SVEUČILIŠTE U SPLITU
SVEUČILIŠNI ODJEL ZA STRUČNE STUDIJE

TEHNIČKI ENGLESKI JEZIK

ENGLISH IN ELECTRICAL ENGINEERING

syllabus

akademska godina 2012/2013

Split, srpanj 2012.

OSNOVNI PODACI O KOLEGIJU				
Naziv kolegija	**Tehnički engleski jezik**			
Bodovi	**2 ECTS**			
Status kolegija	**obvezan**			
Godina i semestar studija	**2. godina-3.semestar/3.godina-5.semestar**			
Web stranica kolegija				
Ukupno sati	**predavanja**	**30 sati**		
Jezik predavanja	**Engleski jezik**			
Vrijeme održavanja nastave				
Kod	SELT11			

OSNOVNI PODACI O NASTAVNICIMA		
Nositelj kolegija	**Margita Malešević, prof.- viši predavač**	
e-mail	**mmalesev@oss.unist.hr**	
Telefon	**021 393 208**	
GSM	**091 33 44 154**	
konzultacije	**vrijeme**	
	mjesto	**Kopilica 5- Zavod za jezike**
Asistent		
e-mail		
Telefon		
GSM		
konzultacije		

O KOLEGIJU	
Cilj kolegija	Osposobljavanje studenta za korištenje svih jezičnih vještina i upoznavanje sa stručnom terminologijom iz područja elektrotehnike na engleskom jeziku.
Kompetencije koje se stječu	Osposobljenost za: • praćenje stručnih izlaganja na engleskom jeziku • razgovor o temama vezanim za elektroniku i uspješno prezentiranje odabrane teme • korištenje stručne literature

PLAN RADA			
Tjedan	**datum**	**Oblik nastave**	**Tema**
1.		**Predavanja**	*1. HISTORY OF ELECTRICITY* 1.1. Evolution of Electricity 1.2. Nikola Tesla, the Man Who Lit up the World 1.3. Exercises
		vježbe	
2.		**Predavanja**	*2. ELECTRONIC COMPONENTS* 2.1. Components and Their Symbols 2.2. Describing Components and Their Functions 2.3. Exercises
		vježbe	
3.		**Predavanja**	*3. THE INTERNATIONAL SYSTEM of MEASUREMENTS* 3.1. Component name abbreviations widely used in industry 3.2 Mathematical Expressions 3.3 Algebraic Expressions 3.4. Exercises
		vježbe	

4.		**Predavanja**	4. COMPONENT VALUE CODES 4.1. Resistor codes 4.2. Capacitor codes 4.3. Diode codes 4.4. Exercises
		vježbe	
5.		**Predavanja**	5. TRANSISTORS 5. 1. Bipolar transistors 5. 2. Unipolar transistors 5. 3. Diagrams 5. 4. Exercises
		vježbe	
6.		**Predavanja**	6. SEMICONDUCTORS 6.1. Intrinsic semiconductors 6.2. Extrinsic semiconductors 6.3. Exercises
		vježbe	
7.		**Predavanja**	***7. WRITTEN TEST ONE***
		vježbe	
8.		**Predavanja**	8. ELECTROSTATICS 8.1. Electricity and the Electron 8.2. Electrical Charges; Electrical Conductivity 8.3. Exercises
		vježbe	
9.		**Predavanja**	9. ELECTRODYNAMICS 9.1. Classical Electromagnetism 9.2. Electromagnetic induction 9.3. Exercises
		vježbe	
10.		**Predavanja**	10. METAL DETECTOR 10.1. VFL Technology 10.2. Buried Treasure 10.3. Passive 10.4. Exercises

		vježbe	
11.		Predavanja	*11. TELECOMMUNICATIONS* 11.1 The Internet 11.2.Local area networks and wide area networks 11.3. Computer vocabulary 11.4. Exercises
		vježbe	
12.		Predavanja	*12.TURBINES,GENERATORS,POWER PLANTS* 12.1. Hydropower Plants 12.2. Transmission Systems 12.3. The Distribution Grid 12.4. Renewable Energy Sources 12.5. Exercises
		vježbe	
13.		Predavanja	*13. MECHATRONICS* 13.1. Why Study Mechatronics? 13.2. Mechatronic Engineers 13.3. Automation 13.4. Venn Diagram
		vježbe	
14.		Predavanja	*14. TECHNICAL TEXTS* 14.1. Multiword Lexical Units 14.2. How to Read an English Technical Text 14.3. Six Principles of Technical Writing 14.4. Abstract Writing Guidelines
		vježbe	
15.		dopunski	***15. WRITTEN TEST TWO***

LITERATURA	
Obvezna literatura	1. Malešević, M. (2012) *English in Electrical Engineering, Web izdanje* 2. Glendinning, E.H., McEwan,J.(1996) *Oxford English for Electronics* Oxford:Oxford University Press
Dopunska literatura	1. Štambuk, A. (2002) *English in Electrical Engineering and Computing* Split: Fakultet elektrotehnike, strojarstva i brodogradnje, Sveučilište u Splitu 2. Materijali s Interneta 3. Bryson, B. (2004) *A Short History of Nearly Everything* Reading: Cox& Wyman Ltd
web stranice	
Časopisi	

NAČINI PROVJERE ZNANJA	
Elementi ocjenjivanja	***Postotak udjela u konačnoj ocjeni***
Nazočnost na predavanjima	**10**
Kvaliteta pismenih radova i zadataka	**10**
1. kolokvij	**40**
2. kolokvij	**40**

UNIT 1
Evolution of Electricity

Many inventions have taken several centuries to develop into their modern forms and modern inventions are rarely the product of a single inventor's efforts. The inventions listed below were only one small step towards the ultimate goal.

Electricity has fascinated human kind since our ancestors first witnessed lightning. In ancient Greece, Thales observed that an electric charge could be generated by rubbing **amber**, for which the Greek word is **electron**.

1729 The English physicist **Stephen Gray** discovered electrical conductivity in 1729.

1752 **Benjamin Franklin** proposes the notion of positive and negative charge. His famous kite experiments, identifying lightning as a form of electrical discharge, take place in 1752.

1800 **Alessandro Volta** invents an electric battery, the first source of DC current.

1827 **Georg Simon Ohm** determined that the current that flows through a wire is proportional to its cross sectional area and inversely proportional to its length or Ohm's law. These fundamental relationships are of such great importance, that they represent the true beginning of electrical circuit analysis.

1831 **Michael Faraday** experimentally characterizes magnetic induction. The most thorough of early electrical investigators, he formulates the quantitative laws of electrolysis, the principles of electric motors and transformers, investigates diamagnetic materials, and posits a physical reality for the indirectly observed magnetic and electrical lines of force.

1879 **Thomas Alva Edison** invented the light bulb. He originated the concept and implementation of electric-power generation and distribution to homes, businesses, and factories – a crucial development in the modern industrialized world. His first power station was on Manhattan Island, New York.

1885 During his development of the braking and signalling systems, in the mid 1880s**, George Westinghouse** became quite interested in electricity. He began pursuing the technology of alternating current and he associated with those who were developing AC devices.

1886 On March 20, 1886, **William Stanley** demonstrated a system of high voltage transmission via a "parallel connected transformer." The device, combined with high-voltage transmission lines, made it possible to spread electric service over a wide area and allowed alternating current to be available at different voltages.

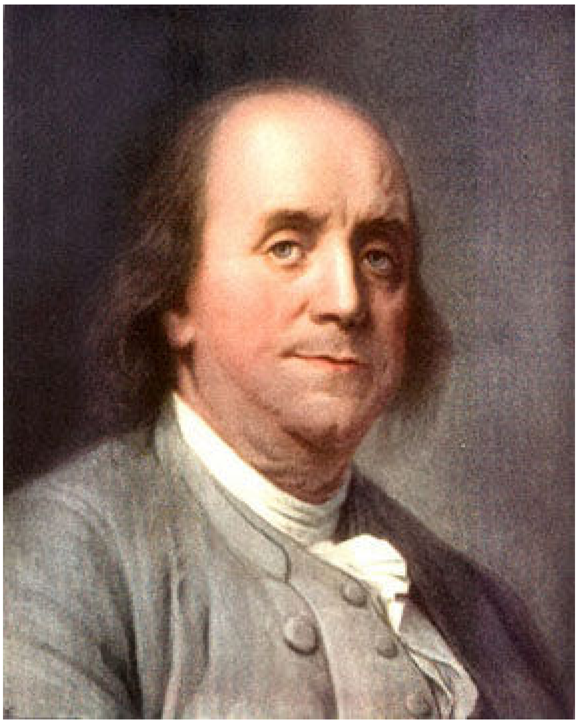
1888 **Heinrich Hertz** discovers and measures the waves, radio waves, predicted earlier by Faraday and Maxwell.

1888 **Nikola Tesla** invented the first practicable AC motor and polyphase power transmission system. Westinghouse acquired exclusive rights to Nikola Tesla's patent for the polyphase system and lured Tesla to join the electric company and continue his work on the AC motor he had developed.

1901 **Elihu Thomson,** electrical engineer, inventor, and entrepreneur, was an innovator in electrification in both a technical and corporate sense. Thomson acquired nearly 700 patents in his career, his major contributions included (electrostatic motors, electrical meters, high-pressure steam engines, dynamos, generators and, X-rays).

http://www.ideafinder.com/features/smallstep/electricity.htm (adapted)

B. Franklin



S. Gray

A. Volta

1) Comprehension questions

1) Where does the word **electricity** come from?
2) What did **B. Franklin** propose?
3) Who invented the **first source** of DC current?
4) What did **Faraday** formulate**?**
5) Why is **Edison** important in the history of electricity?
6) What did **Hertz** discover?

2) Match the scientists to their inventions or discoveries.

a) B. Franklin	1) light bulb
b) A. Volta	2) magnetic induction
c) M. Faraday	3) radio waves
d) T. Edison	4) positive and negative charge
e) H. Hertz	5) electric battery

a_____ b_____ c_____ d_____ e_____

3) Complete the text with the words from the box.

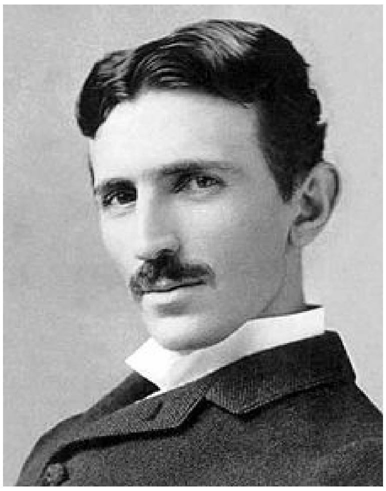
electricity	forwards	magnetic	alternating
transport	plant	source	switching

The turning point of the electric age came with the development of AC power systems. With____________ 1) current, power plants could _______________ 2) electricity much further than before it. In 1895, G. Westinghouse opened the first major power plant at Niagara Falls using alternating current. While Edison's DC_____________ 3) could only transport electricity within one square mile of his Pearl Street Power Station, the Niagara Falls plant was able to transport ____________ 4) more than 200 miles.

In DC, the electrons flow steadily in a single direction, or _____________ 5). In AC, electrons keep _____________ 6) directions, sometimes going "forwards" and then going "backwards." The power that comes from wall outlets is AC.

Electricity is a very different energy _____________ 7) than heat or light. In nature, electricity only rarely occurs, in some animals or with lightning. In the search to create electrical energy, scientists discovered that electrical and ______________ 8) fields are related. A magnetic field near a wire causes electrons to flow in a single direction along the wire because they are repelled and attracted by the north or south poles. Thus, DC power from a battery was born, primarily attributed to Thomas Edison's work and promotion.

Nikola Tesla, the Man Who Lit up the World



Nikola Tesla was born in 1856 in Smiljan Lika, Croatia. He was the son of a Serbian Orthodox clergyman. Tesla studied engineering at the Austrian Polytechnic School. He emigrated to the United States in 1884 to work at the Edison Machine Works.

Nikola Tesla was Thomas Edison's rival at the end of the 19th century. Tesla and Edison battled bitterly and publicly over AC and DC electrical power. Tesla had joined up with entrepreneur George Westinghouse to build AC power stations, while Edison was pushing DC power.

Ultimately, Tesla was proved right: AC power is easier to generate (the generators are simpler, cheaper, and more reliable), it can be transmitted much further (DC power was limited to short distances and necessitated power stations close to consumers), and its voltage can be converted using a simple transformer.

During his lifetime, Tesla invented fluorescent lighting, the Tesla induction motor, the Tesla coil, and developed the alternating current (AC) electrical supply system that included a motor and transformer, and 3-phase electricity. In total, Nikola Tesla was granted more than one hundred patents and invented countless unpatented inventions. He is also credited with inventing modern radio.

The Tesla coil, invented in 1891, is still used in radio and television sets and other electronic equipment.

Ten years after patenting a successful method for producing alternating current, Nikola Tesla claimed the invention of an electrical generator that would not consume any fuel but cosmic rays. This invention has been lost to the public. His invention of polyphase electric power earned him worldwide fame and fortune. Yet Tesla died poor, on January 7, 1943, having lost both his fortune and scientific reputation.

http://www.arkcode.com/custom3_25.html (adapted)

4) Fill in the gaps with a word from the box.

ferromagnetic	magnet	negative	voltage	induced
transformer	changing	maximum	DC sine	

AC Versus DC

Direct current, or1) ____________, is simple: it's the type of electricity that batteries supply. In a DC circuit, electricity flows in one direction only--for example, from the positive terminal of a battery through a circuit to the 2) __________terminal. Alternating current, or AC, changes direction cyclically, typically in the form of a 3) _____________wave.

AC varies in voltage from a positive 4) ____________to a negative minimum over time. To generate AC power, a current can be 5) __________in a pair of coils using a rotating magnet. The current varies as the 6) ____________rotates. Since the magnet does not touch the coils, AC generators are reliable and simple. DC generators, on the other hand, require a more complex mechanism.

It is simple to change the voltage of AC using a7) ___________. A basic transformer consists of a pair of coils, separated either by air or, more commonly, by some 8) __________material such as a bar of iron. As the AC voltage varies over time, it creates a 9) __________magnetic field around the coil it is connected to. This magnetic field induces an AC voltage in the other coil.

AC's biggest advantage is in power transmission. Since AC's voltage can be increased or decreased using transformers, it is possible to choose the most appropriate 10) ________for a given situation.

5) Match the beginnings of the sentences with the proper endings.

1) Tesla believed that alternating current was superior to Edison's direct current because of ____
____
2) He also worked with ground electromagnetic waves and ________________________
____
3) While working with radio waves, ____
____
4) Tesla also had a deep desire ____
____
5) He may be considered as a pioneer of the transistor _____________________________
____

a) invented the idea of radio as we know it today.

b) since two of his patents from 1903 contained the basic principles of the logical ‘AND’ circuit element.

c) the fact that it can be altered (converted) to suit a variety of situations.

d) he created the Tesla coil as a means to generate and receive this form of energy.

e) to provide global wireless communications and energy systems.

6) Electronics and the Letter "F"
Match the definitions to the appropriate terms.

1) This characteristic was formerly measured in cycles-per-second, but its modern unit of measure is named after a German physicist.

2) The unit of measure for a capacitor is the...?"

3) The "FET" is a type of transistor. Its full name is ________ effect transistor.

4) Voltage is sometimes referred to as EMF or Electromotive...?

5) The FFT, a mathematical process, is used extensively in digital signal processing (DSP). What word does the second "F" in FFT stand for?

a) Field
b) Force
c) Frequency
d) Farad
e) Fourier

1) ____ 2) ____ 3) ____ 4) ____ 5) ____

UNIT 2

Electronic Components and Their Symbols

An **electronic component** is a basic electronic element and may be available in a discrete form (a **discrete device** or **discrete component**) having two or more electrical terminals (or *leads*). These are intended to be connected together, usually by soldering to a printed circuit board, in order to create an electronic circuit (a discrete circuit) with a particular function (for example an amplifier, radio receiver, or oscillator). Basic electronic components may be packaged discretely, as arrays or networks of like components, or integrated inside of packages such as semiconductor integrated circuits, hybrid integrated circuits, or thick film devices.

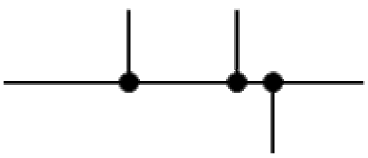
Classification

A component may be classified as **passive** or **active**.

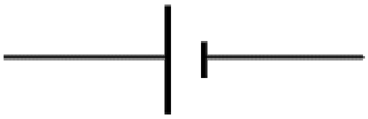
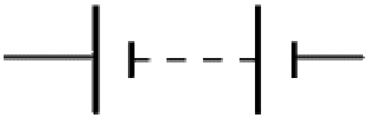
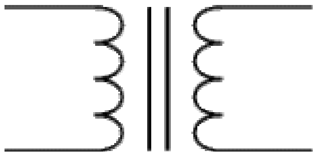
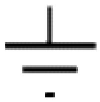
Passive components are those which cannot introduce net energy into the circuit they are connected to. They also cannot rely on a source of power except for what is available from the (AC) circuit they are connected to. As a consequence they are unable to amplify (increase the power of a signal), although they may well increase a voltage or current such as is done by a transformer or resonant circuit. Passive components are two-terminal components such as resistors, capacitors, inductors, and transformers.

Active components rely on a source of energy (usually from the DC circuit, and are usually able to inject power into a circuit. This includes amplifying components such as transistors, triode vacuum tubes (valves), and tunnel diodes.

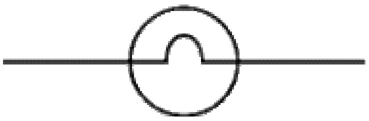
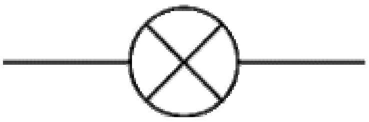
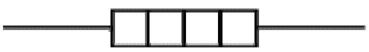
http://www.answers.com/library/Sci%252DTech+Dictionary-letter-1R

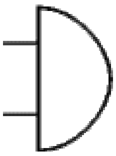
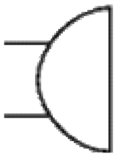
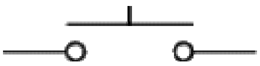
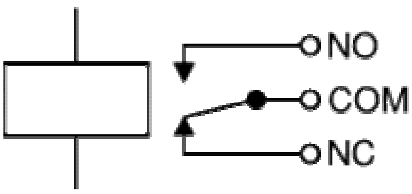
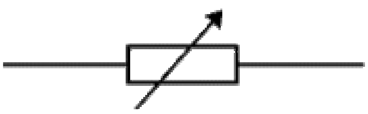
Wires and connections		
Component	**Circuit Symbol**	**Function of Component**
Wire		To pass current very easily from one part of a circuit to another.
Wires joined		A 'blob' should be drawn where wires are connected (joined), but it is sometimes omitted. Wires connected at 'crossroads' should be staggered slightly to form two T-junctions, as shown on the right.

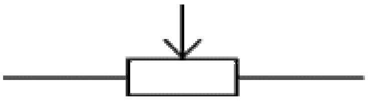
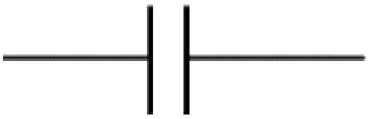
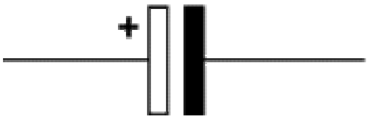
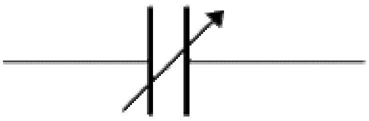
Power Supplies

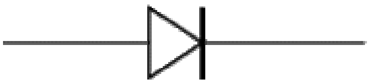
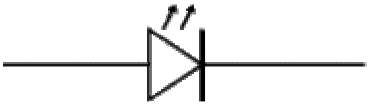
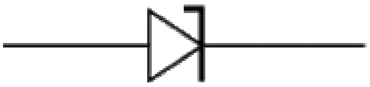
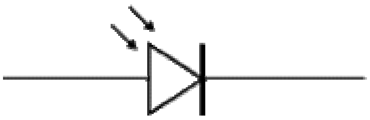
Component	Circuit Symbol	Function of Component
Cell		Supplies electrical energy. The larger terminal (on the left) is positive (+). A single cell is often called a battery, but strictly a battery is two or more cells joined together.
Battery		Supplies electrical energy. A battery is more than one cell. The larger terminal (on the left) is positive (+).
DC supply		Supplies electrical energy. DC = Direct Current, always flowing in one direction.
AC supply		Supplies electrical energy. AC = Alternating Current, continually changing direction.
Fuse		A safety device which will 'blow' (melt) if the current flowing through it exceeds a specified value.
Transformer		Two coils of wire linked by an iron core. Transformers are used to step up (increase) and step down (decrease) AC voltages. Energy is transferred between the coils by the magnetic field in the core. There is no electrical connection between the coils.
Earth (Ground)		A connection to earth. For many electronic circuits this is the 0V (zero volts) of the power supply, but for mains electricity and some radio circuits it really means the earth. It is also known as ground.

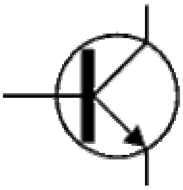
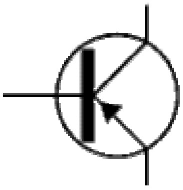
Output Devices: Lamps, Heater, Motor, etc.

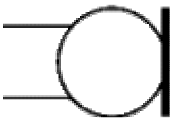
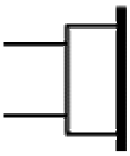
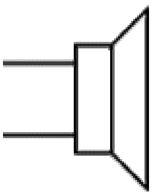
Component	Circuit Symbol	Function of Component
Lamp (lighting)		A transducer which converts electrical energy to light. This symbol is used for a lamp providing illumination, for example a car headlamp or torch bulb.
Lamp (indicator)		A transducer which converts electrical energy to light. This symbol is used for a lamp which is an indicator, for example a warning light on a car dashboard.
Heater		A transducer which converts electrical energy to heat.

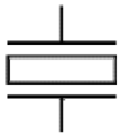
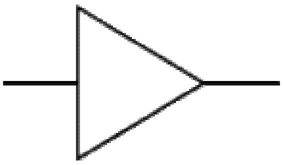
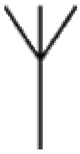
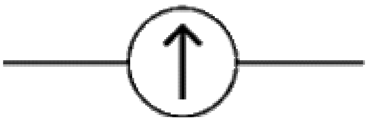
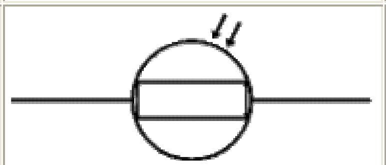
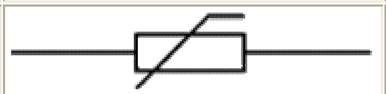
Motor		A transducer which converts electrical energy to kinetic energy (motion).
Bell		A transducer which converts electrical energy to sound.
Buzzer		A transducer which converts electrical energy to sound.
Inductor (Coil, Solenoid)		A coil of wire which creates a magnetic field when current passes through it. It may have an iron core inside the coil. It can be used as a transducer converting electrical energy to mechanical energy by pulling on something.
Switches		
Component	**Circuit Symbol**	**Function of Component**
Push Switch (push-to-make)		A push switch allows current to flow only when the button is pressed. This is the switch used to operate a doorbell.
Push-to-Break Switch		This type of push switch is normally closed (on), it is open (off) only when the button is pressed.
On-Off Switch (SPST)		SPST = Single Pole, Single Throw. An on-off switch allows current to flow only when it is in the closed (on) position.
Relay		An electrically operated switch, for example a 9V battery circuit connected to the coil can switch a 230V AC mains circuit. NO = Normally Open, COM = Common, NC = Normally Closed.
Resistors		
Component	**Circuit Symbol**	**Function of Component**
Resistor		A resistor restricts the flow of current, for example to limit the current passing through an LED.
Variable Resistor (Rheostat)		This type of variable resistor with 2 contacts (is usually used to control current. Examples include: adjusting lamp brightness, adjusting motor speed, adjusting the rate of charge flow into a capacitor in a timing circuit.

Variable Resistor (Potentiometer)		This type of variable resistor with 3 contacts (a potentiometer) is usually used to control voltage. It can be used like this as a transducer converting position (angle of the control spindle) to an electrical signal.
Capacitors		
Component	**Circuit Symbol**	**Function of Component**
Capacitor		A capacitor stores electric charge. A capacitor is used with a resistor in a timing circuit. It can also be used as a filter, to block DC signals but pass AC signals.
Capacitor, polarised		A capacitor stores electric charge. This type must be connected the correct way round. A capacitor is used with a resistor in a timing circuit. It can also be used as a filter, to block DC signals but pass AC signals.
Variable Capacitor		A variable capacitor is used in a radio tuner.

Diodes		
Component	**Circuit Symbol**	**Function of Component**
Diode		A device which only allows current to flow in one direction.
LED Light Emitting Diode		A transducer which converts electrical energy to light.
Zener Diode		A special diode which is used to maintain a fixed voltage across its terminals.
Photodiode		A light-sensitive diode.

Transistors		
Component	**Circuit Symbol**	**Function of Component**
Transistor NPN		A transistor amplifies current. It can be used with other components to make an amplifier or switching circuit.
Transistor PNP		A transistor amplifies current. It can be used with other components to make an amplifier or switching circuit.

Audio and Radio Devices		
Component	**Circuit Symbol**	**Function of Component**
Microphone		A transducer which converts sound to electrical energy.
Earphone		A transducer which converts electrical energy to sound.
Loudspeaker		A transducer which converts electrical energy to sound.

Piezo Transducer		A transducer which converts electrical energy to sound.
Amplifier (general symbol)		An amplifier circuit with one input. Really it is a block diagram symbol because it represents a circuit rather than just one component.
Aerial (Antenna)		A device which is designed to receive or transmit radio signals. It is also known as an antenna.
Meters and Oscilloscope		
Component	**Circuit Symbol**	**Function of Component**
Voltmeter		A voltmeter is used to measure voltage. The proper name for voltage is 'potential difference', but most people prefer to say voltage!
Ammeter		An ammeter is used to measure current.
Galvanometer		A galvanometer is a very sensitive meter which is used to measure tiny currents, usually 1mA or less.
Ohmmeter		An ohmmeter is used to measure resistance. Most multimeters have an ohmmeter setting.
Oscilloscope		An oscilloscope is used to display the shape of electrical signals and it can be used to measure their voltage and time period.
Sensors (input devices)		
Component	**Circuit Symbol**	**Function of Component**
LDR		A transducer which converts brightness (light) to resistance (an electrical property). LDR = Light Dependent Resistor
Thermistor		A transducer which converts temperature (heat) to resistance (an electrical property).

http://www.kpsec.freeuk.com/components/capac.htm

1) Match the sentences halves.

1) The terminals of a diode are	a) three terminals.
2) A full wave bridge rectifier consists of	b) drain, gate and source.
3) BJT has	c) anode and cathode.
4) The terminals of an FET are	d) emitter, base and collector
5) The terminals of a BJT are	e) four diodes.

1) ___ 2) ___ 3) ___ 4) ___ 5) ___

2) True, False, Yes or No: Circuits- Circle the correct answer.

1. Will a light bulb that is a part of a complete circuit light up? Yes or no?

2. An open circuit is a type of circuit. True or false?

3. A series circuit has one path from the source and back to the source again. True or false?

4. A parallel circuit has one path to the source and back to the source. True or false?

5. In a series circuit, the already existing light bulb dims when another light bulb is added. True or false?

6. Will a broken circuit light up? Yes or no?

7. If you take out a bulb on a series circuit, the rest of the bulbs will keep shining. Yes or no?

8. If you unscrew one of the light bulbs in a parallel circuit, the rest will stop lighting. True or false?

9. Impure graphite is a conductor of electricity. Yes or no?

10. Glass is a conductor of electricity. True or false?

www.funtrivia.com/quizzes/.../electronics (adapted)

Language study-Describing components

We need to be able to **1) label components:** **What is it called?**
2) describe their function: **What does it do?**

A) We can use two ways of labelling components: It **is called** a Zinc-carbon cell.

It **is known** as a NiCad cell.

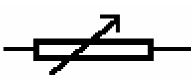
B) The function can be described like this: A cell **provides** electricity.

Cells **change** chemical energy into electricity.

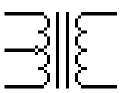
3) Label and describe the function of the following circuit symbols.

SYMBOLS:

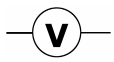
1) 

2) 

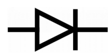
3) 

4) 

5) 

6) 

7) 

8) 

9) 

10) 

FUNCTIONS:

a) varies capacitance in a circuit
b) rectifies alternating current
c) adds resistance to a circuit
d) measures very small currents
e) breaks a circuit

f) protects a circuit
g) varies the current in a circuit
h) steps AC voltages up & down
i) receives RF signals
j) measures voltages

e.g. ***4) h*** ***It's called a transformer. It steps AC voltages up or down.***

UNIT 3

Component name abbreviations widely used in industry:

- AE: aerial, antenna
- B: battery
- BR: bridge rectifier
- C: capacitor
- CRT: cathode ray tube
- D or CR: diode
- DSP: digital signal processor
- F: fuse
- FET: field effect transistor
- GDT: gas discharge tube
- IC: integrated circuit
- J: wire link ("jumper")
- JFET: junction gate field-effect transistor
- L: inductor
- LCD: Liquid crystal display
- LDR: light dependent resistor
- LED: light emitting diode
- LS: speaker
- M: motor
- MCB: circuit breaker
- Mic: microphone
- MOSFET: Metal oxide semiconductor field effect transistor
- Ne: neon lamp
- OP: Operational Amplifier
- PCB: printed circuit board
- PU: pickup
- Q: transistor
- R: resistor
- RLA: RY: relay
- SCR: silicon controlled rectifier
- SW: switch
- T: transformer
- TFT thin film transistor(display)
- TH: thermistor
- TP: test point
- Tr: transistor
- V: valve (tube)
- VC: variable capacitor
- VFD: vacuum fluorescent display
- VLSI very large scale integration
- VR: variable resistor
- X: crystal, ceramic resonator
- Z or ZD: Zener diode

The International System of Measurements (SI)

- In 1960, the Eleventh General Conference on Weights and Measures was held in Paris. They adopted a universal system of measurement units called Le Systeme International d'Unites (French), which is a revised version of the metric system. This International System, or **SI**, as it is commonly referred to, is used for commerce and science around the world.
- There are seven SI base units. Everything that is measurable can be measured by these base units, or by units derived from these bases. The table below shows the bases, their international symbols, and what they are used to measure.

Table 2.1a SI Base Units

Base Quantity	Name of unit	Symbol
Length	Meter	M
Mass	Kilogram	Kg
Time	Second	S
Electrical Current	Ampere	A
Temperature	Kelvin	K
Amount of Substance	Mole	Mol
Luminous Intensity	Candela	Cd

Units that are made up of some combination of SI base units are called **Derived Units**. Table 2.1b shows some of the derived units that are common in Science.

Table 2.1b Derived Units

Base Quantity	Common Units
Volume	dm^3
Density	kg/dm^3
Acceleration	m/s^2
Force	$kg \times m/s^2$

Prefixes are used with the base units in order to increase or decrease the value that they represent. All of the prefixes represent some factor of 10, and they can be used with any of the SI base units. Table 1.3 represents some of the most common prefixes, their symbols, and the number that is used to multiply the base factor by.

Table 2.1c SI Prefixes

Prefix	Symbol	Multiply the base by
exa-	E	1 000 000 000 000 000 000
peta-	P	1 000 000 000 000 000
tera-	T	1 000 000 000 000
giga	G	1 000 000 000
mega	M	1 000 000
kilo	k	1000
hecto-	h	100
deca-	da	10
deci-	d	0.1
centi	c	0.01
milli-	m	0.001
micro-	u	0.000 001
nano-	n	0.000 000 001
pico-	p	0.000 000 000 001
femto-	f	0.000 000 000 000 001
atto-	a	0.000 000 000 000 000 001

4) Circle the correct answer.

1) The newton is a unit of:

a) mass b)force c) pressure d)energy

2) What is the SI base unit for the amount of substance?

a) Kelvin b) kilogram c) mole d)candela

3) Which of the following is *not* a unit of mass?

a) gram b) pound c) pinti d) ton

4) Which SI prefix stands for "million"?

a) giga b) centi c) milli d) mega

5) A square meter is a unit of:

a) volume b) length c) area d) energy

6) A unit of electric resistance is the:

a) ohm b) weber c) tesla d) henry

7) Which SI prefix stands for "thousand"?

a) milli b) deci c) micro d) kilo

8) What is the SI base unit for temperature?

a) Celsius b) Fahrenheit c) Centigrade d) Kelvin

9) Which SI prefix stands for "hundredth"?

a) nano b) micro c) deci d) centi

10) What is the SI base unit for Electric current?

a) mole b) ampere c) ohm d) volt

Mathematical expressions

$+$	plus/and	How much is seven plus three?
$-$	minus/take away	How much is seven minus three?
x	times/ is multiplied by	Three times two equals six.
:	is divided by	Nine divided by three equals three.
$=$	equals/is equal to	
$<$	is less than	
$>$	is greater than	
$\frac{1}{2}$	one half ; $\frac{5}{2}$ five halves	
$\frac{1}{3}$	one third	
$\frac{a}{b}$	**a** over **b**	
0.25	nought point two five; zero point twenty-five	
$\sqrt{\ }$	square root	
$\sqrt[3]{\ }$	cube root	
$\mathbf{x^2}$	**x** squared	
$\mathbf{x^3}$	**x** cubed	
$\mathbf{x^5}$	**x** to the power of five	
$\mathbf{x^{-5}}$	**x** to the power of minus five	
$\mathbf{x_n}$	**x** sub **n;** **x** subscript **n**	
n!	**n** factorial	
$\int$	the integral of	
17,537	seventeen thousand, five hundred **and** thirty-seven	

When expressing large numbers (more than one hundred) read in groups of hundreds. The order is as follows: billion, million, thousand and hundred. Notice that hundred, thousand, etc. is NOT followed by an**'s'**.

two hundred *NOT two hundreds*

In British English, a **billion** used to be equivalent to a million million (i.e. 1,000,000,000,000), while in American English it has always equated to a thousand million (i.e. 1,000,000,000). British English has now adopted the American figure, though, so that a billion equals a thousand million in both varieties of English.

The same sort of change has taken place with the meaning of **trillion**. In British English, a trillion used to mean a million million million (i.e. 1,000,000,000,000,000,000). Nowadays, it's generally held to be equivalent to a million million (1,000,000,000,000), as it is in American English.

NOTE: British English takes 'and' between 'hundred and ...' American English omits 'and'. In the examples below, this is represented: (AND)

Hundreds

350 – three hundred (AND) fifty 425 – four hundred (AND) twenty five

Thousands

786,450 – seven hundred (AND) six thousand four hundred (AND) fifty

Millions

2,450,000 – two million four hundred (AND) fifty thousands

Decimals

Read decimals as the given number **point** XYZ

2.36 = two point three six

Fractions

Read the top number as a **cardinal** number, followed by the **ordinal** number +'s'

3/8 = three eighths

NOTE: 1/4 = one quarter, 2/3 = two thirds,1/2 = one half

http://esl.about.com/od/beginningvocabulary/a/ex_numbers.htm (adapted)

Algebraic Expressions

In algebra we use letters as well as numbers. The letters represent numbers. We imitate the rules of arithmetic with letters, because we mean that the rule will be true for *any* numbers.

The numbers are the numerical symbols, while the letters are called literal symbols.

The four operations of arithmetic, and their operation signs:

1) Addition: $a + b$. The operation sign is +, and is called the *plus sign*. Read $a + b$ as "*a* plus *b*."

2) Subtraction: $a - b$. The operation sign is −, and is called the *minus sign*. Read $a - b$ as "*a* minus *b*."

3) Multiplication: $a \cdot b$. Read $a \cdot b$ as "*a* times *b*." The multiplication sign in algebra is a centred dot.

4) Division: a:b or $\frac{a}{b}$. Read $\frac{a}{b}$ as "*a* divided by *b*."
In algebra, we use the horizontal division bar

http://www.themathpage.com/alg/algebraic-expressions.htm

5) Circle the correct answer.

1) Which expression means the product of 8 and a number b?

a) 8/b b) 8-b c) 8+b d) 8xb

2) Choose the expression that means the difference between 11 and the number b.

a) 11-b b) 11/b c) b-11 d) 11+b

3) 2x + 3x + x is same as:

a) 7x b) 6x c)5x d) 4x

4) What does (x + y) mean?

a) the product of x and y b) the sum c) the difference d) x is greater than y

5) In the expression, t + 10, the letter t is called a:

a) variable b) algebraic letter c) expression d) mystery letter

UNIT 4

Component Value Codes

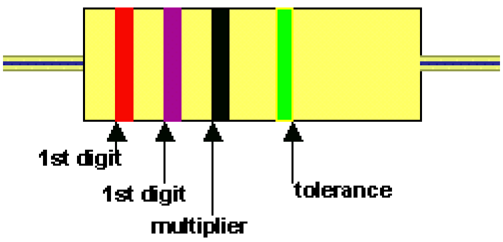
Resistor values / Resistor tolerances / Capacitor values

Electronic components have various ways of denoting the values; increasingly (due to advances in printing technology) they have numbers printed on.

Decimal points are often denoted by placing the multiplier in as a decimal point, e.g. resistors labelled 5R6 = 5.6ohms; 4k7= 4.7kohms, and capacitors labelled 2u2 (or 2μ2) = 2.2 microfarads.

Resistor Colour Codes

Resistors are often labelled with colour bands to ease the problem of marking such small components.; the first two bands stand for the first two digits, the third band shows the number of zeros, and the fourth shows the tolerance. The following code is used for the values:

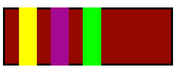


The first digit is the one nearest the end.

The two digits are the value; the multiplier adds zeros.

0 Black
1 Brown
2 Red
3 Orange
4 Yellow
5 Green
6 Blue
7 Purple *or* Violet
8 Grey
9 White

Examples:

- red + red + orange = 22 followed by 3 zeros, = 22000 ohms = 22kOhms
- yellow + purple + green = 47 followed by 5 zeros = 4,700,000 = 4.7 megOhms
- grey + red + black = 82 followed by 0 zeros, = 82 ohms

http://users.cscs.wmin.ac.uk/~wooda/components/code/

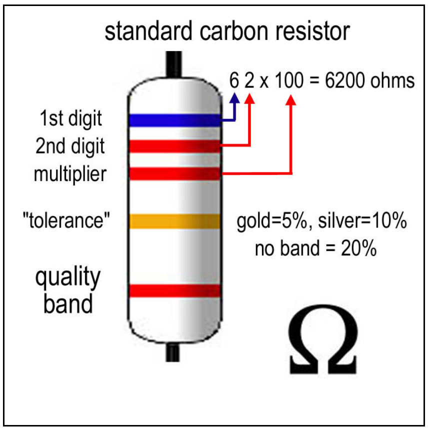
Resistor Tolerance (accuracy) Code

Tolerance band	Tolerance
-no band-	20%
Silver	10%
Gold	5%
Red	2%
Brown	1%
Green	0.5%
Blue	0.25%
Violet	0.1%

A tolerance of 10% means that the component value may be anything between the nominal value -10% and the nominal value +10%, so a 10% tolerance 12k resistor may have a value between (12-1.2) and (12+1.2), or 10.8k - 13.2k.

These tolerances may seem to reflect poor manufacture but in most circuits they are quite satisfactory. Relaxing the tolerance enables the manufacturer to sell them more cheaply.

1) Find the values and tolerances of the resistors banded as follows.



1) red	**violet**	**orange**	**silver**	___________
2) blue	**grey**	**brown**	**gold**	___________
3) green	**blue**	**red**	**silver**	___________
4) red	**red**	**green**	**-----**	___________
5) brown	**black**	**orange**	**-----**	___________
6) orange	**orange**	**brown**	**gold**	___________

7) yelow	**orange**	**red**	**gold**	___________
8) brown	**green**	**green**	**-----**	___________
9) violet	**green**	**brown**	**red**	___________
10) white	**brown**	**red**	**red**	___________

2) Comprehension questions

1) Why are resistors coded with coloured bands?
2) What do the colours represent?
3) What does each band indicate?
4) What would be the effect of making resistors with a much higher tolerance?
5) Betwen which values might a resistor marked green, blue, orange and silver vary?

Capacitor Values

Capacitors have various methods for marking the value:

- Value written "normally" - e.g. 2.2µF = 2.2 microFarads
- Written using the prefix as the decimal point - e.g. 2u2 = 2.2 microFarads
- Using a three digit code: two digits are value, and then the number of zeros, with the value in picoFarads: e.g. 334 = 330000 pF = 330nanoFarads.
- Using a three-band colour code similar to the resistor code, to give the value in picoFarads.

Extra numbers or bands may indicate the maximum working voltage. For example:

220pF, 2.5%

Band1 red = 2

Band 2 red = 2

Band 3 brown = one zero

Band 4 orange = 2.5% tolerance

TOLERANCES

BAND

		4	5
COLOUR	**black**	**20%**	**------**
	white	**10%**	**------**
	green	**5%**	**------**
	orange	**2.5%**	**------**
	red	**2%**	**250V**
	brown	**1%**	**------**
	yellow	**------**	**400V**

3) Name the colour bandings of the following capacitors.

1 100pF, 20% _________________

2 180pF, 10% _________________

3 22nF, 5%250V _________________

4 47nF, 20% _________________

4) Answer the following questions.

1) A resistor's first three colour bands are; brown, black, and red, - What is its value?
2) Which digit does the colour yellow denote on a resistor colour band?
3) A 47 Kohm resistor would have which colours on its first 3 bands?
4) Which digit does the colour orange denote on a resistor colour band?
5) A resistor's first three colour bands are; red, yellow, black, - What is its value?
6) Which digit is represented by a black band on a resistor?
7) A resistor's first three colour bands are; brown, green, red, - What is its value?
8) Which colour represents the digit 6 in the resistor colour code?
9) Which of these colours is NOT used in the resistor value colour code?
10) Which digit is represented by a red band on a resistor?

UNIT 5

Transistors

A transistor, generally speaking, is a solid-state switch that allows a small signal to control a large signal, such as a current flow. The first transistor was invented by **John Bardeen**, Walter Brattain, and William Shockley in 1945. They were awarded the Nobel Prize for physics in 1956. Since that time, transistors of all types have become crucial for modern **electronics** to function. They are used for a wide variety of control functions such as amplification, oscillation and frequency conversion. The term ***transistor*** was coined of the term "transfer resistor".

A transistor has three terminals. Current flows between two of them while the third one controls the current. In **semiconductors**, there are two charge carriers. One is the **electron**, which carries negative charges. The other is a **hole**, which carries positive charges. The amount of electrons and holes is often unequal. Consequently, the carrier which has a larger amount is called a majority carrier and the other is called a minority carrier. Depending on what carriers produce the current, transistors can be classified as **bipolar** or **unipolar** transistors.

In **bipolar transistors**, the current is carried by both majority and minority carriers. The three terminals are the **emitter**, the **collector**, and the **base**. Two structures are possible, p-n-p and n-p-n. In a "p" type the majority carriers are holes (positive), while "n" indicates the type where the majority carriers are electrons (negative).

In **unipolar transistors**, only the majority carriers carry the current. The field-effect transistor (FET) is an example of a unipolar transistor. The three terminals are the **source**, the **drain**, and the **gate**. The region between the source and drain is called a substrate. FETs are used widely in today's electronic industry. Depending on whether there is an insulation layer between the gate and the substrate, there are junction-gate FETs (JFET) or insulated gate FETs (IGFET). Oxide is often used as the insulation material, so IGFET is often called MOSFET (Metal-Oxide-Semiconductor Field Effect Transistor). The electrical properties of JFET and MOSFET differ significantly.

Unipolar transistors differ from bipolar transistors because the current flow is controlled by the variation of the electric field, while with bipolar transistors it is controlled by the variation of the current in the base terminal. When building integrated circuits based on millions of transistors, many issues need to be taken into account. One is the **power** consumption. The type of transistors used, should not consume too much power. In making integrated circuits, FETs, built on silicon, turn out to be very good, which is why silicon devices are widely used today.

http://www.bookrags.com/research/transistors (adapted)

1) Complete this box where possible.

collect	collection	collective
	difference	
	emitter	
vary		
convert		
		amplified
consume		
		operational
control		
insulate		

2) Fill in the gaps using the words from the box.

1) Transistors are used for a _____________ of control functions including _____________, _____________ and frequency _______________.

2) The current flow through FET is _____________ by the variation of the electric field.

3) Electrical properties of JFET and MOSFET ____________ significantly.

4) Oxide is often used as the ____________ material.

5) One of the factors to be taken into account when building integrated circuits based on millions of transistors is the power _______________.

3) Answer the questions.

1) What is a transistor?

2) Where does the name transistor come from?

3) What are the 3 parts of a transistor?

4) What does IC stand for?

5) What are transistors made of?

4) Circle the correct answer.

1) It can be made from a variety of materials, such as carbon; it inhibits the flow of current.

a) inductor b) choke c) capacitor d) resistor

2) It consists of two plates and can store charge; it is useful in tuning and filtering circuits.

a) transistor b) capacitor c) relay d) inductor

3) It can consist of a simple wire and develops a magnetic field when current passes through it. It is also used in tuning circuits and filters.

a) transistor b) inductor c) capacitor d) semiconductor

4) It is a type of a semiconductor that only allows current to flow in one direction. It is usually used to rectify AC signals (conversion to DC).

a) inductor b) diode c) transformer d) relay

5) It consists of an electromagnet, which is used to open or close a contact(s).

a) inductor b) transistor c) relay d) rheostat

6) It is a type of a semiconductor in which the flow of current can be controlled through a base or gate terminal. It is usually used for electronic switching or amplifiers.

a) varistor b) diode c) resistor d) transistor

7) It consists of two coils which usually share a magnetic core. It is used to convert an AC source or signal into another AC source or signal with the same power (ideally) but different voltage and current.

a) choke b) transistor c) transformer d) relay

8) It is a special type of diode that breaks down when a critical reverse voltage is applied. It is most commonly used to regulate voltage.

a) LED b) anode c) Zener diode d) cathode

9) It is a special type of a diode that lights up when a small voltage is applied; it is usually used as an indicator in displays.

a) Zener diode b) LED c) LCD d) incandescent lamp

10) It is a type of a display that uses tiny polarized crystals; very popular in watches, calculators, and lap-tops.

a) LCD b) LED c) Quartz Crystal d) CRT

Block Diagrams

Block diagrams are used to understand (and design) complete circuits by breaking them down into smaller units or blocks. Each block performs a particular function and the block diagram shows how they are connected together. No attempt is made to show the components used within a block (unit), only the inputs and outputs are shown. The way of looking at circuits by focusing on the function of each unit is called the **systems approach**.

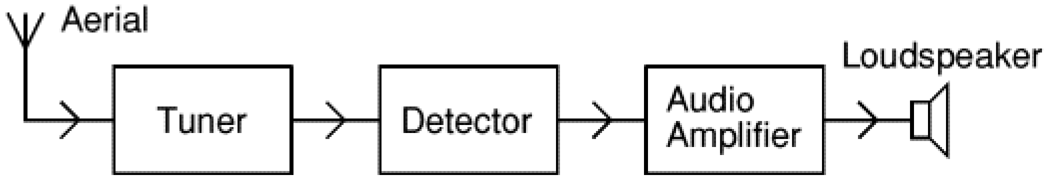
Audio Amplifier System

Block Diagram of an Audio Amplifier System

The power supply (not shown) is connected to the pre-amplifier and power amplifier blocks.

- **Microphone** - a transducer which converts sound to voltage.
- **Pre-Amplifier** - amplifies the small audio signal (voltage) from the microphone.
- **Tone and Volume Controls** - adjust the nature of the audio signal.
  The tone control adjusts the balance of high and low frequencies.
  The volume control adjusts the strength of the signal.
- **Power Amplifier** - increases the strength (power) of the audio signal.
- **Loudspeaker** - a transducer which converts the audio signal to sound.

Radio Receiver System



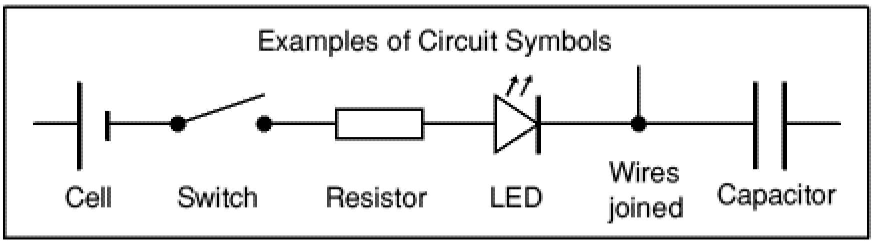
Block Diagram of a Radio Receiver System

The power supply (not shown) is connected to the audio amplifier block.

- **Aerial** - picks up radio signals from many stations.
- **Tuner** - selects the signal from just one radio station.
- **Detector** - extracts the audio signal carried by the radio signal.
- **Audio Amplifier** - increases the strength (power) of the audio signal.
  This could be broken down into the blocks like the Audio Amplifier System shown above.
- **Loudspeaker** - a transducer which converts the audio signal to sound.

Circuit Diagrams

Circuit diagrams show how electronic components are connected together. Each component is represented by a symbol and a few are shown here.

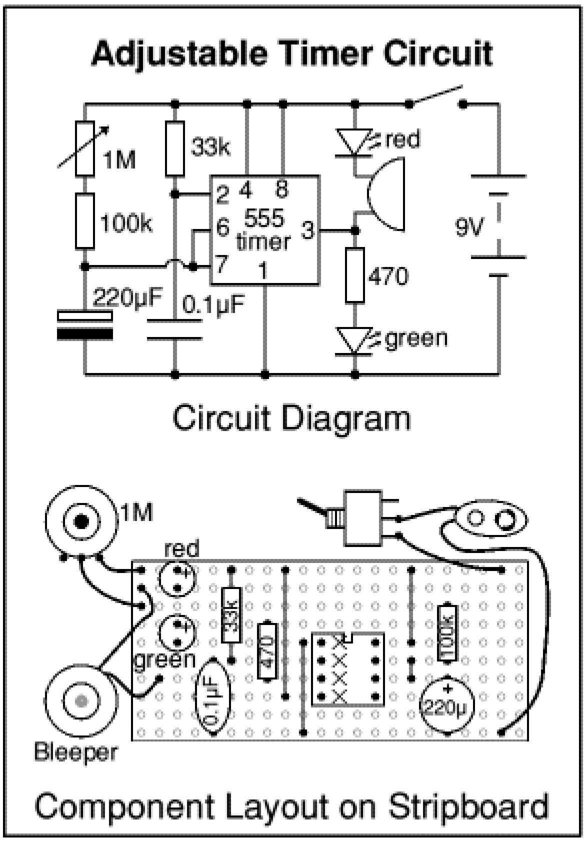


Circuit diagrams and component layouts

Circuit diagrams show the connections as clearly as possible with all wires drawn neatly as straight lines. The actual layout of the components is usually quite different from the circuit diagram and this can be confusing for the beginner. The secret is to concentrate on the *connections*, not the actual positions of components.

The circuit diagram and stripboard layout for the Adjustable Timer project are shown here so you can see the difference.

A circuit diagram is useful when testing a circuit and for understanding how it works. This is why the instructions for projects include a circuit diagram as well as the stripboard or printed circuit board layout which you need to build the circuit.



http://www.kpsec.freeuk.com/bdiags.htm

Diagrams: **Block diagram**- shows the function of each unit and the path of the signals between them.

Circuit diagram- shows the connection and values of the components.

Systems approach- understanding the function of each unit.

UNIT 6

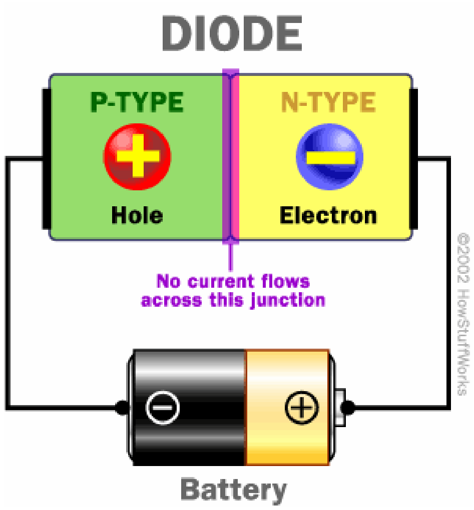
Semiconductors

Introductory questions

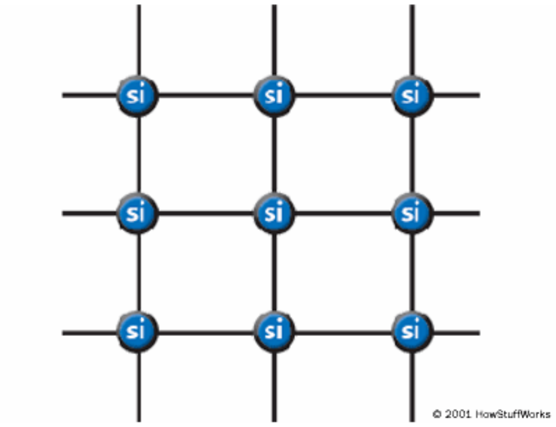
1) Which are most frequently used semiconductor materials?
2) What two processes take part between electrons and holes in semiconductor materials?
3) At what temperature are there no electrons in the conduction band of a semiconductor?

Semiconductors have had a monumental impact on our society. You find semiconductors at the heart of microprocessor chips as well as transistors. Anything that's computerized or uses radio waves depends on semiconductors.

Today, most semiconductor chips and transistors are created with **silicon**. Carbon, silicon and germanium (germanium, like silicon, is also a semiconductor) have a unique property in their electron structure -- each has **four electrons in its outer orbital**. This allows them to form nice crystals. The four electrons form perfect covalent bonds with four neighbouring atoms, creating a **lattice**. In carbon, we know the crystalline form as diamond. In silicon, the crystalline form is a silvery, metallic-looking substance.



A **diode** is the simplest possible semiconductor device, and is therefore an excellent beginning point to understand how semiconductors work.



In a **silicon lattice**, all silicon atoms bond perfectly to four neighbours, leaving no free electrons to conduct electric current. This makes a silicon crystal an insulator rather

Semiconductors are materials that have resistivity in the range between conductors and insulators. The conductivity increases not only with **temperature** but also with the presence of **impurities** in the crystal lattice.
They are used in a wide variety of solid state devices, such as transistors, integrated circuits, diodes etc.

Intrinsic semiconductors are those in which the energy gap between the conduction band and the valence band is comparable to thermal energies. To separate the electron-pair bonds and provide free electrons for electrical conduction, it is necessary to apply high temperatures or strong electric field.

Each electron that is thermally excited into the **conduction band** leaves behind a vacant energy level in the **valence band.** The vacancies are **holes** or **positive charge carriers**.
The number of electron-hole pairs per second produced in the semiconductor is the **generation rate.**

Another way to obtain free electrons is to add small amounts of other elements that have a different atomic structure (impurities). The presence of impurities in a semiconductor affects the conductivity significantly.

Extrinsic semiconductors are those whose properties depend on the presence of impurities and on the type and concentration of impurity.

Donor impurities are atoms which have more valence electrons than are required to complete the bonds with neighbouring atoms. The number of conduction electrons is greater than the number of mobile holes, and the semiconductor is **n-type**.

Acceptor impurities are atoms that have fewer valence electrons than required to complete the bonds with neighbouring atoms, so they accept any electrons to complete the bonds. Therefore holes are predominant and the semiconductor is known as **p-type**.

Majority carriers are those that predominate in a particular semiconductor, while the others are **minority carriers**.
The conductivity of an extrinsic semiconductor depends on the type and amount of impurities present. This can be controlled by adding impurities of a particular sort to achieve the desired type of conductivity. This process is called **doping** and the amount of impurity is the **doping level.**
http://www.howstuffworks.com/diode.htm (adapted)

1) Comprehension questions

1) What are semiconductors? Where are they used?
2) What increases conductivity?
3) What is an intrinsic semiconductor?
4) How are free electrons obtained in an extrinsic semiconductor?

2) Multiple Choice

1) What property clearly distinguishes semiconductors from metals and non-metals?

a) luster b) electrical conductivity c) ductility d) none of the above

2) Which of the following are semiconductor materials?

a) gallium arsenide b) germanium c) silicon d) all of the above

3) Why are semiconductors valuable in modern electronics?

a) use low power b) fast switching c) reliable d) all of the above

4) Which electronic devices are primarily made from semiconductors?

a) transistors b) resistors c) capacitors d) none of the above

5) How does the conductivity in pure semiconductors vary with temperature?

a) it increases as temperature goes down b) it increases as temperature goes up

c) it does not change with temperature

6) What explains why semiconductors have different electrical properties from metals?

a) more valence electrons b) band gap structure

c) fewer valence electrons d) no differences

3) Short answers

1) Name the 3 categories of materials based on their ability to conduct electricity.

_______________ _________________ __________________

2) Label each as C-conductor, SC semiconductor, or I- insulator:

Copper wire____ Glass rod ____ Silicon chip _____

3) Which would have a smaller energy gap between the valence band and the conduction band, glass or silicon? _____________

4) In a metallic conductor, are the valence shells filled, empty, or partially filled? __________

5) In a semiconductor, are the valence shells filled, empty, or partially filled? ___________

6) Are electrons in the valence band of a semiconductor in the bonding or anti bonding state? _______________

7) At what temperature are there no electrons in the conduction band of a semiconductor?

8) As one electron is promoted from the valence band to the conduction band, a _____ is formed in the valence band.

9) Both _________ and ______ are considered charge carriers.

10) A diode contains both _____________ and ___________ regions.

4) Write 2 adjectives or nouns which describe the following.

a) __________________, __________________ semiconductor

b) __________________, __________________ impurities

c) __________________, __________________ band

d) __________________, __________________ charge

e) __________________, __________________ charge carrier

5) Complete the text with a word or phrase from the box.

consume	*light-weight*	*construction*	*required*
advantages	*environmental*	*electronic*	*long-lasting*

Solid-state devices have many important _______________ over other types of _______________ devices. They are very small and _______________. They _______________ very little power. They are solid in _______________, extremely _______________, and can be made resistant to many severe _______________ conditions. The circuits _______________ for their operation are usually simple.

UNIT 7

Electrostatics

Introductory questions:

1) What do you know about the structure of atom?
2) How is it connected to electric current?
3) How is electricity defined?
4) How can materials be divided according to their conductivity?

Electrostatics is the branch of science that deals with the phenomena arising from stationary or slow-moving electric charges, while **electrodynamics** is a study of phenomena associated with charged bodies in motion.

Electrostatics involves the buildup of charge on the surface of objects due to contact with other surfaces. Although charge exchange happens whenever any two surfaces contact and separate, the effects of charge exchange are usually only noticed when at least one of the surfaces has a high resistance to electrical flow.

Some basic rules:

1) **There are two types of charges: positive and negative. Like charges repel and opposite charges attract. Electrostatics is based on this principle.**

2) **In general, a material is either a conductor or an insulator. A conductor allows electric charge to travel through it easily; an insulator does not.** Each type of material has a different arrangement of atoms, electrons, and protons. The particular arrangement of a material's atoms can be very advantageous for electric charge to travel through it (metals), or it can be disadvantageous (rubber, for instance).

3) **When certain types of materials are rubbed against other types, charge may be transferred from one to the other.** Objects contain charge. For most objects, the number of negative charges equals the number of positive charges, giving a net charge of zero.

4) **When an uncharged object is placed near a charged object its charges rearrange themselves.** Those charges attracted to the charged object move towards the charged object and those charges repelled, move away. This effect is known as **polarization.**

5) Charges on a conductor tend to gather at sharp points due to the properties of electric fields and conductors.

Electricity and the Electron

1) Complete the text with the words from the box.

nucleus	heavier	positive	balanced
charge	dense	identity	mass

Atom

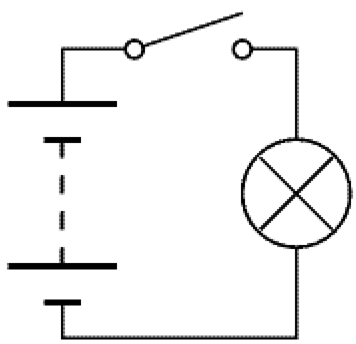
Every atom is made from three kinds of elementary particles: **protons**, which have a _____________ electrical charge; **electrons**, which have a negative electrical charge; and **neutrons**, which have no_____________. Protons and neutrons are packed into the_____________, while electrons spin around outside. The number of protons is what gives atom its chemical_____________. An atom with one proton is an atom of hydrogen, one with two protons is helium, and so on. Each time you add a proton, you get a new element. The number of protons is always _____________by an equal number of electrons, so you can say that it is the number of electrons that defines an element.

Neutrons don't influence an atom's identity, but they add to its_____________.

Neutrons and protons occupy the atom's nucleus. The nucleus of an atom is tiny- only one millionth of a billionth of the full volume of the atom- but fantastically_____________, as it contains the entire atom's mass. If an atom was expanded to the size of a cathedral, the nucleus would be only about the size of a fly – but a fly is many thousands of times _____________than the cathedral.

What is electricity?

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



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

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

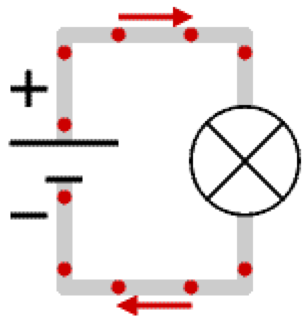
With the **switch open** the circuit is broken - so electricity cannot flow and the lamp is off.

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

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

Which way does electricity flow?

We say that electricity flows from the positive (+) terminal of a battery to the negative (-) terminal of the battery. We can imagine particles with positive electric charge flowing in this direction around the circuit, like the red dots in the diagram.



Imaginary positive particles moving in the direction of the conventional current

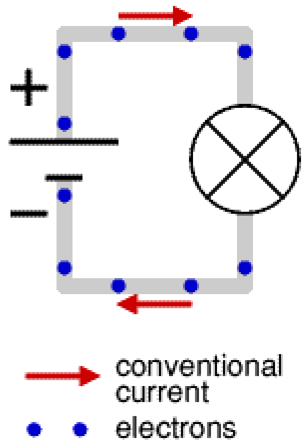
This flow of electric charge is called **conventional current**.

This direction of flow is used throughout electronics and it is the one you should remember and use to understand the operation of circuits.

However this is not the whole answer because the particles that move in fact have negative charge! And they flow in the opposite direction!

The electron

When electricity was discovered scientists tried many experiments to find out which way the electricity was flowing around circuits, but in those early days they found it was impossible to find the direction of flow.



They knew there were two types of electric charge, positive (+) and negative (-), and they decided to say that electricity was a flow of positive charge from + to -. They knew this was a guess, but a decision had to be made! Everything known at that time could also be explained if electricity was negative charge flowing the other way, from - to +.

The electron was discovered in 1897 and it was found to have a negative charge. The guess made in the early days of electricity was wrong! Electricity in almost all conductors is really the flow of electrons (negative charge) from - to +.

By the time the electron was discovered the idea of electricity flowing from + to - (conventional current) was firmly established. Luckily it is not a problem to think of electricity in this way because positive charge flowing forwards is equivalent to negative charge flowing backwards.

To prevent confusion you should **always use conventional current** when trying to understand how circuits work, imagine positively charged particles flowing from + to -.

http://www.kpsec.freeuk.com/electron.htm (adapted)

Electric charges; Electrical conductivity

One fundamental property of electrical charge is its existence in two varieties that are named **positive** and **negative. A**ll charged particles can be divided into two classes, where all members of one class repel each other, while attracting members of the other class.
Electric current is caused by the motion of charge carriers. The electric current is a measure of the amount of charge passing any point of the wire per unit time. (količina naboja koja u jedinici vremena prođe kroz poprečni presjek vodiča)
According to their ability to conduct current, materials are divided into electrical **insulators** and electrical **conductors**. The electrical difference between a good insulator and a good conductor is huge, as both properties depend on the mobility of atomic particles; in the electric, the mobility of the charge carriers, electrons or ions.
In electrical conductivity some substances can change conductivity, depending on conditions such as their temperature. Materials called **semiconductors** have this property.
Metals are the best conductors. Their conductivity is caused by free electrons. Since they are not attached to any single atom, they are able to move through the whole crystal lattice.

2) Comprehension questions

1) What is electrostatics and what electrodynamics?
2) Explain polarisation!
3) What does an atom consist of and how is it connected to electric current?
4) Which way does electricity flow and what is conventional current?
5) How are materials divided according to their conductivity?
6) Why are metals the best conductors?

3) Use the information from the text to complete the following sentences.

1) Charged particles can be divided into two classes: ____________________________
2) Regarding their conductivity, materials are divided into ___________________, ___________________ and __________________.
3) Semiconductors are materials that ____.

4) High conductivity of metals is caused by ____________________________________

5) The electric current is ____.

4) Match the definitions to the correct terms

1) the study of electric charges that can be collected and held in one place

2) force between objects with charge, just as the gravitational force is a force between objects with mass

3) materials in which charges are free to move about

4) materials in which charges are not free to move about

5) materials which can change their conducting properties

6) materials that lose all resistance to charge movement at temperatures near absolute 0

7) if an atom losses or gains balanced electrons to become positive or negative

8) if a molecule has a net positive charge on one side and a negative charge on the other

9) a charged object near a neutral object polarizes the charge of the neutral object

10) an object that is electrically neutral overall, but permanently polarized

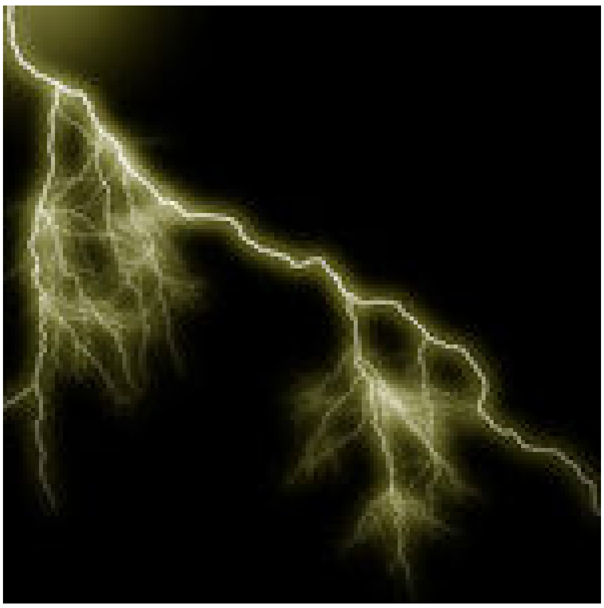
11) providing a path from a charged object to the earth

a) Superconductors
b) Electric dipole
c) Electrostatics
d) Polarization
e) Electric force
f) Ion
g) Grounding
h) Conductors
i) Polar
j) Insulators
k) Semiconductors

1) __ 2) __ 3) __ 4) __ 5) __ 6) __ 7) __ 8) __ 9) __ 10) __ 11) __

5) True or False: Circle the correct answer.

1) An object that does not allow electricity to flow is called an insulator. **T F**
2) An object with 4 positive charges and 3 negative charges is electrically neutral. **T F**
3) A copper wire is an example of a poor conductor. **T F**
4) The only type of subatomic particles that can travel along a wire carrying electricity are protons. **T F**
5) Oppositely charged objects repel each other whereas similarly charged objects attract each other. **T F**
6) The sound of thunder comes before the associated lightning discharge because sound travels faster than light. **T F**



UNIT 8

Electrodynamics

Electrodynamics, study of phenomena associated with charged bodies in motion and varying electric and magnetic fields); since a moving charge produces a magnetic field, electrodynamics is concerned with effects such as magnetism, electromagnetic radiation, and electromagnetic induction, including such practical applications as the electric generator and the electric motor. This area of electrodynamics, often known as **classical electrodynamics**, was first systematically explained by the physicist James Clerk Maxwell.

Classical electromagnetism

Classical electromagnetism (or **classical electrodynamics**) is a branch of theoretical physics that studies consequences of the electromagnetic forces between electric charges and currents.

The theory of electromagnetism was developed over the course of the 19th century, most prominently by James Clerk Maxwell. In physics, **electromotive force**, or most commonly **emf** (seldom capitalized), or (occasionally) **electromotance** is "that which tends to cause current (actual electrons and ions) to flow."

Devices that can provide emf include voltaic cells, thermoelectric devices, solar cells, electrical generators, transformers, and even Van de Graaff generators.

Electromagnetic induction

Electromagnetic induction is the production of voltage across a conductor situated in a changing magnetic field or a conductor moving through a stationary magnetic field.

Electromagnetic induction underlies the operation of generators, all electric motors, transformers, induction motors, synchronous motors, solenoids, and most other electrical machines.

Electromagnetic induction is the production of an electromotive force (emf) in a conductor as a result of a changing magnetic field about the conductor and is the most important of the three phenomena. It was discovered in 1831 by Michael Faraday and independently by Joseph Henry. Variation in the field around a conductor may be produced by relative motion between the conductor and the source of the magnetic field, as in an electric generator , or by varying the strength of the entire field, so that the field around the conductor is also changing.

Since a magnetic field is produced around a current-carrying conductor, such a field can be changed by changing the current. Thus, if the conductor in which an emf is to be induced is part of an electric circuit, the induction can be caused by changing the current in that circuit; this is called self-induction. Changing the current in a given circuit can also induce an emf in another, nearby circuit unconnected with the original circuit; this type of electromagnetic induction, called mutual induction, is the basis of the transformer.

Electrostatic induction is the production of an unbalanced electric charge on an uncharged metallic body as a result of a charged body being brought near it without touching it. If the charged body is positively charged, electrons in the uncharged body will be attracted toward it; if the opposite end of the body is then grounded, electrons will flow onto it to replace those drawn to the other end, the body thus acquiring a negative charge after the ground connection is broken.

Magnetic induction is the production of a magnetic field in a piece of unmagnetized iron or other ferromagnetic substance when a magnet is brought near it. The magnet causes the individual particles of the iron, which act like tiny magnets, to line up so that the sample as a whole becomes magnetized. Most of this induced magnetism is lost when the magnet causing it is taken away

http://en.wikipedia.org/wiki/Electromagnetic_induction (adapted)

1) Comprehension questions:

1) What is electrodynamics?
2) Why is it concerned with magnetism, electromagnetic radiation and electromagnetic induction?
3) Who was the first to explain classical electromagnetism, and what does electromagnetism study?
4) What is emf and how can it be provided?
5) Define electromagnetic induction! Who discovered it?
6) What is magnetic induction?
7) What is the basis of the transformer?

2) Complete the text with the words below.

battery	***opposite***	***potential***	***reverses***
motion	***conventional***	***electromotive***	***direction***

Electrodynamics is the study of charges in1) _______________. A flow of electric charge constitutes an electric current. Historically, the 2) _______________of current was described in terms of the motion of imaginary positive charges; this convention is still used by many scientists, although it is directly 3) _______________to the direction of electron flow, which is now known to be the basis of electric current in solids. Current considered to be composed of imaginary positive charges is often called 4) _______________current. In order for a current to exist in a conductor, there must be an electromotive force (emf), or 5) _______________difference, between the conductor's ends. An electric cell, a battery of cells, and a generator are all sources of 6) _______________force.

If the source is a 7) _______________, the current is in one direction only and is called direct current (DC). If the source is a generator without a commutator, the current direction 8) _______________twice during each rotation of the armature, passing first in one direction and then in the other; such current is called alternating current (AC). The number of times alternating current makes a double reversal of direction each second is called the frequency of the current.

3) Match the sentences halves.

1) The movement of electrons in a current
2) Each electron moves
3) In a direct current
4) In an alternating current
5) In liquids and gases

a) the electrons are spread evenly through the conductor.
b) in a series of stops and starts.
c) the electrons tend to congregate along the surface of the conductor.
d) the current carriers are not only electrons but also positive and negative ions.
e) is not steady.

1)_____ 2)_____ 3) _____ 4) _____ 5) _____

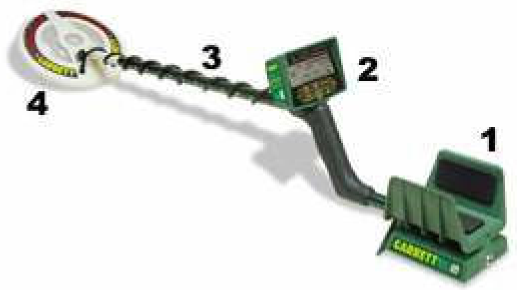
UNIT 9

Anatomy of a Metal Detector

A typical metal detector is light-weight and consists of just a few parts:

Stabilizer (optional) - used to keep the unit steady as you sweep it back and forth
Control box - contains the circuitry, controls, speaker, batteries and the microprocessor
Shaft - connects the control box and the coil; often adjustable so you can set it at a comfortable level for your height
Search coil - the part that actually senses the metal; also known as the "search head," "loop" or "antenna"

Most systems also have a **jack** for connecting headphones, and some have the control box below the shaft and a small **display unit**.



Operating a metal detector is simple. Once you turn the unit on, you move slowly over the area you wish to search. In most cases, you sweep the coil (search head) back and forth over the ground in front of you. When you pass it over a target object, an audible signal occurs. More advanced metal detectors provide displays that pinpoint the type of metal it has detected and how deep in the ground the target object is located.

Metal detectors use one of three technologies:

Very low frequency (VLF)
Pulse induction (PI)
Beat-frequency oscillation (BFO)

VLF Technology

Very low frequency (VLF), also known as **induction balance**, is probably the most popular detector technology in use today. In a VLF metal detector, there are two distinct coils:

- **Transmitter coil** - This is the outer coil loop. Within it is a coil of wire. Electricity is sent along this wire, first in one direction and then in the other, thousands of times each second. The number of times that the current's direction switches each second establishes the frequency of the unit.
- **Receiver coil** - This inner coil loop contains another coil of wire. This wire acts as an antenna to pick up and amplify frequencies coming from target objects in the ground.

Metal detectors, despite their technical complexity, are based on a few very simple principles**.** The most important is that of electromagnetic induction. This means that if a metal object is placed in a changing magnetic field, an electrical voltage is created in the object.

Alternating current is applied to the coil in the search head from the battery in the control box. This creates an ever-changing electromagnetic field around the coil. An electric current is induced in any metal object the coil passes near.

The current induced in the metal object produces its own magnetic field, which in turn induces a voltage in the search coil, as the alternating current changes direction.

The circuitry in the control box senses this reaction and converts the voltage into an audible note, which is sent to the headset. As the metal object is approached, the sound becomes louder, or changes pitch.

The metal detector can determine approximately how deep the object is buried based on the strength of the magnetic field it generates. The closer to the surface an object is, the stronger the magnetic field picked up by the receiver coil and the stronger the electric current generated. The deeper below the surface, the weaker the field. Beyond a certain depth, the object's field is so weak at the surface that it is undetectable by the receiver coil.

Buried Treasure

Metal detectors are great for finding buried objects. But typically, the object must be within a foot or so of the surface for the detector to find it. Most detectors have a normal maximum depth somewhere between 8 and 12 inches (20 and 30 centimetres). The exact depth varies based on a number of factors:

- The type of metal detector - The technology used for detection is a major factor in the capability of the detector. Also, there are variations and additional features that differentiate detectors that use the same technology. For example, some VLF detectors use higher frequencies than others, while some provide larger or smaller coils. Plus, the sensor and amplification technology can vary between manufacturers and even between models offered by the same manufacturer.
- The type of metal in the object - Some metals, such as iron, create stronger magnetic fields than others.
- The size of the object - A dime is much harder to detect at deep levels than a quarter.
- The makeup of the soil - Certain minerals are natural conductors and can seriously interfere with the metal detector.
- The object's **halo** - When certain types of metal objects have been in the ground for a long time, they can actually increase the conductivity of the soil around them.
- Interference from other objects - This can be items in the ground, such as pipes or cables, or items above ground, like power lines.

Hobbyist metal detecting is a fascinating world with several sub-groups. Here are some of the more popular activities:

- **Coin shooting** - looking for coins after a major event, such as a ball game or concert, or just searching for old coins in general
- **Prospecting** - searching for valuable metals, such as gold nuggets
- **Relic hunting** - searching for items of historical value, such as weapons used in the U.S. Civil War
- **Treasure hunting** - researching and trying to find caches of gold, silver or anything else rumoured to have been hidden somewhere

http://electronics.howstuffworks.com/gadgets/other-gadgets/metal-detector.htm (adapted)

1) Comprehension questions:

1) What are the basic parts of a metal detector?
2) Describe their functions!
3) How does a metal detector operate?
4) What technologies do metal detectors use?
5) What are the two coils in a VLF detector?
6) What factors cause the exact depth to vary?

2) Put the following steps in the correct order.

a) Magnetic field around the object.
b) AC voltage in the search coil.
c) Electric current in the metal object.
d) Induced voltage in the search coil.
e) Note heard in headset.
f) Magnetic field around the coil.

1_____ 2_____ 3_____ 4_____ 5_____ 6_____

Passive

Here are some verbs, often used in electronics: **generate, induce, detect.**

They are transitive verbs (followed by a direct object) so they can be used in the passive, when the object becomes the subject.

Active: The magnetic field **induces** a voltage.
Passive: A voltage **is induced** by the magnetic field.

3) Complete the sentences with *generate*, *induce, create, convert* or *detect*.

1) Sound ________________ by a microphone.

2) The magnetic field _______________ a voltage in the search coil.

3) An electric current ________________ in any metal object the coil passes near.

4) Alternating current applied to the coil ________________an ever-changing electromagnetic field around the coil.

5) The circuitry in the control box ______________ the voltage into an audible note.

UNIT 10
Telecommunications

Basic elements

- a **transmitter** that takes information and converts it to a signal;
- a **transmission medium** that carries the signal; and,
- a **receiver** that receives the signal and converts it back into usable information.

For example, in a radio broadcast the broadcast tower is the transmitter, free space is the transmission medium and the radio is the receiver. A single device acting as both a transmitter and receiver is called a **transceiver (**a mobile phone).

Telecommunication over a telephone line is called **point-to-point communication** (between one transmitter and one receiver), while the one over radio is called **broadcast communication** because it is between one powerful transmitter and numerous receivers.

Analogue or digital

Signals can be either **analogue** or **digital**. In an analogue signal, the signal is varied continuously with respect to the information. In a digital signal, the information is encoded as a set of discrete values (for example ones and zeros). During transmission the information contained in analogue signals will be degraded by noise. **Noise resistance** represents a key advantage of digital signals over analogue signals.

Networks

A network is a collection of transmitters, receivers and transceivers that communicate with each other. Digital networks consist of one or more **routers** that work together to transmit information to the correct user. An analogue network consists of one or more **switches** that establish a connection between two or more users. For both types of network, **repeaters** may be necessary to amplify or recreate the signal when it is being transmitted over long distances.

Channels

A channel is a division in a transmission medium so that it can be used to send multiple streams of information.The medium is divided by frequency and each channel receives a separate frequency to broadcast on.

Modulation

The shaping of a signal to convey information is known as modulation. Modulation can be used to represent a digital message as an analogue waveform. This is known as **keying** and several keying techniques exist (these include phase-shift keying, frequency-shift keying and amplitude-shift keying). **Bluetooth**, for example, uses phase-shift keying to exchange information between devices.

The Internet

The Internet is a worldwide network of computers and computer networks that can communicate with each other using the Internet Protocol. Any computer on the Internet has a unique IP address that can be used by other computers to route information to it. Hence, any computer on the Internet can send a message to any other computer using its IP address.

It is estimated that the 51% of the information flowing through two-way telecommunications networks in the year 2000 were flowing through the Internet (most of the rest (42%) through the landline telephone). By the year 2007 the Internet clearly dominated and captured 97% of all the information in telecommunication networks (most of the rest (2%) through mobile phones). As of 2008, an estimated 21.9% of the world population has access to the Internet.

For the Internet, the physical medium and data link protocol can vary several times as packets traverse the globe. This is because the Internet places no constraints on what physical medium or data link protocol is used. This leads to the adoption of media and protocols that best suit the local network situation. In practice, most intercontinental communication will use the **Asynchronous Transfer Mode** (ATM) protocol (or a modern equivalent) on top of optic fibre.

Local area networks and wide area networks

Local area networks ("**LANs**" – computer networks that do not extend beyond a few kilometres in size) do not require all the features associated with larger networks and are often more cost-effective and efficient without them. When they are not connected with the Internet, they also have the advantages of privacy and security.

There are also independent **wide area networks** ("**WANs**" – private computer networks that can and do extend for thousands of kilometres.) Some of their advantages include their privacy, security, and complete ignoring of any potential hackers – who cannot "touch" them. Prime users of private LANs and WANs include armed forces and intelligence agencies that **must** keep their information completely secure and secret.

As the Internet grew in popularity and a larger percentage of traffic became Internet-related, LANs and WANs gradually moved towards the TCP/IP (**Transmission Control Protocol/Internet Protocol**) protocols, and today networks mostly dedicated to TCP/IP traffic are common.

It is at the data-link layer, though, that most modern LANs diverge from the Internet. Whereas **Asynchronous Transfer Mode (ATM)** or **Multiprotocol Label Switching (MPLS)** are typical data-link protocols for larger networks such as WANs; **Ethernet** and **Token Ring** are typical data-link protocols for LANs

Despite the modest popularity of IBM token ring in the 1980s and 90's, virtually all LANs now use either wired or wireless Ethernets. At the **physical** layer, most wired Ethernet implementations use **copper twisted-pair cables.** However, some early implementations used heavier **coaxial cables** and some recent implementations (especially high-speed ones) use **optical fibres**.

http://en.wikipedia.org/wiki/Telecommunication (adapted)

1) Matching exercise:

Match the items A-L with the correct definitions 1-12.

1) Communicating over a distance

2) Sending or receiving information to another computer via a modem and a phone line

3) A device that permits a computer to transmit and receive data over a telephone line

4) The speed at which signals are sent and received by a modem

5) Sending data from one computer to another

6) Receiving data from another computer

7) Electronic mail is sent and received from one computer to another

8) The act of connecting with another system or on-line service

9) The act of signing off and disconnecting with another computer or system

10) A global network of thousands of computer networks that offers e-mail and information services to millions of users

11) A term used to describe electronic information networks that carry audio, video, and computer data

12) A term used to describe an interface to the internet that contains millions of hypertext documents that are linked together and contain text, sound, video, and graphics

a) **baud rate**

b) upload

c) log-off

d) telecomputing

e) internet

f) world wide web

g) information highway

h) modem

i) **log-on**

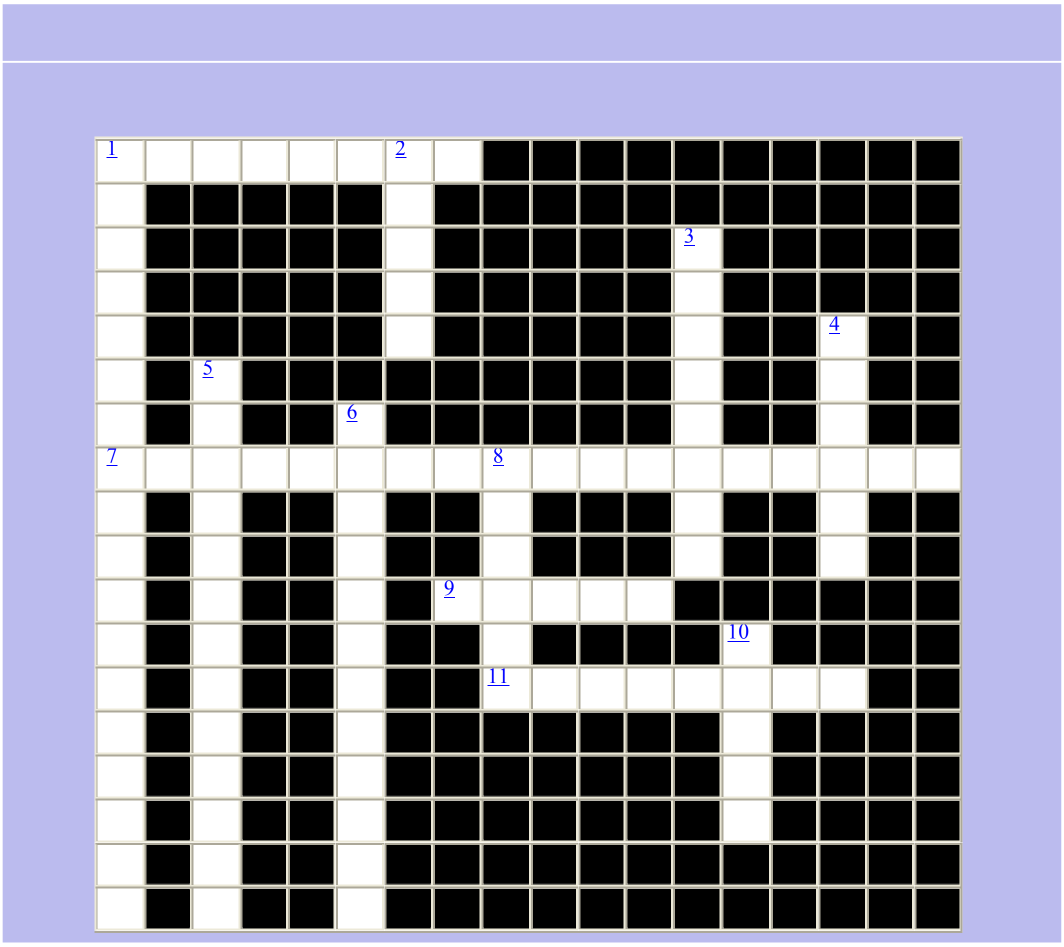
j) **e-mail**

k) **download**

l) **telecommunications**

1)___ 2) ___ 3) ___ 4) ___ 5) ___ 6) ___ 7) ___ 8) ___ 9) ___ 10) ___ 11) ___ 12) ___

2) Crossword



Across:

1. Network of thousands of computer networks that offers e-mail and information to millions of users

7. Communicating over a distance

9. Allows a computer to transmit and receive data over a telephone line

11. Receiving data from another computer

Down:

1. Word that describes electronic information network that carry audio, video, and computer data

2. Electronic mail sent and received from one computer to another

3. The speed at which information is sent and received by a modem

4. Act of signing off and disconnecting from a network

5. Sending or receiving information to another computer via a modem

6. Term describing an interface to the internet that contains millions of pages of information

8. Sending data from one computer to another

10. The act of connecting with another system or on-line service

http://www.catawba.k12.nc.us

Computer Vocabulary

1.	biometric security measures	Security measures that examine a fingerprint, a voice pattern, or the iris or retina of the eye.
2.	cable modem	transmits data through a coaxial cable
3.	client	a computer that uses the services of another program
4.	client/server network	A computer configuration in which one or more computers are used as a server
5.	digital subscriber line	an Internet connection technology that provides for the transfer of information to a computer at a high-speed bandwidth over ordinary copper telephone lines
6.	extranet	a network configuration that allows selected outside organizations to access internal information systems
7.	firewall	a combination of hardware and software that limits the exposure of a computer or computer network to attack from crackers
8.	hacker	expert computer user who invades someone else's computer either for personal gain or simply for the satisfaction of being able to do it
9.	hub	a junction where information arrives from connected computers or peripheral devices and is then forwarded in one or more directions to other
10.	internet	the largest network used as a communication tool
11.	intranet	a network designed for the exclusive use of computer users within an organization that cannot be accessed by users outside the organization
12.	local area network	A number of computers and other devices (such as printers or scanners) connected together within a single building or organization
13.	modem	Communications hardware device that facilitates the transmission of data.
14.	node	a device on the network (computer/client)
15.	peer-to-peer network	A network configuration in which each machine is considered to be an equal. Messages and data are shared directly between individual computers. Each machine continuously operates as both a client and a server.
16.	public switched telephone network	(PSTN) supports telephone service and is the world's collection of interconnected commercial and government-owned voice-oriented systems
17.	router	a device that directs traffic on a network by dividing data into smaller packets that travel by different routes and then are reassembled at their destination
18.	server	a computer that handles requests for data, e-mail, file transfers, and other network services from other computers (clients)
19.	server operating system	high-end programs designed to provides network control and include special functions

20. T-1 Line	type of fiber-optic telephone line that can transmit up to 1.544 megabits per second or can be used to transmit 24 digitized voice channels
21. Wide area network	A computer network that covers a large geographical area. Most WANs are made up of several connected LANs.
22. WiMAX	(worldwide interoperability for microwave access) is a technology aimed at providing wireless data over long distances in a variety of ways
23. Wireless internet service provider	An ISP that allows subscribers to connect to a server at designated hotspots or access points using a wireless connection;30 times faster than dial-up connections
24. Wireless LAN	LAN that uses no physical wires

http://quizlet.com/4218981/computer-lit-lesson-24-flash-cards/

3) Multiple choice

1) __ is one of the 2 main types of a network.

a) Bridge b) Hub c) LAN d) Server

1) What is a LAN confined relatively to?

a) no area b) small area c) large area d) medium area

2) What do most networks consist of?

a) Bridge & Gateway b) Cable modem and modem

c) Wireless media & physical media d) Computer clients & Network server

3) An example of physical media is:

a) Radio signals b) MSN messenger c) satellite transmissions d) optical fibre

4) An example of communication hardware is:

a) Keyboard b) Monitor c) Modem d) Internet

5) What is the least expensive type of cable?

a) coaxial cable b) Microwaves c) fibre-optic cable d)Twisted –pair cable

UNIT 11

Turbines, Generators and Power Plants

Conventional: Energy that has been used from ancient times is known as conventional energy. Coal, natural gas, oil, and firewood are examples of conventional energy sources (or usual) sources of energy are coal, oil, wood, peat, uranium.

Electricity is generated in a power plant. Various resources are used to make the heat to produce electricity.

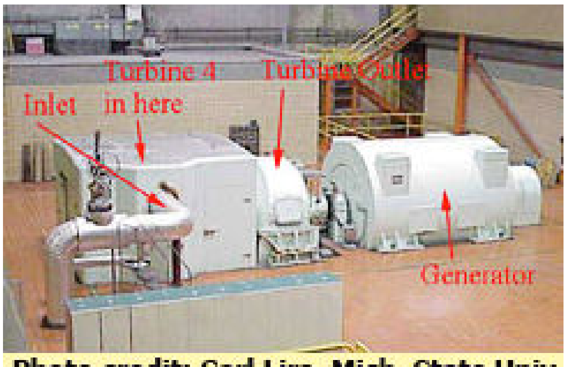


Photo credit: Carl Lira, Mich. State Univ.

Thermal power plants have big boilers that burn a fuel to make heat. When the water boils, the steam comes through a tiny hole on the top of the spout. In a power plant, the water is brought to a boil inside the boiler, and the steam is then piped to the turbine through very thick pipes.

In the picture above, there is a **turbine** and a **generator**. The big pipe on the left side is the steam inlet. On the right side of the turbine is where the steam comes out. The steam is fed under high pressure to the turbine. The turbine spins and its **shaft** is connected to a turbo generator that changes the mechanical spinning energy into electricity.

The turbine has many hundreds of blades that are turned at an angle like the blades of a fan. When the steam hits the **blades** they spin the turbine's shaft that is attached to the bottom of the blades.

After the steam goes through the turbine, it usually goes to a **cooling tower** where it becomes water again and then goes back into the boiler to be heated again.

Most power plants use cleaner-burning natural gas to produce electricity. Others use oil or coal to heat the water. Nuclear power plants use nuclear energy to heat water to make electricity. Still others, called geothermal power plants, use steam or hot water found naturally below the earth's surface without burning a fuel.

Hydropower plants

Hydropower plants harness water's energy and use simple mechanics to convert that energy into electricity. Hydropower plants are actually based on a rather simple concept -- water flowing through a dam turns a turbine, which turns a generator.

1) Match the basic components of a hydropower plant to their definitions:

1) Most hydropower plants rely on it to hold back water, creating a large reservoir.
2) Gates on the dam open and gravity pulls the water through the penstock, a pipeline that leads to the turbine. Water builds up pressure as it flows through this pipe.
3) The water strikes and turns its large blades; it is attached to a generator above it by means of a shaft.
4) As the turbine blades turn, so do a series of magnets inside it. Giant magnets rotate past copper coils, producing alternating current (AC) by moving electrons.
5) Inside the powerhouse it takes the AC and converts it to higher-voltage current.
6) Out of every power plant come four wires: the three phases of power being produced simultaneously plus a neutral or ground common to all three.
7) Used water is carried through pipelines, called tailraces, and re-enters the river downstream.

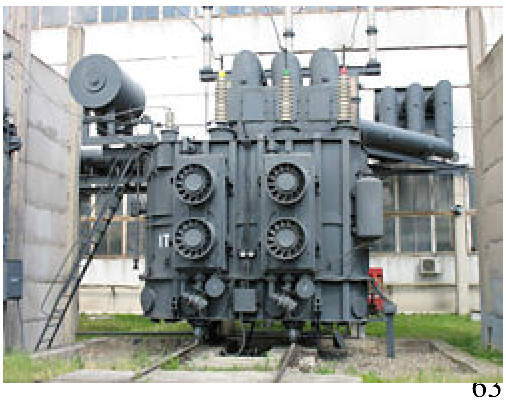
a) generators
b) intake
c) transformer
d) dam
e) outflow
f) power lines
g) turbine

1) ___ 2) ___ 3) ___ 4) ___ 5) ___ 6) ___ 7) ___

Electricity Transmission Systems

After electricity is produced at power plants it has to get to the customers that use the electricity.

As large generators spin, they produce electricity with a voltage of about 25,000 volts. The electricity first goes to a **transformer** at the power plant that boosts the voltage up to 400,000 volts. When electricity travels long distances it is better to have it at higher voltages because that way it can be transferred more efficiently.



The long thick cables of **transmission lines** are made of copper or aluminium because they have a low resistance. High voltage transmission lines carry electricity long distances to a **substation**.

The power lines go into substations. Here transformers change the very high voltage electricity back into lower voltage electricity.

From these substations electricity at different power levels is used to run factories, streetcars and mass transit, light street lights and stop lights, and is sent to homes.

Another small transformer mounted on a pole (see picture) or in a utility box converts the power to even lower levels to be used in homes. The voltage is eventually reduced to 220 volts for all the appliances.

Rather than over-head lines, some new distribution lines are underground. The power lines are protected from the weather, which can cause them to break.

When electricity enters a home, it must pass through a meter. A utility company worker reads the meter so the company will know how much electricity has been used.

After being metered, the electricity goes through a fuse box into a home. The fuse box protects the house in case of problems. When a fuse (or a circuit breaker) "blows" or "trips", something is wrong with an appliance or something was short- circuited. http://www.energyquest.ca.gov/story (adapted)

The Distribution Grid

For power to be useful in a home or business, it comes off the transmission grid and is **stepped-down** to the distribution grid. This may happen in several phases. The place where the conversion from "transmission" to "distribution" occurs is in a **power substation**. A power substation typically does two or three things:

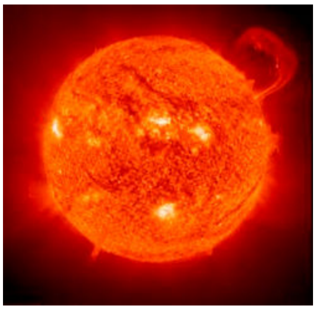
- It has transformers that step transmission voltages (in the tens or hundreds of thousands of volts range) down to distribution voltages (typically less than 10,000 volts).
- It has a "bus" that can split the distribution power off in multiple directions.
- It often has circuit breakers and switches so that the substation can be disconnected from the transmission grid or separate distribution lines can be disconnected from the substation when necessary.

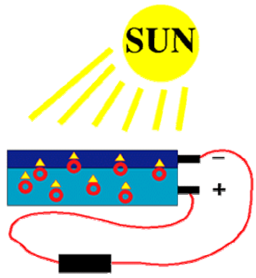
http://www.science.howstuffworks.com › ... › Energy Production (adapted)

Renewable Energy Sources

<u>Non-conventional</u> sources of energy include:
• Solar power
• Hydro-electric power (dams in rivers)
• Wind power
• Tidal power
• Ocean wave power
• Geothermal power (heat from deep under the ground)
• Ocean thermal power (the difference in heat between shallow and deep water)
• Biomass (burning of vegetation to stop it producing methane)
• Biofuel (producing ethanol (petroleum) from plants

Solar Energy



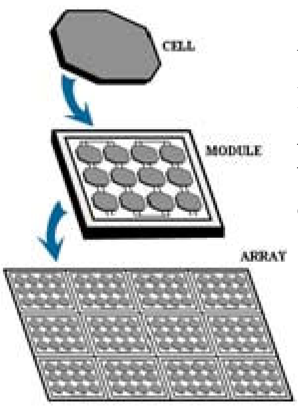


Solar cell

The ways in which the sun's energy can be used:

Solar Hot Water
Solar Thermal Electricity
Solar Cells or Photovoltaic Energy

The sunlight can also be changed directly into electricity using solar cells. Solar cells are also called **photovoltaic cells** – or **PV cells** for short – and can be found on many small appliances, like calculators, and even on spacecraft. They were first developed in the 1950s for use on U.S. space satellites. They are made of silicon, a special type of melted sand.



When sunlight strikes the solar cell, electrons (red circles) are knocked loose. They move toward the treated front surface (dark blue colour). An electron imbalance is created between the front and back. When the two surfaces are joined by a connector, like a wire, a current of electricity occurs between the negative and positive sides.

These individual solar cells are arranged together in a **PV module** and the modules are grouped together in an array. Some of the arrays are set on special tracking devices to follow sunlight all day long.

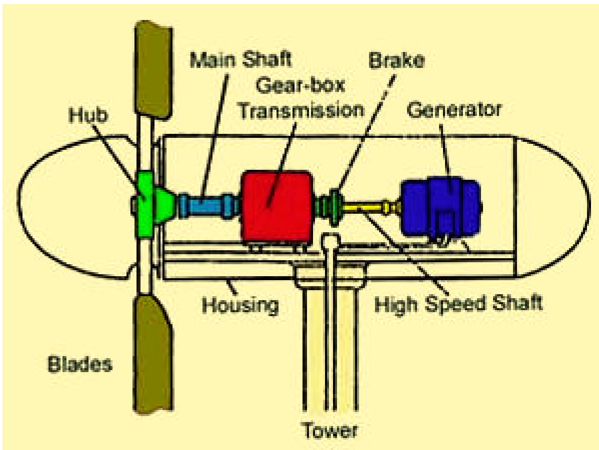
The electrical energy from solar cells can then be used directly. It can be used in a home for lights and appliances. It can be used in a business. Solar energy can be stored in batteries.

Some experimental cars also use PV cells. They convert sunlight directly into energy to power electric motors on the car.

Wind Energy

The **kinetic** energy of the wind can be changed into other forms of energy, either mechanical energy or electrical energy.

Today, the wind is also used to make electricity.



Blowing wind spins the **blades** on a **wind turbine**. This device is called a wind turbine and not a windmill.

The blades of the turbine are attached to a **hub** that is mounted on a **turning shaft**. The shaft goes through a gear transmission box where the turning speed is increased. The transmission is attached to a high speed shaft which turns a **generator** that makes electricity.

If the wind gets too high, the turbine has a **brake** that will keep the blades from turning too fast and being damaged.

You can use a single smaller wind turbine to power a home or a school. A small turbine makes enough energy for a house..

In order for a wind turbine to work efficiently, wind speeds usually must be above 12 to 14 miles per hour. Wind has to be this speed to turn the turbines fast enough to generate electricity. The turbines usually produce about 50 to 300 kilowatts of electricity each.

The turbines grouped together are called wind farms. These wind farms are located mostly in the three windiest areas of the state.

Once electricity is made by the turbine, the electricity from the entire wind farm is collected together and sent through a transformer. The voltage is increased to be sent long distances over high power lines.

Renewable Energy vs. Fossil Fuels

2) Reconstruct the following text by filling in the correct word.

greenhouse	**wind**	**megawatt**	**pollute**	**silicon**
collectors	**produce**	**facilities**	**environment**	**fuelled**

Unlike fossil fuels, which 1) _____________the atmosphere, renewable energy has less impact on the2) _____________. Renewable energy resource development will result in new jobs for people and less oil to be bought.

Clean energy sources can be harnessed to 3) ____________electricity, process heat, fuel and valuable chemicals with less impact on the environment.

In contrast, emissions from cars 4) ____________by gasoline and factories and other facilities that burn oil affect the atmosphere. Polluted air results in the so-called 5) ___________gases. About 81% of all the U.S. greenhouse gases are carbon dioxide emissions from energy-related sources.

However, there are also some drawbacks to renewable energy development.

<u>Firstly</u>, **solar thermal energy**, involving the collection of solar rays through 6) ___________, needs large tracts of land as a collection site. This influences the natural habitat, meaning the plants and animals that live there.

<u>Secondly</u>, the fluid most often used with solar thermal electric generation is very toxic and spills can happen.

Solar or PV cells use the same technologies as the production of 7) ____________chips for computers. The manufacturing process uses toxic chemicals. Toxic chemicals are also used in making batteries to store solar electricity through the night and on cloudy days.

Thirdly, all the solar production 8) ___________in the entire world only make enough solar cells to produce about 350 megawatts, about enough for a city of 300,000 people. The cost of producing much more electricity would be about four times more expensive than a regular natural gas-fired power plant.

Wind power development too, has its downside, mostly involving land use. The average 9) __________farm requires 17 acres of land to produce one 10) ____________of electricity. However, farms and cattle grazing can use the same land under the wind turbines.

Environmental concerns are associated with **dams** to produce **hydroelectric power**. People are displaced and prime farmland and forests are lost in the flooded areas above dams. Downstream, dams change the chemical, physical and biological characteristics of the river and land.

http://www.energyquest.ca.gov/story (adapted)

3) Under each method of power generation write whether it is a conventional (C) or renewable (R) energy source.

HYDRO POWER	NATURAL GAS	SOLAR POWER
______	______	______
PEAT	WAVE POWER	COAL
______	______	______
BIO FUELS	WIND POWER	NUCLEAR ENERGY
______	______	______
TIDAL POWER	OIL	
______	______	

4) Circle the correct answer.

1) Electrical generator performs which kind of energy conversion?

a) solar to mechanical b) mechanical to electrical c) electrical to wind

2) Who discovered the operating principle of electromagnetic generators?

a) A. Einstein b) N. Bohr c) M. Faraday

3) Which was the first electric generator capable of delivering power to industry?

a) Dynamite b) Dynamo c) Motor

4) Which are the two main mechanical parts in a generator?

a) rotor & stator b) wire & copper disc c) magnet & copper disc

5) What is the power-producing component of a generator called?

a) rotor b) armature c) field

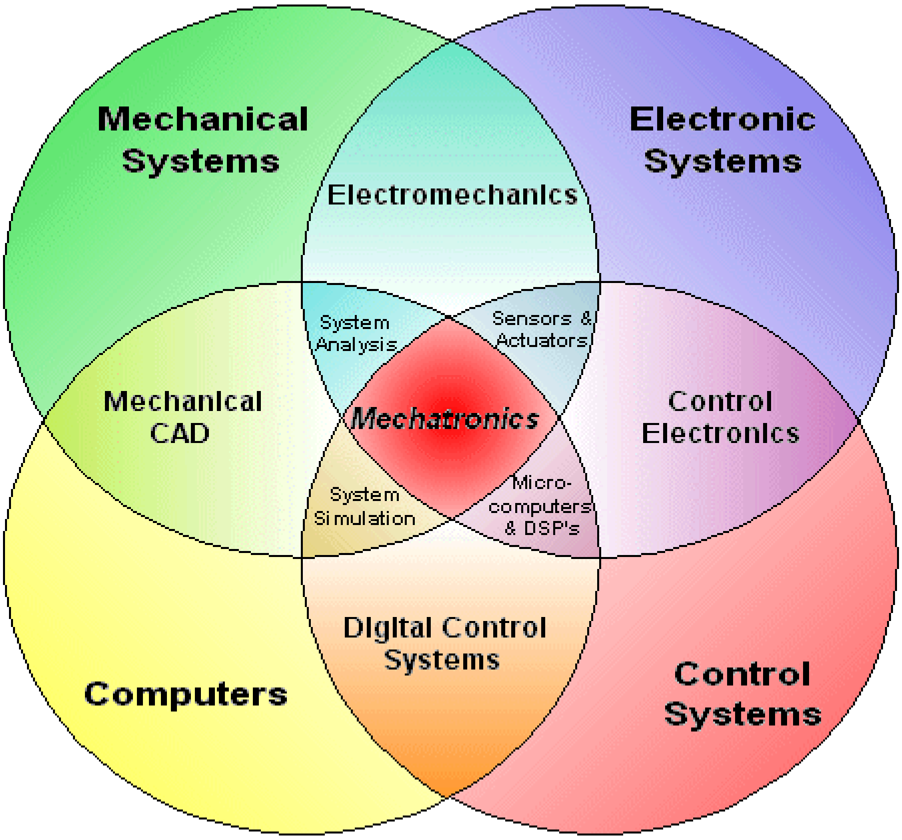
6) What is the magnetic field component of a generator called?

a) armature b) stator c) field

UNIT 12

Mechatronics

Mechatronics is the combination of Mechanical engineering, Electronic engineering, Computer engineering, Control engineering, and Systems Design engineering to create useful products.



Aerial Venn diagram from RPI's (Rensselaer Polytechnic Institute in New York) website describes the various fields that make up Mechatronics

Mechatronics is centered on mechanics, electronics, computing, control engineering, molecular engineering (from nanochemistry and biology) which, combined, make possible the generation of simpler, more economical, reliable and versatile systems. The portmanteau (*a new word formed by joining two others and combining their meanings*) "mechatronics" was coined by Mr. Tetsuro Mori and Er. Jiveshwar Sharma, the senior engineers of the Japanese company Yaskawa in 1969. An industrial robot is a prime example of a mechatronics system; it includes aspects of electronics, mechanics and computing, so it can carry out its day to day jobs.

The name Mechatronics stems from mechanical and electronics and is a relatively new approach to product design and development, merging the principles of electrical, mechanical, computer and industrial engineering. It addresses the four interconnected disciplines used for all complex modern devices. Mechatronic systems are typically composed of traditional mechanical and electrical components but are referred to as "smart" devices or systems because of the incorporation of sensors, actuators and computer control systems. Over the years, the term "mechatronics" has come to mean the integrated methodology for designing products that exhibit fast, precise performance.

1) Reconstruct the following paragraph by filling in the correct word

mechatronics	***accuracy***	***components***
integrates	***design***	***smart***

Mechatronics is an emerging field of engineering that 1) _______________ electrical engineering, mechanical engineering, computer science, control engineering and information technology. In layman's terms, mechatronics combines these areas of engineering to allow the 2) _______________, development and application of "3) _______________ devices" in an integrated, cross-disciplinary manner. The 4) _______________ concept establishes basic principles for a contemporary engineering design methodology. In this methodology, engineering products and processes have 5) _______________ that require manipulation and control of dynamic (moving) constructions to the required high degree of 6)_______________. Also, the design process requires integrating enabling technologies such as information technology and control engineering. A key factor for the design process involves integrating modern microelectronics and the engineering of software into mechanical and electromechanical systems.

Why Study Mechatronics?

Mechatronics has been popular in Japan and Europe for many years but has been slow to gain industrial and academic acceptance as a field and practice in Great Britain and the United States. In the past, machine and product design has been the domain of mechanical engineers. After the machine was designed by mechanical engineers, solutions to control and programming problems were added by software and computer engineers. This sequential-engineering approach usually resulted in less-than-optimal designs and is now recognized as less than optimal itself.

The prime role of mechatronics is one of initiation and integration throughout the whole of the design process, with the mechatronics engineer as the leader. Experts in the interdisciplinary mechatronics field must acquire general knowledge of various techniques and be able to master the entire design process. They must be able to use the special knowledge resources of other people and the particular blend of technologies that will provide the most economic, innovative, elegant and appropriate solution to the problem at hand. Industry needs mechatronics engineers to continue to rapidly develop innovative products with performance, quality and low cost.

Where do Mechatronic Engineers work?

Mechatronic devices or "smart" devices have become common in our technologically advanced society. Mechatronics engineers can work in any company that develops, designs or manufactures and markets "smart" devices. Opportunities exist in manufacturing, sales and as well as research. Mechatronic devices have crept into everyday life.

Examples include:

- Robots
- Anti-lock brakes
    - A sophisticated control system takes over the braking function when the sensors recognize one or more wheels are locking up.
- Photocopiers
- Computer disk drives
- Humidity sensitive clothes dryers and windshield wipers
    - How do these devices "know" if clothes are still damp or drizzle is hitting the windshield? Sensors, that's how.

Mechatronic devices can be found in medicine and surgery, agriculture, buildings, homes, automobiles, the toy and entertainment industry, intelligent aids for the elderly and disabled.

Physical implementations

For most mechatronic systems, the main issue is no longer how to implement a control system, but how to implement actuators and what is the energy source. Within the mechatronic field there are mainly two movements: the piezo-electric actuators and motors, or the electromagnetic actuators and motors. Maybe the most famous mechatronics systems are the well known camera autofocus system or camera anti-shake systems.

Concerning the energy sources, most of the applications use batteries. However, there is a new trend which allows transformation of mechanical energy from shock, vibration, or thermal energy into electricity.

Variant of the field

An emerging variant of this field is biomechatronics, whose purpose is to integrate mechanical parts with a human being, usually in the form of removable gadgets such as an exoskeleton. Such an entity is often identified in science fiction as a cyborg. This is the "real-life" version of cyberware.

http://en.wikipedia.org/wiki/Mechatronics (adapted)

Automation

KUKA Industrial Robots being used at a bakery for food production

Automation is the use of control systems (such as numerical control, programmable logic control, and other industrial control systems), in concert with other applications of information technology (such as computer-aided technologies [CAD, CAM, CAx]), to control industrial machinery and processes, reducing the need for human intervention.

Computer-aided technologies (**CAx**) is a broad term that means the use of computer technology to aid in the design, analysis, and manufacture of products.

Advanced CAx tools merge many different aspects of the product lifecycle management (PLM), including design, finite element analysis (FEA), manufacturing, production planning, product testing with virtual lab models and visualization, product documentation, product support, etc. CAx encompasses a broad range of tools, both those commercially available and those proprietary to individual engineering firms.

The term **CAD/CAM** (computer-aided design and computer-aided manufacturing) is also often used in the context of a software tool that covers a number of engineering functions.

In the scope of industrialization, automation is a step beyond mechanization. Whereas *mechanization* provided human operators with machinery to assist them with the *muscular* requirements of work, *automation* greatly reduces the need for human *sensory* and *mental* requirements as well. Processes and systems can also be automated.

Automation plays an increasingly important role in the world economy and in daily experience. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities.

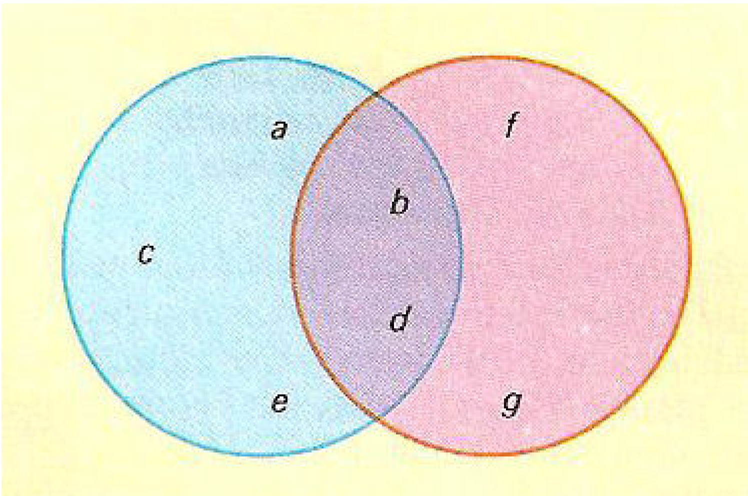
Many roles for humans in industrial processes presently lie beyond the scope of automation. Human-level pattern recognition, language recognition, and language production ability are well beyond the capabilities of modern mechanical and computer systems. Tasks requiring subjective assessment or synthesis of complex sensory data, such as scents and sounds, as well as high-level tasks such as strategic planning, currently require human expertise. In many cases, the use of humans is more cost-effective than mechanical approaches even where automation of industrial tasks is possible.

Specialised hardened computers, referred to as programmable logic controllers (PLCs), are frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events. This leads to precisely controlled actions that permit a tight control of almost any industrial process.

Human-machine interfaces (HMI) or computer human interfaces (CHI), formerly known as *man-machine interfaces*, are usually employed to communicate with PLCs and other computers, such as entering and monitoring temperatures or pressures for further automated control or emergency response. Service personnel who monitor and control these interfaces are often referred to as stationary engineers.

Venn diagram

Venn diagram is a simple way of representing sets and subsets, which makes use of overlapping circles. Venn diagrams are named after the Englishman John Venn (1834–1923), a fellow of Cambridge University. Venn was a cleric in the Anglican Church, an authority on what was then called "moral science," the compiler of a massive index of all Cambridge alumni, and a rather mundane mathematician who worked in logic and probability theory. The diagrams he used for representing syllogisms appear to have been first called "Venn diagrams" by Clarence Irving in his book *A Survey of Symbolic Logic* in 1918. However, Venn was lucky to be so immortalized. Both Gottfried Leibniz and Leonhard Euler used very similar forms of representation many years earlier.



Venn diagram illustrating two sets, $S_1 = \{a, b, c, d, e\}$ and $S_2 = \{b, d, f, g\}$ for which the intersection of S_1 and S_2, $S_1 \cap S_2 = \{b, d\}$ and their union, $S_1 \cup S_2 = \{a, b, c, d, e, f, g\}$.

http://en.wikipedia.org/wiki/Venn_diagram

UNIT 13

Reading and Writing Technical texts

Multiword Lexical Units in Technical English

Multiword lexical units (MLUs) consist of more than one word. They are frequently used in technical writing because they supply information in the shortest possible way. The more technical and specialized is the subject, the more complicated and more frequent are the multiword lexical units.

Scientific journals contain more MLUs than course books. However, the most complicated of all probably occur in technical advertisements, because the writers have to put as much information as they can into as few words as possible.

When translating a MLU you should always follow the principle:

<u>**Begin at the end, with the last word, and then work backwards**</u>. For example:

AC electrical supply system

What is the last word?

Therefore, the most important thing is that it is some kind of *system.*

What is the next last word, etc.

Therefore, it is a *system* which is <u>used to</u> *supply AC electricity.*

circuit component	a *component* <u>of the circuit</u>
component value code	a *code* <u>used to denote</u> *the value* <u>of</u> a *component*
field-effect transistor	a *transistor* <u>with</u> the *effect* of a *field*
feedback control system	a *system* <u>of</u> *control* <u>by means of</u> *feedback*
power transmission system	a *system* <u>for</u> the *transmission* <u>of</u> *power*
quantum theory	a theory <u>dealing with</u> quantums

How to Read an English Technical Text (a four-step guide)

Reading technical research papers is a matter of experience and skills and partly learning the specific vocabulary of a field. First of all, DON'T PANIC! If you approach it step by step, even an impossible-looking paper can be understood.

1. Skimming

Skim the paper quickly, carefully review for headings, figures and the purpose of the reading. This takes just a few minutes. You're not trying to understand it yet, but just to get an overview.

2. Vocabulary

Go through the paper word by word and line by line, underlining or highlighting every word and phrase you don't understand. Don't worry if there is a lot of underlining. When you start, you are not trying to make sense of the article. Now you have several things you might do with these vocabulary and questions, depending on every question you can:

a. <u>Look for simple words and phrases</u>.

Most often the biggest problem is vocabulary—what is an Allen wrench, bolt or the semilunar valve.
A technical English dictionary is a good place to look for definitions. Your shelf dictionary is not a good source, because the definitions may not be precise enough or may not reflect the way in which engineers use a word (for example "stress" has a common definition, but the technical definition is totally different.)

b. <u>Get an understanding from the context in which it is used.</u>

Words that are used to describe the procedures in engineering can be often understood from the context, and may be very specific to the paper you are reading. You should be careful when deciding that you understand a word from its context, because it might not mean what you think.

3. Comprehension, section by section.

Trying to deal with all the words and phrases, probably there will be a few technical terms that you won't understand. Now go back and read the whole paper, section by section, for comprehension.

4. Reflection and criticism

After you understand the article and can summarize it, you can return to questions and draw your own conclusions. It is very useful to keep track of your questions as you go along, returning to see whether they have been answered.

http://www.scribd.com/doc/3546631/How-to-Read-an-English-Technical-Text (adapted)

Six Principles of Technical Writing

If you take a technical writing workshop, the materials will address numerous areas; some are very specific while others are more general in nature. A good starting point is to look at six principles of technical writing.

1. Use Good Grammar
2. Write Concisely
3. Use the Active Voice
4. Use Positive Statements
5. Avoid Long Sentences
6. Punctuate Correctly

Principle One: Use Good Grammar

Your readers expect technical documents to be written in standard English. Certain grammatical errors can actually cause your reader to misinterpret the information. However, because technical documents must be precise and accurate, readers expect documents to be professional, polished, and flawless.

One grammatical rule to is to stick to subject-verb agreement. Note the choice of verbs below:

One employee *is* absent.   Two employees *are* absent

This subject-verb agreement is easy to make because in each sentence, the subject is obvious: *employee* in the first sentence agrees with *is* and *employees* in the second sentence agrees with *are*. The real challenge is when the subject is not as obvious. In the following sentences, which verb would you select?

Either of the levers *is* clearly marked.

Either of the levers *are* clearly marked?

You must decide if the subject is *either* or *levers*. If you selected *either* as the subject and *is* as the verb, you made the correct choice. A list of indefinite pronouns that are always singular is listed below:

each, either, everybody, everyone, neither, one, anyone, anybody, someone, somebody, no one, nobody

The following indefinite pronouns are always plural:

both, few, many, several

Just to keep your life interesting, the following pronouns can be either singular or plural.

all, more, most, none, some

You may wonder how some pronouns can be both singular and plural. Review the following examples:

Some of the information *is* inaccurate.

Some of the figures *are* inaccurate.

Principle Two: Writing Concisely

In technical writing, clarity and brevity is your goal. Why take 32 words to express what could be stated in 14 or 15? The dictates of effective technical writing suggest that the average length for a sentence is 15-20 words. How do you achieve clarity and conciseness?

One of the best ways is to look for multiword phrases that can be replaced by one or two words. Try replacing the multiword phrases below with a word or two.

A large number of ________________

Prior to that time ________________

In the process of tabulating ________________

As shown in table 3 ________________

Exhibits the ability ________________

Similarly, when you reorganize sentences, your readers don't have to walk through extra wordiness. How would you streamline the sentence below?

"To obtain maximum performance from your computer, you should endeavour to follow the maintenance program furnished in the manual accompanying your computer."

Experts have found that there are two ways we lose our readers: using words with which they are unfamiliar and overly long sentences. By replacing wordy phrases with shorter, you are doing your readers a favour.

NOTE: Answers: *many, before, when tabulating, table 3 shows, can*

To enhance your computer's performance, follow the manual's maintenance program.

Principle Three: Using the Active Voice

Imperative sentences, or command sentences, are written in the active voice. The active voice is more natural to people when they speak, but technical writers often turn to the passive voice when writing technical documents. One of the main reasons you should use the active voice rather than the passive in technical writing is the active voice more closely resembles the way people remember and process information.

Compare the following sentences:

Staff hours are calculated by the manager on the actual work load.

The manager calculates staff hours on the actual work load.

In the active voice sentence, the subject acts. In the passive voice sentence, something is done to the subject.

Another reason to avoid the passive voice sentence is you run the risk of omitting the doer of the action. Note the absence of the "doer" in the following sentence:

Documented practical examinations will be given for backhoes (excavators) of the same type with different operating characteristics.

Your reader will probably wonder who will give the practical examinations. If the technical writer had used the active voice, the "doer" would be clear.

Principle Four: Using Positive Statements

Technical writers should word instructions as positive statements. Whenever possible, phrase commands in a positive manner. Compare the following:

Negative: Do not close the valve.

Positive: Leave the valve open.

Telling your readers what NOT to do is a negative statement. It is also abstract rather than concrete. Your readers have to take time to think about what is true (positive) so they can determine what is NOT true (negative).

One exception to this rule is when a negative statement is clearer than a positive one. Keep in mind studies show it is almost 50% harder for your readers to understand the meaning when you use negatives.

Principle Five: Avoiding Long Sentences

Short sentences are easier to understand than long sentences. For this reason, it is best to write your technical documents in short sentences. If you are asking your readers to perform several actions, begin the step with an active verb. This highlights the action itself. Compare the following sentences:

Example of a sentence with multiple steps within the sentence:

For Forte applications, create an empty workspace, populate it with application source code, and compile the workspace.

Example of a sentence with multiple steps set apart:

For Forte applications, perform the following steps:

- Create an empty workspace.
- Populate it with application source code.
- Compile the workspace.

Another tip when separating steps into distinct bullet points is to make sure that the action verbs in each bulleted item are in the same tense. For example, if the first step was worded, "*Creating an empty workspace*," then the next bullet would be, "*Populating it with application source code*," and the third bullet point would be, "*Compiling the workspace*. “

Principle Six: Using Standard Punctuation

Your readers expect standard punctuation when they read your documents. Complicated or "creative" punctuation will confuse them. One suggestion is to select syntax that minimizes the need for punctuation. You may wish to divide compound or complex sentences into shorter sentences to avoid excessive or confusing punctuation.

One example of this is deciding where to place your commas, periods, colons, and semicolons when using quotation marks. Commas and periods always go *inside* the closing quotation mark.

Most corporations adopt the belief, "the customer is always right."

On the other hand, semicolons and colons are always placed *outside* the quotation marks.

Many technical writing workshops focus on advanced topics, expecting participants to already be familiar with the basic beliefs of good technical writing. While these six principles are a good starting point, you may be surprised to see how often they are ignored. Challenge yourself to read and analyze other technical documents and ask yourself: What makes some documents a struggle to read while others are easy to comprehend? As you incorporate these and other sound writing techniques, your readers will benefit.

http://cypressmedia.net/articles/article/26/six_principles_of_technical_writing (adapted)

Abstract Writing Guidelines

What is an abstract?
The abstract is a mini-version of the thesis. It should give a brief summary of the main sections of the paper. In other words, it is a summary of the "information" the thesis contains.

Its purpose:
To give readers a quick identification of the basic content of the thesis. It should "stand on its own" and be a self-contained document. There should be no need to look elsewhere in the thesis for an understanding of what is said in the abstract.

Length:

The abstract should be very concise - the maximum length being 50% of one page (outside of the header formatting and keywords line). This means you will need to economise your use of words and tie ideas together. Use the most precise and relevant words to best express the content of the abstract. Abstracts that are too long will have to be re-written.

Content:
The abstract can be written as one large paragraph, or for easy reading you can use paragraphs for each section of the content. Paragraph 1 should contain your objectives and scope, Paragraph 2 a description of the methods used, Paragraph 3 a summary of the results, and Paragraph 4 a statement of the main conclusions.

Other considerations:
The abstract is usually written in the past tense because the research is already done. In other words, write the thesis first!

While first person ("I", "we") may be used in the body of your thesis, you must use third person (passive) in the abstract.

DO NOT include abbreviations or acronyms in your abstract if you can help it, but if you must, don't use them without explaining them first. For example, the first time you use the abbreviation you must write out the full form and put the abbreviation in brackets. e.g. "Magnetic Resonance Imaging (MRI)" From then on you may use "MRI" for the duration of the abstract.

DO NOT use headings for your abstract paragraphs. (e.g. Objectives, Methods, Results and Conclusions)

Keep your abstract clear and simple - you are trying to show the key points of your thesis to attract interest.

Always check your grammar, spelling, and formatting. Please use either British English spelling conventions or American English spelling conventions throughout your abstract, but not both.

Remember:

The abstract is the first thing a reader reads. It is an indication of the quality of your thesis and what is to come for the reader. Impressions drawn from the reading of the abstract greatly impact the reading of your thesis.

Using some of language samples below that; for example, introduce the different sections of the abstract, will help make the abstract easier to read and more clear to the reader. These are examples only - you must use the language correctly in the proper context and for the correct purpose.

Other words:
objective
aim
intention
purpose
goal
target

OBJECTIVE(S)
The purpose of this study was to investigate... Another aim was to find out... Finally, ... was examined in the study.

METHOD(S)
(X) method was applied. (E.g. quantitative/qualitative - both/other?)
The study/survey/thesis/questionnaire/opinion poll...examined, inspected, focused on, was conducted, carried out, sent out, administered
Questionnaires were sent out/administered... (X number) responses were received

RESULT(S)/CONCLUSION(S)
The results of the study were that... It was found/discovered that... The results revealed/indicated...

The principal conclusion was that... One conclusion was that...

MISCELLANEOUS
Please note the correct singular and plural versions of the following:

Singular	Plural
thesis	theses
criterion	criteria
phenomenon	phenomena
appendix	appendices (British English) appendixes (American English)

http://www.squidoo.com › Education (adapted)

Common Mistakes in Abstract Writing

Paragraph one:

1.1. No purpose indicated-Difficult to see the research problem or reason for the research.

1.2. No background information provided.

1.3. More information than required-Student notes many purposes for the research, but it is difficult to understand the main purpose.

1.4. Mention of “I” in the abstract-Third person passive should be used, “the author”.

1.5. The purpose of the research was to “find out”-Use identify or discover.

Paragraph two:

2.1. No mention of the research methodology used-Was the research quantitative or qualitative? Were questionnaire used or interviews?

2.2. Student details non essential information- Computer programmes used.

2.3. Student includes outcome or conclusion of the research-It comes later in the abstract.

Paragraph three:

3.1. No conclusion mentioned.

3.2. Respondents-Respondents is the word for the people who answer the research.

3.3. Conclusion does not refer to the research question.

Paragraph four:

4.1. Student does not suggest any recommendations-having carried out the research, the student should indicate how improvements could be made, or the problem solved, based on the research findings.

4.2. Student‘s recommendations appear to be an opinion and not based on the findings.

Keywords:

5.1. No keywords in the abstract-All abstracts should have keywords.

5.2. Too many keywords-Only five to seven keywords should appear in the abstract.

REFERENCES:

Glendinning, E.H., McEwan,J.(1996) *Oxford English for Electronics* Oxford:Oxford University Press

Štambuk, A. (2002) *English in Electrical Engineering and Computing* Split: Fakultet elektrotehnike, strojarstva i brodogradnje, Sveučilište u Splitu

Bryson, B. (2004) *A Short History of Nearly Everything* Reading: Cox& Wyman Ltd

http://www.ideafinder.com/features/smallstep/electricity.htm

http://www.arkcode.com/custom3_25.html

http://www.answers.com/library/Sci%252DTech+Dictionary-letter-1R

http://www.kpsec.freeuk.com/components/capac.htm

www.funtrivia.com/quizzes/.../electronics

http://esl.about.com/od/beginningvocabulary/a/ex_numbers.htm

http://www.themathpage.com/alg/algebraic-expressions.htm

http://users.cscs.wmin.ac.uk/~wooda/components/code/

http://www.bookrags.com/research/transistors

http://www.kpsec.freeuk.com/bdiags.htm

http://www.howstuffworks.com/diode.htm

http://www.kpsec.freeuk.com/electron.htm

http://en.wikipedia.org/wiki/Electromagnetic_induction

http://electronics.howstuffworks.com/gadgets/other-gadgets/metal-detector.htm

http://en.wikipedia.org/wiki/Telecommunication http://www.catawba.k12.nc.us

http://quizlet.com/4218981/computer-lit-lesson-24-flash-cards/

http://www.energyquest.ca.gov/story

http://www.science.howstuffworks.com › ... › Energy Production

http://www.energyquest.ca.gov/story

http://en.wikipedia.org/wiki/Mechatronics

http://en.wikipedia.org/wiki/Venn_diagram

http://www.scribd.com/doc/3546631/How-to-Read-an-English-Technical-Text

http://cypressmedia.net/articles/article/26/six_principles_of_technical_writing

http://www.squidoo.com › Education