**BIOMEDICAL INSTRUMENTATION**

**NOTES**

**STRUCTURE OF HUMAN HEART-**

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**The human heart consist of four chambers-**

* **The upper chambers are called Auricles and the lower chambers are called ventricles.**
* **The ventricals are divided into right and left ventricals by a septum.**
* **The upper chambers auricles are also divided into right and left auricles by a septum.**
* **In the wall of right auricle two nodes are present called SA-node (sino auricular node) and AV-node (auriculo ventricular node).**
* **The SA node is also called pacemaker, because it generates the electrical signals for the contraction of the heart wall.**
* **Between right auricle and right ventricle, a valve is present called Tricuspid valve**
* **Between left auricle and left ventricle another valve is present called bicuspid valve or mitral valve.**
* **From the AV node a fibre arises called Bundle of His, which travel down the ventricle and become branched. The branches are called Purkinje fibres.**
* **The wall of heart is made of cardiac muscle called myocardium.**

**Path of blood in heart-**

**The heart follows following path during it’s circulation in heart-**

**Blood from whole body is poured in right auricle**

**From right auricle blood flows into the right ventricle through tricuspid valve**

**From right ventricle the blood goes to the lungs for purification through pulmonary artery**

**After purification in lungs the purified blood returns into the left auricle through pulmonary vein**

**From left auricle the blood enters into the left ventricle through bicuspid valve**

**From left ventricle the blood is circulated in the entire body through Aorta and it’s branches**

**Shock Hazards from electrical equipments-**

From the main hospital substation, the power is distributed to individual buildings at 4800Vthrough underground cables

A stepdown transformer in each building has a secondary winding for 230V that is center tapped and thus can provide two circuits of 115V each.

This center tapped is grounded to the earth by a connection to a ground rod or water pipe near the building’s substation.

Heavy electrical devices, such as large air conditionars, ovans, X-ray machines operate at 230 V from the two underground terminals of the transformer secondary.

Lights and normal wall receptacles receive 115 V through black hot wire from one of the underground terminals of the transformer secondary and a white neutral wire that is connected to the ground center tap.

When a person experience a major electrical shock hazard, he must be in contact with both the hot and neutral conductors simultaneously, or both hot conductors of 230V circuit.

Because the neutral wire is connected to ground, the same shock hazard may occur between the hot wire and any conductive object that is in way connected to ground such as room radiators, water pipes, or metallic building structures. In the designing of electrical equipments, the care is taken to prevent the person from accidentally contacting the hot wire by the use of suitable insulating materials and the observations of safe distance between conductors and the equipment.

**Methods of accident prevention**-

To reduce the shock hazards the following preventive measures must be taken-

1. **Grounding-** The protection method used most frequently is proper grounding of the equipment. The purpose of this method is to make the grounding resistance small enough for all possible values of the fault resistance, the majority of the false current bypass the body of the victim and the body current remains at a safe level even if contact and body resistances is small.
2. **Double insulation-** in double insulated equipment the covering of the equipment is made of nonconductive material, usually a plastic. If accessible metal parts are used, they are attached to the conductive main body of the equipment through a separate, protective layer of insulation in additional to functional insulation that separates this body from electrical parts. The purpose of this insulation is to assure that fault resistance is always very large. Double insulated equipment need not be grounded, therefore, it is equipped with plug that does not have a ground pin.
3. **Protection by low voltage-**Instead of line voltage, if another voltage source is used, and the voltage of this source is made small enough, the body resistance would be sufficient to limit the body current to a safe level.on way of creation this situation is to operate the equipment from batteries. additional advantage of battery operated equipments is that battery operated equipments does not have to be grounded. Normally battery operation is limited to small devices but occasionally, large portable X-ray machines may use this method of protection.
4. **Ground fault circuit interrupter-** most of the electrical accidents are of the type in which the body of the victim provides a conductive path to ground. In the case of such accident, part of the current actually returns through the body of victim and through ground. In the ground fault circuit interrupter, the difference between the current in hot and neutral wires of the power line is monitored by a differential transformer and an electronic amplifier. If this difference exceeds a certain value, usually 5mA, the power is interrupted by a circuit breaker. This interruption occurs so rapidly that EVEN IN THE CASE OG A LARGE CURRENT FLOW THROUGH THE BODY OF A VICTIM NO HARMFUL EFFECT ENCOUNTERED.