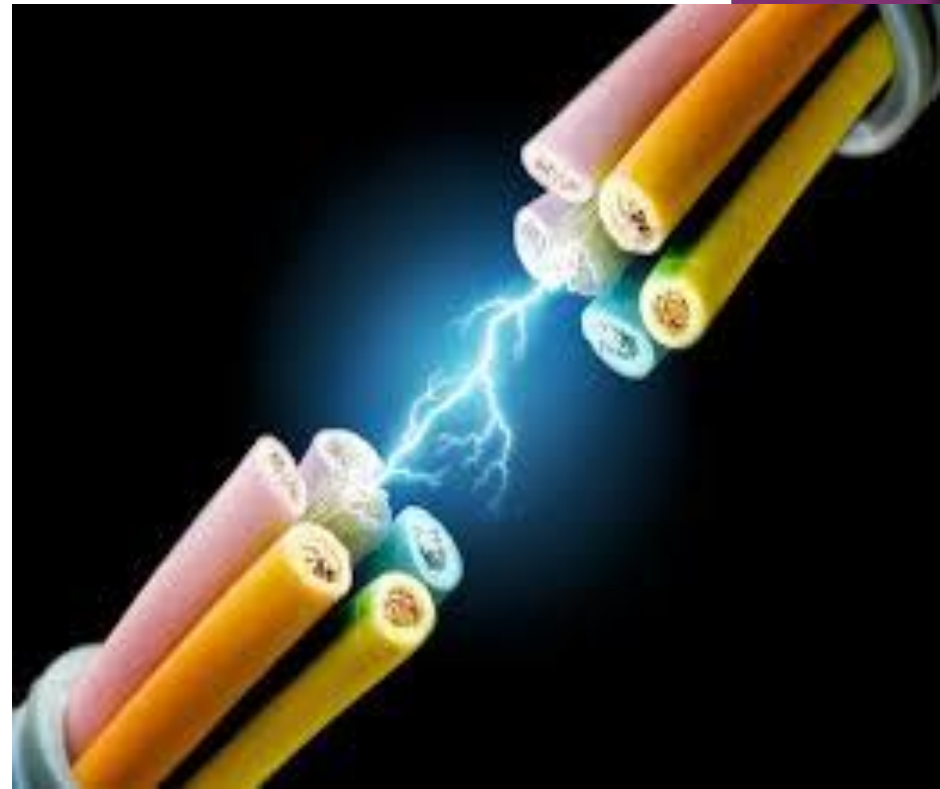


ELECTRIC SHOCK

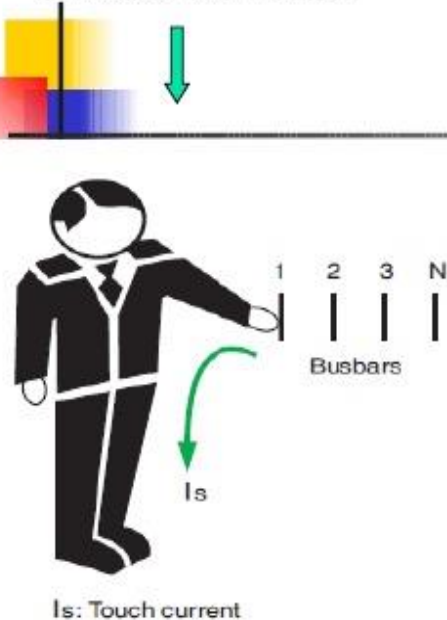


- ◉ **DEFINITION**-An electric shock is a painful stimulation of sensory and motor nerves caused by a sudden flow, cessation of flow or variation of the intensity of the current passing through the body resulting in mild discomfort and fear for loss of consciousness and *death in a few cases.*
- ◉ THE FUNDAMENTALS OF PROTECTION AGAINST ELECTRIC SHOCK IS DTAILED IN THE DOCUMENT IEC 61140.
- ◉ STANDARD DISTINGUISH 2 KINDS OF DANGEROUS CONTACT-**DIRECT AND INDIRECT CONTACT.**

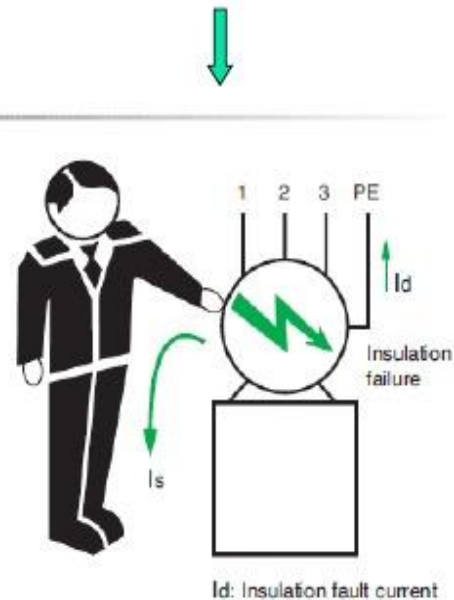
- **DIRECT CONTACT-** Refers to a person coming into contact with a conductor which is live in normal circumstances.
- **INDIRECT CONTACT-** Refers to a person coming into contact with any part of electric circuit which is not normally live, but has become live due to an accidental insulation failure or some other fault.
- **LIVE-**Electrically connected to a source of potential difference ,or electrically charged so it has a potential significantly different from that of the earth in vicinity.

1.2 - Direct and indirect contact

Direct contact



Indirect contact



A direct contact refers to a person coming into contact with a conductor which is live in normal circumstances

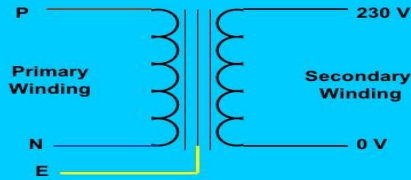
Contact with an exposed conductive-part which is not normally alive, but has become alive accidentally (due to insulation failure or some other cause).

PROTECTION AGAINST DIRECT AND INDIRECT CONTACT

- A measure that combines protection against direct and indirect contact (for example-safety class III appliances that operates on a safety extra low voltage of 50V AC or 120V DC-because of their low power such appliances are not widespread in use).
- The combination of a measures of protection against direct and indirect contact-:
- **THE MEASURE AGAINST DIRECT CONTACT ARE:**
- Insulation of live parts
- Barriers or Enclosures
- Obstacles
- Placing out of reach
- **THE MEASURES AGAINST INDIRECT CONTACT ARE:**
- Automatic disconnection of supply
- Non-conducting location
- Electrical separation
- Earth free location equipotential bonding

Section 413

Protective Measure: Electrical Separation



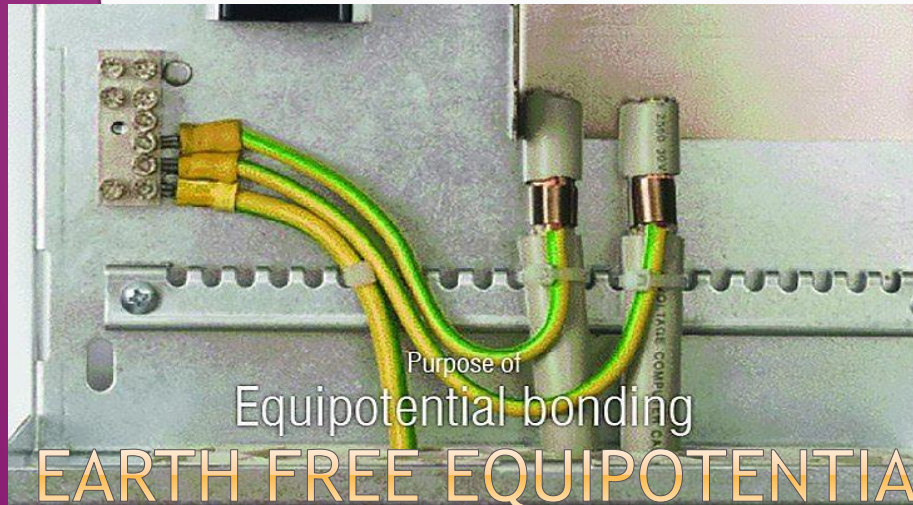
No physical or electrical contact between Primary Winding and Secondary Winding.

The two sides are deemed to be Electrically Separate BS EN61558 (705.512.3, 414.3(i)) 14



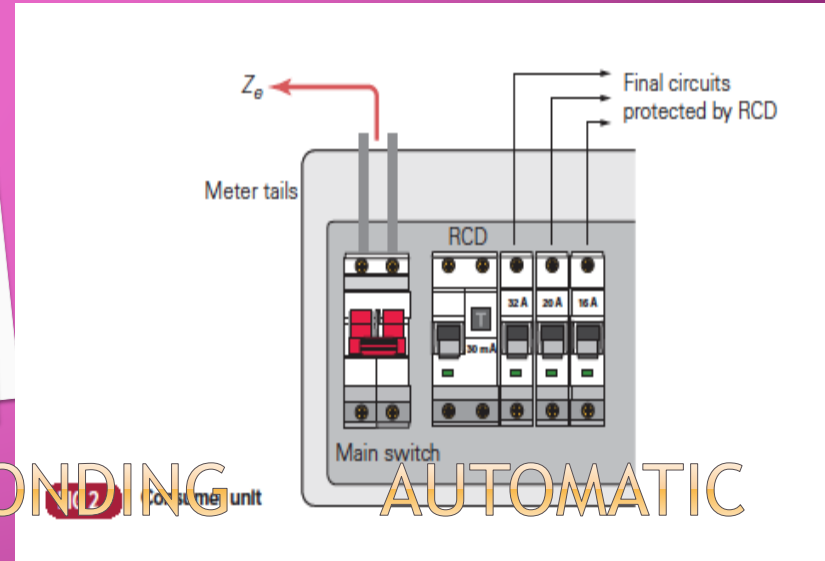
ELECTRICAL SEPERATION

BARRIERS OR ENCLOSURES



EARTH FREE EQUIPOTENTIAL BONDING

DISCONNECTION OF SUPPLY



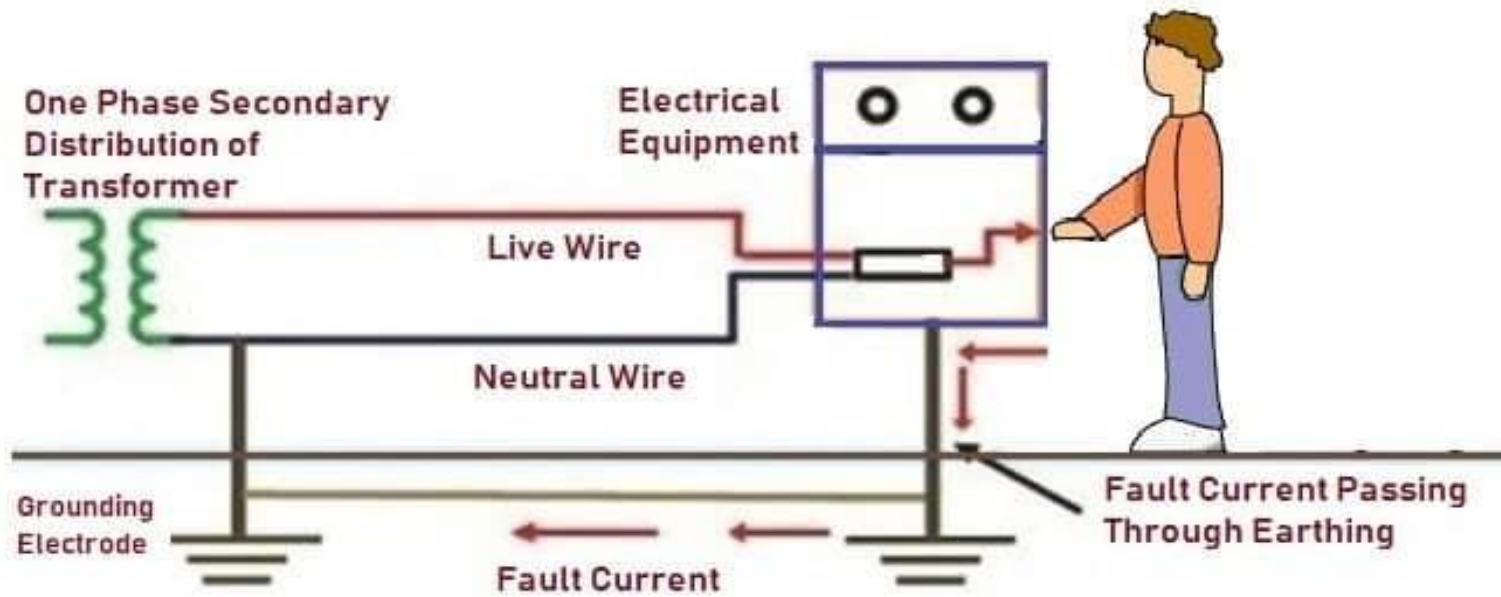
AUTOMATIC

PROTECTIVE EARTHING

- It requires all exposed and conductive part to be connected to a protective conductor which in turn is connected to the main earthing terminal.
- By doing so the body of the electrical equipment is brought to the same potential as earth , and this prevents flow of leakage of current(if any) through body of an operator in case he/she touched the equipment accidentally.

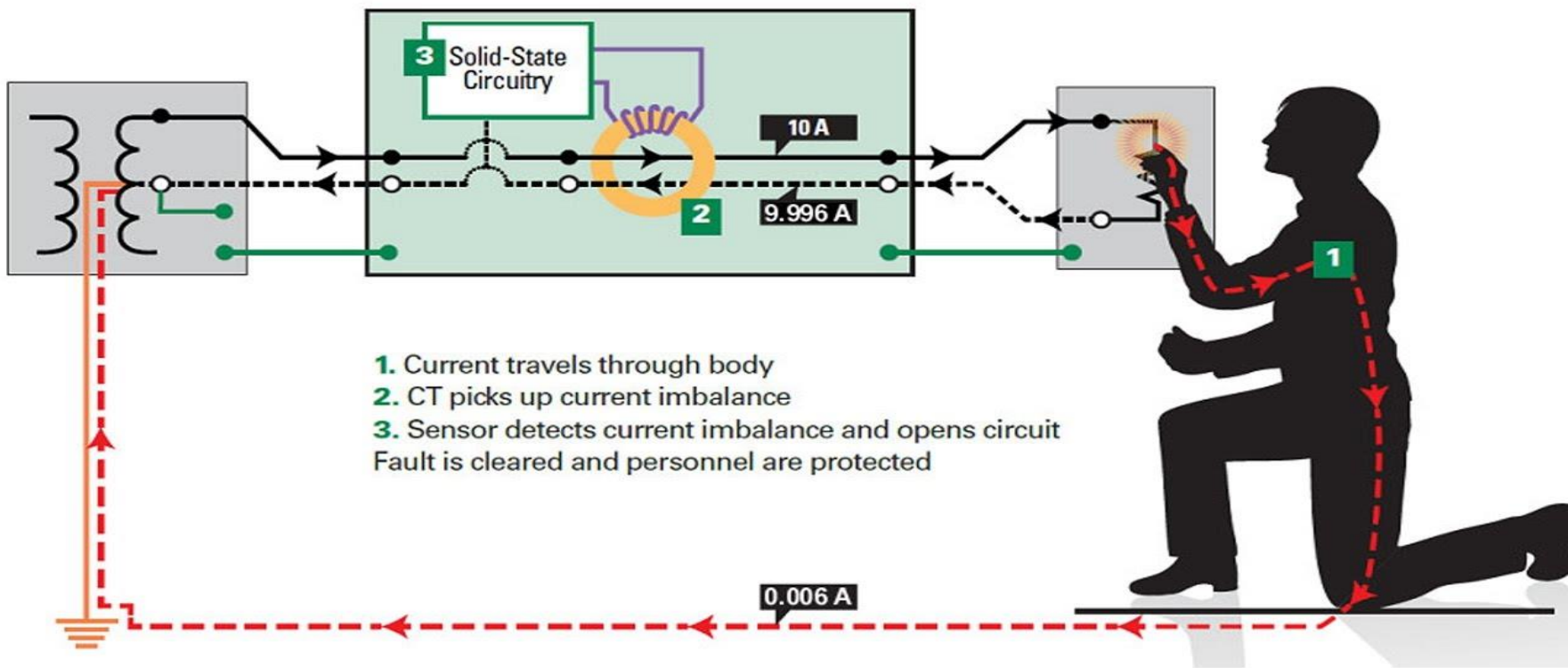
○ **ADDITIONALLY PROTECTION-:RCD**

- In certain circumstances all of the preceding protective measures are not sufficiently effective due to , for example:
- Lack of proper maintenance
- Carelessness normal wear and tear of insulation
- Immersion in water
- Accidental contact



PROTECTIVE EARTHING

Residual Current Device (RCD)



IMPORANT INFLUENTIAL FACTORS

○ THE HARMFUL EFFECT ON THE INTERNAL ORGANS AND THEIR PROPER FUNCTION MAINLY DEPENDS ON THE FOLLOWING FACTORS:

- Amount of current (voltage, ampere, low frequency, high frequency)
- Duration of contact time
- Path of current
- Type of current(AC or DC)

Electrical Shock Effects on Human Body	
Current Levels (Milliamps)	Probable Effect on Human Body
1mA	Slight tingling sensation. (Still dangerous under some conditions.)
5mA	Slight shock felt. Disturbing but not painful. Average person can let go.
6mA – 16mA	Painful shock causing some loss of muscle control. Commonly termed “let go” range or freezing current.
17mA- 99mA	Extreme pain, respiratory arrest, severe muscle contractions, individual cannot let go. Death is possible.
100mA – 2000mA	Ventricular fibrillation, muscular contraction and nerve damage. Death is likely.
Over 2000mA	Cardiac arrest. Internal organ damage and severe burns. Death is probable.

SHOCK RESCUE PROCEDURE

- ◉ The right help in first few minutes, until the arrival of the emergency services, can be crucial for the severity of injuries or even for survival.
- ◉ First responders in an electrical accident must first ensure for their own safety, It is essential that all power sources are isolated before first aid is provided to injured persons.
- ◉ If anyone grabs the victim or pulls the person off the current with their hands , they might become the part of the circuit and become injured as well.
- ◉ It is necessary to turn the power off at the mains ,if possible or remove any live part , that is still in contact with the casualty and also to isolate yourself from the ground.
- ◉ It is also possible to use an object of low conductivity to push away the power source . Overhead power cables are an example of high voltage power source.
- ◉ High voltage has the ability to jump or arc distances of up to a few metres and step voltage can also be dangerous.
- ◉ It is necessary to remain at a safe distance until the power has been switched off by an official company.
- ◉ Once safety is ensured, it is necessary to continue with the normal procedures applicable to first aid.
- ◉ Only suitably trained persons may perform effective first aid.

SUBTOPICS-TYPES OF ELECTRIC SHOCK AND ELECTRICAL HAZARD

- Electric Shock can be of two types depending upon

1.Amount of current flow/According to point of entry

A)Macro shock.

B)Micro shock.

2. Severity of shock

A)Mild shock.

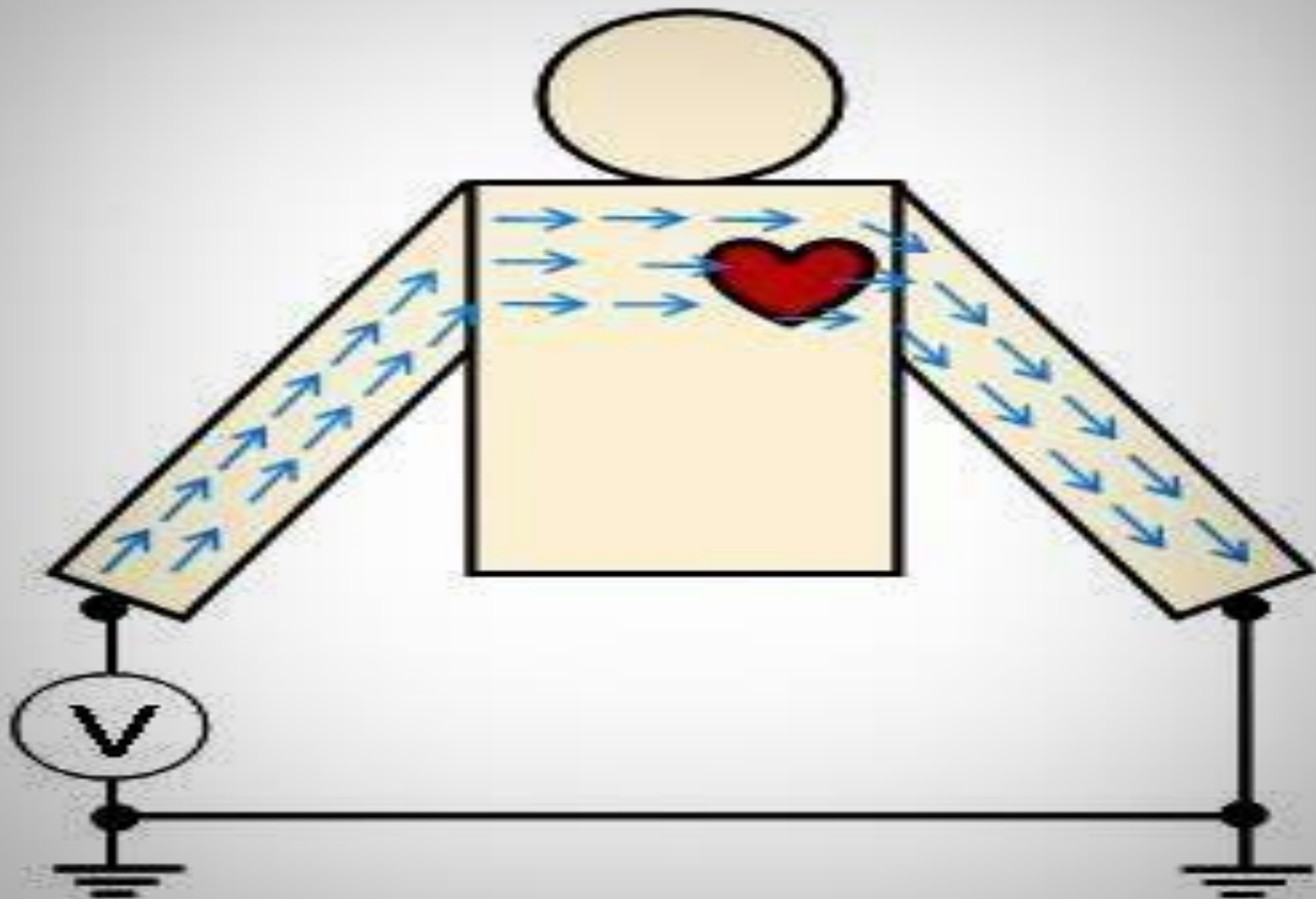
B)Severe shock.

MACROSHOCK



- If the current flow is from the body surface through the skin into the body a relatively large amount of current is needed to produce a harmful shock.
- Macro shock is a harmful shock.
- Example:-Main current (AC).
- Macro shock occurs when current passes between two contact point on the skin.

MACROSHOCK

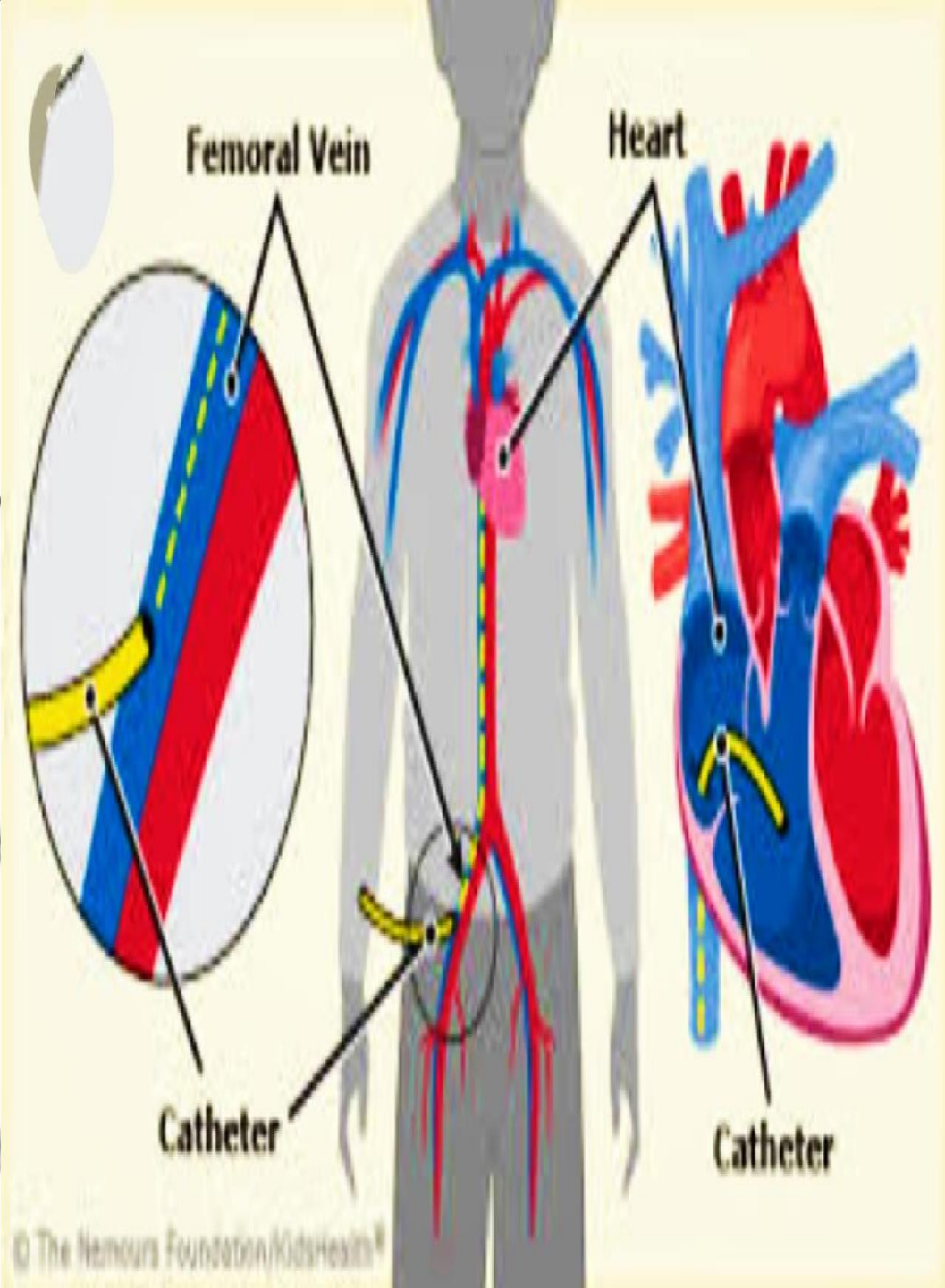
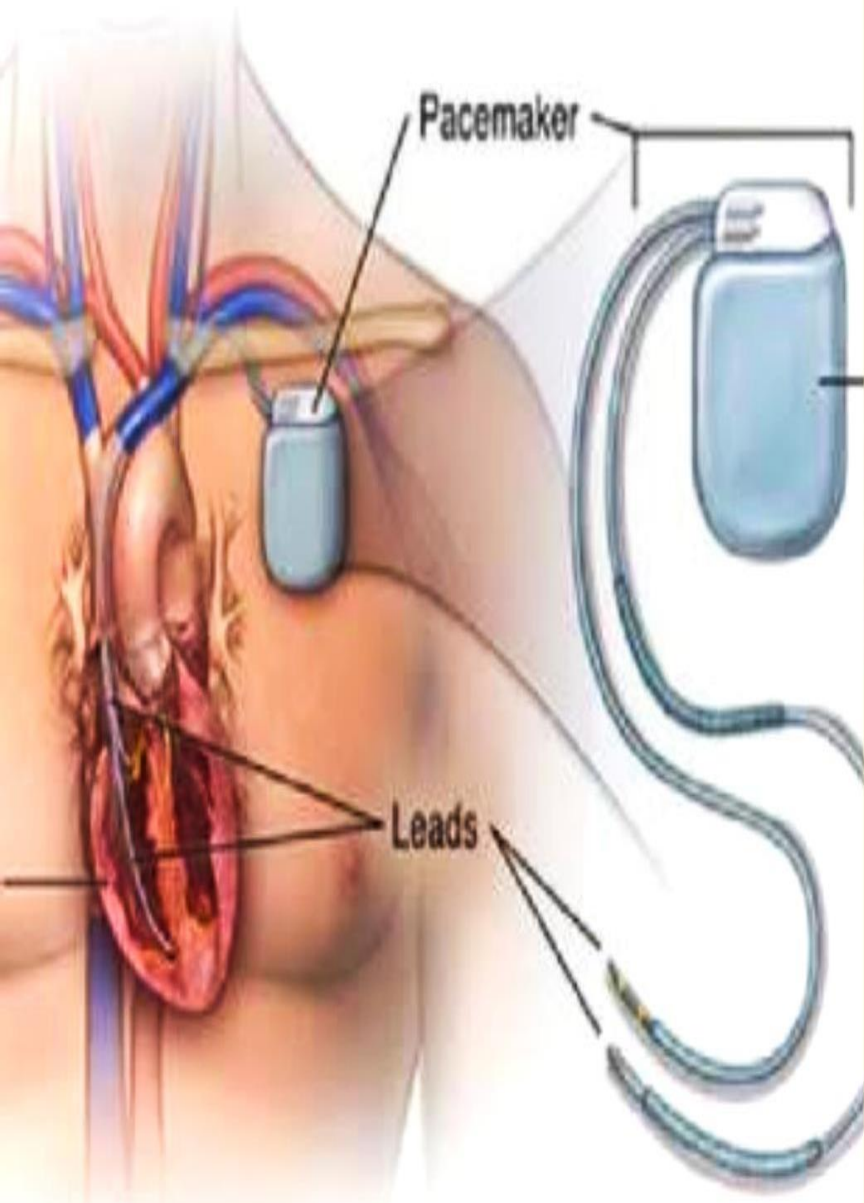


MICROSHOCK



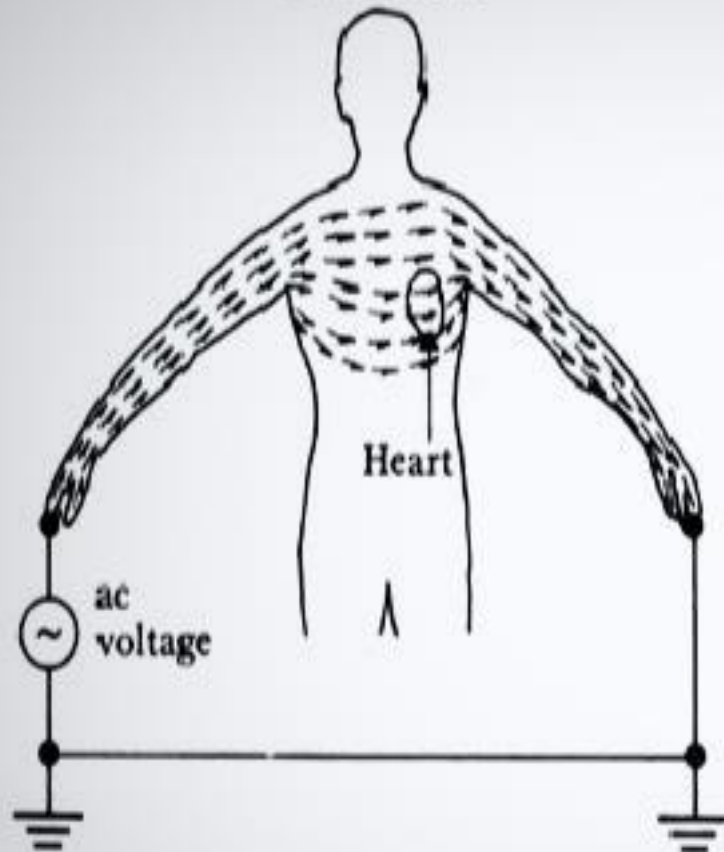
- If the current by passes through body and enters the heart by way of the myocardial electrodes (Pace maker), and a transvenous catheter a minute current can produce a fatal shock without the patient experiencing any thing.
- For e.g if the therapist may be handling a patient with a electrical electrodes (pace maker) on the heart.
- Then the patient feel Micro shock or ventricular fibrillation.

Pacemaker



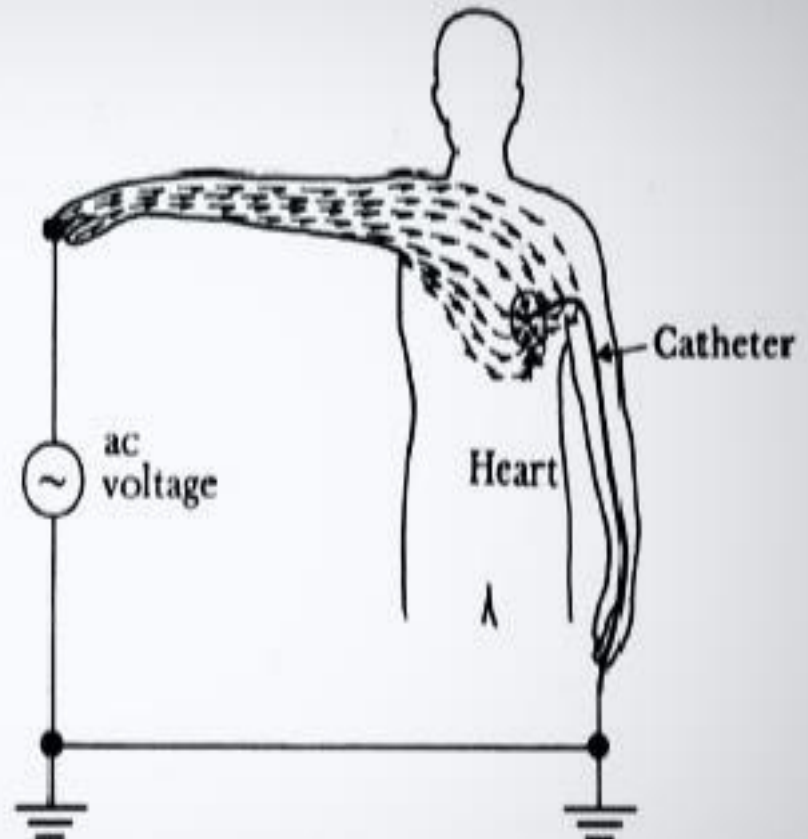
➤ Points of entry

Macroshock



(a)

Microshock



(b)

Effect of entry points on current distribution (a) *Macroshock*, externally applied current spreads throughout the body. (b) *Microshock*, all the current applied through an intracardiac catheter flows through the heart.

MILD SHOCK

- **When the intensity of current gives rise to shock is upto 20mA.**
- **The patient may only gets a painful sensory stimulation and upset breathing with lots pf fear and distress.**
- **And there is no loss of consciousness.**
- **In this case the victim May become frightened and possibly historical.**

SEVERE SHOCK

- * If the current flow more than 20mA.
- It results in difficulty to the person can not move from the conductor away.
- So which lead to muscular paralysis, falls in blood pressure and cause loss of consciousness so if we can see the person who falling on the ground he is affecting with severe shock.
- And also severe shock causes the cessation of respiration, ventricular fibrillation irregular heartbeat.
-

- ⦿ And cardiac arrest may be caused in few cases result in death.
- ⦿ Normally death usually occurs i.e above 100A.

500 mA



Immediate cardiac arrest resulting in death

70-100 mA



Cardiac fibrillation; the heart begins to vibrate no longer beats at a steady rate

This contraction can cause respiratory paralysis

20-30 mA



Muscle contraction can cause respiratory paralysis

10 mA



Muscle contraction: the person remains "stuck" to the conductor

1-10 mA



Prickling sensations



ELECTRICAL HAZARD

- **An electrical hazard can be defined as a serious workplace hazard that exposes workers to electrical injury.**

A blue triangular warning sign with a white lightning bolt symbol inside, indicating an electrical hazard.

**ELECTRICAL
HAZARD**

ELECTRICAL INJURY

- **Direct/Primary Hazards:**

- a) **Electrocution or death to the electrical shock.**

- b) **Electric shock.**

- c) **burns.**

Indirect/Secondary hazards:

- 1) **falls**

- 2) **fire**

ELECTROCUTION

- **Electrocution results when a human is exposed to a lethal amount of electrical energy.**



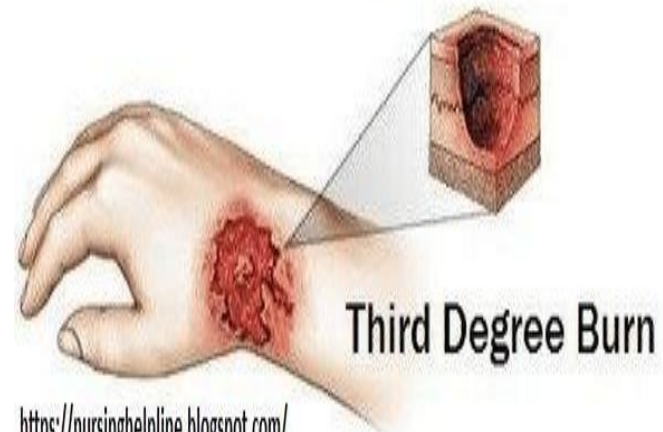
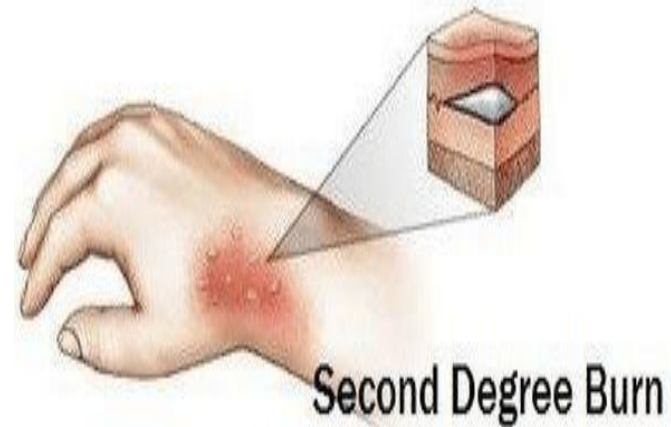
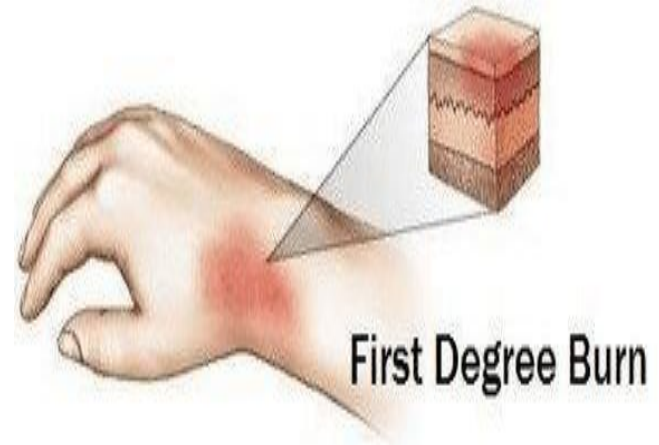
ELECTRIC SHOCK

- Shock results when the body becomes part of the electrical circuit.
- It is also defined as reflex response to the passage of electric current through the body.



BURNS

- A burn is the most common electrical related injury.
- Typically occurs on hands.
- Very serious injury that needs immediate attention.



FIRE AND EXPLOSION

- **Most electrical fires results from problems with faulty electrical outlets,old wiring, problem with cords, plugs and switches.**
- **Explosion happens when electrical faults develop into fires when combustible materials are present.**



IMPROPER GROUNDING

- Unwanted voltage will not be safely eliminated.
- Leakage of current to the ground.
- Removal of the ground pin.



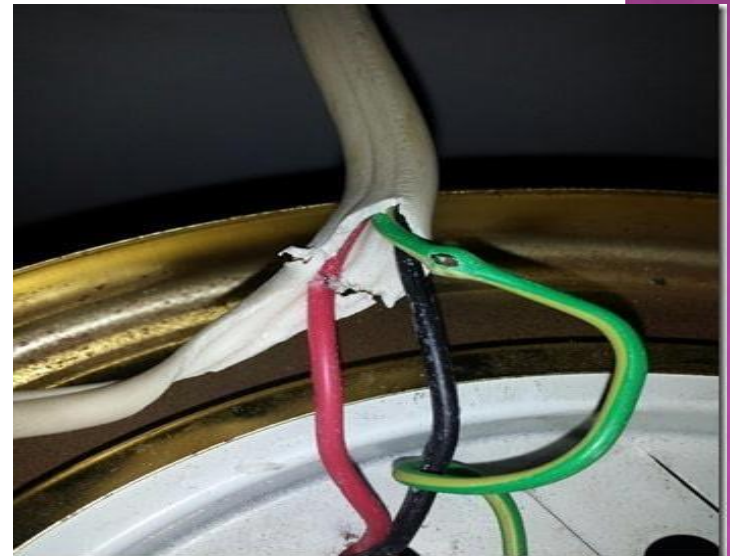
EXPOSED ELECTRICAL TOOLS

- **Exposed electrical tools can include:**
 - ***Breakers Boxes without a cover,electrocal terminals in motors,**
 - applicances and electronic equipment,**
 - exposed electrical parts.**



DAMAGED INSULATION

- Defective insulation to protect you, electrical wires are insulated by a plastic or rubber covering.
- Insulation prevents conductors from coming in contact with each other and with people.
- Make sure the insulation of tools and cords you are using



OVERLOADED CIRCUITS

- **Overloading a circuit increases the potential for fires to occur.**
- **Overload hazards exist if:**
 - ***Too many devices are plugged into a circuit.**
 - ***No overcurrent protection device is used overloaded circuits.**



WET CONDITIONS

- **Wet Conditions are hazardous because you can become an easy path for electrical current.**
- **There are many circumstances that create wet conditions:**
 - ***Standing in water.**
 - ***Wet clothing.**
 - ***High humidity etc.**



EFFECTS OF ELECTRIC SHOCKS :

THE EFFECTS OF ELECTRIC SHOCK CAN DEPENDS ON THREE MAIN FACTORS :

- 1.HOW MUCH CURRENT IS FLOWING THROUGH THE BODY
2. THE PATH OF CURRENT THROUGH THE BODY
3. HOW LONG THE BODY IS IN THE CIRCUIT



Health Effects :

A shock can cause cardiac arrest :

If a current of 50 mA passes through the heart, it can cause cardiac arrest.

The heart is also a muscle, which beats to pump blood through the body. The rhythm of our heartbeat is controlled by electric impulses—it is these impulses that are monitored by an electrocardiogram. If a current from outside the body passes through the heart, it can mask these impulses and disturb the heart's rhythm. This irregular heartbeat is called arrhythmia and can even manifest as a total disorganization of the rhythm, known as ventricular fibrillation.

When ventricular fibrillation occurs, the heart stops pumping and the blood stops circulating. The victim rapidly loses consciousness and dies

A shock can cause burns to tissues and organs :

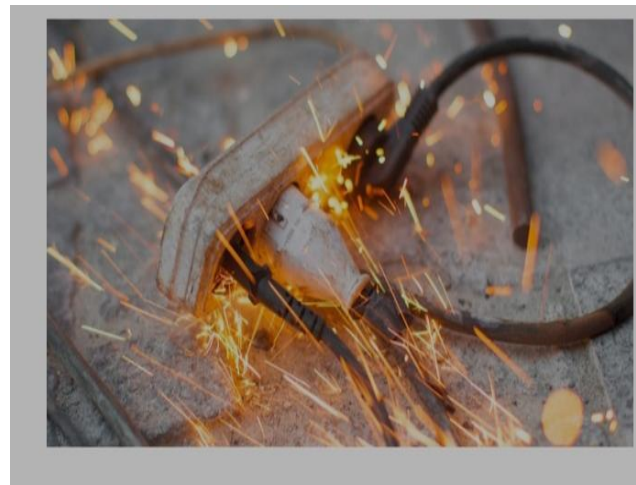
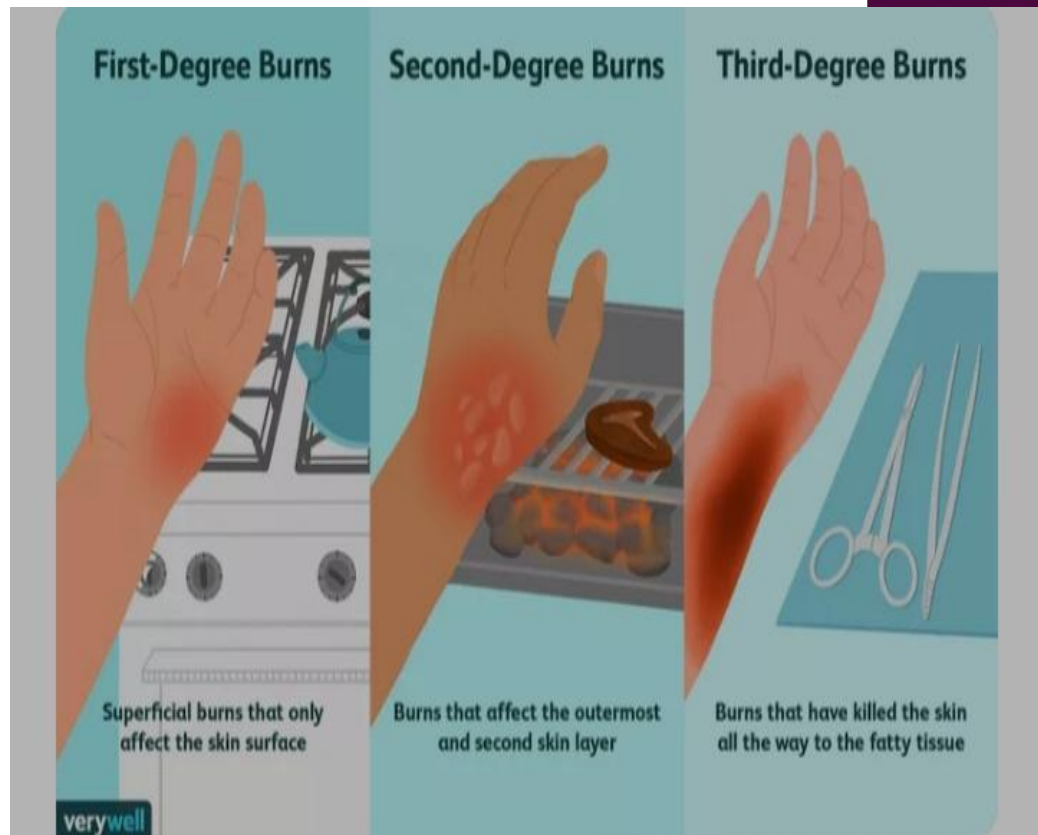
When a current above 100 mA passes through the body, it leaves marks at the points of contact with the skin. Currents above 10,000 mA (10 A) cause serious burns that may require amputation of the affected limb.

Some burns are easy to recognize because they look like the burns you can get from contact with heat. Others may seem harmless but aren't: tiny charred craters indicate the presence of much more serious internal burns.

Electrical burns often affect internal organs.

A shock can effect the nervous system :

When nerves are effected by an electric shock , the consequences includes pain, tingling, numbness ,weekness, difficulty moving a limbs these effects may clear up with time or be permanent . Electric injury can also effects the central nervous system



Effects of electric current passing through the human body :

Currents in milliamperes :

1. 1 ma
2. 5 ma
3. 10 to 30 ma
muscular control)
4. 50 to 150 ma
damage or
to death)

Effects :

- only a faint tingle
- slightly shocks(not painful)
- painful shock (loss of
- streamly painful job(tissue
heart fibrillation, leading

CAUSES OF ELECTRIC SHOCK

- ◉ Poorly designed or badly serviced electro-medical apparatus.
- ◉ Mishandling of equipments.
- ◉ Poor insulation of equipment and connecting leads/wires.
- ◉ Poor communication between physiotherapist and patient, for example-no prior instructions or improper instructions to the patient regarding treatment modalities and its effects.
- ◉ Poor safety measures related to the equipment selection , inspection and maintenance, clinical use of modality, environmental safety of Electrotherapy department.

A Person may obtain a shock without touching the active wire of the power supply by the following ways

- 1. Sudden alteration of the current flow-** If, while on the start of treatment the low or medium frequency current is switched on with control turns up or if insufficient time is allow for apparatus to warm up. So that the current come on suddenly after the controls have been turned up ,it results in sudden flow of current giving shock.
- 2. Faulty Electrical Components-** The presence of faulty components such as a faulty transformer or leaky capacitor may be dangerous giving electric shock.
- 3. Non-insulated Flooring-** It is mandatory to have the floor of Electrotherapy unit to be insulated throug “**VINYL**” or some other ininsulate floorings, it enhances the occurrence of the earth shock.

4. Leakage Currents- With high quality insulation material and good circuit designs there will be no problem with leakage currents but with poor designs the leakage current from the wires carrying the current will be dangerous.



SYMPTOMS OF ELECTRIC SHOCK

The symptoms of Electric Shock depend on how severe it is.

- ⦿ Potential symptoms of an electric shock include:-
 1. Loss of consciousness
 2. Muscle spasms
 3. Numbness or tingling
 4. Breathing problems
 5. Headache
 6. Problems with vision



7. Burns

8. Seizures

9. Irregular heartbeat

10. Pain in hand or foot or a deformity of a part of the body may indicate a possible broken bone resulting from the Electric Shock

11. In Children, the typical electrical mouth burn from biting an electric cord appears as a burn on the lip. The area has a red or dark, charred appearance

-Electric shocks can also cause **“COMPARTMENT SYNDROME”**. This happens when muscle damage causes your limb to swell. In turn this can compress arteries, leading to serious health problems. Compartment Syndrome might not be noticeable immediately after the shocks, so keep an eye on your arms and legs following a shock.

TREATMENT:-

- Current should be switched off immediately patient has not to be disconnected from the source of supply if there is no switch in the circuit, the victim must be removed from the contact with the conductor but the rescuer must take care not to get a shock by touching the affected person.
- The contact with the affected person should only be made by a thick layer of insulated material.
- Following a minor shock, the patient is reassured and given rest.

- ◉ Water may be given to drink but not drinks should be avoided as they cause vasodilation and sweating leading to further fall in blood pressure.
- ◉ Tight clothing should be removed and plenty of air should be given.
- ◉ If the shock is more given and response of the person has stopped than the airways are immediately cleared and artificial respiration must be given.

- If the patient is unconscious, than no water or anything else should be given through the mouth as it may lead to aspiration and medical officers should be called.
- If the respiration has ceased, clear the airways and start artificial respiration by mouth to nose method and proceed for oxygen administration by a bag and mask
- In the event of cardiac arrest start external cardiac arrest start external cardiac massage. It is essential to call for medical health immediately but no delay should be made in starting the CARDIOPULMONARY RESUSCITATION [CPR] must be given and patient should be shifted to the hospital as early as possible.



DO CPR, IF NECESSARY :-

When you can safely touch the person, do CPR if the person is not breathing or does not have a pulse.

- For a child, start CPR for children.
- For an adult, start adult CPR.

CHECK FOR INJURY:-

- If the person is bleeding, apply pressure and elevate the wound if its an arm or leg.
- They may be a fracture if the shock caused the person to fall.
- For burn, see BURN TREATMENT.

HOW ARE ELECTRIC SHOCK TREATED?

- ◉ Even if the injuries seems minor, its crucial to see a doctor after an electric shock to check for internal injury.
- ◉ Depending upon the injury, potential electric shock treatment include:-
- ◉ Burn treatment, including the application of antibiotic ointment and sterile dressings.
- ◉ Pain medication.
- ◉ Intravenous fluid.
- ◉ A tetanus shot, depending on the source of the shock and how it occurred.

- For severe shocks, a doctor may recommend staying in the hospital for a day or two so they can monitor you for any heart issues or severe injuries.

WHAT ARE THE INDICATORS THAT A PERSON MAY BECOME UNCONCIOUS?

- ◉ Symptoms that may indicate that unconsciousness is about to occur include:-
- ◉ Sudden inability to respond.
- ◉ Slurred speech.
- ◉ A rapid heart rate.
- ◉ Confusion.
- ◉ Dizziness or lightheadedness.

PRECAUTION TO AVOID ELECTRIC SHOCK

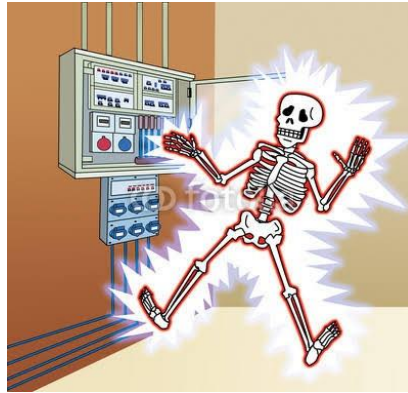
- All the apparatus should be checked before use.
- All the wire connection should be checked before application.



- Control should be checked to ensure that they are at zero before switching on the apparatus.
- All the connecting wires should be inspected carefully for any cuts or cracks.



- The current intensity should be increase gradually .
- Patient should never be allowed to touch the electrical equipment.



- All the apparatus should be properly serviced regularly by the technicians.
- Avoid water at all times when working with electricity.



- ⦿ Never use equipment with frayed cords, damaged insulation or broken plugs.
- ⦿ Do not turn electrical switches on or off or touch an electric appliance while your hands are wet, while standing in water , or when sitting in a bathtub.



- ⦿ Cover all electric sockets with plastic safety caps..
- ⦿ Covering of apparatus should be of insulating material.

PREVENTION OF ELECTRIC SHOCK

- The following should be absorbed for the prevention of an electric shock particularly while treating patient.
- Arrange the department in such a way that there is less possibility of anyone making an earth connection while is contact with the apparatus.
- Water & gas pipes should be out of reason of the apparatus and of patient receiving treatment.
- The floor should be insulated and kept dry.
- Ensure that the patient does not touch the apparatus which on treatment.

- Switches must break the live wire of fuse must be on the live wires , will so that if an earth circuit is made and a large current passes , the fuse glow and stop the current flow.



