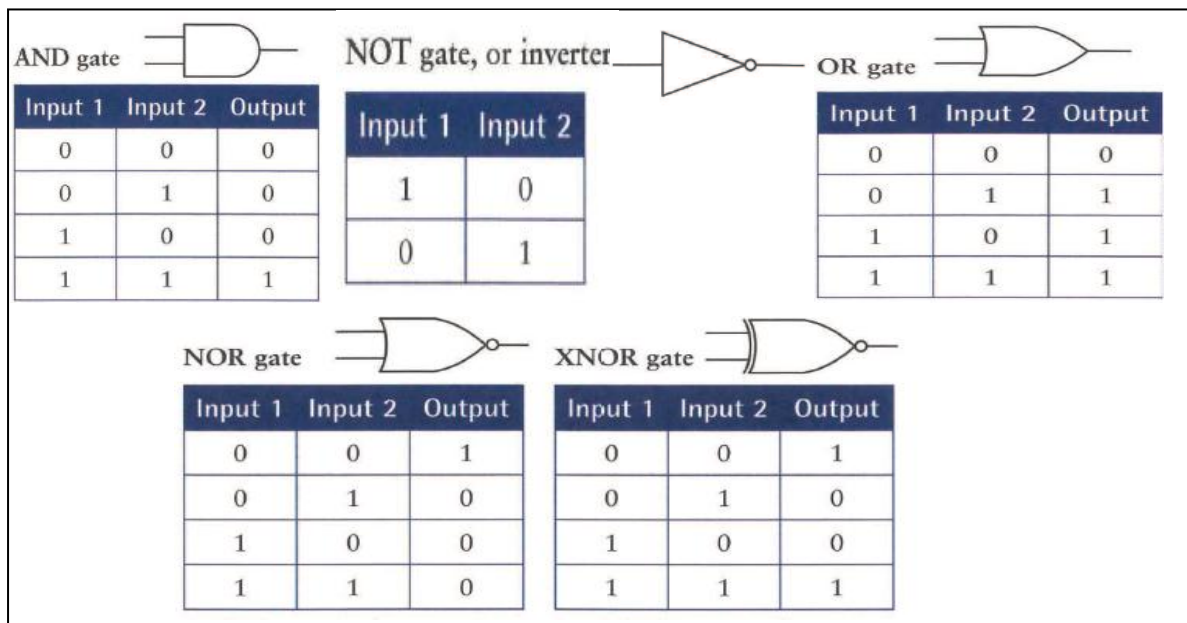
- Before to read the text try to answer the following questions.
 - a- What terms are used in the text for each of the following terms?
 - A digital switching circuit.
 - The output of each gate depending on the combination of its inputs.
 - b- What is shown by a truth table?
 - c- What is another name for a NOT gate?

- Now read the text and check your answers.

The decision making circuits used in modern computers are mainly composed of combinations of digital switching circuits known as logic gates. Fig.1 shows the logic symbols and truth tables for some basic gates.

The output of each gate depends on the combination of its inputs. This is known as combinational logic. The output for all possible inputs is shown using a truth table. The truth tables show that the output of an AND gate, however, stays high unless all its inputs are high. The output of a NOT gate (also known as an inverter) is always the opposite of its input.

Fig.1 Truth tables



- Fill in the blanks using information collected from the task on page 5. ^[10]
 are electronic devices generally made from transistors and diodes. All types of, except, have two input terminals. The input terminals receive in the form of, and are designed to simply detect whether there is a (considered to be the signal '1'), or not (considered to be the signal '0').
 All have one terminal, which can send the signal 1 or the signal 0. Whether the sends a 1 or a 0 depends on the of signals received by the, and on the type of being used.

IV- Language Study: Making Definitions and Conditions ^[11]

1- Classify these devices in the table below.

*flowmeter – ohmmeter – barometer – altimeter — thermistor – photosensor – proximity sensor –
 voltmeter- piezoelectric sensor– hygrometer – smoke detector – thermocouple - accelerometer —
 microphone - ammeter - thermostat - motion detector*

<i>Measuring devices</i>	<i>Sensing devices</i>	<i>Regulating devices</i>

2- Match these functions with the devices above and then write a complete definition.

Example: *a voltmeter is a device which detects and measures voltage.*

- a- *Detects and measures voltage.*
- b- *Detects and measures electric current.*
- c- *Detects and measures electrical resistance.*
- d- *Regulates temperature-switches a heating or cooling system on or off at a set temperature.*
- e- *Measures or controls temperature - produces a voltage which varies proportionally as the temperature difference between two points varies.*
- f- *Measures or controls temperature-produces a resistance which varies proportionally as temperature varies (thermistor is short for 'thermal resistor').*
- g- *A general term for devices that detect and measure light.*
- h- *Measures the distance between itself and nearby objects.*
- i- *Measures movement and strain - produces an electric current when stressed mechanically.*
- j- *Measures the rate of flow of a fluid.*
- k- *Measures atmospheric pressure.*
- l- *Measures the amount of moisture (water vapour) in the air.*
- m- *Measures altitude, usually as a height above sea level.*
- n- *Detects smoke, usually to provide a fire warning.*
- o- *Measures acceleration and deceleration forces.*
- p- *Detects movement-usually of people-that are a certain distance away.*
- q- *Detects sound.*

3- Match each component with its function.

Antenna	inductor
capacitor	inverter
cell	rectifier
circuit –breaker	resistor
diode	transformer
fuse	transistor

- a-* A device with three terminals which can be used as an amplifier or switch.
- b-* Converts direct current to alternating current.
- c-* Produces a precise amount of resistance.
- d-* Receives or transmits (sends) radio signals.
- e-* Consists of two conductors which are separated by a dielectric (insulating) material-allows a certain amount of electrical charge to be stored.
- f-* An electrical storage device, containing chemicals, which supplies a direct current.
- g-* A thin conductor which burns and breaks at a certain amperage, to protect a circuit.
- h-* A coil which is used to produce electromagnetic induction.
- i-* A safety device which automatically switches off a circuit.
- j-* A device with two terminals which allows current to flow in one direction only.
- k-* Increases voltage and reduces amperage or reduces voltage and increases amperage.
- l-* Converts alternating current to direct current.

4- **Conditional type 0:** Complete these statements with the help of the truth tables in fig.1.

Example: In an AND gate: **If** *A* and *B* are low, the output is low.

The output of an AND gate stays high **unless** all its inputs are high.

- Using the truth tables on page 5 make conditional sentences with ‘if’ and ‘unless’.
- a-* AND:
- b-* NOT:
- c-* OR:
- d-* NOT:
- e-* NAND:
- f-* NAND:
- g-* AND:

Key answer

I- Vocabulary Study

1- Simple Circuits

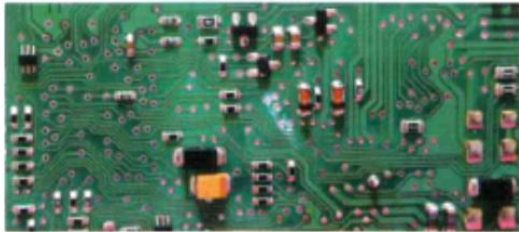
parallel – series – live – neutral – AC – live – neutral

2- Mains AC Circuits and Switchboards

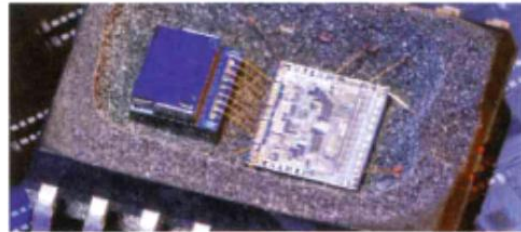
Task:

- a- a power circuit*
- b- a series circuit*
- c- an integrated circuit*
- d- a short circuit*
- e- a parallel circuit*
- f- a printed circuit*

3- Printed and integrated circuits



A printed circuit board



An integrated circuit on a microchip

4- Plugs and Sockets

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

5- Components and Symbols

Component	Type	Value/reference number
R1	<i>Thermistor</i>	<i>15kΩ</i>
R2	<i>Potentiometer</i>	<i>100 kΩ</i>
R3	<i>Resistor</i>	<i>10 kΩ</i>
R4	<i>Resistor</i>	<i>10 kΩ</i>
R5	<i>Resistor</i>	<i>270 kΩ</i>
R6	<i>Resistor</i>	<i>4.7 kΩ</i>
R7	<i>Resistor</i>	<i>1 kΩ</i>
D1	<i>Diode</i>	<i>IN4148</i>
Q1	<i>Transistor</i>	<i>BC107B</i>
SW1	<i>Switch</i>	<i>12V</i>
	Operational amplifier	UA741

The circuit is a simple frost alarm. It is used for warning drivers that roads may be icy or gardeners and fruit farmers to protect their crops.

II- Pronunciation: Reading Component Values

- **Audio script**

A ten-microfarad electrolytic capacitor

A five-hundred-picofarad variable capacitor

A ten-kilohm variable resistor

A nine-volt battery

A sixty-microhenry inductor

A six-volt sixty-milliamp bulb

III- Technical Reading: Combinational Logic

a- What terms are used in the text for each of the following terms?

- A digital switching circuit: *Logic gate*
- The output of each gate depending on the combination of its inputs: *Combinational logic*

b- What is shown by a truth table ?*The output for all possible inputs*

c- What is another name for a NOT gate? *An inverter*

d- *Logic gates - logic gate - NOT gates – signals - voltages – voltage – logic gates – output – logic gate – combination – input terminals – logic gate -*

IV- Language Study: Making Definitions and Conditions

1- Classify these devices in the table below.

<i>Measuring devices</i>	<i>Sensing devices</i>	<i>Regulating devices</i>
<i>Flowmeter j</i>	<i>Ohmmeter</i>	<i>Thermistor</i>
<i>Ohmmeter c</i>	<i>Photosensor g</i>	<i>Thermocouple</i>
<i>Barometer k</i>	<i>Voltmeter</i>	<i>Thermostat d</i>
<i>Altimeter m</i>	<i>Smoke detector n</i>	
<i>Thermistor f</i>	<i>Thermocouple e</i>	
<i>Proximity sensor h</i>	<i>Microphone q</i>	
<i>Voltmeter a</i>	<i>Ammeter</i>	
<i>Piezoelectric sensor i</i>	<i>Motion detector p</i>	
<i>Hygrometer l</i>		
<i>Accelerometer o</i>		
<i>Ammeter b</i>		

2- Match each component with its function.

Antenna - <i>d</i>	Inductor - <i>h</i>
Capacitor - <i>e</i>	Inverter - <i>b</i>
Cell - <i>f</i>	Rectifier - <i>l</i>
circuit -breaker - <i>i</i>	Resistor - <i>c</i>
diode - <i>j</i>	Transformer - <i>k</i>
fuse - <i>g</i>	Transistor - <i>a</i>

3- Conditional type 0:

a- In an AND gate, the output signal is 1 if both input signals are 1

b- In a NOT gate, the output signal is 0 unless the input signal is 0.

c- In an OR gate, the output signal 1 if either one of the input signal is 1, or if both input signals are 1.

d- In a NOT gate, if the input signal is 1, the output signal is 0 and vice versa.

e- In a NAND gate, the output is 1 unless all its inputs are 1.

f- In a NAND gate, if both inputs are 1, the output is 0

g- In an AND gate, the output becomes 0 if one input is 0

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