RLA ACADEMY

TNPSC

BASED ON NEW SYLLABUS

THE HANDBOOK OF PDF STUDY MATERIAL

ELECTRICAL & ELECTRONICS ENGG

CODE: 400

ASSISTANT ENGINEER

USEFUL FOR

TNEB
TNMAWS
SSC JE
RRB JE
PSU EXAMS

ENGLISH MEDIUM

AE-EEE-400-ENGLISH

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UNIT – 01 ELECTRICA...

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INTRODUCTION:

An Electric circuit is an interconnection of various elements in which there is at least one closed path in which current can flow. An Electric circuit is used as a component for any engineering system.

The performance of any electrical device or machine is always studied by drawing its electrical equivalent circuit. By simulating an electric circuit, any type of system can be studied for e.g., mechanical, hydraulic thermal, nuclear, traffic flow, weather prediction etc.

All control systems are studied by representing them in the form of electric circuits. The analysis, of any system can be learnt by mastering the techniques of circuit theory.

The analysis of any system can be learnt by mastering the techniques of circuit theory.

Elements of an Electric circuit:

An Electric circuit consists of following types of elements.

Active elements:

Active elements are the elements of a circuit which possess energy of their own and can impart it to other element of the circuit.

Active elements are of two types

a) Voltage source   b) Current source

A Voltage source has a specified voltage across its terminals, independent of current flowing through it.
A current source has a specified current through it independent of the voltage appearing across it.

Passive Elements:

The passive elements of an electric circuit do not possess energy of their own. They receive energy from the sources. The passive elements are the resistance, the inductance and the capacitance. When electrical energy is supplied to a circuit element, it will respond in one and more of the following ways.

If the energy is consumed, then the circuit element is a pure resistor.

If the energy is stored in a magnetic field, the element is a pure inductor.

And if the energy is stored in an electric field, the element is a pure capacitor.

Linear and Non-Linear Elements.

Linear elements show the linear characteristics of voltage & current. That is its voltage-current characteristics are at all-times a straight-line through the origin.

For example, the current passing through a resistor is proportional to the voltage applied through its and the relation is expressed as V□I or V = IR. A linear element or network is one which satisfies the principle of superposition, i.e., the principle of homogeneity and additivity.

Resistors, inductors and capacitors are the examples of the linear elements and their properties do not change with a change in the applied voltage and the circuit current.

Non linear element's V-I characteristics do not follow the linear pattern i.e. the curren through it does not change linearly with the linear change in the voltage across it. Exar semiconductor devices such as diode, transistor.

Bilateral and Unilateral Elements:

An element is said to be bilateral, when the same relation exists between voltage for the current flowing in both directions.

Ex: Voltage source, Current source, resistance, inductance & capacitance.

The circuits containing them are called bilateral circuits.

An element is said to be unilateral, when the same relation does not exist between voltage and current when current flowing in both directions. The circuits containing them are called unilateral

What is Power Factor?

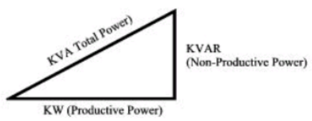
Power factor is the percentage of electricity that is being used to do useful work. It is defined as the ratio of 'active or actual power' used in the circuit measured in watts or kilowatts (W or KW), to the 'apparent power' expressed in volt-amperes or kilo volt-amperes (VA or KVA).

$$\text{Power factor} = \frac{\text{Active Power}}{\text{Apparent Power}} \text{ or } \frac{W}{VA}$$

The apparent power also referred to as total power delivered by utility company has two components.

1) 'Productive Power' that powers the equipment and performs the useful work. It is measured in KW (kilowatts)
2) 'Reactive Power' that generates magnetic fields to produce flux necessary for the operation of induction devices (AC motors, transformer, inductive furnaces, ovens etc.). It is measured in KVAR (kilovolt-Ampere-Reactance).

Reactive Power produces no productive work. An inductive motor with power applied and no load on its shaft should draw almost nil productive power, since no output work is being accomplished until a load is applied. The current associated with no-load motor readings is almost entirely "Reactive" Power. As a load is applied to the shaft of the motor, the "Reactive" Power requirement will change only a small amount. The 'Productive Power' is the power that is transferred from electrical energy to some other form of energy (i.e. such as heat energy or mechanical energy). The apparent power is always in always in excess of the productive power for inductive loads and is dependent on the type of machine in use.
The working power (KW) and reactive power (KVAR) together make up apparent power, which is measured in kilovolt-amperes (KVA). Graphically it can be represented as:



$$\text{Power Factor} = \frac{\text{KW (Productive Power)}}{\text{KVA (Total Power)}}$$

The cosine of the phase angle Ø between the KVA and the KW components represents the power factor of the load. KVAR represents the non-productive reactive power and Ø is lagging phase angle.

The Relationship between KVA, KW and KVAR is non-linear and is expressed $KVA^2 = KW^2 + KVAR^2$

A power factor of 0.72 would mean that only 72% of your power is being used to do useful work. Perfect power factor is 1.0, (unity); meaning 100% of the power is being used for useful work.

Understanding Power Factor?

Any industrial process using electric motors (to drive pumps, fans, conveyors, refrigeration plant etc.) introduces inefficiencies into the electricity supply network by drawing additional currents, called "inductive reactive currents".

Although these currents produce no useful power, they increase the load on the supplier's switchgear & distribution network and on the consumer's switchgear & cabling. The inefficiency is expressed as the ratio of useful power to total power (KW/KVA), known as Power Factor. The typical 'un-corrected power factor' by different sectors of industry are as follows:

UNIT – 02 ELECTRIC A...

Name

01. Coulomb's Law-Electric Fi...
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02. Gauss Law.pdf
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03. Divergence - Electric Fiel...
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04. Effect of Dielectric Mediu...
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05. Magnetic Circuits.pdf
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06. Magnetomotive force -Rel...
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07. Faraday's laws-Lenz's law....
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08. Biot-Savart's law - Fleming...
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10. Lorentz force.pdf
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11. Inductance - Self and Mutu...

Introduction:

The electric charge is a fundamental property of matter and charge exist in integral multiple of electronic charge. Electrostatics can be defined as the study of electric charges at rest. Electric fields have their sources in electric charges.

(Note: Almost all real electric fields vary to some extent with time. However, for many problems, the field variation is slow and the field may be considered as static. For some other cases spatial distribution is nearly same as for the static case even though the actual field may vary with time. Such cases are termed as quasi-static.)

In this chapter we first study two fundamental laws governing the electrostatic fields, viz, (1) Coulomb's Law and (2) Gauss's Law. Both these law have experimental basis. Coulomb's law is applicable in finding electric field due to any charge distribution, Gauss's law is easier to use when the distribution is symmetrical

.

Coulomb's Law :

Statement:

Coulomb's Law states that the force between two point charges Q1and Q2 is directly proportional to the product of the charges and inversely proportional to the square of the distance between them.

Point charge is a hypothetical charge located at a single point in space. It is an idealized model of a particle having an electric charge.

Mathematically,

$$F = \frac{kQ_1Q_2}{R^2} \qquad k = \frac{1}{4\pi\varepsilon_0}$$

Where k is the proportionality constant. And ε_0 , is called the permittivity of free space

In SI units, Q1 and Q2 are expressed in Coulombs(C) and R is in meters.

Force F is in Newton's (N)

(We are assuming the charges are in free space. If the charges are any other dielectric medium, we will use $\varepsilon = \varepsilon_0\varepsilon_r$ instead where ε_r is called the relative permittivity or the dielectric constant of the medium).

Therefore $F = \frac{1}{4\pi\varepsilon_0}\frac{Q_1Q_2}{R^2}$ .... (1)

As shown in the Figure 1 let the position vectors of the point charges Q1and Q2 are given by $\vec{r_1}$ and $\vec{r_2}$. Let $\vec{F_{12}}$ represent the force on Q1 due to charge Q2.

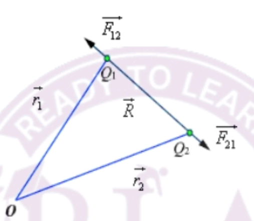

Fig 1: Coulomb's Law

The charges are separated by a distance of $R = |\vec{r_1} - \vec{r_2}| = |\vec{r_2} - \vec{r_1}|$. We define the unit vectors as

$\hat{a}_{12} = \frac{(\vec{r_2} - \vec{r_1})}{R}$ and $\hat{a}_{21} = \frac{(\vec{r_1} - \vec{r_2})}{R}$ ..... (2)

Lorentz Force

Lorentz force refers to a combination of magnetic and electric force that acts on a point charge due to the presence of electromagnetic fields. Furthermore, the Lorentz force is also known by experts as the electromagnetic force.

Introduction to Lorentz Force

Experts define Lorentz force as the combination of the magnetic and electric force. Furthermore, this force acts on a point charge due to electromagnetic field.

Lorentz force explains the equations of mathematical nature along with the physical importance of forces which act on the charged particles. Moreover, these particles travel through space which contains electric and magnetic field.

How do we Measure Lorentz Force?

Lorentz force on a moving charge that is present in a B Field

Lorentz force happens when the movement of a charged particle takes place through a magnetic field and cuts through field lines in the process. This force acts at right angles to both the particle velocity, v, and the magnetic field, B.

This force's direction in various situations is dependent on the direction of the velocity of the particle and the magnetic field as well as the sign of the particle's charge. There are two ways of remembering the direction of this force and both these ways are variants of the "left-hand rule".

Thumb, First finger and Second finger:

These are held at right angles to each other and a rotation takes place so that:

- the pointing of the First finger is in the direction of the Magnetic Field
- furthermore, the pointing of the Second finger is in the direction of the Current
- the pointing of the Thumb's direction is in the direction that the Motion would tend to if the magnetic force in case is the only force present.

There is an alternative way of remembering the left-hand rule that involves using the acronym "FBI" to label your fingers. As such, "I" refers to the middle finger, "F" refers to the thumb, and "B" refers to the first finger.

Holding these three fingers at right angles to each other would show the relationship between the directions of the current I, force F, and magnetic field B.

Lorentz Force on a current-carrying wire that is present in a magnetic field:

A current refers to the movement of charged particles, so if a wire wh
has current is within a magnetic field, then all of the charged particles wou
experiencing a Lorentz force.

So, one would need to find out the sum of the forces on the moving charged par
This is because the sum of the forces on the moving charged particles would be
to the overall force on the wire.

Lorentz Force by Making Use of Vector Notation

Using vector notation, the force which acts on a moving charge, q, in a magnetic field, B, is expressed as:

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UNIT – 03 MEASUREM...

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02. Static and Dynamic Chara...
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09. Power Quality Analyser.
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FUNDAMENTAL AND DERIVED UNITS

Fundamental or absolute units may be defined as those in which the various other units may be expressed, either in whole or small number or fraction of the fundamental units. The word "absolute" in this sense does not necessarily imply supremacy and extreme accuracy; rather it is used as opposed to "relative."

The Committee of the British Association of Electrical Units and Standards which met in 1863 came with the decision that even electrical units should be defined by some *natural* law that expresses the relation between the quantity concerned and the fundamental quantities of length, mass and time.

The units that relate to these fundamental quantities are known as fundamental units[1].

Each one of these units itself may be indentified in terms of mile, kilometre, metre; gramme, pound, tonne, ton; and second, minute, hour, respectively, depending on the *system* of units used or the 'ease' of expression.

Units in Electrical Engineering

In electrical engineering, and measurements related to electricity and magnetism, two more aspects related to units in use, in addition to the fundamental units (of length, mass and time) must be considered depending on the properties of the media in which the electrical and/or magnetic actions take place. These are known as *specific electric constant,* also called specific inductive capacitance or "permittivity of free space" [ε_0], and *magnetic space constant* or "permeability of free space" [μ_0].

DERIVED UNITS

CGS esu and emu Systems of Unit

The earliest system of units used to express nearly all quantities of electricity and magnetism was based on the use of centimetre[c], gramme[g] and second[s] as the fundamental units *and* either one or both of the above constants. Owing to the process involved in *deriving* the required units in terms of length, mass, time and/or ε_0 and μ_0, these units are called derived units and are generally related mathematically, usually in the form of ratios, to the fundamental units.

[1] As seen, these (fundamental) quantities represent the basic existence and motion of beings in the universe.

The CGS esu system

This system involves only the permittivity ε of the medium[1] as well as units of length, mass and time. In the basic system, evolved in the very beginning, the permittivity *as a whole* is taken as unity, or $\varepsilon = 1$. The acronym esu stands for "electrostatic units".

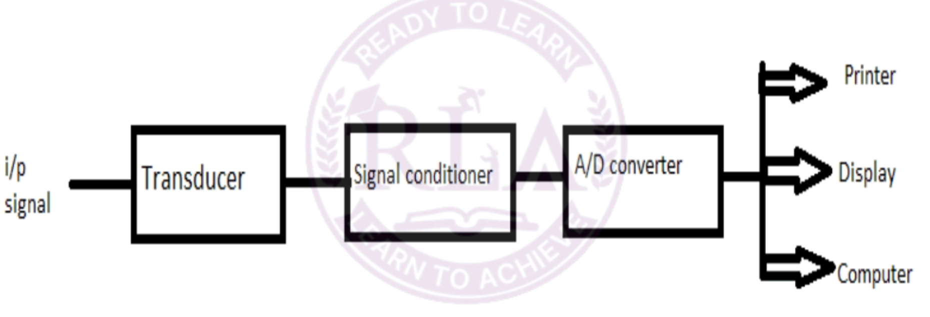
The CGS emu system

This system is based on the use of permeability, μ, as well as units of length, mass and time and is known as CGS "electromagnetic unit" system. The emu system is found to be more convenient from the point of view of most electrical measurements and hence has been more generally used than the esu system.

The MKS (or Giorgi) System of Units

The CGS systems of unit are reduced to only historic interest, being of not much practical use in the modern engineering practices due to the units being too "small" or too "large", or otherwise. For example, the magnetic flux used to be expressed as maxwells (or the number of lines of force) and

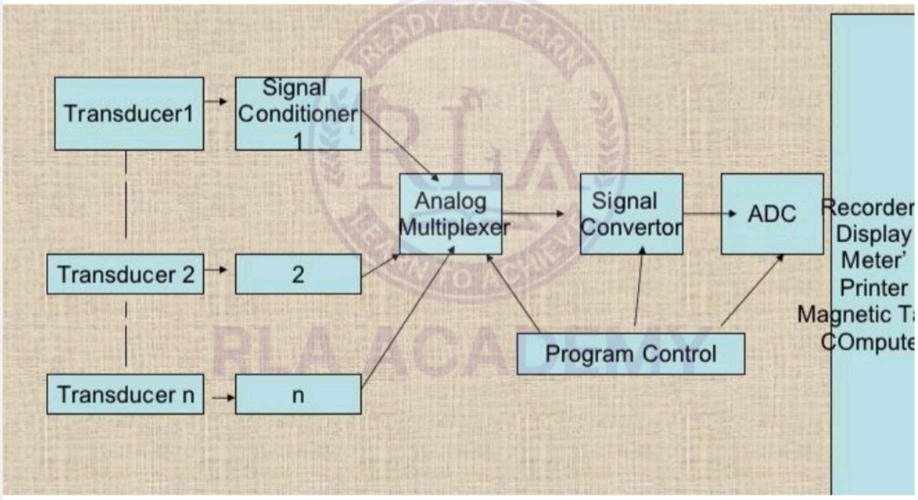
Single channel DAS



Single channel DAS

It's basically working as the common analog DAS. Same components are used for it.

Multichannel DAS



- The individual analog signal are applied to conditioning circuit. These signal are multiplexed.
- Sample & Hold is used to store the previous data. This signal is then digitized.
- When conversion is complete the status line form

Display Device

- A **display device** is an output device for presentation of information in visual or tactile form (the latter used for example in tactile electronic displays for blind people).

Electronic displays

Segment displays

- Some displays can show only digits or alphanumeric characters.
- They are called **segment displays**, because they are composed of several segments that switch on and off to give appearance.
- The segments are usually single LEDs or liquid crystals.
- They are mostly used in digital watches and pocket calculators. There are of several types

Display devices

- The display system is the final link betwe measuring process and the user.
- Display devices are used in instrumentation s to provide instantaneous but nonpermanent communication of information between a process or system and a human observer.

UNIT – 04 CONTROL...

Name

01. Mathematical Modelling of...
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02. Transfer Function - Block ...
Modified Jun 16

03. Time Domain Analysis-Sta...
Modified Jun 16

04. Frequency Domain Analysi...
Modified Jun 16

05. Root Locus – Gain and Ph...
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Mathematical Model of Physical Systems

- Mechanical, electrical, thermal, hydraulic, economic, biological, etc, systems, may be characterized by differential equations.
- The response of dynamic system to an input may be obtained if these differential equations are solved.
- The differential equations can be obtained by utilizing physical laws governing a particular system, for example, Newtons laws for mechanical systems, Kirchhoffs laws for electrical systems, etc.

Mathematical models: The mathematical description of the dynamic characteristic of a system.

➡ The first step in the analysis of dynamic system is to derive its model.
➡ Models may assume different forms, depending on the particular system and the circumstances.
➡ In obtaining a model, we must make a compromise between the simplicity of the model and the accuracy of results of the analysis.

Linear systems: Linear systems are one in which the equations of the model are linear.

A differential equation is linear, if the coefficients are constant or functions only of the independent variable (time).

(1) $\frac{d^2y}{dt^2}+3\frac{dy}{dt}+6y=e^t$ is linear differential equation.

(2) $\frac{d^3y}{dt^3}+(6-t)\frac{d^2y}{dt^2}+t^2\frac{dy}{dt}+y=\sin t$ is linear differential equation.

or $\dddot{y}+(6-t)\ddot{y}+t^2\dot{y}+y=\sin t$

∗ The most important properties of linear system is that the principle of superposition is applicable.

∗ In an experimental investigation of dynamic system, if cause and effect are proportional, thus implying that the principle of superposition holds, then the system can be considered linear.

Linear time invariant systems: the system which represented by differential equation whose coefficients are function of time for example

$\dddot{y}+(t-6)\ddot{y}+2t^2\dot{y}+4y=e^{-2t}$

An example of time varying control system is a spacecraft control system.

Non linear system: Non linear system are ones which are represented by non linear equations. Examples are

Y=sin(x) , $y=x^2$, $z=x^2+y^2$

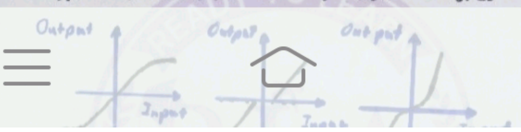
A differential equation is called non linear if it is not linear. For examples

$\frac{d^2y}{dt^2}+(\frac{dy}{dt})^2+y=A\sin wt$

$\frac{d^2y}{dt^2}+(y^2-1)\frac{dy}{dt}+y=0$

$\frac{d^2y}{dt^2}+\frac{dy}{dt}+y+y^3=0$

∗ characteristic curves for various non linearities



ROOT LOCUS DIAGRAM

Root Locus describes qualitatively the changes in the transient response and stability of a system as a system parameter is varied.

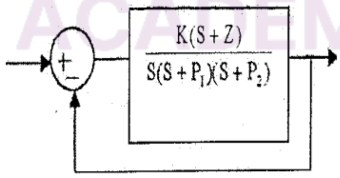
Purpose :

1. To find the CLCS stability
2. To find the range of 'K' value for system stability
3. To find the K value to become the system marginally stable
4. To find the un-damped natural frequency of oscillations
5. To find the 'K' value for un-damped, under damped, critically damped and over damped systems.
6. To find the relative stability, if the root locus branches moving towards the right then the system is less relatively stable.
7. If the root locus branches moving towards the left the system is more relatively stable..
8. The best method to find the relative stability is root locus.
9. The best method to find the absolute stability is RH-criteria.

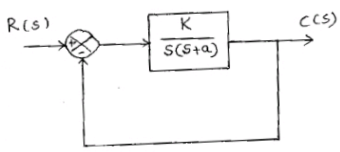
ROOT LOCUS DIAGRAM (RLD):

Root locus diagram introduced by W.R.Evan.

- RLD is a plot of loci of roots of the characteristic equation while gain 'k' is varied from 0 to ∞.
- If gain 'K' is varied from - ∞ to 0 the diagram is called as inverse or complimentary RLD.
- If more than one parameter is varied the corresponding diagram is called as root contour diagram.



Where K = gain of the system



THE ROOT LOCUS CONCEPT :

The open loop transfer function of the system is

$$G(s) = \frac{k}{s(s+a)} \quad \text{.............(1)}$$

Where 'k' and 'a' are constants.

The closed loop transfer function of the system with unity feed back is given by

$$\frac{C(S)}{R(S)} = \frac{k}{s^2 + as + k} \quad \text{..........(2)}$$

From equation (2) the characteristic equation of the system is,

$$s^2 + as + k = 0 \quad \text{.............(3)}$$

From above equations we can say the closed loop system poles depends on 'k' value

ROOT LOCUS

It is defined as the locus of the closed loop poles as a function of open loop gain (k), when k is varied from 0 to ∞

INVERSE ROOT LOCUS

It is defined as the locus of the closed loop poles as a function of open loop gain (k) is when k is varied from - ∞ to 0

ANGLE AND MAGNITUDE CONDITIONS

The closed loop transfer function poles can be obtained from, 1 + G(s).H(S) = 0

G(s).H(s) = −1

(or) $G(s).H(s) = 1\angle\pm180^0$

and

$G(s).H(s) = \pm(2q+1)180^0$

UNIT – 05 ELECTRICA...

Name

01. D.C. Machines – Construct...
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02. Generators and Motors – ...
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Modified Feb 14

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06. Induction Machine.pdf
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08. Three phase induction mo...
Modified Feb 14

10. V and inverted V curves of ...
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11. Permanent magnet synchro...
Modified Jun 16

12. Permanent magnet brushle...
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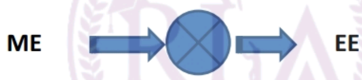
DC Machines

- When a machine converts mechanical energy into electrical energy which is DC in nature, it is called as a **DC Generator**.



- Whenever a machine converts electrical energy which is DC in nature, into mechanical energy, it is called a **DC Motor**.

DC Generator

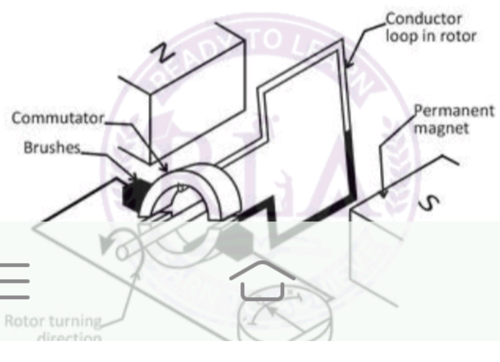
Working Principle

- **Faraday's Laws of Electro magnetic Induction**.

  Whenever a conductor cuts the flux of a magnetic field, an emf is produced in the conductor. If the two ends of the conductor are connected to an outside circuit, the induced emf causes current to flow in the circuit.

- The direction of induced current is given by **Fleming's right hand rule**.

Single Turn Generator



Classification of Transformers:

The transformers are often classified according to their **applications.** Following are the important types of transformers:

(*i*) Power Transformers: These transformers are used to step up the voltage at the generating station for transmission purposes and then to step down the voltage at the receiving stations. These transformers are of large capacity (generally above 500 kVA). These transformers usually operate at high average load, which would cause continuous capacity copper loss, thus affecting their efficiency. To have minimum losses during 24 hours, such transformers are designed with low copper losses.

(*ii*) Distribution Transformers: These transformers are installed at the distribution sub-stations to step down the voltage. These transformers are continuously energized causing the iron losses for all the 24 hours, Generally the load on these transformers fluctuate from no-load to full load during this period. To obtain high efficiency, such transformers are designed with low iron losses.

(*iii*) Instrument Transformers: To measure high voltages and currents in power system potential transformer (*P.T.*) and current transformer (*C.T.*) are used, respectively. The potential transformers are used to decrease the voltage and current transformers are used to decrease the current up to measurable value. These are also used with protective devices.

(*iv*) Testing transformers: These transformers are used to step up voltage to a very high value for carrying out the tests under high voltage, e.g., for testing the dielectric strength of transformer oil.

(*v*) Special purpose transformer: The transformers may be designed to serve special purposes, these may be used with furnaces, rectifiers, welding sets etc.

(*vi*) Auto-transformers: These are single winding transformers used to step down the voltages for starting of large three-phase squirrel cage induction motors.

(*vii*) Isolation transformer: These transformers are used only to isolate (electrically) the electronic circuits from the main electrical lines, therefore, their transformation ratio is usually one.

(*viii*) Impedance matching transformer: These transformers are used at the output stage of the amplifier for impedance matching to obtain maximum output from the amplifiers.

Auto Transformer

A transformer, in which a part of the winding is common to both the primary and secondary circuits, is called an auto-transformer. In a two winding transformer, primary and secondary windings are electrically isolated, but in an auto-transformer the two windings are not electrically isolated rather a section of the same winding acts as secondary or primary of the transformer.

Construction:

The core of an auto-transformer may be rectangular [Fig. 1(a)] or circular type [Fig.1(b)] in shape. A single winding is wound around one or two limbs of rectangular core or it is wound over the ring as shown in Fig-2. Terminal '*B*' is taken common point from which one terminal for primary and one terminal of the secondary is taken out. The second terminal of the secondary is connected to point '*C*' which may be fixed or movable as shown in Fig. 2. The number of turns between *AB* are taken as N_1 and the number of turns between *BC* are taken as N_2 as shown in Fig. 3(a). Thus, one section of the same winding acts as a primary and the other section of the same winding acts as a secondary. When the number of secondary turns N_2 is less than the primary turns N_1 (i.e., $N_2 < N_1$) as shown in Fig. 3(a), the auto-transformer works as step-down

1.1STEPPER MOTOR

Stepper Motors have revolutionized machinery in today's world. These motors are mostly ed in 3D printers, CNC machines, Robotics etc. Stepper motor is nothing but a DC motor that moves in steps and each step can be controlled with precision. Therefore stepper Motors have high accuracy compared to other Motors also they have high torque which can handle heavy loads making it an ideal choice for machinery

CONSTRUCTION OF STEPPER MOTOR:

Stepper motor construction is quite similar to DC motor. It also has a permanent magnet as Rotor. Rotor will be in the center and will rotate when force is acts on it. This rotor is surrounded by a number of stator which is wound by magnetic coil all over it. Stator will be placed as close as possible to rotor so that magnetic fields in stators can influence rotor's movement. To control the stepper motor each stator will be powered one by one alternatively. In this case the stator will magnetize and act as an electromagnetic pole exerting repulsive force on the rotor and pushes it to move one step. Alternative magnetizing and demagnetizing of stators will move the rotor step by step and enable it to rotate with great control.

TYPES OF STEPPER MOTOR BASED ON CONSTRUCTION:

There are different types of stepper motor which varies with its complexity in construction and working. In this tutorial we will see some of the basic types and its construction.

PERMANENT MAGNET STEPPER MOTOR:

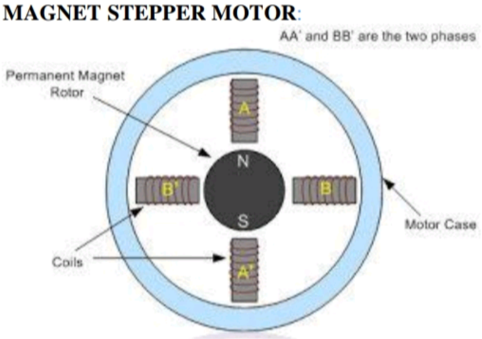


Figure 1.1.1 permanent magnet stepping motor

In this motor a permanent magnet is used as Rotor and electromagnetic stators around

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UNIT – 06 POWER SY...

Name

01. Single Line Diagram of Po...
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PER UNIT REPRESENTATION OF POWER SYSTEMS

One Line Diagram

In practice, electric power systems are very complex and their size is unwieldy. Itis very difficult to represent all the components of the system on a single frame. The complexities could be in terms of various types of protective devices, machines (transformers, generators, motors, etc.), their connections (star, delta, etc.), etc. Hence, for the purpose of power system analysis, a simple single phase equivalent circuit is developed called, the one line diagram (OLD) or the single line diagram (SLD). *An SLD is thus, the concise form of representing a given power system.* It is to be noted that a given SLD will contain only such data that are relevant to the system analysis/study under consideration. For example, the details of protective devices need not be shown for load flow analysis nor it is necessary to show the details of shunt values for stability studies.

Symbols used for SLD

Various symbols are used to represent the different parameters and machines as single phase equivalents on the SLD,. Some of the important symbols used are as listed in the table of Figure 1.

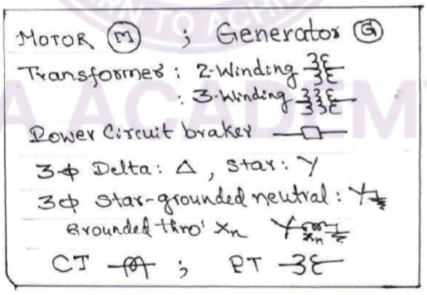
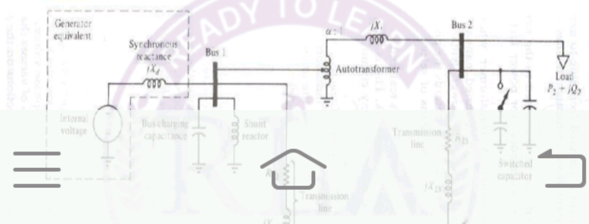


Figure 1. TABLE OF SYMBOLS FOR USE ON SLDS

Example system

Consider for illustration purpose, a sample example power system and data as under:
Generator 1: 30 MVA, 10.5 KV, X"= 1.6 ohms, Generator 2: 15 MVA, 6.6 KV, X"=
ohms, Generator 3: 25 MVA, 6.6 KV, X"= 0.56 ohms, Transformer 1 (3-phase): 15 MVA, 33/11 KV, X=15.2 ohms/phase on HT side, Transformer 2 (3-phase): 15 MVA, 33/6.2 KV, X=16.0 ohms/phase on HT side, Transmission Line: 20.5 ohms per phase Load A: 15 MW, 11 KV, 0.9 PF (lag); and Load B: 40 MW, 6.6 KV, 0.85 PF (lag). Th corresponding SLD incorporating the standard symbols can be shown as in figure 2.



POWER SYSTEM NETWORK MATRICES

1. FORMATION OF Y_{BUS} AND Z_{BUS}

The bus admittance matrix, YBUS plays a very important role in computer aided power system analysis. It can be formed in practice by either of the methods as under:
1. Rule of Inspection
2. Singular Transformation
3. Non-Singular Transformation
4. ZBUS Building Algorithms, etc.

The performance equations of a given power system can be considered in three different frames of reference as discussed below:

Frames of Reference:
Bus Frame of Reference: There are b independent equations (b = no. of buses) relating the bus vectors of currents and voltages through the bus impedance matrix and bus admittance

matrix:

EBUS = ZBUS IBUS
IBUS = YBUS EBUS
Branch Frame of Reference: There are b independent equations (b = no. of branches of a selected Tree sub-graph of the system Graph) relating the branch vectors of currents and voltages through the branch impedance matrix and branch admittance matrix:

EBR = ZBR IBR
IBR = YBR EBR
Loop Frame of Reference: There are b independent equations (b = no. of branches of a selected Tree sub-graph of the system Graph) relating the branch vectors of currents and voltages through the branch impedance matrix and branch admittance matrix:

ELOOP = ZLOOP ILOOP
ILOOP = YLOOP ELOOP

Of the various network matrices refered above, the bus admittance matrix (YBUS) and the bus impedance matrix (ZBUS) are determined for a given power system by the rule of inspection as explained next.

Rule of Inspection

Consider the 3-node admittance network as shown in figure5. Using the basic branch relation: I = (YV), for all the elemental currents and applying Kirchhoff"s Current Law principle at the nodal points, we get the relations as under:

At node 1: I1 =Y1V1 + Y3 (V1-V3) + Y6 (V1 – V2)
At node 2: I2 =Y2V2 + Y5 (V2-V3) + Y6 (V2 – V1)

UNIT - IV

A.C DISTRIBUTION SYSTEMS

AC Distribution Calculations:

AC Distribution Calculations differ from those of D.C. distribution in the following respects:

- In case of D.C. system, the voltage drop is due to resistance alone. However, in A.C. system, the voltage drops are due to the combined effects of resistance, inductance and capacitance.
- In a D.C. system, additions and subtractions of currents or voltages are done arithmetically but in case of A.C. system, these operations are done vectorially.
- In an A.C. system, power factor (p.f.) has to be taken into account. Loads tapped off form the distributor are generally at different power factors.
- There are two ways of referring power factor viz
- It may be referred to supply or receiving end voltage which is regarded as the reference
- It may be referred to the voltage at the load point itself.

There are several ways of solving AC Distribution Calculations. However, symbolic notation method has been found to be most convenient for this purpose. In this method, voltages, currents and impedances are expressed in complex notation and the calculations are made exactly as in D.C. distribution.

Methods of Solving AC Distribution Problems:

In AC Distribution Calculations, power factors of various load currents have to be considered since currents in different sections of the distributor will be the vector sum of load currents and not the arithmetic sum. The power factors of load currents may be given

(i) w.r t. receiving or sending end voltage or

(ii) w.r.t. to load voltage itself. Each case shall be discussed separately.

(i) **Power Factors Referred To Receiving End Voltage:** Consider an a.c. distributor AB with concentrated loads of I1 and I2 tapped off at points C and B as shown in Fig. 14.1. Taking the receiving end voltage VB as the reference vector, let lagging power factors at C and B be cos Φ1 and cos Φ2 w.r.t. VB. Let R1,X1 and R2,X2 be the resistance and reactance of sections AC and CB of the distributor.

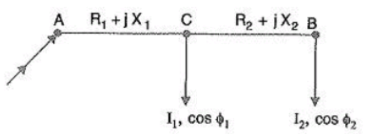


Fig. 14.1

Impedance of section *AC*, $\overrightarrow{Z_{AC}} = R_1 + jX_1$

Impedance of section *CB*, $\overrightarrow{Z_{CB}} = R_2 + jX_2$

Load current at point *C*, $\overrightarrow{I_1} = I_1 (\cos\phi_1 - j\sin\phi_1)$

Load current at point *B*, $\overrightarrow{I_2} = I_2 (\cos\phi_2 - j\sin\phi_2)$

Current in section *CB*, $\overrightarrow{I_{CB}} = \overrightarrow{I_2} = I_2 (\cos\phi_2 - j\sin\phi_2)$

Current in section *AC*, $\overrightarrow{I_{AC}} = \overrightarrow{I_1} + \overrightarrow{I_2}$

$= I_1 (\cos\phi_1 - j\sin\phi_1) + I_2 (\cos\phi_2 - j\sin\phi_2)$

Voltage drop in section *CB*, $\overrightarrow{V_{CB}} = \overrightarrow{I_{CB}}\,\overrightarrow{Z_{CB}} = I_2 (\cos\phi_2 - j\sin\phi_2)(R_2 + jX_2)$

Voltage drop in section *AC*, $\overrightarrow{V_{AC}} = \overrightarrow{I_{AC}}\,\overrightarrow{Z_{AC}} = (\overrightarrow{I_1} + \overrightarrow{I_2})\,\overrightarrow{Z_{AC}}$

1.0 Need of energy conservation:

Fossil fuels like coal, oil that has taken years to form is on the verge of depleting soon. In last 200 years we have consumed 60% of all resources. For sustainable development we need to adopt energy efficiency measures. Today 85% of primary energy sources come from non-renewable and fossil sources. These reserves increasing consumption and will exist for future generations.

Energy survey conducted by Ministry of Power in 1992 reveled that there is requirement of improvement in energy generation efficiency, improvement in energy transportation (transmission & distribution systems) and enhancing the performance efficiency of use end apparatus. Study of 'Energy strategies for Future' evolved two things - efficient use of energy, energy conservation and use of Renewable Energy. Energy conservation emerges out to be the first and least cost option.

1.1 Important terms and definitions

The formal definition of the basic terms are given below

The formal definitions of the basic terms are given below:

Energy Policy

Energy Policy defines the overall guidelines for the efforts to achieve greater energy efficiency. It is established and maintained by the top management of the company.

Energy Planning

Energy Planning involves setting of concrete energy targets complying with the overall energy policy and elaborate action plans to achieve the targets in a given time frame. Planning of several activities includes, forecast, budget, infrastructure, material, equipment, technology, financial resource, human resource and R & D planning.

Energy management

Energy management can be defined in many ways. One way of defining it is: "The judicious and effective use of energy to maximize profit and enhance competitive positions" another comprehensive definition is: "The strategy of adjusting and optimizing energy, using systems and procedures so as to reduce energy requirements per unit of output while holding constant or reducing total cost of producing the output from these systems"

The objective of energy management is to achieve and maintain optimum energy procurement and utilization throughout the organization and to: (i) minimize energy cost/energy waste without affecting production and quality, (ii) minimize environmental effects.

Energy Audit

Energy audit is an inspection, survey and analysis of energy flows for energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the output(s). It also includes submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption. In commercial and industrial real estate, an energy audit is the first step in identifying opportunities to reduce energy expense.

The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a "benchmark" (reference point) for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization.

Energy conservation

Energy conservation means reduction in growth of energy consumption and is measu physical terms.

Energy conservation is the practice of decreasing the quantity of energy used while achi a similar outcome of end use. (This practice may result in increase of financial capi environmental value, national security, personal security and human comfort.)

Energy conservation also means reduction or elimination of unnecessary energy used and wasted.

Energy Efficiency

Energy Efficiency is define saving energy, but keeping the same level of service. For example,

UNIT – 07 ANALOG A...

Name

01. Semiconductor Devices – ...
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02. Transistors.pdf
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03. FET (Field Effect Transisto...
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05. Photo diodes and their ap...
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Modified Jun 16

18. Logic gates.pdf
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19. Simplification of Logic F
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SEMICONDUCTOR DIODE

SEMICONDUCTOR

A **semiconductor** is a material which has electrical conductivity to a degree between that of a metal (such as copper) and that of an insulator (such as glass). Semiconductors are the foundation of modern electronics, including transistors, solar cells, light-emitting diodes (LEDs), quantum dots and digital and analog integrated circuits.

DIODE

Diode – Di + ode

Di means two and ode means electrode. So physical contact of two electrodes is known as diode and its important function is alternative current to direct current.

REVIEW OF INTRINSIC AND EXTRINSIC SEMICONDUCTORS

INTRINSIC SEMICONDUCTOR

An intrinsic semiconductor is one, which is pure enough that impurities do not appreciably affect its electrical behavior. In this case, all carriers are created due to thermally or optically excited electrons from the full valence band into the empty conduction band.

Thus equal numbers of electrons and holes are present in an intrinsic semiconductor. Electrons and holes flow in opposite directions in an electric field, though they contribute to current in the same direction since they are oppositely charged. Hole current and electron current are not necessarily equal in an intrinsic semiconductor, however, because electrons and holes have different effective masses (crystalline analogues to free inertial masses).

The concentration of carriers is strongly dependent on the temperature. At low temperatures, the valence band is completely full making the material an insulator.

Both silicon and germanium are tetravalent, i.e. each has four electrons (valence electrons) in their outermost shell. Both elements crystallize with a diamond-like structure, i.e. in such a way that each atom in the crystal is inside a tetrahedron formed by the four atoms which are closest to it. Each atom shares its four valence electrons with its four immediate neighbours, so that each atom is involved in four covalent bonds.

EXTRINSIC SEMICONDUCTOR

An extrinsic semiconductor is one that has been doped with impurities to modify the number and type of free charge carriers. An extrinsic semiconductor is a semiconductor that has been *doped*, that is, into which a doping agent has been introduced, giving it different electrical properties than the intrinsic (pure) semiconductor.

Doping involves adding dopant atoms to an intrinsic semiconductor, which changes the electron and hole carrier concentrations of the semiconductor at thermal equilibrium. Dominant carrier concentrations in an extrinsic semiconductor classify it as either an n-type or p-type semiconductor. The electrical properties of extrinsic semiconductors make them essential components of many electronic devices.

A pure or intrinsic conductor has thermally generated holes and electrons. However these are relatively few in number. An enormous increase in the number of charge carriers can by achieved by introducing impurities into the semiconductor in a controlled manner.

The result is the formation of an extrinsic semiconductor. This process is referred to as doping. There are basically two types of impurities: donor impurities and acceptor impurities. Donor impurities are made up of atoms (arsenic for example) which have five valence electrons. Acceptor impurities are made up of atoms (gallium for example) which have three valence electrons.

The two types of extrinsic semiconductor

N-TYPE SEMICONDUCTORS

Extrinsic semiconductors with a larger electron concentration than hole concentration are known as n-type semiconductors. The phrase 'n-type' comes from the negative charge of the electron. In n-type semiconductors, electrons are the majority carriers and holes are the minority carriers. N-type semiconductors are created by doping an intrinsic semiconductor with donor.

What is Zener Diode?

Zener diode is defined as

The semiconductor which is heavily doped to operate in reverse direction or in breakdown region.

The **Zener diode** behaves just like a normal general-purpose diode consisting of a silicon PN junction and when biased in the forward direction, that is Anode positive with respect to its Cathode, it behaves just like a normal signal diode passing the rated current.

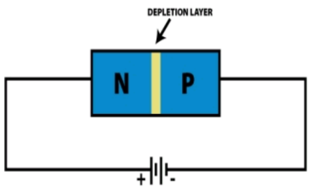
However, unlike a conventional diode that blocks any flow of current through itself when reverse biased, that is the Cathode becomes more positive than the Anode, as soon as the reverse voltage reaches a pre-determined value, the zener diode begins to conduct in the reverse direction.

Zener Diode Symbol

The symbol for Zener diode is represented as below,

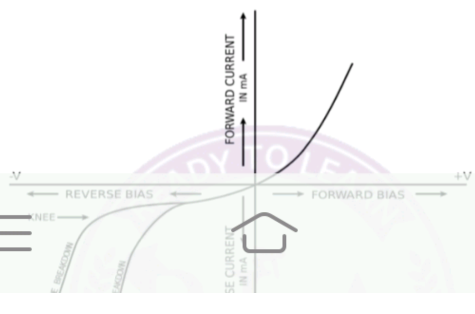
Zener Diode Circuit

We can define Zener diode as a single diode connected in a reverse bias. It can be connected in reverse bias positive as in the circuit shown below:



V-I Characteristics of Zener Diode

The diagram given below shows the V-I characteristics of the Zener diode. When the Zener diode is connected, in forward bias, diode acts as a normal diode. But Zener breakdown voltage occurs when the reverse bias voltage is greater than a predetermined voltage.



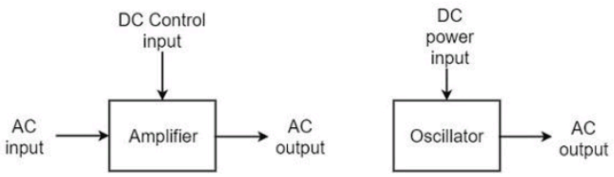
Oscillators

An **oscillator** generates output without any ac input signal. An electronic oscillator is a circuit which converts dc energy into ac at a very high frequency. An amplifier with a positive feedback can be understood as an oscillator.

Amplifier vs. Oscillator

An **amplifier** increases the signal strength of the input signal ap an **oscillator** generates a signal without that input signal, but it requi operation. This is the main difference between an amplifier and an oscillator.

Take a look at the following illustration. It clearly shows how an amplifier takes energy from d.c. power source and converts it into a.c. energy at signal frequency. An oscillator produces an oscillating a.c. signal on its own.



The frequency, waveform, and magnitude of a.c. power generated by an amplifier, is controlled by the a.c. signal voltage applied at the input, whereas those for an oscillator are controlled by the components in the circuit itself, which means no external controlling voltage is required.

Alternator vs. Oscillator

An **alternator** is a mechanical device that produces sinusoidal waves without any input. This a.c. generating machine is used to generate frequencies up to 1000Hz. The output frequency depends on the number of poles and the speed of rotation of the armature.

The following points highlight the differences between an alternator and an oscillator −

- An alternator converts mechanical energy to a.c. energy, whereas the oscillator converts d.c. energy into a.c. energy.
- An oscillator can produce higher frequencies of several MHz whereas an alternator cannot.
- An alternator has rotating parts, whereas an electronic oscillator doesn't.
- It is easy to change the frequency of oscillations in an oscillator than in an alternator.

Oscillators can also be considered as opposite to rectifiers that convert a.c. to d.c. as these convert d.c. to a.c.

Classification of Oscillators

Electronic oscillators are classified mainly into the following two categories −

- **Sinusoidal Oscillators** − The oscillators that produce an output having a sine waveform are called **sinusoidal** or **harmonic oscillators**. Such oscillators can provide output at frequencies ranging from 20 Hz to 1 GHz.
- **Non-sinusoidal Oscillators** − The oscillators that produce an output having a square, rectangular or saw-tooth waveform are called **non-sinusoidal** or **relaxation oscillators**. Such oscillators can provide output at frequencies ranging from 0 Hz to 20 MHz.

Sinusoidal Oscillators

Sinusoidal oscillators can be classified in the following categories −

Random-Access Memory

- A memory unit stores binary information in groups of bits called words.
  1 byte = 8 bits

1 word = 2 bytes
2 The communication between a memory and its environment is achieved through data input and output lines, address selection lines, and control lines that specify the direction of transfer.

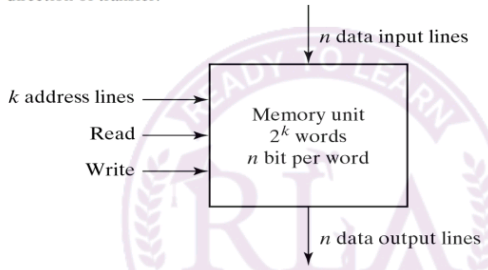


Fig. 7-2 Block Diagram of a Memory Unit

Content of a memory:

- Each word in memory is assigned an identification number, called an address, starting from 0 up to 2^k-1, where k is the number of address lines.
- The number of words in a memory with one of the letters K=2^{10}, M=2^{20}, or G=2^{30}.
  64K = 2^{16} 2M = 2^{21}
  4G = 2^{32}

Write and Read operations :

- Transferring a new word to be stored into memory:
1. Apply the binary address of the desired word to the address lines.
2. Apply the data bits that must be stored in memory to the data input lines.
3. Activate the write input.
- Transferring a stored word out of memory:
1. Apply the binary address of the desired word to the address lines.
2. Activate the read input.
- Commercial memory sometimes provide the two control inputs for reading and writing in a somewhat different configuration in table 7-1.

Table 7-1
Control Inputs to Memory Chip

Memory Enable	Read/Write	Memory Operation
0	X	None
1	0	Write to selected word
1	1	Read from selected word

Memory address		
Binary	decimal	Memory contest
0000000000	0	1011010101011101
0000000001	1	1010101110001001
0000000010	2	0000110101000110
	⋮	⋮
1111111101	1021	1001110100010100
1111111110	1022	0000110100011110

UNIT - 08 POWER ELE...

Name

01. Principle of Operation and ...
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02. Power Diode, DIAC, SCR, T...
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03. Single and Three Phase A...
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04. Switched Mode Power Su...
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05. buck ,boost and buck boo...
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07. Inverters-Single and Three.
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08. Pulse Width Modulation te
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09. Uninterrupted Power Su
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PDF 08. Pulse Width Modulation te...
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PDF 09. Uninterrupted Power Supp...
Modified Jun 16

PDF 10. Electrical drives-motor loa...
Modified Jun 16

PDF 11. Speed Control of DC Drives...
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PDF 12. Speed control of AC drives...
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PDF 13. induction motor drives –st...
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PDF 14. synchronous motor driv
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Introduction to Power Electronics

Power Electronics is a field which combines Power (electric power), Electronics and Control systems. Power engineering deals with the static and rotating power equipment for the generation, transmission and distribution of electric power. Electronics deals with the study of solid state semiconductor power devices and circuits for Power conversion to meet the desired control objectives (to control the output voltage and output power). Power electronics may be defined as the subject of applications of solid state power semiconductor devices (Thyristors) for the control and conversion of electric power. Power electronics deals with the study and design of Thyristorised power controllers for variety of application like Heat control, Light/Illumination control, Motor control - AC/DC motor drives used in industries, High voltage power supplies, Vehicle propulsion systems, High voltage direct current (HVDC) transmission.

Power Electronics refers to the process of controlling the flow of current and voltage and converting it to a form that is suitable for user loads. The most desirable power electronic system is one whose efficiency and reliability is 100%.Take a look at the following block diagram. It shows the components of a Power Electronic system and how they are interlinked.

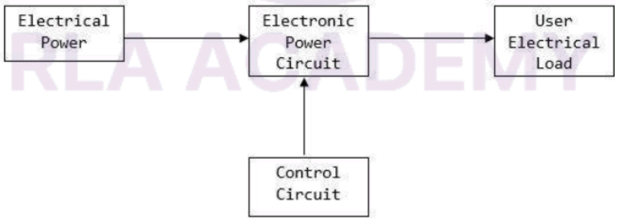


Figure: 1.1. Block diagram of DC power supply

A power electronic system converts electrical energy from one form to another and ensures the following is achieved −

- Maximum efficiency
- Maximum reliability
- Maximum availability
- Minimum cost
- Least weight
- Small size

Applications of Power Electronics:

Power Electronic applications are classified into two types − Static Applications and Drive Applications.

Static Applications

This utilizes moving and/or rotating mechanical parts such as welding, heating, cooling, and electro- plating and DC power.

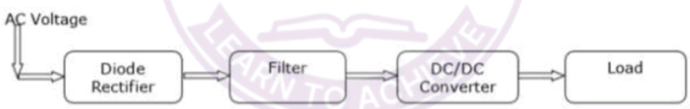


Figure: 1.2. Block diagram of DC power supply

Drive Applications

Drive applications have rotating parts such as motors. Examples include compressors, pumps, conveyer belts and air conditioning systems.

Air Conditioning System

Power electronics is extensively used in air conditioners to control elements such as compressors. A schematic diagram that shows how power electronics is used in air conditioners is shown below.

THREE PHASE SYNCHRONOUS MOTOR DRIVES

Speed control of three phase synchronous motor:

As soon as variable-frequency inverters became a practicable proposition natural to use them to supply synchronous motors, thereby freeing the latter from speed constraint imposed by mains-frequency operation and opening up the poss simple open-loop controlled speed drive. The obvious advantage over the in induction motor is that the speed of the synchronous motor is exactly determined by the frequency, whereas the induction motor always has to run with a finite slip. A precision frequency source (oscillator) controlling the inverter switching is all that is necessary to give an accurate speed control with a synchronous motor, while speed feedback is essential to achieve accuracy with an induction motor.

In practice, open-loop operation of inverter-fed synchronous motors is not as widespread as might be expected, though it is commonly used in multi-motor drives (see below). Closed-loop or self-synchronous operation is however rapidly gaining momentum, and is already well established in two distinct guises at opposite ends of the size range. At one extreme, large excited-rotor synchronous motors are used in place of D.C. drives, particularly where high speeds are required or when the motor must operate in a hazardous atmosphere (e.g. in a large gas compressor). At the other end of the scale, small permanent magnet synchronous motors are used in brushless D.C. drives. We will look at these closed-loop applications after a brief discussion of open-loop operation.

Open-loop inverter-fed synchronous motor drives

This simple method is attractive in multi-motor installations where all the motors must run at exactly the same speed. Individually the motors (permanent magnet or reluctance) are more expensive than the equivalent mass-produced induction motor, but this is of set by the fact that speed feedback is not required, and the motors can all be supplied from a single inverter, as shown in Figure below.

The inverter voltage-frequency ratio will usually be kept constant to ensure that the motors operate at full flux at all speeds, and therefore have a 'constant-torque' capability. If prolonged low-speed operation is called for, improved cooling of the motors may be necessary. Speed is precisely determined by the inverter frequency, but speed changes (including run-up from rest) must be made slowly, under ramp control, to avoid the possibility of exceeding the pull-out load angle, which would result in stalling.

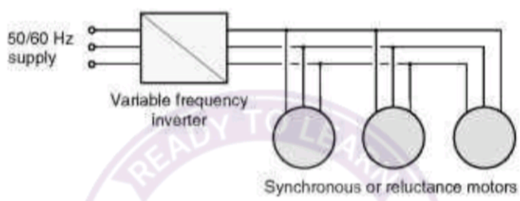


Figure: Open-loop operation of a group of several synchronous or reluctance motors supplied from a single variable-frequency inverter

A problem which can sometimes occur with this sort of open-loop operation is that the speed of the motor exhibits apparently spontaneous oscillation or hunting'. The supply frequency may be absolutely constant but the rotor speed is seen to fluctuate about its expected (synchronous) value, sometimes with an appreciable amplitude, and usually at a low frequency of perhaps 1 Hz. The origin of this unstable behaviour lies in the fact that the motor and load constitute at least a fourth-order system, and can therefore become very poorly damped or even unstable for certain combinations of the system parameters. Factors that influence stability are terminal voltage, supply frequency, motor time-constants and load inertia and damping. Unstable behaviour in the strict sense of the term (i.e. where the

UNIT – 09 DIGITAL PR...

Name

01. Architecture of 8085– Inst...
Modified Jun 16

02. Architecture of 8086 and ...
Modified Jun 16

03. Interfacing for memory an...
Modified Jun 16

04. 8255 ProgrammablePeriph...
Modified Jun 16

05. 8253 Programmable Timer...
Modified Jun 16

06. 8279 Programmable Keyb...
Modified Jun 16

07. 8257 Direct Memory Acces...
Modified Jun 16

08. Classification of Signals a...
Modified Jun 16

10. Digital Communication Sys...
Modified Jun 16

11. Frequency Division and Tim...
Modified Jun 16

12. Data Communication Netw...

1. INTRODUCTION TO MICROPROCESSOR

A *microprocessor* is a programmable electronics chip that has computing and decision making capabilities similar to central processing unit of a computer. Any microprocessor-based systems having limited number of resources are called *microcomputers*. Nowadays, microprocessor can be seen in almost all types of electronics devices like mobile phones, printers, washing machines etc. Microprocessors are also used in advanced applications like radars, satellites and flights. Due to the rapid advancements in electronic industry and large scale integration of devices results in a significant cost reduction and increase application of microprocessors and their derivatives.

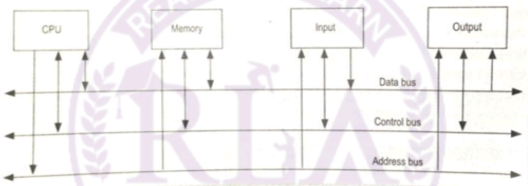


Fig.1 Microprocessor-based system

- **Bit**: A bit is a single binary digit.
- **Word**: A word refers to the basic data size or bit size that can be processed by the arithmetic and logic unit of the processor. A 16-bit binary number is called a word in a 16-bit processor.
- **Bus**: A bus is a group of wires/lines that carry similar information.
- **System Bus**: The system bus is a group of wires/lines used for communication between the microprocessor and peripherals.
- **Memory Word**: The number of bits that can be stored in a register or memory element is called a memory word.
- **Address Bus**: It carries the address, which is a unique binary pattern used to identify a memory location or an I/O port. For example, an eight bit address bus has eight lines and thus it can address $2^8 = 256$ different locations. The locations in hexadecimal format can be written as 00H – FFH.
- **Data Bus**: The data bus is used to transfer data between memory and processor or between I/O device and processor. For example, an 8-bit processor will generally have an 8-bit data bus and a 16-bit processor will have 16-bit data bus.
- **Control Bus**: The control bus carry control signals, which consists of signals for selection of memory or I/O device from the given address, direction of data transfer and synchronization of data transfer in case of slow devices.

A typical microprocessor consists of arithmetic and logic unit (ALU) in association with control unit to process the instruction execution. Almost all the microprocessors are based on the principle of store-program concept. In *store-program concept*, programs or instructions are sequentially stored in the memory locations that are to be executed. To do any task using a microprocessor, it is to be programmed by the user. So the programmer must have idea about its internal resources, features and supported instructions. Each microprocessor has a set of instructions, a list which is provided by the microprocessor manufacturer. The instruction set of a microprocessor is provided in two forms: *binary machine code and mnemonics*.

Microprocessor communicates and operates in binary numbers 0 and 1. The set of instructions in the form of binary patterns is called a *machine language* and it is difficult for us to understand. Therefore, the binary patterns are given abbreviated names, called mnemonics, which forms the *assembly language*. The conversion of assembly-level language into binary machine-level language is done by using an application called *assembler*.

<u>Technology Used</u>:

The semiconductor manufacturing technologies used for chips are:

- Transistor-Transistor Logic (TTL)
- Emitter Coupled Logic (ECL)
- Complementary Metal-Oxide Semiconductor (CMOS)

<u>Classification of Microprocessors</u>:

Based on their specification, application and architecture microprocessors are classified.

Based on size of data bus:

- 4-bit microprocessor
- 8-bit microprocessor

4.3 Intel 8253/54 - Programmable Interval Timer

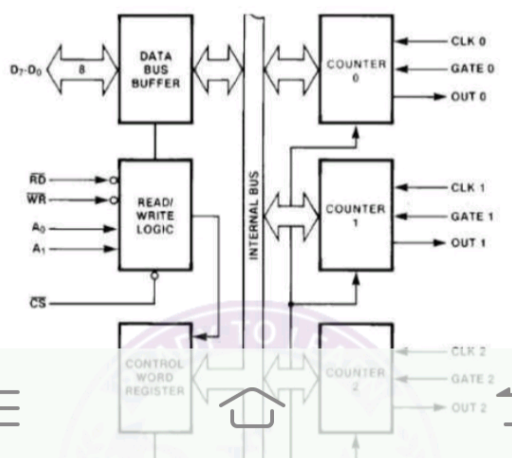
The Intel 8253 and 8254 are Programmable Interval Timers (PTIs) designed for microprocessors to perform timing and counting functions using three 16-bit registers. Each counter has 2 input pins, i.e. Clock & Gate, and 1 pin for "OUT" output. To operate a counter, a 16-bit count is loaded in its register. On command, it begins to decrement the count until it reaches 0, then it generates a pulse that can be used to interrupt the CPU. The following table differentiates the features of 8253 and 8254,

8253	8254
Its operating frequency is 0 - 2.6 MHz	Its operating frequency is 0 - 10 MHz
It uses N-MOS technology	It uses H-MOS technology
Read-Back command is not available	Read-Back command is available
Reads and writes of the same counter cannot be interleaved.	Reads and writes of the same counter can be interleaved.

The most prominent features of 8253/54 are as follows –

- It has three independent 16-bit down counters.
- It can handle inputs from DC to 10MHz.
- These three counters can be programmed for either binary or BCD count.
- It is compatible with almost all microprocessors.
- 8254 has a powerful command called READ BACK command, which allows the user to check the count value, the programmed mode, the current mode, and the status of the counter.

8254 Architecture:

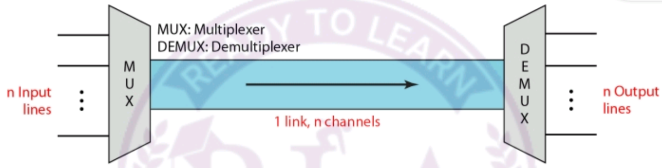


MODULE – IV

Multiplexing- Space Division Multiplexing-Frequency Division Multiplexing: Wave length Division Multiplexing - Time Division multiplexing: Characteristics, Digital Carrier system, SONET/SDH- Statistical time division multiplexing: Cable Modem - Code Division Multiplexing. Multiple Access–CDMA.

1. Multiplexing

- Multiplexing to refer to the combination of information streams from multiple sources for transmission over a ***shared medium.***
- The aim is to share a scarce resource. For example, in telecommunicatio[illegible]ho calls may be carried using one wire.



  - each sender communicates with a single receiver
  - all pairs share a single transmission medium
  - multiplexor combines information from the senders for transmission in such a way that the demultiplexer can separate the information for receivers

- There are four basic approaches to multiplexing that each have a set of variations and implementations
  1. Frequency Division Multiplexing (FDM)
  2. Wavelength Division Multiplexing (WDM)
  3. Time Division Multiplexing (TDM)
  4. Code Division Multiplexing (CDM)

- TDM and FDM are widely used
- WDM is a form of FDM used for optical fiber
- CDM is a mathematical approach used in cell phone mechanisms

1.1 Frequency Division Multiplexing

- Frequency Division Multiplexing (FDM) Frequency-division multiplexing is a form of signal multiplexing which involves assigning non-overlapping frequency ranges to different signals or to each "user of a medium.
- FDM achieves the combining of several signals into one medium by sending signals in several distinct frequency ranges over a single medium.
- Frequency division multiplexing involves translation of the speech signal from the frequency band 300-3400 Hz to a higher frequency band. Each channel is translated to a different hand and then all the channels are combined to form a frequency division multiplexed signal.

- In FDM, the speech channels are stacked at intervals of 4 kHz to provide a **guard band** between adjacent channels.

- FDM can be applied when the bandwidth of a link (in hertz) is greater than the combined bandwidths of the signals to be transmitted.

- A demultiplexer applies a set of filters that each extract a small range of frequencies near one of the carrier frequencies

Advantage of FDM:

1. The senders can send signals continuously.
2. FDM support full duplex information flow
3. Works for analog signals too
4. Noise problem for analog communication has lesser effect
5. AM and FM radio broadcasting and Television broadcasting

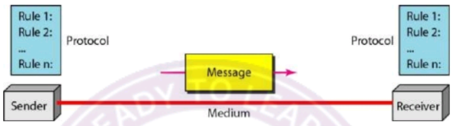
Disadvantage of FDM:

Introduction to Computer Networks

1.1 Data Communication: When we communicate, we are sharing information. This sharing can be local or remote. Between individuals, local communication usually occurs face to face, while remote communication takes place over distance.

1.1.1 Components:

A data communications system has five components.



1. Message. The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.

2. Sender. The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.

3. Receiver. The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.

4. Transmission medium. The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves

5. Protocol. A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating, just as a person speaking French cannot be understood by a person who speaks only Japanese.

1.1.2 Data Representation:

Information today comes in different forms such as text, numbers, images, audio, and video.

Text:

In data communications, text is represented as a bit pattern, a sequence of bits (Os or Is). Different sets of bit patterns have been designed to represent text symbols. Each set is called a code, and the process of representing symbols is called coding. Today, the prevalent coding system is called Unicode, which uses 32 bits to represent a symbol or character used in any language in the world. The American Standard Code for Information Interchange (ASCII), developed some decades ago in the United States, now constitutes the first 127 characters in Unicode and is also referred to as Basic Latin.

Numbers:

Numbers are also represented by bit patterns. However, a code such as ASCII is not used to represent numbers; the number is directly converted to a binary number to simplify mathematical operations. Appendix B discusses several different numbering systems.

Images:

Images are also represented by bit patterns. In its simplest form, an image is composed of a matrix of pixels (picture elements), where each pixel is a small dot. The size of the pixel depends on the *resolution.* For example, an image can be divided into 1000 pixels or 10,000 pixels. In the second case, there is a better representation of the image (better resolution), but more memory is needed to store the image. After an image is divided into pixels, each pixel is assigned a bit pattern. The size and the value of the pattern depend on the image. For an image made of only blackand- white dots (e.g., a chessboard), a I-bit pattern is enough to represent a pixel. If an image is not made of pure white and pure black pixels, you can increase the size of the bit pattern to include gray scale. For example, to show four levels of gray scale, you can use 2-bit patterns. A black pixel can be represented by 00, a dark gray pixel by 01, a light gray pixel by 10, and a white pixel by 11. There are several methods to represent color images. One method is called RGB, so called because each color is made of a combination of three primary colors: *red,* green, and blue. The intensity of each color is measured, and a bit pattern is assigned to it. Another method is called YCM, in which a color is made of a combination of three other primary colors: yellow, cyan, and magenta

UNIT – 10 RENEWABL...

Name

01. Renewable Energy – Sourc...
Modified Jun 16

02. Solar Radiation Spectrum-...
Modified Jun 16

03. Solar Photovoltaic Cell –pr...
Modified Jun 16

04. Microhydel- Operating pri...
Modified Jun 16

05. Wind Energy –component...
Modified Jun 16

06. Smart grid .pdf
Modified Jun 16

07. Electric vehicles-V2G and ...
Modified Jun 16

08. Fuel Cells.pdf
Modified Jun 16

09. Batteries-types and chara...
Modified Jun 16

RENEWABLE ENERGY (RE) SOURCES

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

Introduction

Renewable energy is energy produced from sources that do not deplete or can [illegible] or refilled within a human's life time. The most common examples of renewable energy sources include wind, solar, geothermal, biomass, and hydropower. Non-renewable energy comes from sources that will run out or will not be replenished in our lifetime or even in many lifetimes. Most of the non-renewable energy sources are fossil fuels, which influence the environment greatly and contribute to harmful global warming and climate change. Renewable energy is sustainable as it originates from sources that are inexhaustible (unlike fossil fuels). Despite of many advantages renewable energy sources have certain limitations like higher capital cost, intermittency, storage capabilities, geographic limitations, etc., which make them inevitable.

Environmental consequences of fossil fuel use

Fossil fuels are formed from the fossilized, buried remains of plants and animals that lived millions of years ago so they are named accordingly. Fossil fuels, which include coal, natural gas, petroleum, shale oil, and bitumen, are the main sources of heat and electrical energy. All these fuels contain the major constituents like carbon, hydrogen, oxygen and other materials like metal, sulphur and nitrogen compounds. During the combustion process different pollutants like fly ash, sulphur oxides (SO_2 and SO_3), nitrogen oxides ($NO_x = NO_2 + NO$) and volatile organic compounds are emitted. Gross emission of these pollutants constitutes to atmospheric pollution and can affect human beings and environment.

> *TEDA is Tamil Nadu Energy Development Agency. It is an independent agency setup by Government of Tamil Nadu in the year 1984, as a registered society with a specific purpose – to create awareness and migrate the State from using fossil fuels to renewable energy.*

Atmospheric Pollution

Atmospheric pollution occurs in many forms but can generally be thought of as gaseous and particulate contaminants that are present in the earth's atmosphere. Chemicals discharged into the air that have a direct impact on the environment are called primary pollutants. These primary pollutants sometimes react with other chemicals in the air to produce secondary pollutants. The most commonly found air pollutants are oxides of Sulphur, oxides of nitrogen, oxides of carbon, hydrocarbons, particulates (fly ash).

Oxides of Sulphur (SO2)

Sulphur dioxide (SO_2) is a colourless gas with a sharp, irritating odour. It is produced by burning fossil fuels and by the smelting of mineral ores that contain sulphur. Erupting volcanoes can be a significant natural source of sulphur dioxide emissions.

Environmental effects

When sulphur dioxide combines with water and air, it forms sulphuric acid, which is the main component of acid rain. Acid rain can:

- Cause deforestation
- Acidify waterways to the detriment of aquatic life
- Corrode building materials and paints.

Health effects

- Sulphur dioxide affects the respiratory system, particularly lung function and can irritate the eyes.
- Sulphur dioxide irritates the respiratory tract and increases the risk of tract infections.
- It causes coughing, mucus secretion and aggravates conditions such as asthma and chronic bronchitis.

Oxides of Nitrogen (NOx)

The term nitrogen oxides (NOx) describes a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2), which are gases produced from natural sources, motor vehicles and other fuel burning processes. Nitric oxide is colourless and is oxidised in the atmosphere to form nitrogen dioxide. Nitrogen dioxide has an odour and is an acidic and highly corrosive gas that can affect our health and environment. In poorly ventilated situations, indoor domestic appliances such as gas stoves and gas or wood heaters can be significant sources of nitrogen oxides.

Environmental and health effects of nitrogen oxides

- Elevated levels of nitrogen dioxide can cause damage to the human respiratory tract and increase a person's vulnerability to respiratory infections and asthma.
- Long-term exposure to high levels of nitrogen dioxide can cause chronic lung disease.
- It may also affect the senses of smell an odour.
- High levels of nitrogen dioxide are also harmful to vegetation, damaging foliage, decreasing growth or reducing crop yields.
- Nitrogen dioxide can fade and discolour furnishings and fabrics, reduce visibility and react with surfaces.

Oxides of Carbon (CO, CO2)

Carbon monoxide is a colourless, odourless gas formed when substances containing carbon (such as petrol, gas, coal and wood) are burned with an insufficient supply of air. Motor vehicles are the main source of carbon monoxide pollution in urban areas.

Health effects

- Carbon monoxide has serious health impacts on humans and animals.
- When inhaled, the carbon monoxide bonds to the haemoglobin in the blood in place of oxygen to become carboxyhaemoglobin. This reduces the oxygen-carrying capacity of the red blood cells and decreases the supply of oxygen to tissues and organs, especially the heart and brain.
- For people with cardiovascular disease, this can be a serious problem.
- The effects are reversible, so symptoms decrease gradually when exposure to carbon monoxide stops.

UNIT 1

- **Smart Grid**

  A Smart Grid is an electricity Network based on Digital Technology that is used to supply electricity to consumers via Two-Way Digital Communication. This system allows for monitoring, analysis, control and communication within the supply chain to help improve efficiency, reduce the energy consumption and cost and maximise the transparency and reliability of the energy supply chain.

- **Application of Smart Grid**

  The areas of application of smart grids include: smart meters integration, demand management, smart integration of generated energy, administration of storage and renewable resources, using systems that continuously provide and use data from an energy network

- **Give some of the benefits of Smart Grid**
  - Reduction in AT & C losses
  - Reduction in CO_2 Emission
  - Enabling Energy Audit
  - Reduction in Cost Billing
  - Remote Load Control

- **advantages of Smart Grid**
  - Improved Reliability
  - Higher asset utilization
  - Better integration of plug-in hybrid electric vehicles (PHEVs) and renewable energy
  - Reduced operating costs for utilities
  - Increased efficiency and conservation
  - Lower greenhouse gas (GHG) and other emissions

- Pillars of Smart Grid
  - Transmission Optimization
  - Demand Side Management
  - Distribution Optimization
  - Asset Optimization

- **Five Key Aspects of Smart Grid**

  The Five Key aspects of smart grid development and deployment are,
  - Computational Intelligence
  - Power System Enhancement
  - Communication and Standards
  - Environment and Economics
  - Test-bed

- **Features of Smart Grid**
  - Reliability
  - Flexibility in Topology
  - Efficiency
  - Platform for advanced services

- **some of the challenges faced presently by the Indian Electrici[illegible] System**
  - Shortage of power
  - Power Theft
  - Poor access to electricity in Rural areas
  - Huge losses in the Grid
  - Inefficient Power Consumption
  - Poor reliability

- Self-Healing

  A smart grid automatically detects and responds to routine problems and quickly recover sif they occur, minimizing downtime and financial loss.

What is a Battery?

- Batteries are a collection of one or more cells whose chemical reactions create a flow of electrons in a circuit. All batteries are made up of three basic components: an anode (the '-' side), a cathode (the '+' side), and some kind of electrolyte (a substance that chemically reacts with the anode and cathode).

Primary Batteries

- Batteries that must be thrown away after use are known as **primary batteries**

Secondary Batteries

- Batteries that can be recharged are called **secondary batteries**.