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THE HANDBOOK OF PDF STUDY MATERIAL

ELECTRICAL & ELECTRONICS ENGG

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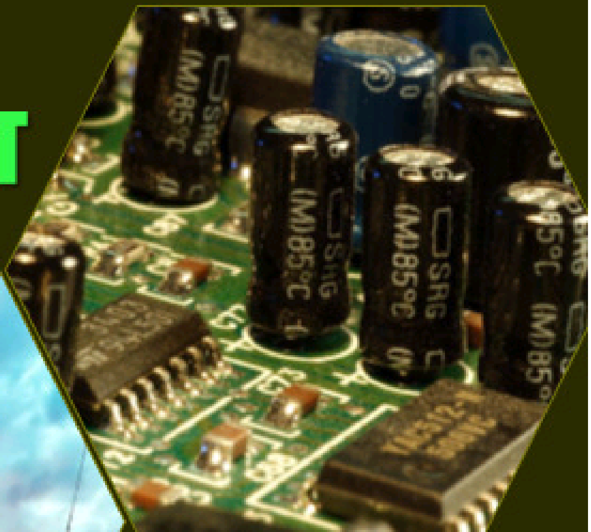

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Diploma EEE (446) - T...

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1.0 Electrostatics:

Electrostatics is the study of charges at rest. Electric charges are fundamental in nature. There are two types of charges and can be produced by friction. When a glass rod is rubbed with a silk cloth, some electrons from glass rod are migrated into the silk cloth. This makes the glass rod positively charged due to loss of electrons in it and the silk cloth negatively charged due to excess of electrons in it. Similarly, when the plastic rod is rubbed with fur, electrons migrate from the fur into the plastic rod making the rod negative and the fur positive. Also there is a force of attraction between the glass rod and silk cloth. There is a force of repulsion between similarly charged bodies and a force of attraction between oppositely charged bodies.

1.1 Electrostatic force:

The forces between particles that are caused by their electric charges. It exists between moving charges as well as stationary ones. This force may be illustrated with lines as shown in Figure 1.1.

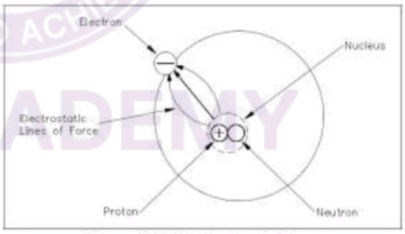

Figure 1.1 Electrostatic Force

1.2 Electric field:

An electric field is defined as the space in which an electric charge experiences a force. The electric field is represented by electric flux lines.

1.2.1 Electric Field Line:

It is defined as the direction of electric field. It leaves the positive charged conductor and enters a negatively charged conductor. The field configuration for isolated charges is shown in figure 1.2.

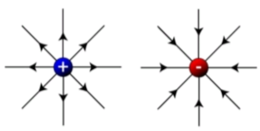

Figure 1.2 Electric Field Line

1.2.2 Properties of Electric field lines:

1. A line starts from a positive charge and ends on a negative charge.
2. The lines enter or leave a charged body at a right angle to the surface.
3. The lines go from more positive body towards the more negative body
4. The lines do not intersect.

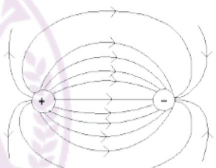

Figure 1.3 Electric field around two unlike charges

1.3 Electric Flux:

The total number of electric field lines is called electric flux. The unit of electric flux is the coulomb. The symbol for electric flux is ψ (psi)

One 'line' of flux is assumed to radiate from the surface of a positive charge of one coulomb and terminate at the surface of a negative charge of one coulomb. Hence the electric flux has the same numerical value as the charge that produces it. Therefore, the coulomb is used as the unit of electric flux.

Introduction

Alessandro Giuseppe Antonio Anastasio Volta (Italian pronounced as Alessandro volta) was an Italian physicist, chemist, and a pioneer of electricity and power who is credited as the inventor of the electrical battery and the discoverer of methane. He invented the Voltaic pile in 1799. The **voltaic pile** was the first electrical battery that could continuously provide an electric current to a circuit. With this invention Volta proved that electricity could be generated chemically by the principle that an emf can exist between two plates of different metals immersed in an electrolyte. He made a simple cell, named after him, the **Voltaic Cell**. It consisted of a glass jar containing dillute H_2So_4 with copper and zinc plates immersed in it. An e.m.f. of 0.8V was developed across the two plates with copper plate as positive electrode. The voltaic pile then enabled a rapid series of discoveries including the electrical decomposition (electrolysis) of water into oxygen and hydrogen by William Nicholson and Anthony Carlisle (1800) and the isolation of the chemical elements sodium , potassium , calcium , boron , barium and magnesium by Humphry Davy.

5.1 Classification of Cells

1. Primary Cell
2. Secondary Cell or Accumulator
   a) Lead – acid Cell
   b) Nickel – Cadmium and Nickel – Iron Cells

5.1.1 Primary Cell

Primary cells can only transform chemical energy into electrical energy and the cell can be re-activated only by renewal of the active materials. Leclanche cell, Voltaic cell, Mercury cell and the well known dry cell, all come under the primary cell group. They suffer from the drawbacks of small capacity and short life. Moreover, the chemical action is not reversible and when one cell loses its action it has to be discarded (particularly the handy dry cell of the modern day).

5.1.2 Secondary Cell

In a secondary cell or accumulator, the electrode materials can be re-activated i.e., the chemical action can be reversed. This means the chemical action is converted into electrical energy when the cell is discharging. The electrical energy is converted into a chemical change or action when the cell is being charged.

Secondary cells may be divided into two types: (a) the lead-acid cell in which lead plates covered with compounds of lead are immersed in dilute sulphuric acid, (b) the nickel cadmium and the nickel-iron cells. The above cells will be seen in greater detail.

5.2 Lead Acid Cell Construction

This type is very familiar to everyone. Since the positive and negative plates are both made of lead (alloy) and the electrolyte is dilute H2So4, it is known as lead-acid cell. The chemical substances that combine to store electrical energy are called active materials. Lead peroxide (Pbo_2) a brown chocolate colour, fairly hard but brittle substance is the active material in the positive plate. With full charge, the negative plate is just lead but it is spongy and porous in nature. The dilute H_2So_4 is made up of 3 parts of water to one part of acid. Under fully charged condition the specific gravity of the electrolyte is about 1.21.

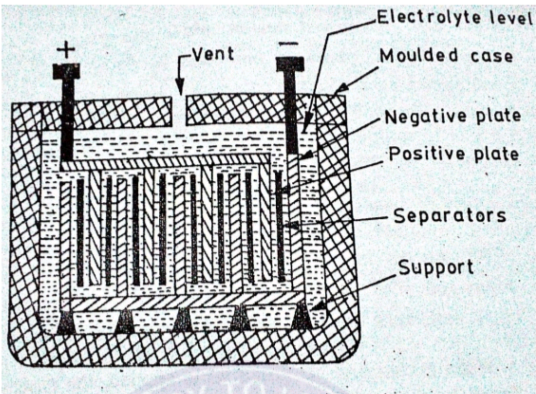

Fig. 2.1 Lead acid battery

The capacity of a cell depends on the amount of active material in the plate. The plate area is increased by arranging a number of a plates in parallel. The positive and negative plates are kept interleaved inside the container. Separators are there in between every positive and negative plate to prevent accident short circuit. Treated wood or perforated hard rubber can be used as separators. A

5.1 CONSTRUCTIONAL FEATURES OF SYNCHRONOUS RELUCTANCE MOTOR

CONSTRUCTION OF SYNCHRONOUS RELUCTANCE MOTOR

The structure of reluctance motor is same as that of salient pole synchronous machine as shown in fig. The rotor does not have any field winding .The stator has three phase symmetrical winding, which creates sinusoidal rotating magnetic field in the air gap, and the reluctance torque is developed because the induced magnetic field in the rotor has a tendency to cause the rotor to align with the stator field at a minimum reluctance position

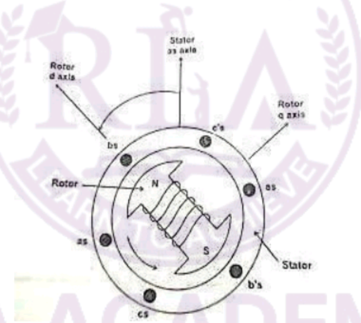

Figure 5.1.1 Idealized Three Phase Four Pole Synchronous Machine (Salient Pole)

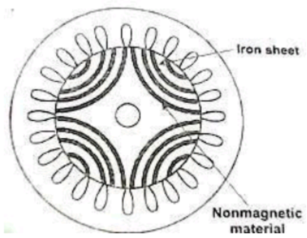

Figure 5.1.2 cross section of synchronous reluctance motor

The rotor of the modern reluctance machine is designed with iron laminations in the axial direction separated by non-magnetic material. The performance of the reluctance motor may approach that of induction machine. With high saliency ratio a power factor oh 0.8 can be reached. The efficiency of a reluctance machine may be higher t[illegible] induction motor because there is no rotor copper loss. Because of inherent si[illegible] robustness of construction and low cost.

The synchronous reluctance motor has no synchronous starting torque and runs up from stand still by induction action. There is an auxiliary starting winding. This has increased the pull out torque, the power factor and the efficiency. Synchronous reluctance motor is designed for high power applications. It can broadly be classified

3.1 Permanent Magnets Material

NdFeB – Neodymium – iron – boron has the highest energy product of all commercially available magnets at room temperature. It has high remanence and coercivity in the motor frame size for the same output compared with motors using ferrite magnets. But it is costlier. But both of the above stated magnets are sensitive to temperature and care should be taken for working temperature above 100˚.For very high temperature applications, alnico or rare earth cobalt magnets must be used.

B – H Loop

It is used for understanding characteristics hysteresis loop as shown.

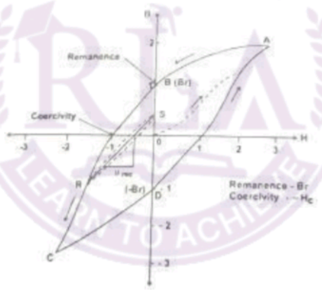

Figure 3.1.1 BH Hysteresis loop of hard permanent magnet

Material X – axis – Magnetizing force or field intensity H.

Y – axis – Magnetic flux density B in the material.

An un-magnetized sample has B = 0 and H = 0 and therefore starts out at the origin.

Curve OA

If it is subjected to a magnetic field, magnetic fixture (an electromagnetic with shaped pole pieces to focus flux into the magnet), then B and H in the magnet follow the curve OA as the external ampere – turns are increased.

Curve AB

If the external ampere – turns are switched off, the magnet relaxes along A operating point (H, B) depends on the shape of the magnet and permanence o surrounding magnetic circuit. If the magnet is surrounded by a highly permeable magnetic circuit, that is if it is keepered then its poles are effectively shorted together so that H = 0 and then the flux density is the value at point remanence Br.

UNIT - 02 AC Machines

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SINGLE PHASE TRANSFORMERS

Introduction:

The main advantage of alternating currents over direct current is that, the alternating currents can be easily transferable from low voltage to high voltage or high voltage to low. Alternating voltages can be raised or lowered as per requirements in the different stages of electrical network as generation, transmission, distribution and utilization. This is possible with a static device called transformer. The transformer works on the principle of mutual induction. It transfer an electric energy from one circuit to other when there is no electrical connection between the two circuits. Thus we can define transformer as below:

The transformer is a static device, in which an electrical power is transformed from one alternating current circuit to another with the desired change in voltage and current, without any change in the frequency.

The use of transformers in transmission system is shown in the Fig 3.1.

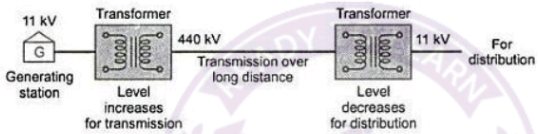

Fig 3.1 Use of transformer in transmission system

3.1 Principle Of Operation

The principle of mutual induction states that when two coils are inductively coupled and if current in one coil is changed uniformly then an e.m.f. gets induced in the other coil. This e.m.f can drive a current, when a closed path is provided to it. The transformer works on the same principle. In its elementary form, it consists of two inductive coils which are electrically separated but linked through a common magnetic circuit. The two coils have high mutual inductance. The basic transformer is shown in the Fig 3.2.

One of the two coils is connected to source of alternating voltage. This coil in which electrical energy is fed with the help of source called primary winding (P). The other winding is connected to load. The electrical energy transformed to this winding is drawn out to the load.

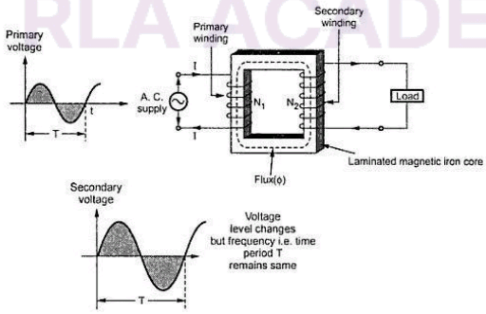

Fig 3.2 Basic Transformer

This winding is called secondary winding (S). The primary winding has N_1 number of turns while the secondary winding has N_2 number of turns. Symbolically the transformer is indicated as shown in the Fig 3.3

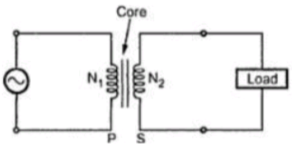

Fig 3.3 Symbolic Representation

When primary winding is excited by an alternating voltage, it circulates an alternating curren
current produces an alternating flux (Φ) which completes its path through common magnetic c
shown dotted in the Fig 3.2. Thus an alternating, flux links with the secondary winding. As the flux
alternating, according to Faraday's law of an electromagnetic induction, mutually induced e.m.f. gets developed in the secondary winding. If now load is connected to the secondary winding, this e.m.f. drives a current through it.

Thus through there is no electrical contact between the two windings, an electrical energy gets transferred from primary to the secondary.

The emf induced in the secondary winding depends upon the number of turns of the windings. If the number of turns in the secondary winding is more than that of the primary winding, the emf

b) Rotor speed

c) Frequency of rotor current

Solution:

Synchronous speed: $n_s = 120\,f/p = (120*60)/6 = 1200$ rpm

Rotor speed: $n_r = (1-s)\,n_s = (1-0.05)(1200) = 1140$ rpm

Frequency of rotor current: $f_r = s\,f = (0.05)(60) = 3$ Hz

3.7 Phasor Diagram of Induction Motor

The phasor diagram of loaded induction motor is similar to the loaded transformer. The only difference is the secondary of induction motor is rotating and short circuited whil secondary is stationary and connected to load. The load on induction motor is mechanica transformer is electrical. Still by finding electrical equivalent of mechanical load on phasor diagram of induction motor can be developed.

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Let Φ = Magnetic flux links with both primary and secondary.

There is self induced e.m.f. E_1 in the stator while a mutually induced e.m.f. E_{2r} in the rotor.

Let R_1 = Stator resistance per phase.

X_1 = Stator reactance per phase

The stator voltage per phase V_1 has to counter balance self induced e.m.f. $E_1$and has to supply voltage drops $I_1 R_1$ and $I_1 X_1$. So on stator side we can write,

$$\overline{V_1} = -\overline{E_1} + \overline{I_1 R_1} + j\,\overline{I_1 X_1} = \overline{E_1} + \overline{I_1}\,(R_1 + j\,X_1) = -\overline{E_1} + \overline{I_1 Z_1}$$

The rotor induced e.m.f. in the running condition has to supply the drop across impedances as rotor short circuited.

$$\therefore \quad \overline{E_{2r}} = \overline{I_{2r} R_2} + j\overline{I_{2r} X_2} = \overline{I_{2r}}\,(R_2 + jX_2) = \overline{I_{2r}}\;\overline{Z_{2r}}$$

The value of E_{2r} depends on the ratio of rotor turns to stator turns.

The rotor current in the running condition is I_{2r} which lags E_{2r} by rotor p.f. angle Φ_{2r}.

The reflected rotor current I_{2r}' on stator side is the effect of load and is given by,

$I_{2r}' = K\,I_{2r}$

The induction motor draws no load current I_o which is phasor sum of I_c and I_m. The total stator current drawn from supply is,

$\bar{I}_1 = \bar{I}_o + \bar{I}_{2r}'$

The Φ_1 is angle between V_1 and I_1 and cos Φ_1 gives the power factor of the induction motor.

Thus using all above relations the phasor diagram of induction motor on load can be obtained.

The steps to draw phasor diagram are,

1. Takes Φ as reference phasor.
2. The induced voltage E_1 lags Φ by 90°.
3. Show - E_1 by reversing voltage phasor.
4. The phasor E_{2r} is in phase with E_1. So I_{2r} show lagging E_{2r} i.e. E_1 direction by Φ_{2r}.
5. Show I_{2r} R_2 in phase with I_{2r} and I_{2r} X_{2r} leading the resistive drop by 90°, to get exact location of.
6. Reverse I_{2r} to get I_{2r}'.
7. I_m is in phase with Φ while Ic is at leading with. Add I_m and Ic to get I_o.
8. Add I_o and I_{2r}' to get I_1.
9. From tip of - E_1 phasor, add I_1 R_1 in phase with I_1 and I_1X_1 at 90° leading to I_1 to V_1 get phasor.
10. Angle between V_1 and I_1 is Φ_1.

The phasor diagram is shown in the Fig. 1.

5.1 PERMANENT MAGNET SYNCHRONOUS MOTOR

INTRODUCTION

A permanent magnet synchronous motor is also called as brushless permanent magnet sine wave motor. A sine wave motor has a

1. Sinusoidal or quasi-sinusoidal distribution of magnetic flux in the air gap.

2. Sinusoidal or quasi-sinusoidal current wave forms.

3. Quasi-sinusoidal distribution of stator conductors (i.e.) short-pitched and distributed or concentric stator windings.

The quasi sinusoidal distribution of magnetic flux around the air gap is achieved by tapering the magnet thickness at the pole edges and by using a shorter magnet pole arc typically 120º. The quasi sinusoidal current wave forms are achieved through the use of PWM inverters and this may be current regulated to produce the best possible approximation to a pure sine wave. The use of short pitched distributed or concentric winding is exactly the same as in ac motors.

5.1.1 CONSTRUCTION AND PRINCIPLE OF OPERATION

Permanent magnet synchronous machines generally have same operating and performance characteristics as synchronous machines. A permanent magnet machine can have a configuration almost identical to that of the conventional synchronous machines with absence of slip rings and a field winding.

Construction

Fig. 5.1 shows a cross section of simple permanent magnet synchronous machines. It consists of the stationary member of the machine called stator. Stator laminations for axial air gap machines are often formed by winding continuous strips of soft steel. Various parts of the laminations are the teeth slots which contain the armature windings. Yoke completes the magnetic path. Lamination thickness depends upon the frequency of the armature source voltage and cost. Armature windings are generally double layer (two coil side per slot) and lap wound. Individual coils are connected together to form phasor groups. Phasor groups are connected together in series/parallel combinations to form star, delta, two phase (or) single windings.

AC windings are generally short pitched to reduce harmonic voltage generated in the windings. Coils, phase groups and phases must be insulated from each other in the end-turn regions and the required dielectric strength of the insulation will depend upon the voltage ratings of the machines.

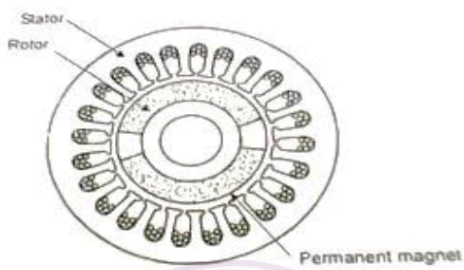

Fig. 5.1 structure of the stator and rotor

In a permanent magnet machines the air gap serves an role in that its length largely determi operating point of the permanent magnet in the no-load operating condition of the machines .Also air gaps reduce machines wind age losses.

The permanent magnets form the poles equivalent to the wound field pole of conventional synchronous machines. Permanent magnet poles are inherently ―salient‖ and there is no equivalent to the cylindrical rotor pole configurations used in many convectional synchronous machines.

Many permanent magnet synchronous machines may be cylindrical or ―smooth rotor‖ physically but electrically the magnet is still equivalent to a salient pole structure. Some of the PMSM rotor have the permanent magnets directly facing the air gap as in fig. 5.2

UNIT - 03 Measureme...

Name

01. Classification and charact...
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MEASURING INSTRUMENTS

1.1 Introduction to measuring instruments:

The **measurement** of a given quantity is the result of comparison between the quantity whose magnitude is unknown and a predefined standard. Since two quantities are compared the result is expressed in numerical values. Measurements involve the use of instruments as a physical means of determining variables.

Instrument can be defined as a device for measuring the value or magnitude of quantity or variable. Instruments are broadly classified into two categories (i) Absolute instruments (ii) Secondary instruments. Absolute instruments give the magnitude of the quantity under measurement in terms of physical constants of the instruments. Secondary instruments are so constructed that the quantity being measured can only be measured by observing the output indicated by the instruments. The indications are given by a pointer moving over a calibrated scale.

The instrument which measures the voltage in volts across any two points of a circuit is called **voltmeter** while the instrument which measures the current in ampere is called **ammeter**. The instruments which are used to measure the power in watts are called **power meters** or **watt meters**. These instruments are calibrated by comparison with an absolute instrument.

Application of measuring instruments:

Measurements and instruments are used for different applications. They are,

1. Monitoring of processes and operation
2. Control of processes and operations
3. Experimental Engineering analysis

1.2 Basic forces for indicating instrument:

There are three types of forces for indicating instrument. They are

1. Deflecting force
2. Controlling force
3. Damping force

1.2.1 Deflecting Force

It is also called the operating force. It causes the moving system of the instrument to move from its zero position to the indicating position. The zero position of the moving system is the position of it when the instrument connected to the circuit is disconnected from the supply. This force is made to act by utilizing any one of the following effect.

1. Magnetic and electromagnetic effect
2. Heating effect
3. Electrostatic effect
4. Induction effect

1.2.2 Controlling Force

The deflecting of the moving system will be infinite if there were no opposing force. Such an opposing force is called "controlling force". The system producing

2.7 Introduction to CRO:

The cathode ray oscilloscope (CRO) is a very useful and versatile laboratory instrument used for display, measurement and analysis of waveforms. CROs are also used to investigate waveforms, transient phenomena and other time varying quantities from a very low frequency range to the radio frequencies.

It is an electronic device, which gives the visual indication of signal waveforms. It can be used to study the wave shape of a signal with respect to amplitude, distortion and deviation from the normal. It can also be used to measure voltage, frequency and phase shift.

2.7.1 Block diagram of CRO

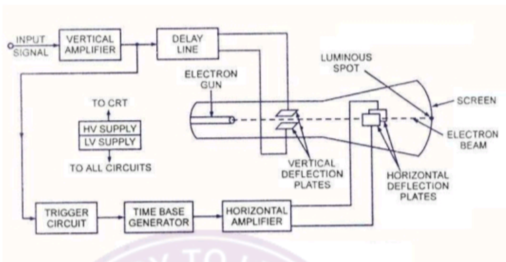


Fig 2.7.1.1 Block diagram of CRO

The block diagram of CRO is shown in fig 2.7.1.1. The various blocks of CRO are as follows.

1. **CRT**

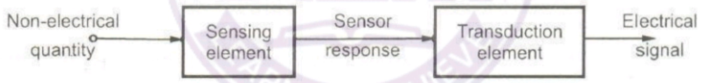
It consists of an electron gun. The electron gun produces an electron beam. This beam is narrow and is allowed to pass down the tube, and to fall on the screen. The screen is formed by the flat end of glass tube which is coated with the fluorescent material. The point at which the electron beam strikes the screen, a spot is formed. The electron beam passes through two pairs of electrostatic deflection plates i.e. the horizontal and vertical deflecting plates.

The voltages which are applied to these plates defect the beam. Horizontal deflecting plates move the spot in horizontal direction and vertical deflecting plates move the spot on the screen in vertical direction. These two movements i.e. vertical and horizontal are independent of each other and thus the beam may be displayed anywhere on the screen.

2. **Vertical amplifier**

TRANSDUCERS

INTODUCTION
A device which converts a physical quantity into the proportional electrical signal is called a transducer. The electrical signal produced may be a voltage, current or frequency. A transducer uses many effects to produce such conversion. The process of transforming signal from one form to other is called transduction. A transducer is also called pick up. The transduction element transforms the output of the sensor to an electrical output, as shown in theFig.



A transducer will have basically two main components. They are

1. SensingElement
The physical quantity or its rate of change is sensed and responded to by this part of the transistor.

2. TransductionElement
The output of the sensing element is passed on to the transduction element. This element is responsible for converting the non-electrical signal into its proportional electricalsignal.

There may be cases when the transduction element performs the action of both transduction and sensing. The best example of such a transducer is a thermocouple. A thermocouple is used to generate a voltage corresponding to the heat that is generated at the junction of two dissimilar metals.

Classification of Transducers

The Classification of Transducers is done in many ways. Some of the criteria for the classification are based on their area of application, Method of energy conversion, Nature of output signal, According to Electrical principles involved, Electrical parameter used, principle of operation, &

Typical applications.
The transducers can be classified broadly
i. On the basis of transduction formused
ii. As primary and secondarytransducers
iii. As active and passivetransducers
iv. As transducers and inversetransducers.
Broadly one such generalization is concerned with energy considerations wherein they are classified as active & Passive transducers. A component whose output energy is supplied entirely by its input signal (physical quantity under measurement) is commonly called a „passive transducer". In other words the passive transducers derive the power required for transduction from an auxiliary source. Active transducers are those which do not require an auxiliary power source to produce their output. They are

also known as self generating type since they produce their own voltage or current output. Some of the passive transducers (electrical transducers), their electrical parameter (resistance, capacitance, etc), principle of operation and applications are listed below.

Resistive Transducers

1. Resistance Strain Gauge – The change in value of resistance of metal semi-conductor due to elongation or compression is known by the measurement of torque, displacement orforce.
2. Resistance Thermometer – The change in resistance of metal wire due to the change in temperature known by the measurement oftemperature.
3. Resistance Hygrometer – The change in the resistance of conductive strip due to the changeof moisture content is known by the value of its correspondinghumidity.
4. Hot Wire Meter – The change in resistance of a heating element due to convection cooling of a flow of gas is known by its corresponding gas flow orpressure.
5. Photoconductive Cell – The change in resistance of a cell due to a corresponding change in light flux is known by its corresponding lightintensity.
6. Thermistor – The change in resistance of a semi-conductor that has a negative co-efficient of resistance is known by its corresponding measure oftemperature.
7. Potentiometer Type – The change in resistance of a potentiometer reading due to the movement of the slider as a part of an external force applied is known by its corresponding pressure or displacement.

Capacitance Transducers

1. Variable capacitance pressure gage-
Principle of operation: Distance between two parallel plates is varied by an externally applied force Applications: Measurement of Displacement, pressure
2. Capacitormicrophone
Principle of operation: Sound pressure varies the capacitance between a fixed plate and a movable diaphragm. Applications: Speech, music, noise
3. Dielectricgauge
Principle of operation: Variation in capacitance by changes in the dielectric. Applications: Liquid level, thickness

Inductance Transducers

1. Magnetic circuit transducer
Principle of operation: Self inductance or mutual inductance of ac-excited coil is varied by changes in the magnetic circuit. Applications: Pressure, displacement

UNIT - 04 Electronic D...

Name ↑

- 01. Semi Conductor Diodes.pdf
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- 02. Rectifiers - Half wave, full ...
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- 03. Filter - Types - Capacitor ...
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- 08. Opto electronic-Solar cell,...
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- 09. Amplifier - RC Coupled am...
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- 10. Oscillator - Hartley Oscillat...
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Introduction:

Atomic theory

Atom:

It is the smallest particle of an element.It consists of positively charged protons, negatively charged electrons and neutral neutrons.The central part which consists of protonsand neutrons is called nucleus.Electrons revolve around nucleus in various orbits.The maximum number of electrons in each orbit is limited by the formula $2n^2$.

Valence electrons:

The electrons in the last orbit are called valence electrons.

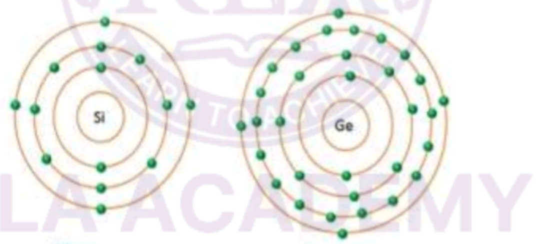
Free electrons:

The valence electrons which are loosely connected with the nucleus are called free electrons.They can move from atom to other.

Bounded electrons:

The electrons which are tightly attached with nucleus are called bounded electrons.They are the innermost orbit electrons.

Atomic structure of Silicon & Germanium



Silicon:

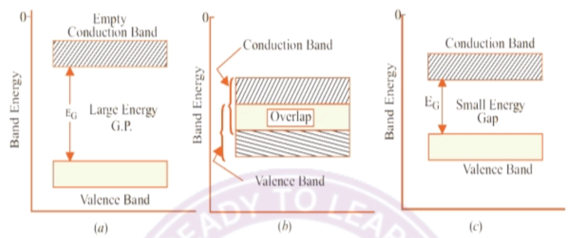
Its atomic number is 14.It consists of 14 protons& 14 electrons.The 1st orbit consists of 2 electrons.The 2nd orbit has 8 electrons.The 3rd has 8 electrons.The valence number is 4.

Germanium

Its atomic number is 32.It consists of 32 protons& 32 electrons.The 1st orbit consists of 2 electrons.The 2nd orbit has 8 electrons.The 3rd has 18 electrons.The 4th has 4 electrons.The valence number is 4.These elements are called semiconductors.

Energy Band diagrams

The electrons moving in a particular orbit possess energy.The energies possessed by the electrons of the same orbit are not equal.The range of energies possessed by the electrons of the same orbit is called as energy band of that orbit.



Valance band:

It is the highest occupied energy band. It represents the range of energies possessed by valence electrons.The band may be completely or partially filled in.

Conduction band:

It represents the range of energies possessed by free electrons.These electrons move freely and conduct electric current.This band may be empty or partially filled in.

RECTIFIERS & FILTERS:

INTRODUCTION

For the operation of most of the electronics devices and circuits, a d.c. source is required. So it is advantageous to convert domestic a.c. supply into d.c.voltages. The process of converting a.c. voltage into d.c. voltage is called as rectification. This is achieved with i) Step-down Transformer, ii) Rectifier, iii) Filter and iv) Voltage regulatorcircuits.

These elements constitute d.c. regulated power supply shown in the fig 1 below

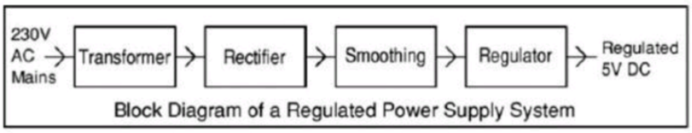


fig1 . Block diagram of Regulated D.C. Power Supply

- ✓ Transformer – steps down 230V AC mains to low voltageAC.
- ✓ Rectifier – converts AC to DC, but the DC output isvarying.
- ✓ Smoothing – smooth the DC from varying greatly to a smallripple.
- ✓ Regulator – eliminates ripple by setting DC output to a fixedvoltage.

The block diagram of a regulated D.C. power supply consists of step-down transformer, rectifier, filter, voltage regulator and load. An ideal regulated power supply is an electronics circuit designed to provide a predetermined d.c. voltage Vo which is independent of the load current and variations in the input voltage ad temperature. If the output of a regulator circuit is a AC voltage then it is termed as voltage stabilizer, whereas if the output is a DC voltage then it is termed as voltage regulator.

RECTIFIER:

Any electrical device which offers a low resistance to the current in one direction but a high resistance to the current in the opposite direction is called rectifier. Such a device is capable of converting a sinusoidal input waveform, whose average value is zero, into a unidirectional Waveform, with a non-zero average component. A rectifier is a device, which converts a.c. voltage (bi-directional) to pulsating d.c. voltage (Unidirectional).

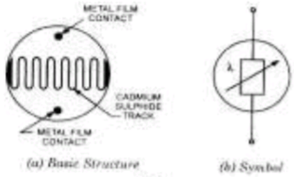
Characteristics of a Rectifier Circuit:

Any electrical device which offers a low resistance to the current in one direction but a high resistance to the current in the opposite direction is called rectifier. Such a device is capable of converting a sinusoidal input waveform, whose average value is zero, into a unidirectional waveform, with a non-zero average component.

A rectifier is a device, which converts a.c. voltage (bi-directional) to pulsating d.c..Load currents: They are two types of output current. They are average or d.c. current and RMS currents.

Average or DC current: The average current of a periodic function is defined as the area of one cycle of the curve divided by the base.

PHOTO CONDUCTIVE CELL (OR) LIGHT DEPENDENT RESISTOR:



(a) Basic Structure (b) Symbol

LDR

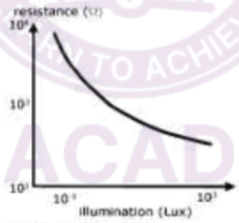
Construction:

It is generally made up of cadmium compounds such as cadmium sulphide (cds), cadmium selenide (cdse). The device is in the form of either a slab of a semiconductor in bulk form (or) a thin film deposited on an insulating substrate. The ohmic contacts are made at the opposite ends. The material is arranged in the form of a long strip, zigzagged across a disc. A glass (or) plastic cover may be included for protection.

Operation:

When the device is exposed to light, the conductivity increases. The radiation supplied to the semiconductor ionizes the covalent bonds. Hence new e^{-ns} -hole pairs are produced. Due to this the resistance decreases and the conductivity is increased. Hence it is called photo resistor (or) photo conductor.

Characteristics:



With the increase in illumination, the resistance decreases.

Applications:

LDRs are used

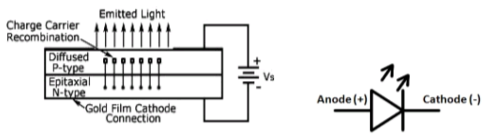
1. As switches
2. In counting application
3. In burglar alarms
4. In relay controls
5. As smoke detector
6. To measure intensity of light.

LIGHT EMITTING DIODE (LED):

A p-n junction which emits light when forward biased is known as LED. The amount of light output is proportional to the forward current.

Construction:

LED Construction



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An n-type epitaxial layer is grown upon a substrate. The p- region is created by diffusion. The recombination occurs in the p- region. So this region is kept uppermost. The metal film anode is made such that most of the light is emitted from the p-region. A gold film is applied to the bottom of the device. It provides cathode connection. The colours of light depend on the LED materials.

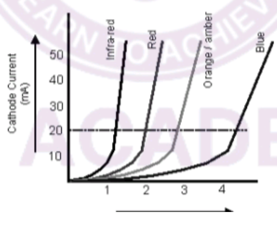
Ga As – infrared (invisible)

Ga P – red or green

Ga As P – red or yellow

Operation:

When the LED is forward biased, the e^{-ns} and holes move towards the junction. Then the charge carrier recombination takes place. So, it releases energy in the form of light. The brightness of the emitted light is directly proportional to the forward bias current. The characteristics are similar to that of a p-n junction diode.



OSCILLATORS:

Many electronic devices require a source of energy at a specific frequency, which may range from few Hz to several MHz. This is achieved by an electronic device called oscillator.

Definition:

Oscillator is an electronic device which generates an AC signal with required freq[illegible]d amplitude and required wave shape. In radio and television receivers, oscillators are us[illegible] frequency carrier signals. Oscillators are widely usedin radars, electronic equipment an[illegible] devices.

Oscillators are broadly classified into two types.

They are

1) Sinusoidal oscillators
2) Non-sinusoidal oscillators (Relaxation oscillators)

The sinusoidal oscillators are used for generating only sinusoidal signals with required frequency and required amplitude.The non-sinusoidal oscillators are used for producing non-sinusoidal signals like square, rectangular, triangular, or saw toothsignals with required amplitude and required frequency.

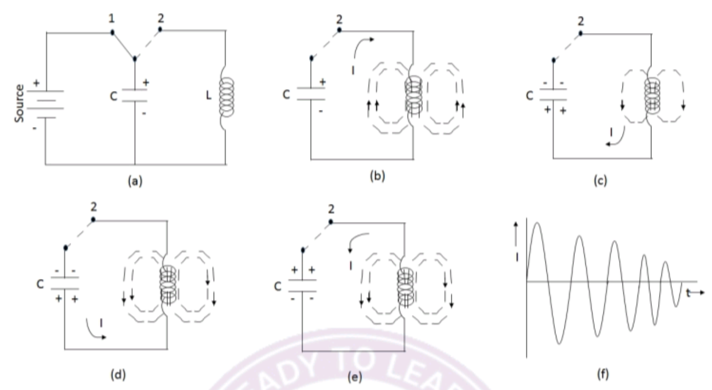
CLASSIFICATION OF OSCILLATORS:

Oscillators are classified into the following different types

- (a) According to the wave form generated
  - (1) Sinusoidal oscillators
    - LC oscillators, and
    - RC oscillators
  - (2) Non-sinusoidal oscillators (Relaxation oscillators)
    - Square wave, rectangular wave, saw tooth etc.
- (b) According to the fundamental mechanism used
  - (1) Negative resistance oscillators
  - (2) Feedback oscillators
- (c) According to the frequency generated
  - (1) Audio Frequency(AF) oscillators
  - (2) Radio Frequency(RF) oscillators
  - (3) Very High Frequency (VHF) oscillators
  - (4) Ultra High Frequency (UHF) oscillators
  - (5) Microwave oscillators

Basic Theory of Oscillator:

A circuit which produces electrical oscillations of any desired frequency is known as an Oscillatory circuit or tank circuit.An amplifier uses a positive feedback. The feedback is a property, which allows to feedback the part of the output, to the same circuit as its input. Such a feedback is said to be positive whenever the part of the output that is feedback in the amplifier as its input, is in phase with the original input signal applied to the amplifier.



Now, if the switch S is changed to position 2, as shown in fig b. the capacitor will discharge through the inductor and the current flow will be in the direction indicated by the arrow. The current that passes through the inductor will set magnetic field around the coil. Due to the inductive effect of the coil, the current through the coil increases slowly and attains the maximum. Thus the electrostatic energy across the capacitor is totally transferred to inductance as magnetic energy. Now the capacitor is fully discharged.

When the capacitor is fully discharged, the magnetic field, in the inductance will collapse and produce counter e.m.f. As per the lenz's law, the counter e.m.f will charge capacitor in the opposite direction (upper plate as negative and lower plate as positive).

Finally the magnetic field is completely collapsed and the capacitor is fully charged as shown in fig C. Now once again an electrostatic energy is established across capacitor discharges by transferring energy to inductor. Thus the capacitor will discharge through the inductor and the current flows through the inductor will be in the direction as indicated by the arrow, which is opposite to the figure b. It is shown in fig d.

Again the energy from the inductor is transferred to capacitor is empty now. It is shown in fig e.

The charging and discharging result in alternating motion of current through the inductor. If there were no loss of energy in the component, the oscillating current would continue and we can obtain oscillation continuously. But due to energy conversion from one to another, there will be losses. So, the amplitude of oscillating current decreases gradually and it became zero after some time. Therefore, the oscillation produced by the tank circuit is by nature a damped one.

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1.1 The operational amplifier:

An operational amplifier is a direct coupled high gain amplifier consisting of one or more differential (OPAMP) amplifiers and followed by a level translator and an output stage. An operational amplifier is available as a simplex integrated circuit package.

An operational amplifier is designed to perform mathematical operations like addition, subtraction, differentiation, integration, multiplication, division etc in analog computers. Hence it is called as operational amplifiers.

Symbol of Operational Amplifier:

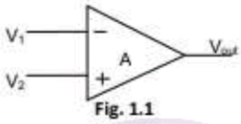


Fig. 1.1

1. In fig 1.1 an op.amp contains two inputs and a single output. The inputs are named as inverting input marked with a negative or "minus" sign, (-) and non-inverting input marked with a positive or "plus" sign (+).
2. If the non-inverting input is grounded and a signal is applied to the inverting input, the output signal will be 180 degrees out of phase with the input signal.
3. If the inverting input is grounded and a signal is applied to the non-inverting input, the output signal will be in phase with the input signal.

Block Diagram of Op-Amp

The block diagram of Op-Amp is shown in **Fig. 1.2**.

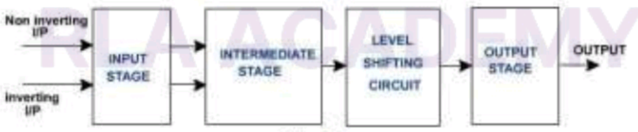


Fig. 1.2

The input stage is a dual input balanced output differential amplifier. This stage provides most of the voltage gain of the amplifier and also establishes the input resistance of the Op-Amp. The intermediate stage of Op-Amp is another differential amplifier which is driven by the output of the first stage. This is usually dual input unbalanced output.

Because of direct coupling, the dc voltage level at the output of intermediate stage is well above ground potential. Therefore level shifting circuit is used to shift the dc level at the output downwards to zero with respect to ground. The output stage is generally a push pull complementary amplifier. The output stage increases the output voltage swing and raises the current supplying capability of the Op-Amp. It also provides low output resistance.

AN IDEAL OP.AMP:

An ideal op.amp shown in **Fig. 1.3** is a differential input and a single ended output device.

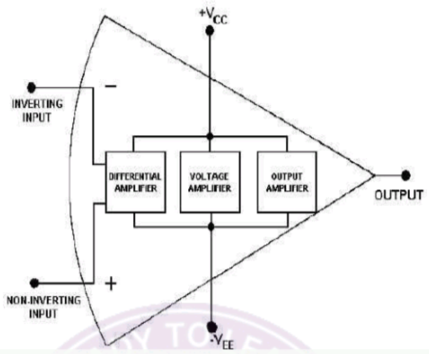


Fig. 1.3

CHARACTERISTICS OF AN IDEAL OP.AMP.

1. High input impedance $R_i = \infty$
2. Low output impedance $R_O = 0$

BOOLEAN ALGEBRA

2.1 Numbering System

The study of *number systems* is important from the viewpoint of understanding how data are represented before they can be processed by any digital system including a digital computer. It is one of the most basic topics in digital electronics. In this chapter we will discuss different number systems commonly used to represent data. We will begin the discussion with the decimal number system. Although it is not important from the viewpoint of digital electronics, a brief outline of this will be given to explain some of the underlying concepts used in other number systems. This will then be followed by the more commonly used number systems such as the binary, octal and hexadecimal number systems.

The table 2.1 given below shows some examples of number system which are often used in digital circuits.

Table 2.1 examples of number system.

S.No	Types	Base/Radix	Numbers
1	Decimal number system	10	0,1,2,....9
2	Binary number system	2	0,1
3	Octal number system	8	0,1,2,3...7
4	Hexa decimal number system	16	0,1,2,....9, A,B,C,D,E,F

Table 2.1

Decimal Number System

The decimal system is composed of 10 numerals or symbols. These 10 symbols are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Using these symbols as digits of a number, we can express any quantity. The decimal system is also called the base-10 system because it has 10 digits

Weight of each digit	10^3	10^2	10^1	10^0		10^{-1}	10^{-2}	10^{-3}
Digit value	=1000	=100	=10	=1	•	=0.1	=0.01	0.001
Bit position	Most Significant Digit				Decimal point			Least Significant Digit

Binary Number System

In the binary system, there are only two symbols or possible digit values, 0 and 1. This base-2 system can be used to represent any quantity that can be represented in decimal or other base system

Weight of each digit	2^3	2^2	2^1	2^0		2^{-1}	2^{-2}	2^{-3}
Digit value	=8	=4	=2	=1	•	=0.5	=0.25	=0.125
Bit position	Most Significant Digit				Binary point			Least Significant Digit

Octal Number System

The octal number system has a base of eight, meaning that it has eight possible digits: 0,1,2,3,4,5,6,7

Weight of each digit	8^3	8^2	8^1	8^0		8^{-1}	8^{-2}	8^{-3}
Digit value	=512	=64	=8	=1	•	=1/8	=1/64	=1/512
Bit position	Most Significant Digit				Octal point			Least Significant Digit

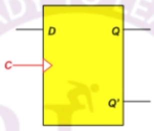
Hexadecimal Number System

The hexadecimal system uses base 16. Thus, it has 16 possible digit symbols. I[illegible] the digits 0 through 9 plus the letters A, B, C, D, E, and F as the 16 digit symbols

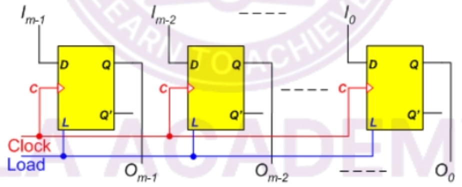
Weight of each digit	16^3	16^2	16^1	16^0		16^{-1}	16^{-2}	16^{-3}
Digit value	=4096	=256	=16	=1	•	=1/16	=1/256	=1/4096
Bit position	Most Significant Digit				Hexa Decimal point			Least Significant Digit

Introduction:

The smallest unit of information a digital system can store is a ***bit***, which can be stored in a ***flip-flop*** or a ***1-bit register***.



To store *m* bits of data, an ***m-bit register*** with parallel load capability may be used available on the ***m***-bit input lines (I_0 to I_{m-1}) may be stored/*written* into this register under control of the clock by asserting the "*Load*" control input. The stored ***m*** bits of data may be *read* from the register outputs (O_0 to O_{m-1}).

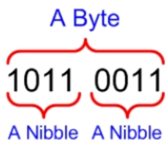


The ***m*** bits of data stored in a register make up a ***word***. It is simply a number of bits operated upon or considered by the hardware as a group. The number of bits in the word, ***m,*** is called ***word length***.

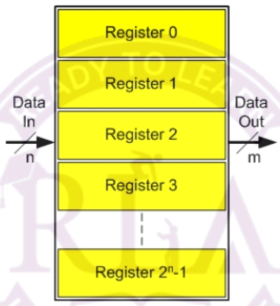
The *m* inputs of the register are provided through an *m*-bit input data *bus* and *m* outputs by an *m*-bit output data *bus*.

A ***bus*** is a number of signal lines, grouped together because of similarity of function, which connect two or more systems or subsystems.

A unit of 8-bits of information is referred to as a ***byte***, while 4-bits of information is referred to as a ***nibble***.



A ***memory*** device can be looked at as consisting of a number of equally sized registers sharing a *common set of inputs*, and a *common set of outputs*, as shown in the Figure.



Storing data in a memory register is referred to as a memory ***write*** operation and looking up the contents of a memory register is referred to as a memory ***read*** operation.

In case of a write operation, the input data need to be written into one *particular* register in the memory device.

Since the input data lines are common to all registers of the memory device, only the selected register should have its ***load*** control signal asserted while the other registers should not.

If the number of registers is 2^n, *n* lines will be required to select the register to be written into. The *n*-lines are used as an input to a decoder where the decoder's 2^n outputs may be used as the ***load*** control inputs to the 2^n registers.

The load control signal of a particular register is asserted by a unique combination of the *n*-select lines. This unique combination is considered as the ***address*** for that particular register.

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Name

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GENERATION OF ELECTRICAL POWER

1.1Introduction

Sources of electricity are available everywhere in the world. Worldwide, variety of energy resources available to generate electricity.

These energy resources fall into two main categories

(i) Renewable (or) Non-conventional sources of energy
(ii) Non-renewable energy resources (or) Conventional sources of energy.

These resources can be used as a source to generate electricity, which is a very useful way of transferring energy from one place to another.

1.1.1Conventional sources of energy: Coal, petroleum, natural gas, fissionable materials like uranium.

1.1.2Non-conventional sources of energy: Wind, Hydro Power, solar, Ocean Tidal Energy, Interior of the Earth, Biogas, Plants, Vegetable waste etc.

1.2.1Conventional Energy Sources:

The energy sources which cannot be compensated, once these are used is called conventional energy sources .Some important conventional energy sources are discussed below:

1. Coal:

Power plants burn fossil fuels to heat water and produce steam. The steam pushes around turbines in a generator which converts mechanical energy in to electrical energy.

2. Hydropower:

Energy obtainable from water flow or water falling from a higher potential to lower potential, is known is hydro- power. It is a conventional and renewable form of energy which can be transmitted to long distance through cables and wires.

3. Nuclear energy:

Nuclear fission of uranium produces heat, and this heat is used to heat the water and make steam. The steam rotates turbines which turn generators. The generators produce electricity.

1.2.2 Non conventional energy sources:

The conventional energy sources discussed above are exhaustible and in some cases, installation of plants to get energy is highly expensive. In order to meet the energy demand of increased population, alternate nonconventional natural Resources sources of energy is developed which should be renewable and provide a pollution free environment.

Some nonconventional, renewable and inexpensive energy sources are described below:

1. Solar energy.
2. Wind energy.
3. Tidal energy.
4. Geothermal energy.
5. Bio-mass based energy.

1.3 THERMAL POWER STATION

1.3.1 Working principle

In a thermal power plant a steam turbine is rotated with the help of high pressure ar temperature steam by using fossil fuels and this rotation is transferred to a generator to pr electricity.

1.3.2 Schematic arrangement of steam power station

Steam power station simply involves the conversion of heat energy into electrical energy. The schematic arrangement of a modern steam power station is shown in Figure.

The whole arrangement can be divided into the following stages:

1.14 Load Curve

A load curve is a graphical record showing the power demands for every instant during a certain time interval.

Such a record may cover 1 hour, in which case it would be an hourly load graph;, a month in which case it would be a monthly load graph, or a year (7860 hours), in which case it would be a yearly load graph.

1.14.1 Significance of Load Curves:

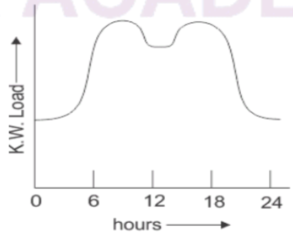
(i) The area under the load curve represents the energy generated in the period considered.

(ii) The area under the curve divided by the total number of hours gives the average load power station.

(iii) The peak load indicated by the load curve/graph represents the maximum demand of the power station.

(iv) Load curves give full information about the incoming and help to decide the installed capacity of the power station and to decide the economical sizes of various generating units.

These curves also help to estimate the generating cost and to decide the operating schedule of the power station, i.e. the sequence in which different units should be run.



Industrial Load

1.15 Load Duration Curve

1.15.1 Definition:

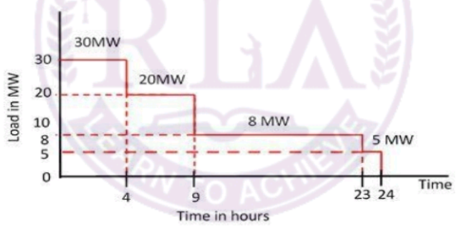
The load duration curve is defined as the curve between the load and time in which the ordinates representing the load, plotted in the order of decreasing magnitude, i.e., with the greatest load at the left, lesser loads towards the rights and the lowest loads at the time extreme right.

This curve represents the same data as that of the load curve. The load duration curve is constructed by selecting the maximum peak points and connecting them by a curve.

The load duration curve plotting for 24 hours of a day is called the daily load duration curve. Similarly, the load duration curve plotted for a year is called the annual load curve.

$$Average\ Demand = \frac{kWh\ (or\ MWh)consumed\ in\ a\ given\ period\ of\ time}{hours\ in\ the\ time\ period}$$

$$Average\ Demand = \frac{area\ under\ the\ load\ duration\ curve}{base\ of\ the\ load\ duration\ curve}$$



Load Duration Curve

1.15.2 Information Available Form Load Duration Curve

1. The load duration curve gives the minimum load present throughout the specified period.
2. It authorizes the selection of base load and peak load power plants.
3. Any point on the load duration curve represents the total duration in hours for the corresponding load and all loads of greater values.
4. The area under the load duration curve represents the energy associated with the load duration curve.

2.7 Over Head Line

Overhead lines have more advantages than underground lines. The underground cables are rarely used for power transmission due to two main reasons. Firstly, power is generally transmitted over long distances to load centres.Obviously; the installation costs for underground transmission will be very heavy. Secondly, electric power has to be transmitted at high voltages for economic reasons. It is very difficult to provide proper insulation to the cables to withstand such higher pressures. Therefore, as a rule, power transmission over long distances is carried out by using overhead lines.

An overhead line is subjected to uncertain weather conditions and other external interferences. This calls for the use of proper mechanical factors of safety in order to ensure the continuity of operation in the line. In general, the strength of the line should be such so as to provide against the worst probable weather conditions. In this we shall focus our attention on the various aspects of mechanical design of overhead lines.

2.8 Main components of Overhead lines:

An overhead line may be used to transmit or distribute electric power.The successful operation of an overhead line depends to a great extent upon the mechanical design of the line.While constructing an overhead line, it should be ensured that mechanical strength of the line is such so as to provide against the most probable weather conditions.In general, the main components of an overhead line are:

(i) Conductors which carry electric power from the sending end station to the receiving end station.

(ii) Supports which may be poles or towers and keep the conductors at a suitable level above the ground.

(iii) Insulators which are attached to supports and insulate the conductors from the ground.

(iv) Cross arms which provide support to the insulators.

(v) Miscellaneous items such as phase plates, danger plates, lightning arrestors, anti-climbing wires etc.

Conductor materials used in Overhead lines:

The conductor is one of the important items as most of the capital outlay is invested for it. Therefore, proper choice of material and size of the conductor are of considerable importance. The conductor material used for transmission and distribution of electric power should have the following properties :

(i) High electrical conductivity.

(ii) High tensile strength in order to withstand mechanical stresses.

(iii) low cost so that it can be used for long distances.

(iv) Low specific gravity so that weight per unit volume is small.

All above requirements are not found in a single material. Therefore, while selecting a conductor material for a particular case, a compromise is made between the cost and the required electrical and mechanical properties.

2.8.1 Commonly used conductor materials:

The most commonly used conductor materials for overhead lines are copper, aluminum, steel-cored aluminum, galvanized steel and cadmium copper. The choice of a partic material will depend upon the cost, the required electrical and mechanical properties and th conditions.

All conductors used for overhead lines are preferably stranded in order to increase the flexib stranded conductors, there is generally one central wire and round this, successive layers o containing 6, 12, 18, 24 ...... wires. Thus, if there are n layers, the total number of individual wires is

$3n(n + 1) + 1$. In the manufacture of stranded conductors, the consecutive layers of wires are twisted or spiraled in opposite directions so that layers are bound together.

1. Copper:

Copper is an ideal material for overhead lines owing to its high electrical conductivity and greater tensile strength. It is always used in the hard drawn form as stranded conductor. Although hard drawing decreases the electrical conductivity slightly yet it increases the tensile

5.12 Grounding:

Introduction

In power system, grounding or earthing means connecting frame of electrical equipment (non-current carrying part) or some electrical part of the system (e.g. neutral point in a star-connected system, one conductor of the secondary of a transformer etc.) to earth i.e. soil. This connection to earth may be through a conductor or some other circuit element (e.g. a resistor, a circuit breaker etc.) depending upon the situation. Regardless of the method of connection to earth, grounding or earthing offers two principal advantages. First, it provides protection to the power system. For example, if the neutral p connected system is grounded through a circuit breaker and phase to earth fault occurs or large fault current will flow through the circuit breaker. The effects of the fault. Secon electrical equipment (e.g. domestic appliances, hand-held tools, industrial motors etc.) ensu of the persons handling the equipment. For example, if insulation fails, there will be a direct contact of the live conductor with the metallic part (i.e. frame) of the equipment. Any person in contact with the metallic part of this equipment will be subjected to a dangerous electrical shock which can be fatal. In this chapter, we shall discuss the importance of grounding or earthing in the line of power system with special emphasis on neutral grounding.

Grounding or Earthing

The process of connecting the metallic frame (i.e. non-current carrying part) of electrical equipment or some electrical part of the system (e.g. neutral point in a star-connected system, one

conductor of the secondary of a transformer etc.) to earth (i.e. soil) is called **grounding** or **earthing.** It is strange but true that grounding of electrical systems is less understood aspect of power system. Nevertheless, it is a very important subject. If grounding is done systematically in the line of the power system, we can effectively prevent accidents and damage to the equipment of the power system and at the same time continuity of supply can be maintained. Grounding or earthing may be classified as : **(i)** Equipment grounding **(ii)** System grounding.

Equipment grounding deals with earthing the non-current-carrying metal parts of the electrical equipment. On the other hand, system grounding means earthing some part of the electrical system

e.g. earthing of neutral point of star-connected system in generating stations and sub-stations.

Equipment Grounding

The process of connecting non-current-carrying metal parts (i.e. metallic enclosure) of the electrical equipment to earth (i.e. soil) in such a way that in case of insulation failure, the enclosure effectively remains at earth potential is called **equipment grounding.**

We are frequently in touch with electrical equipment of all kinds, ranging from domestic appliances and hand-held tools to industrial motors. We shall illustrate the need of effective equipment grounding by considering a single-phase circuit composed of a 230 V source connected to a motor M as shown in Fig. 26.1. Note that neutral is solidly grounded at the service entrance. In the interest of easy understanding, we shall divide the discussion into three heads viz. **(i)** Ungrounded enclosure **(ii)** enclosure connected to neutral wire **(iii)** ground wire connected to enclosure.

(i) Ungrounded enclosure. Fig. 5.18 shows the case of ungrounded metal enclosureIf a person touches the metal enclosure, nothing will happen if the equipment is functioning correctly. But if the winding insulation becomes faulty, the resistance Re between the motor and enclosure drops to a low value (a few hundred ohms or less). A person having a body resistance Rb would complete the current path as shown in Fig. 5.18.

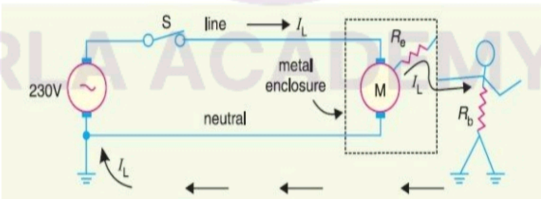


Fig 5. 18

If Re is small (as is usually the case when insulation failure of winding occurs), the leakage current I_L through the person's body could be dangerously high. As a result, the person would get severe electric shock which may be fatal. Therefore, this system is unsafe.

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UNIT - 07 Distribution...

Name ↑

PDF 00. AC and DC Distribution.pdf
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PDF 01. Substations.pdf
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PDF 02. Industrial Drives.pdf
Modified Sep 28, 2024

PDF 03. Traction motors and contr...
Modified Sep 28, 2024

PDF 04. Electric Traction.pdf
Modified Sep 28, 2024

PDF 05. Magnetic Levitation.pdf
Modified Sep 28, 2024

PDF 06. Illumination.pdf
Modified Sep 28, 2024

PDF 07. Laws of Illumination.pdf
Modified Sep 28, 2024

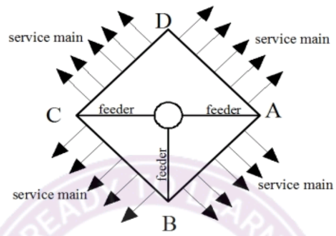
PDF 08. Electric Heating.pdf
Modified Sep 28, 2024

PDF 09. Electric Furnaces.pdf
Modified Sep 28, 2024

PDF 10. Electric welding.pdf
Modified Sep 28, 2024

1.15. Distribution system

That part of power system which distributes electric power for local use is known as distribution system. In general the distribution system is the electrical system between the substation fed by the transmission system and the consumer's meters. It generally consists of feeder's distributors and the service mains. The single line diagram of a typical low tension distribution system is Fig 1.9



Feeders

A feeder is a conductor which connects the substation or localized generating station to the area where power is to be distributed, Generally no tapping's are taken from the feeder so that current in it remains the same throughout. The main consideration in the design of a feeder is the current carrying capacity

Distributor

A distributor is a conductor from which tapping's are taken for supply to the consumers. In BC CD and DA are the distributors. The current through a distributor is not constant because tappings are taken at various places along its length. While designing a distributor voltage drop along its length is the main consideration since the statutory limit of voltage variations is 5% of rated value at the consumer's terminals

Service mains

A service mains is generally a small cable which connects the distributor to the consumer terminals.

1.16. Classification of Distribution Systems

1. A distribution system may be classified according to Nature of current:

i) d.c. distribution system ii)a.c. distribution system

Now a days ac system is universally adopted for distribution of electric power as it is simpler and more economical than direct current method

2. Type of construction

According to type of construction distribution system can be classified as

i) Overhead system

ii) Underground system.

The overhead system is generally employed for distribution as it is 5 to 10 times cheaper than the equivalent underground system. In general the underground system is used at places where overhead construction is impracticable or prohibited by the local laws

3. Scheme of connection

According to scheme of connection the distribution system may be classified as:

i) Radial system

ii) Ring main system

iii) Interconnected system.

1.17. AC Distribution

Now a day's electrical energy is generated transmitted and distributed in the form of alternating current. One important reason for the widespread use of alternating current in preference to direct current is th that alternating voltage can be conveniently changed in magnitude by means of a transformer. Tran has made it possible to transmit ac power at high voltage and utilize it at a safe potential. High tran and distribution voltages have greatly reduced the current in the conductors and the resulting line los

There is no definite line between transmission and distribution according to voltage or bulk However in general the ac distribution system is the electrical system between the step down substa by the transmission system and the consumer's meters. The ac distribution system is classified into pr distribution system and secondary distribution system.

a) Primary distribution system

It is that part of ac distribution system which operates at voltages somewhat higher than general utilization and handles large blocks of electrical energy than the average low voltage consumer uses. The voltage used for primary distribution depends upon the amount of power to be conveyed and the distance of the substation required to be fed. The most commonly used primary distribution voltages are 11KV 6.6KV and

5.3.7.ELECTRIC WELDING EQUIPMENTS

1. AC welding equipments
2. DC welding equipments
3. Other equipments
   a) Welding Holder
   b) Welding Leads
   c) Ground Connection
   d) Hand Shields

1. AC welding equipments

1. Number of phases used with AC supply
   a) Single phase is suitable for obtaining lower current, thinner sections & small diameter electrodes
   b) Two phase is suitable for higher current and thicker jobs
   c) Three phase is used, where more than one operator has to work simultaneously
2. Current range is up to 600 amperes
3. One circuit voltage is from 70 to 100 volts
4. Single or multi operator sets are used
5. It has drooping characteristics
6. Small Transformers are of air cooled type
7. Large Transformers are of oil cooled type

ADVANTAGES

1. Not having rotating parts
2. Do not produce noise
3. Occupies less space
4. Less initial cost

5. Less maintenance cost
6. Possess High efficiency
7. Consume less energy per unit weight of deposited metal
8. High no load voltage

DISADVANTAGE

- Melting rate of electrode cannot be controlled

2. DC welding equipments

1. AC Transformer with Silicon or Selenium Rectifier (or) DC Generator driven by A Motor as a prime mover (or) DC Generator driven by Petrol/Diesel engine as a prir mover can be used.
2. Current range is up to 600 amps
3. One circuit voltage is from 45 to 75 volts
4. Drooping, Slightly drooping or flat characteristics

Fig.5.29.DC welding equipment

UNIT - 08 Microcontr...

Name ↑

01. 8051 micro controller – Arc...
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02. 8051 micro controller – Ins...
Modified Oct 3, 2024

03. Assembler and Addressin...
Modified Oct 3, 2024

04. Input & Output programmi...
Modified Oct 3, 2024

05. Timer programming.pdf
Modified Oct 3, 2024

06. Serial communication.pdf
Modified Oct 3, 2024

07. Interrupts & IC 8255.pdf
Modified Oct 3, 2024

08. Peripheral interfacing t
Modified Oct 3, 2024

1.1ARCHITECTURE OF 8051

1.1.1COMPARISON OF MICROPROCESSOR AND MICROCONTROLLER

	Microprocessor	Microcontroller
1	It is suited for general purpose system	It is suited for special purp
2	Memory, Timer/Counter, I/O ports are not inbuilt in this chip	Memory, Timer/Counter, I/O ports are inbuilt in this chip
3	To make the system using microprocessor, More peripherals are required	To make the system using microcontroller, lesser no. of peripherals are enough
4	Examples: 8085,8086,pentium	Examples:8051,pic

1.1.1 Block Diagram of Microcontroller

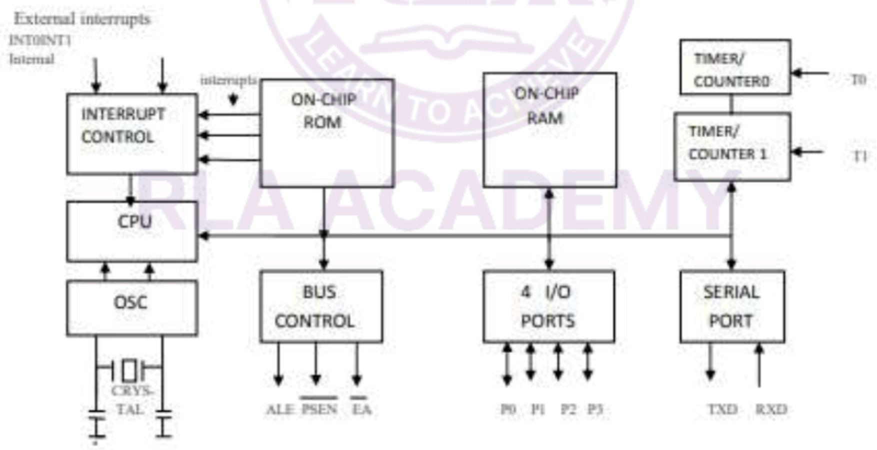


Fig 1.1 Block Diagram of Microcontroller

1.1.2 FUNCTIONS OF EACH BLOCK

Shown in the Fig 1.1 Block Diagram of Microcontroller

CPU- Central Processing Unit comprising of ALU and Control units

ALU-Arithmetic and Logic Unit performing the arithmetic and logical operations. These operations are addition, subtraction , multiplication, logical AND,OR etc. To do this operations one operand should be in Accumulator, another may in B register or in general purpose register. Mostly the result of the ALU operations are in A register. Some results are in B register also.

OSC

Oscillator provides clock for controller operation .Crystal oscillator provides stability and perfect clock. So crystal oscillator is used in this microcontroller .The crystal connected to the pins are intended for this purpose.

INTERRUPT CONTROLLER

Some interrupts are needed for microcontroller operation. Five interrupts are used.The controller controls the operation interrupts. ie some interrupts may be allowed, some others are disabled and priority assigned and changed.

BUS CONTROL

In 8051 ,Data Bus has a width of 8 bits and Address Bus has a width of 16 bits. Lower byte address bus are used for both Address and data. The bus usage is controlled by BUS control. There are 3 control signals, EA, PSEN and ALE. These signals known as External Access (EA), Program Store Enable (PSEN), and Address Latch Enable (ALE) are used for external memory interfacing.

ON CHIP RAM

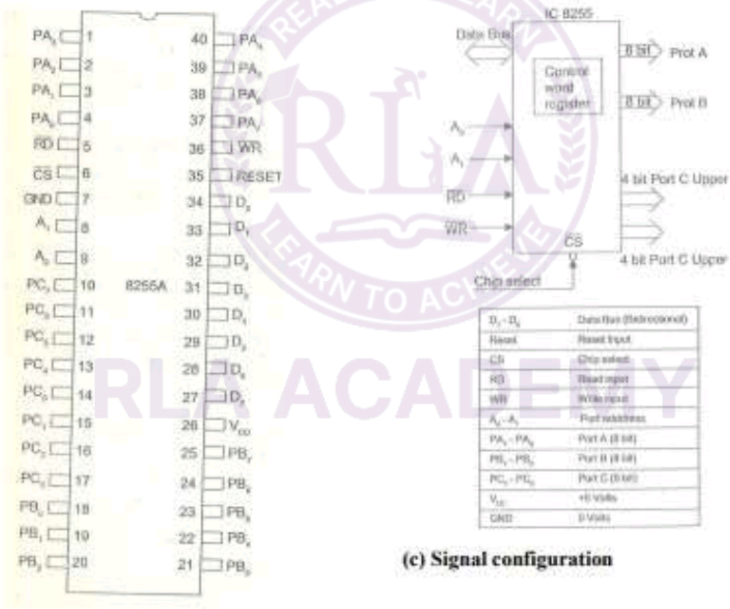
The 8051 has 4 kilobyte of inbuilt ROM. It is otherwise called program memory. Usually

5.1IC 8255 (Programmable Peripheral interface)

8255 Pin details and signal diagram

The Intel 8255 is one such peripheral interface chip. It can be used with the Intel microprocessor or microcontroller. The 8255 is one of the most widely used interface devices for expanding number of input/ output pins.

It is a 40 pin DIP IC. It requires +5V DC power Supply for its operations . The pin out diagram and signal diagram of 8255 A are shown in the fig 5.1



D_7 - D_0	Data Bus (Bidirectional)
Reset	Reset input
CS	Chip select
RD	Read input
WR	Write input
A_0 - A_1	Port address
PA_7 - PA_0	Port A (8 bit)
PB_7 - PB_0	Port B (8 bit)
PC_7 - PC_0	Port C (8 bit)
V_{CC}	+5 Volts
GND	0 Volts

(c) Signal configuration

(a) Pin diagram

Fig 5.1 Programmable Peripheral interface 8255

5.2 FUNCTIONAL BLOCK DIAGRAM of8255

The functional block diagram of 8255 is shown in fig 5.2 It contains Data bus buffer, Read/ Write control Logic Unit and I/O Ports.

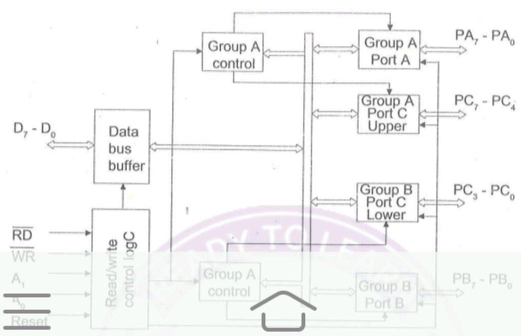


Fig 5.2 Functional block diagram of IC

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UNIT - 09A Power ele...

Name

01. SCR trigger circuits.pdf
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02. Commutation circuits.pdf
Modified Sep 28, 2024

03. Phase controlled Rectifies....
Modified Sep 28, 2024

04. Choppers.pdf
Modified Sep 28, 2024

05. Inverters.pdf
Modified Sep 28, 2024

06. SMPS and UPS.pdf
Modified Sep 28, 2024

07. Control of AC and DC mot
Modified Sep 28, 2024

08. Control of AC and DC.p
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1.5 Silicon Controlled Rectifier (SCR)

1.5.1 Basic Structure and Operation:

SCR is a three-terminal device. It has four layers of *p*-type and *n*-type material (i.e. three *p*–*n* junctions). The control terminal of the SCR is called the gate (*G*) electrode. The other two terminals, called the anode (*A*) and cathode (*K*), handle the large applied potentials and conduct the major current through the SCR. The anode and cathode terminals are connected in series with the load to which the power is to be controlled. SCRs are used as closed switch (no voltage drop between anode and cathode) or open (no anode current flow) switch for the control of power flow in a circuit.

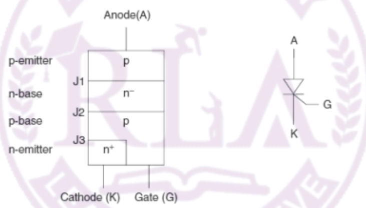

Figure 1.4: SCR Symbol

1.5.2 SCR construction and Symbol

When a positive voltage is applied to the anode with respect to cathode, the thyristor is in its forward-blocking state. Junction J1 and J3 are forward biased and junction J2 is reverse biased. In this operating mode the gate current is zero. As long as the forward applied voltage does not exceed the value necessary to cause avalanche breakdown around J2, the SCR remains in off-state (forward-blocking). If the applied voltage exceeds the maximum forward-blocking voltage of the SCR, it will switch to its on-state. This method of turn on damages the device.

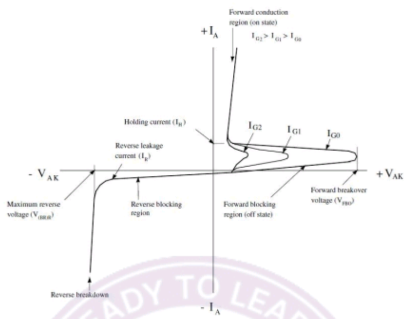

Figure 1.5: SCR V-I Characteristics

When the gate current is given the turn on takes place at lesser anode to cathode vol

The effect of gate current is to lower the blocking voltage at which switching takes place. The SCR moves rapidly along the negatively sloped portion of the curve until it reaches a stable operating point determined by the external circuit. As the SCR moves from forward-blocking to forward conduction, the external circuit must allow sufficient anode current to flow to keep the device latched.

4.1 Switched Mode Power Supply (SMPS)

The 'Switched Mode Power Supply' owes its name to the dc-to-dc switching converter which converts unregulated dc input voltage to regulated dc output voltage. The switch employed is turned 'ON' and 'OFF' (referred as switching) at a high frequency. During 'ON' mode the switch is in saturation mode with negligible voltage drop. During 'OFF' mode the switch is in cut-off mode with negligible current through the collector and emitter terminals. On the contrary the voltage regulating switch, in a linear regulator circuit, always remains in the active region.

As shown in Figure, the bridge is used to generate a high-frequency square wave that is fed to an isolation transformer. Operation at high frequency reduces the size of the transformer and of the filter components. Power densities in excess of 50W per in^3 are commonly available in some commercially available SMPS.

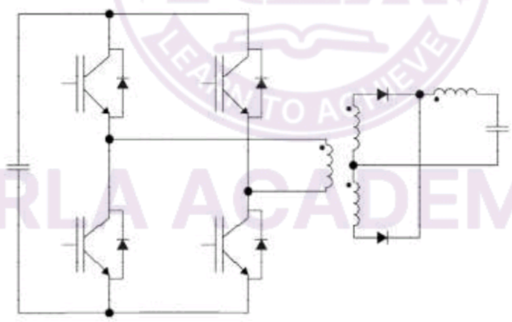

Figure 4.1: SMPS

4.2 Uninterruptible Power Supply Systems

There are two distinct types of uninterrupted power supplies, namely, (i) on-line UPS and (ii) off-line UPS. In the on-line UPS, whether the mains power is on or off, the battery operated inverter is ON all the time and supplies the ac output voltage. In off-line UPS, the inverter is off when the mains power is present. The inverter turns on only when the mains supply goes of[illegible] The block diagrams of on-line UPS, off-line UPS are given in fig.

A UPS generally consists of a rectifier, battery charger, a battery bank and in[illegible] circuit. First it converts the commercial ac input into dc suitable for input to the battery bank [illegible] the inverter. The rectifier should have its input protected and should be capable of supplying power to the inverter when the commercial supply is either slightly below the normal voltage or slightly above.

4.2.1 Online UPS

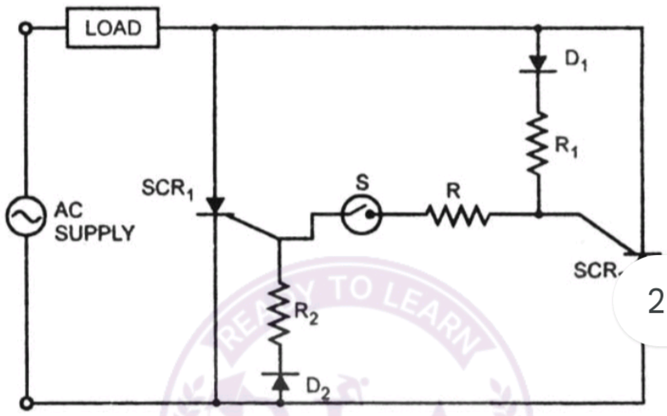

Figure 4.4: Static AC Circuit Breaker

Figure shows a circuit in which two SCRs are used for making and breaking an ac circuit. The input voltage is alternating and the trigger pulses are applied to the gates of SCRs through the control switch S. Resistance R is provided in the gate circuit to limit the gate current while resistors R1 and R2are to protect the diodes D1 and D2 respectively.

For starting the circuit, when switch S is closed, SCR1 will fire at the beginning of the positive half-cycle (the gate trigger current is assumed to be very small). It will turn-off when the current goes through the zero value. As soon as SCR1 is turned-off, SCR2 will be fire since the voltage polarity is already reversed and it gets the proper gate current. The circuit can be broken by opening the switch S. Opening of gate circuit poses no problem, as current through this switch is small. As no further gate signal will be applied to the SCRs, the SCRs will not be triggered and the load current will be zero. The maximum time delay for breaking the circuit is one half-cycle. Thus several hundred amperes of load current can be switched on/off simply by handling gate current of few mA by an ordinary switch. The above circuit is also called the static contactor breaker because it does not have any moving part.

4.3 AC Solid State Relay

The AC type Solid State Relay turns "ON" at the zero crossing point of the AC sinusoidal waveform, prevents high inrush currents when switching inductive or capacitive loads while the inherent turn "OFF" feature of Thyristors and Triacs provides an improvement over the arcing contacts of the electromechanical relays.

Resistor-Capacitor (RC) snubber network is generally required across the output terminals of the SSR to protect the semiconductor output switching device from noise and voltage transient spikes when used to switch highly inductive or capacitive loads. In most modern SSR's this RC snubber network is built as standard into the relay itself reducing the need for additional external components.

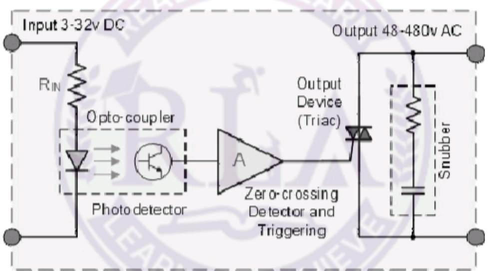

Figure 4.5: High frequency fluorescent lighting

4G+ 2:45 Vo) 1 LTE2 3.80 KB/s 54

UNIT - 09B Electrical...

Name

01. Indian Electricity Rules and...
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02. Wiring systems.pdf
Modified Sep 28, 2024

03. Earthing.pdf
Modified Sep 28, 2024

04. Domestic, commercial and...
Modified Sep 28, 2024

05. Energy auditing.pdf
Modified Sep 28, 2024

06. Lighting systems.pdf
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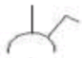
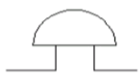
Need of electrical symbols

In case of electrical installations and circuits, may be very difficult to draw the drawing and write the electrical components and instruments. The graphical symbols are used to ir the electrical equipment and components.

Electrical Symbols

Socket outlet 5 Ampere	
Socket outlet 5 Ampere with switch	
Socket outlet 15 Ampere	
Socket outlet 15 Ampere with switch	
Rewirable fuse	
Catridge fuse	
Neutral link	
Earth point	
Bulk head fitting	
Water tight light fitting	 WT
Incandescent lamp	
Fluorescent lamp	
Signal lamp	

Push button	
Bell	
Siren	
Heater	
Ceiling fan	
Exhaust fan	

LIGHTING SYSTEM

Introduction

Lighting is an essential service in all the industries. The power consumption by the industrial lighting varies between 2 to 10% of the total power depending on the type of industry. Innovation and continuous improvement in the field of lighting, has given rise to tremendous energy saving opportunities in this area.

Lighting is an area, which provides a major scope to achieve energy efficiency at the design stage, by incorporation of modern energy efficient lamps, luminaires and gears, apart from good operational practices.

4.9 Basic Terms in Lighting System and Features

Light Source -Lamps

Lamp is equipment, which produces light. The most commonly used lamps are described briefly as follows:

Incandescent lamps:

Incandescent lamps produce light by means of a filament heated to incandescence by the flow of electric current through it. The principal parts of an incandescent lamp, also known as GLS (General Lighting Service) lamp include the filament, the bulb, the fill gas and the cap.

Reflector lamps:

Reflector lamps are basically incandescent, provided with a high quality internal mirror, which follows exactly the parabolic shape of the lamp. The reflector is resistant to corrosion, thus making the lamp maintenance free and output efficient.

Gas discharge lamps:

The light from a gas discharge lamp is produced by the excitation of gas contained in either a tubular or elliptical outer bulb.

The most commonly used discharge lamps are as follows:

- Fluorescent tube lamps (FTL)
- Compact Fluorescent Lamps (CFL)
- Mercury Vapour Lamps
- Sodium Vapour Lamps
- Metal Halide Lamps

Luminaire

Luminaire is a device that distributes filters or transforms the light emitted from one or more lamps. The luminaire includes all the parts necessary for fixing and protecting the lamps, except the lamps themselves. In some cases, luminaires also include the necessary circuit auxiliaries, together with the means for connecting them to the electric supply. The basic physical principles used in optical luminaire are reflection, absorption, transmission and refraction.

Control Gear

The gears used in the lighting equipment are as follows:

Ballast:

A current limiting device, to counter negative resistance characteristics of any discharge lamps. In case of fluorescent lamps, it aids the initial voltage build-up, required for starting.

Igniters:

These are used for starting high intensity Metal Halide and Sodium vapour lamps.

Illuminance

This is the quotient of the luminous flux incident on an element of the surface at a point of surface containing the point, by the area of that element.

The lighting level produced by a lighting installation is usually qualified by the illuminance produced on a specified plane. In most cases, this plane is the major plane of the tasks in the interior and is commonly called the working plane. The illuminance provided by an installation affects both the performance of the tasks and the appearance of the space.

Lux (lx)

This is the illuminance produced by a luminous flux of one lumen, uniformly distributed over a surface area of one square metre. One lux is equal to one lumen per square meter.

Luminous Efficacy (lm/W)

This is the ratio of luminous flux emitted by a lamp to the power consumed by the lamp. It is a reflection of efficiency of energy conversion from electricity to light form.

UNIT - 10 Control of el...

Name

01. Control circuit component...
Modified Sep 28, 2024

02. AC motor control circuits....
Modified Sep 28, 2024

03. Industrial control circuits....
Modified Sep 28, 2024

04. Programmable logic contr...
Modified Sep 28, 2024

OBJECTIVES:

After studying this chapter, the student will be able to:

- State the purpose and general principles of control circuit of motor control.
- Discuss the symbol, construction and operation of selector switch, drum switch, limit switch, pressure switch, temperature switch (Thermostat), float switch, zero speed switch and proximity switches.
- Discuss the construction and operation ofVoltage relay, DC series current relay, frequency response relay, latching relay, phase failure relay and over current relays.
- Explain the operation of the pneumatic and electronic timers.
- Describe the purpose and operation of solenoid valve and solenoid type contactors.
- Describe the operation of a simple ON-OFF motor control circuit, Remote control operation and interlocking of drives.

1.0 Introduction:

Control devices are components that govern the power delivered to an electrical load. Motor control systems make use of a wide variety of control devices. The motor control devices introduced in this chapter range from simple pushbutton switches to more complex solid-state sensors. All components used in motor control circuits may be classified as either primary control devices or pilot control devices. A primary control device, such as a motor contactor, starter, or controller, connects the load to the line. A pilot control device, such as a relay or switch contact, is used to activate the primary control device. Pilot-duty devices should not be used to switch horsepower loads unless they are specifically rated to do so. Contacts selected for both primary and pilot control devices must be capable of handling the voltage and current to be switched.

1.1 Push button:

Pushbutton switches are commonly used in motor control circuits to start and stop motors, as well as to control and override process functions. A push button operates by pressing a button that opens or closes contacts.

Figure 1.1 Symbol of Pushbutton

Construction:

Push button switch can be divided into two parts. One part is the mechanical actuator or operator and the second part is the contact block. The operator is the part of the pushbutton assembly that is pressed, pulled, or rotated to activate the push button's contacts. Operators come in many different colors, shapes, and sizes designed for specific control applications.

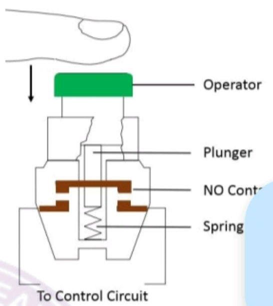


Figure 1.2 Construction of Pushbutton

The contact block is the part of the pushbutton assembly that is activated when the button is pressed as shown in figure 1.2. The contact block contains sets of contacts that open and close when push button is operated. The normal contact configuration allows for one normally open (N.O) and one normally closed (N.C) set of contacts within a contact block. Abbreviations N.O. (normally open) and N.C. (normally closed) represent the state of the switch contacts when the switch is not activated.

Working:

OBJECTIVES:

After studying this chapter, the student will be able to:

- Explain the types of automation.
- Explain the different parts and modes of operation of PLC
- Explain the different types of PLC programming device.
- Compare the hard wired logic and PLC system.
- Explain the criterial for selection of PLC.

4.0 Introduction:

The word "Automation" was first used at the Ford motor company in the late 1940. One definition of automation was proposed in 1947 as "the automatic handling of work pieces into, between, and out of machines.

The word 'Automation' is derived fromgreek words "Auto"(self) and "Matos" (moving). Automation therefore is the mechanism for systems that "move by itself".

Automation means automatic manufacturing without human control. Automation is a technology concerned with the application of mechanical, electronics and computer based systems to operate and control production.

The objective of automation is to cause the work system to be automatic that is self-acting, self-regulating and self-reliant.

4.1 Automation:

Automation is a set oftechnologies that results in operation ofmachinesand systems without significant human intervention and achieves performance superior to manual operation.

4.2 Types of automation:

1. Manufacturing automation:
   a. Fixed Automation
   b. Programmable Automation
   c. Flexible Automation
2. Non-Manufacturing automation:
   a. Office Automation
   b. Home Automation
   c. Building Automation

4.2.1 Manufacturing Automation:

This include fixed automation, programmable automation and flexible automation.

11.2.1.1 Fixed Automation:

Fixed automation refers to the use of special purpose equipment to automate a fixed sequence of processing or assembly operations. This system involves automation and integration of various fixed sequences of operation. It is also known as hard automation. It is used to produce product such as gears, nuts and bolts etc., High specialized equipment, called sp purpose machine tools are utilized to produce a product very efficiently and at high prod rates.

Advantages:

i) Maximum efficiency
ii) Low unit cost
iii) High production rate

Disadvantages:

i) Large initial investment
ii) Inflexible in accommodating product variety.

Applications:

i) Bottling plants
ii) Packaging plants

4.2.1.2 Programmable Automation: