AVIT
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY

VINAYAKA MISSION'S RESEARCH FOUNDATION
(Deemed to be University under section 3 of the UGC Act 1956)

Accredited by NAAC

Approved by AICTE

Department of Biomedical Engineering

LAB MANUAL

Diagnostic and Therapeutic Equipment Lab

HOD(ECE/BME)

List of Experiments

1. 12 Lead ECG
2. Recording of EEG
3. Recording of EOG
4. Recording of EMG
5. Shortwave Diathermy
6. Surgical Diathermy
7. Ultrasound Blood flow meter
8. Biotelemetry
9. Study of Lithotripter
10. Study of Anesthesia Machine

Ex. No. 1 Recording and analysis of Electro Cardio Gram (ECG)

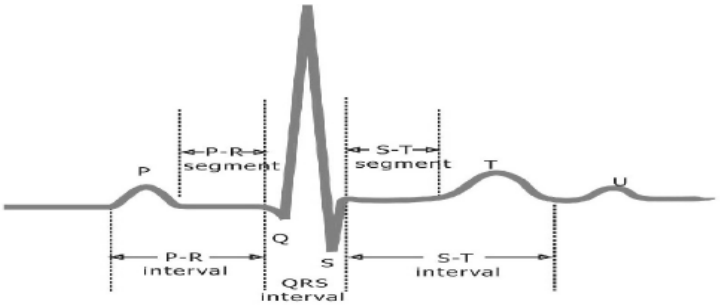
AIM: To acquire real time ECG of 12 lead ECG and analyze the signals.

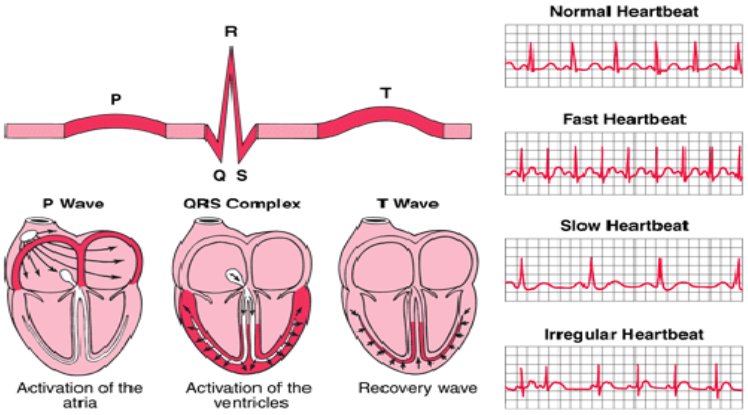
ECG is a transthoracic interpretation of the electrical activity of the heart over time captured and externally recorded by skin electrodes. It is a noninvasive recording produced by an electrocardiographic device.

COMPONENTS REQUIRED:

1 ECG Machine
2.Electrode patches
3. Gel
4. ECG Paper

DIAGRAM:

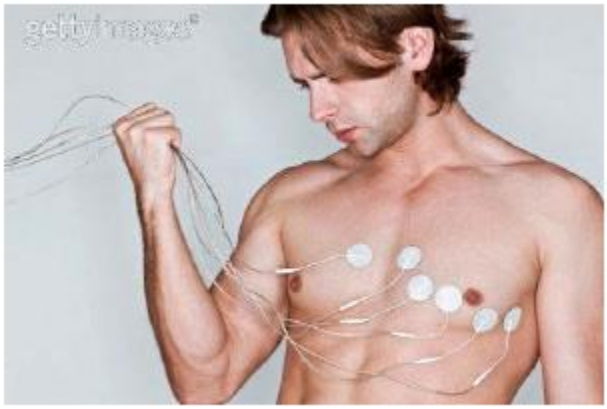




PLACEMENT OF ELECTRODE:

Ten electrodes are used for a 12-lead ECG. They are labeled and placed on the patient's body as

follows:

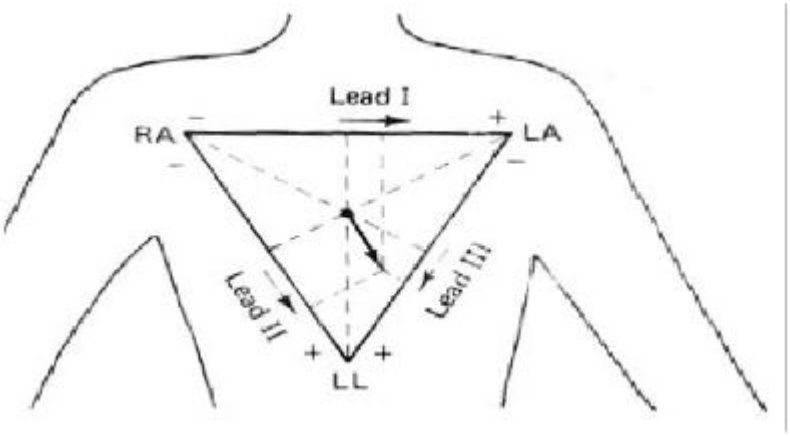


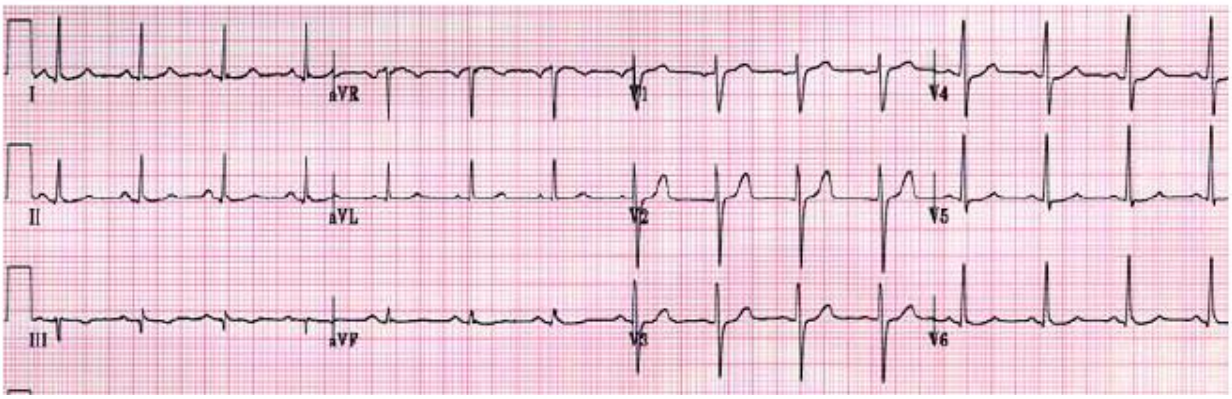
ELECTRODE LABEL (in the USA)	ELECTRODE PLACEMENT
RA	On the right arm, avoiding bony prominences.
LA	In the same location that RA was placed, but on the left arm this time.
RL	On the right leg, avoiding bony prominences.
LL	In the same location that RL was placed, but on the left leg this time.
V1	In the *fourth* intercostal space (between ribs 4 & 5) to the *right* of the sternum (breastbone).
V2	In the *fourth* intercostal space (between ribs 4 & 5) to the *left* of the sternum.
V3	Between leads V2 and V4.
V4	In the fifth intercostal space (between ribs 5 & 6) in the midclavicular line (the imaginary line that extends down from the midpoint of the clavicle (collarbone).
V5	Horizontally even with V4, but in the anterior axillary line. (The anterior axillary line is the imaginary line that runs down from the point midway between the middle of the clavicle and the lateral end of the clavicle; the lateral end of the collarbone is the end closer to the arm.)
V6	Horizontally even with V4 and V5 in the midaxillary line. (The midaxillary line is the imaginary line that extends down from the middle of the patient's armpit.)

Unipolar vs. bipolar leads

There are two types of leads—unipolar and bipolar. Bipolar leads have one positive and one

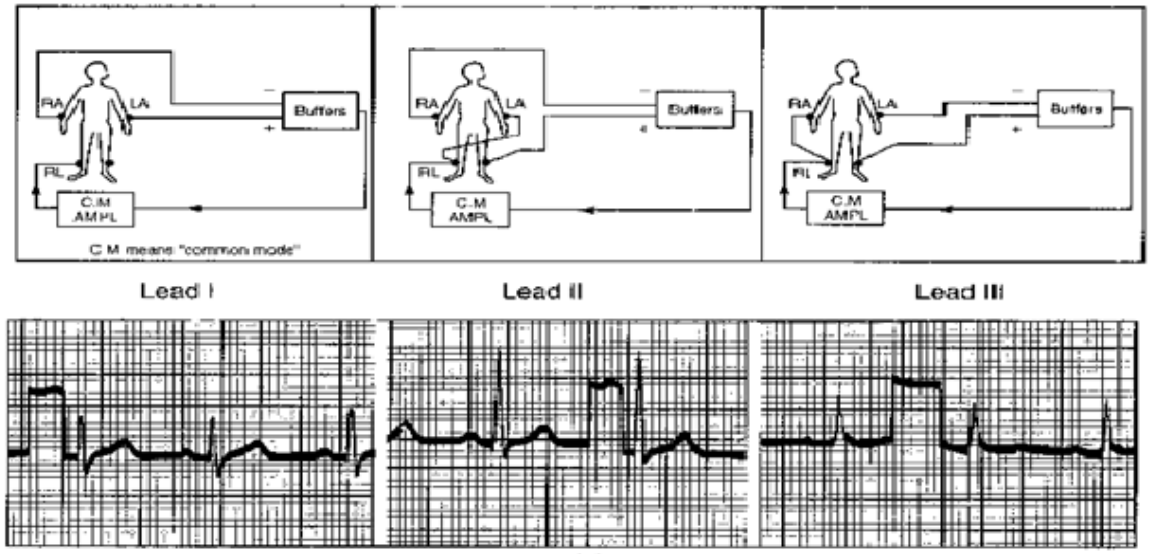
negative pole. In a 12-lead ECG, the limb leads (I, II and III) are bipolar leads. Unipolar leads have only one true pole (the positive pole). The negative pole is a "composite" pole made up of signals from lots of other electrodes. In a 12-lead ECG, all leads besides the limb leads are unipolar (aVR, aVL, aVF, V1, V2, V3, V4, V5, and V6).



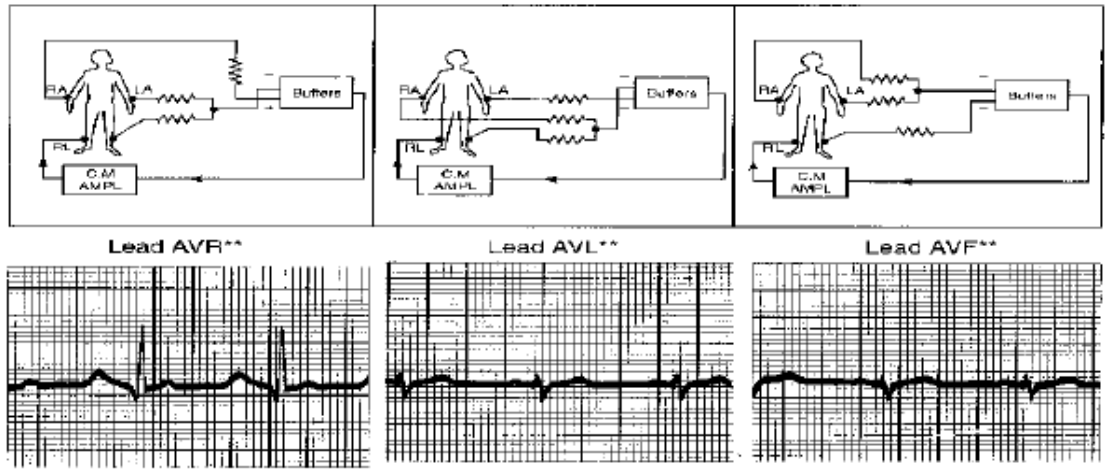


Typical times for segments of an ECG	
Segment	time (ms)
P/Q interval	120-200
QRS complex	60-100
ST interval	80-120
Q/T interval	300-440

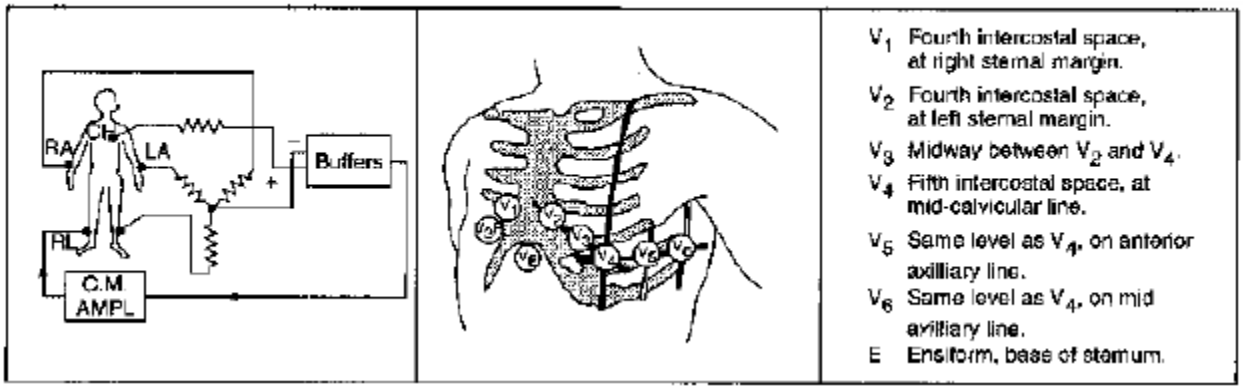
Bipolar Limb Leads



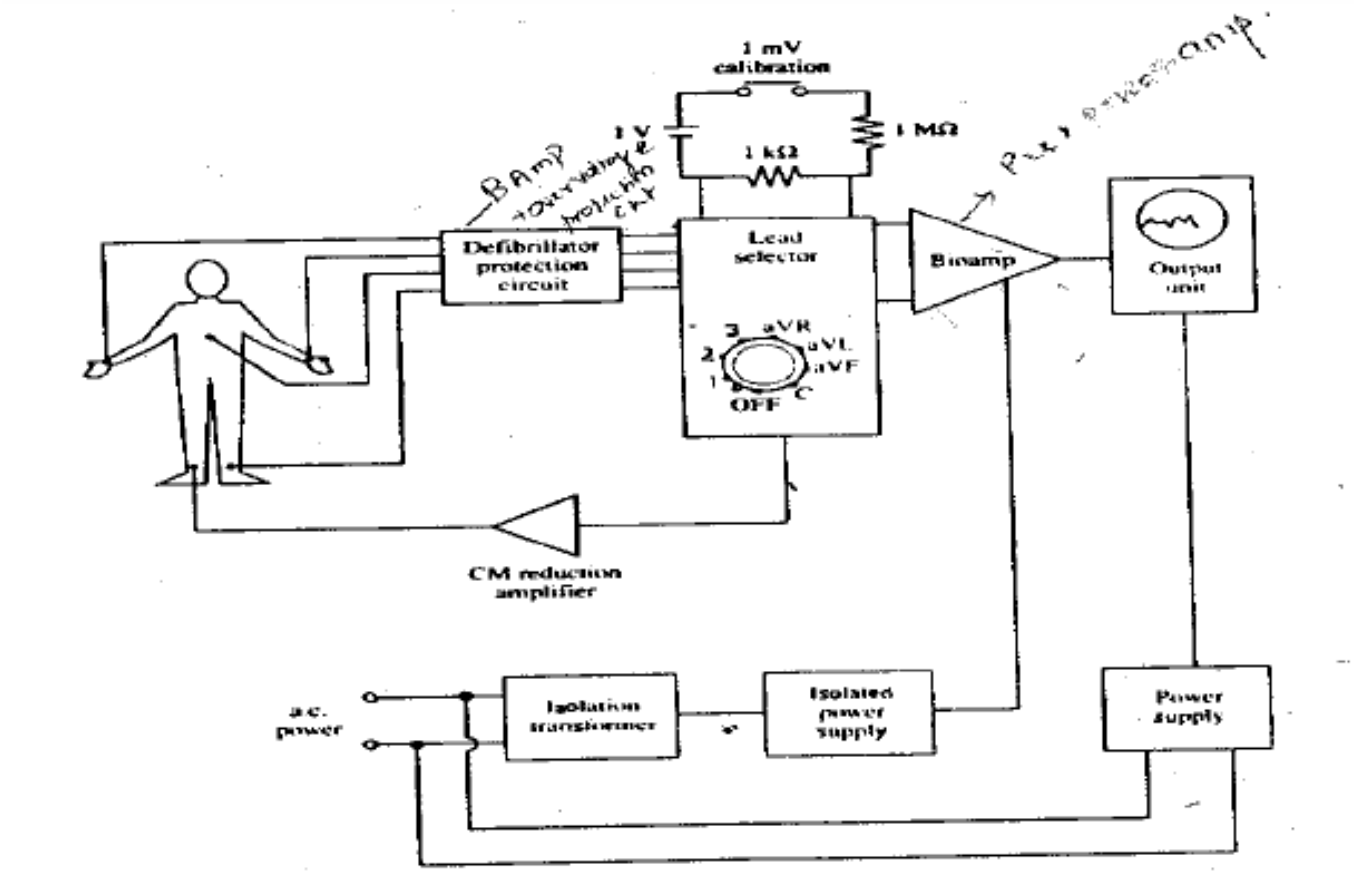
Unipolar Limb Leads:



Unipolar Chest Leads



ECG RECORDING SETUP



Limb leads

Leads I, II and III are called limb leads. The electrodes that form these signals are located on the limbs—one on each arm and one on the left leg. The limb leads form the points of what is known as Einthoven's triangle.

- Lead I is the signal between the (negative) RA electrode (on the right arm) and the (positive) LA electrode (on the left arm).
- Lead II is the signal between the (negative) RA electrode (on the right arm) and the (positive) LL electrode (on the left leg).
- Lead III is the signal between the (negative) LA electrode (on the left arm) and the (positive) LL electrode (on the left leg).

Augmented limb leads

Leads aVR, aVL, and aVF are 'augmented limb leads'. They are derived from the same three electrodes as leads I, II, and III. However, they view the heart from different angles (or vectors) because the negative electrode for these leads is a modification of 'Wilson's central terminal',

- Lead aVR or "augmented vector right" has the positive electrode (white) on the right arm. The negative electrode is a combination of the left arm (black) electrode and the left

leg (red) electrode, which "augments" the signal strength of the positive electrode on the right arm.

- Lead aVL or "augmented vector left" has the positive (black) electrode on the left arm. The negative electrode is a combination of the right arm (white) electrode and the left leg (red) electrode, which "augments" the signal strength of the positive electrode on the left arm.
- Lead aVF or "augmented vector foot" has the positive (red) electrode on the left leg. The negative electrode is a combination of the right arm (white) electrode and the left arm (black) electrode, which "augments" the signal of the positive electrode on the left leg.

The augmented limb leads aVR, aVL, and aVF are amplified in this way because the signal is too small to be useful when the negative electrode is Wilson's central terminal. Together with leads I, II, and III, augmented limb leads aVR, aVL, and aVF form the basis of the hexaxial reference system, which is used to calculate the heart's electrical axis in the frontal plane.

$aVR = -(I + II)/2$

$aVL = I - II/2$

$aVF = II - I/2$

The P. Q, R, S and T deflections and intervals between indicate the following:

The P wave represents the electrical signal produced by the SA node in the right atrium and the propagation of that impulse to the AV node and to the cardiac muscles of the atria.

The PR/PQ interval runs from the beginning of the P wave to the beginning of the QRS complex. During this interval includes what is mentioned in the P wave as well as the contraction produced by the atrial cardiac muscles. Atrial contraction occurs during the flat part of the interval.

The QRS complex represents the depolarization of the ventricles. Reflected in this is the movement of the electrical signal down the AV bundle, right and left bundle branches, Purkinje fibers and the propagation of that signal to the cardiac muscles of the ventricles. Because of the greater muscle mass of the ventricles, the signal is much larger than the P wave. Also during this time you have repolarization of the atrial cardiac muscles, however the electrical signal is masked by the large depolarization produced by the ventricular muscles.

The ST interval represents the contraction of the ventricles. It is measured from the junction of where QRS ends and the T wave begins.

The T wave represents the repolarization of the ventricles. The absolute refractory period occurs during the ST interval and extends to the apex of the T wave. The relative refractory period the latter half of the T wave.

The QT interval runs from the beginning of the QRS complex to the end of the T wave. This represents the time it takes for depolarization and repolarization of the ventricles. This interval will vary with heart rate.

Experimental procedure:

1) Choose one member of your group to be the subject and apply the electrode patches as described in the experimental setup.

2) Record the ECG of your subject at rest. The subject should be sitting, relaxed, and breathing at a normal rate

3) Record the ECG of your subject after three minutes of deep, slow breathing that is done in a supine or sitting position. Try to get the breathing rate down to 5 breaths or less a minute. Record the breathing rate

Tabulation:

Description	Lead I	Lead II	Lead III	aVR	aVL	aVF
P amplitude R T PR Interval QT RR ST QRS P Duration T Duration	0.1 mV	0.2	0.1	0.1	-	0.1V

Analysis

Calculate and find normal or abnormal

a. Heart Rate

b. Normal Sinus Rhythm

C. Cardiac axis

Interpretation

The Recorded ECG is Normal / Abnormal

RESULT:-

Thus the real time ECG is recorded and the signal is analyzed for the subject

Ex. No 2. Recording of Electro Encephalogram (EEG)

AIM:

To measure and record the amplitude and time intervals for the different alpha , theta, beta and gamma EEG waves.

APPARATUS REQUIRED:

1. EEG Machine
2. Connecting probes
4. DSO

THEORY:

Electroencephalography (EEG) is the recording of electrical activity along the scalp produced by the firing of neurons within the brain. In conventional scalp EEG, the recording is obtained by placing electrodes on the scalp with a conductive gel or paste. Electrode locations and names are specified by the International 10–20 system for most clinical and research applications. Each electrode is connected to one input of a differential amplifier (one amplifier per pair of electrodes); a common system reference electrode is connected to the other input of each differential amplifier. These amplifiers amplify the voltage between the active electrode and the reference.

A typical adult human EEG signal is about 10µV to 100 µV in amplitude when measured from the scalp and is about 10–20 mV when measured from subdural electrodes.

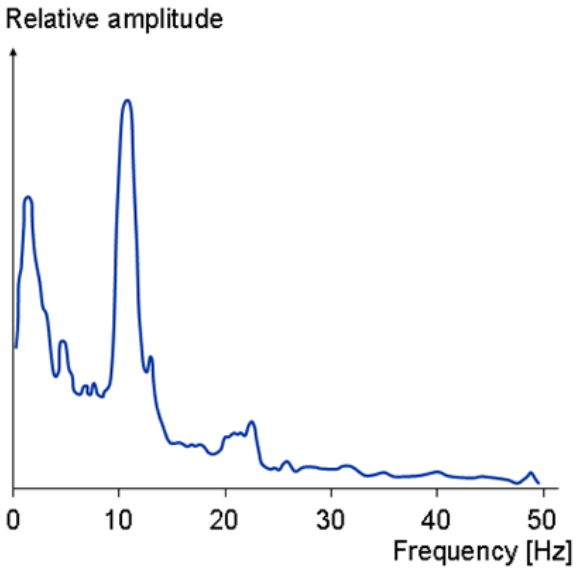
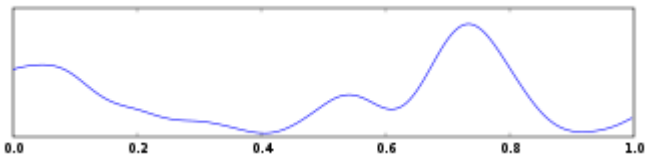


Fig. 13.1. Frequency spectrum of normal EEG.

EEG WAVE PATTERNS:

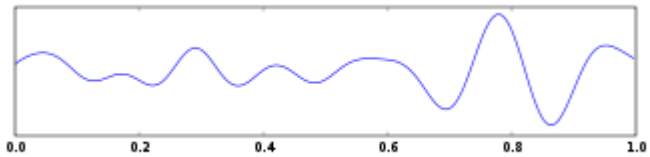
DELTA WAVE:

Delta is the frequency range up to 4 Hz. It tends to be the highest in amplitude and the slowest waves. It is seen normally in adults in slow wave sleep. It is also seen normally in babies.



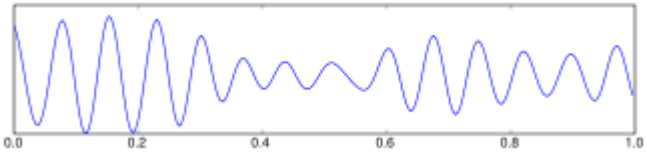
THETA WAVE:

Theta is the frequency range from 4 Hz to 7 Hz. Theta is seen normally in young children. It may be seen in drowsiness or arousal in older children and adults; it can also be seen in meditation.

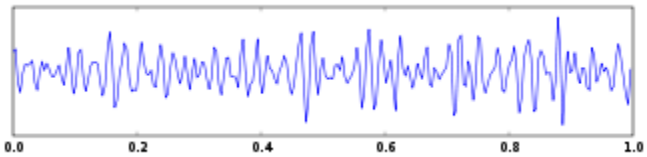


ALPHA WAVES:

Alpha is the frequency range from 8 Hz to 12 Hz. Hans Berger named the first rhythmic EEG activity he saw, the "alpha wave. It emerges with closing of the eyes and with relaxation, and attenuates with eye opening or mental exertion. The posterior basic rhythm is actually slower than 8 Hz in young children.



BETA WAVES:



Beta is the frequency range from 12 Hz to about 30 Hz Beta activity is closely linked to motor behaviour and is generally attenuated during active movements. It is the dominant rhythm in patients who are alert or anxious or who have their eyes open.

Since an EEG voltage signal represents a difference between the voltages at two electrodes, the display of the EEG for the reading encephalographer may be set up in one of several ways. The representation of the EEG channels is referred to as a montage.

BIPOLAR MONTAGE:

Each channel (i.e., waveform) represents the difference between two adjacent electrodes. The entire montage consists of a series of these channels. For example, the channel "Fp1-F3" represents the difference in voltage between the Fp1 electrode and the F3 electrode. The next channel in the montage, "F3-C3," represents the voltage difference between F3 and C3, and so on through the entire array of electrodes.

REFERENTIAL MONTAGE:
Each channel represents the difference between a certain electrode and a designated reference electrode. There is no standard position for this reference; it is, however, at a different position than the "recording" electrodes. Midline positions are often used because they do not amplify the signal in one hemisphere vs. the other. Another popular reference is "linked ears," which is a physical or mathematical average of electrodes attached to both earlobes or mastoids.

AVERAGE REFERNTIAL MONTAGE:
The outputs of all of the amplifiers are summed and averaged, and this averaged signal is used as the common reference for each channel.

LAPLACIAN MONTAGE:
Each channel represents the difference between an electrode and a weighted average of the surrounding electrode.
When analog (paper) EEGs are used, the technologist switches between montages during the recording in order to highlight or better characterize certain features of the EEG. With digital EEG, all signals are typically digitized and stored in a particular (usually referential) montage; since any montage can be constructed mathematically from any other, the EEG can be viewed by the electroencephalographer in any display montage that is desired.

Electrode placement:

EEG LEAD SYSTEMS

The internationally standardized *10-20 system* is usually employed to record the spontaneous EEG. In this system 21 electrodes are located on the surface of the scalp, as shown in Figure 13.2A and B. The positions are determined as follows: Reference points are *nasion*, which is the delve at the top of the nose, level with the eyes; and *inion*, which is the bony lump at the base of the skull on the midline at the back of the head. From these points, the skull perimeters are measured in the transverse and median planes. Electrode locations are determined by dividing these perimeters into 10% and 20% intervals. Three other electrodes are placed on each side equidistant from the neighboring points, as shown in Figure 13.2B (Jasper, 1958; Cooper, Osselton, and Shaw, 1969).

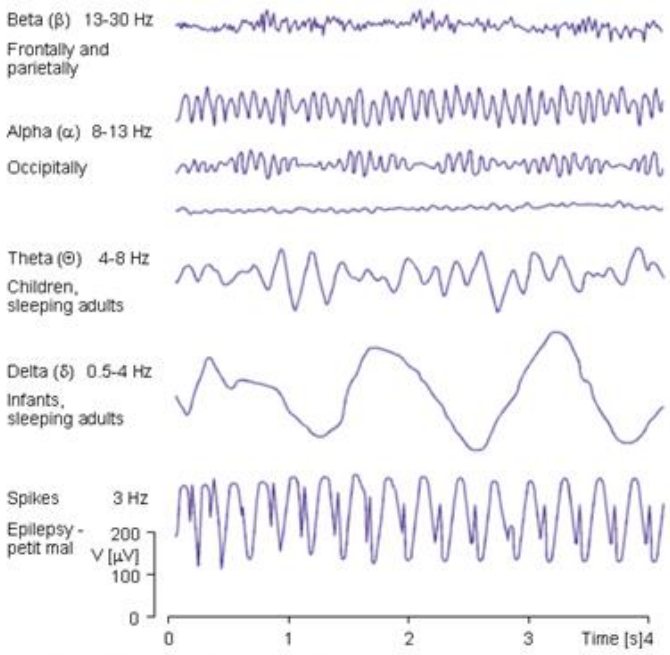
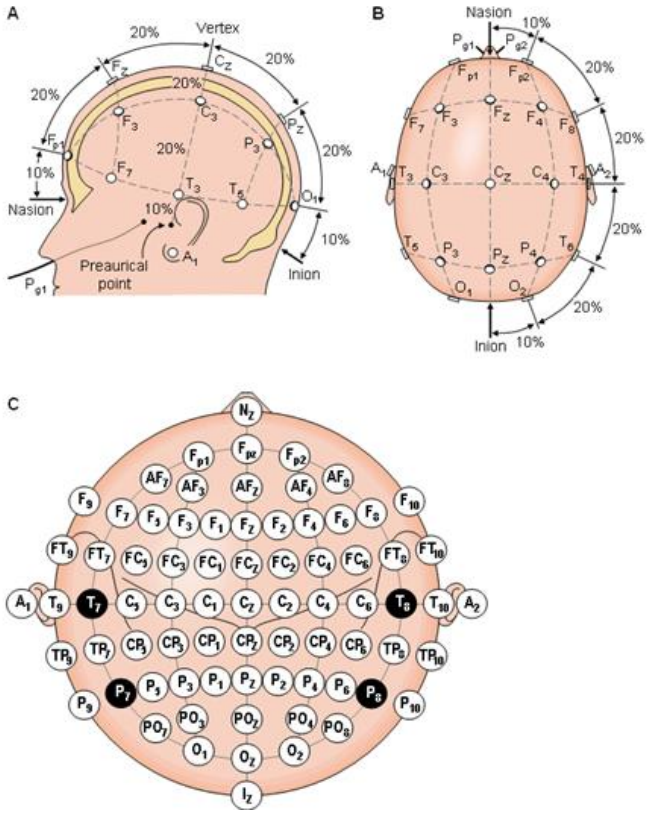


Fig. 13.5. Some examples of EEG waves.



RESULT:

The record of brain waves using EEG machine was studied and different classification was analyzed.

Ex No. 3. Electro occulo gram (EOG)

Aim:

To record and study the Electro occulo gram signal.

Apparatus Required:

EOG instrument
Electrodes
DSO

Operating Procedure:

1. Connect the ERG Amplifier to the mains

2. Instrument ON by mains Switch, the switch will be lighted.

3. Now switch ON DSO

4. Put the DSO on storage mode,

5. Mode switch at DC position

6. Time / Div Knob on the mS Division.

7. Voltage / Div Knob on the 5V. (Change the position as per signal)

8. Now connect the DSO to the instrument.

9. Check the ground, if not proper make arrangement for that.

10. Connect the electrodes to system, Make all Leads of electrodes short, so on the DSO, there is DC line.

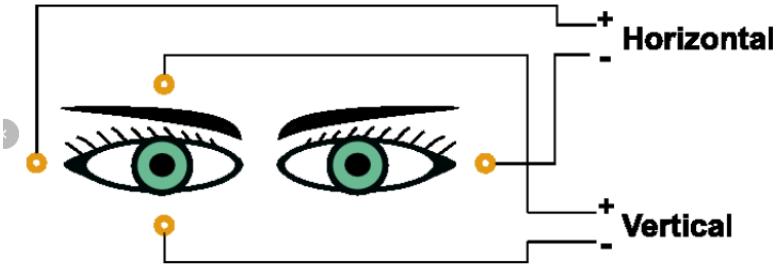
11. Clean the skin where the electrode connects & apply small amount of an electrolyte paste (conductive jelly) on electrodes.

12. Now vary the Gain knob of amplifier or Voltage / Div knob of DSO as per requirement, Also vary Time / Div as per requirement.

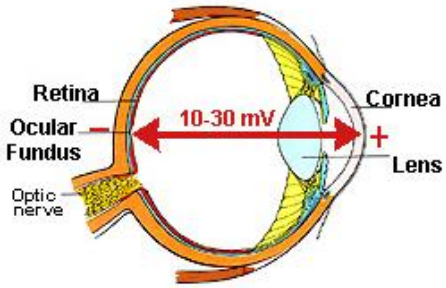
13. If any noise is found on DSO, check the Ground. If Ground or electrodes are not proper

the signal gets distorted.

ELECTRODE PLACEMENT:



THEORY:



Electrooculography (**EOG**) is a technique for measuring the corneo-retinal standing potential that exists between the front and the back of the human eye. The resulting signal is called the electrooculogram. Primary applications are in ophthalmological diagnosis and in recording eye movements

To measure eye movement, pairs of electrodes are typically placed either above and below the eye or to the left and right of the eye. If the eye moves from center position toward one of the two electrodes, this electrode "sees" the positive side of the retina and the opposite electrode "sees" the negative side of the retina. Consequently, a potential difference occurs between the electrodes. Assuming that the resting potential is constant, the recorded potential is a measure of the eye's position.

Principle of EOG

The eye acts as a dipole in which the anterior pole is positive and the posterior pole is negative.

1. Left gaze: the cornea approaches the electrode near the outer canthus of the left eye, resulting in a negative-trending change in the recorded potential difference.
2. Right gaze: the cornea approaches the electrode near the inner canthus of the left eye, resulting in a positive-trending change in the recorded potential difference.

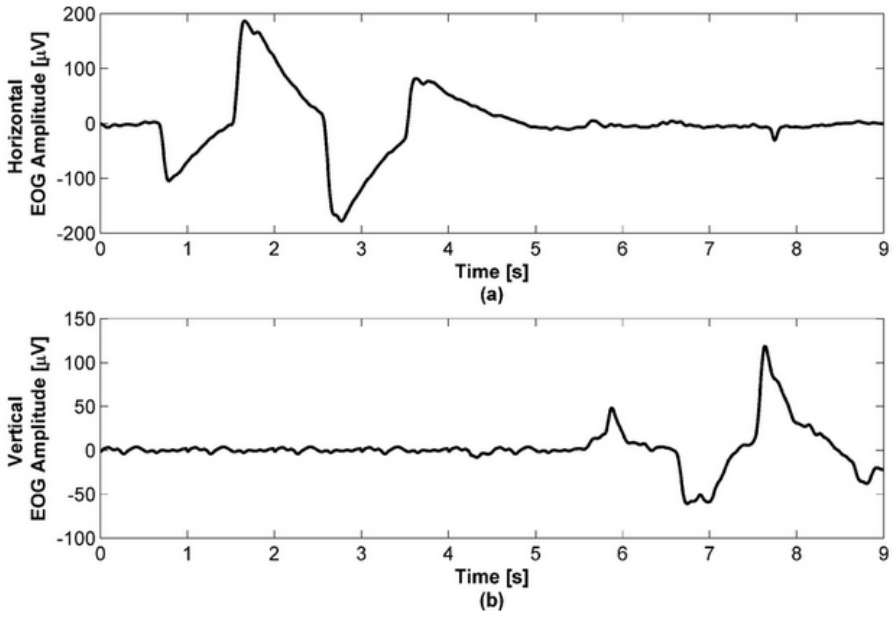
Components of the EOG

The light-insensitive component accounts for the dark trough and is dependent on the integrity of the retinal pigment epithelium (RPE) as well as the cornea, lens, and ciliary body. The light-sensitive component is the slow light rise of the EOG and is generated by the depolarization of the basal membrane of the RPE.

The **Arden ratio,** the ratio of the Light peak (Lp) to dark trough (Dt) is used to determine the normalcy of the results.
An Arden ratio of 1.80 or greater is normal, 1.65 to 1.80 is subnormal, and < 1.65 is significantly subnormal.

EOG is to detect and amplification of bioelectric potential of the eye by electrodes.
This is a Bipolar Electrode system. In this system there are three electrodes, one is Ground & other two are active & reference. Electrodes wire is provided with 5pin connector. The 5-pin socket is provided on the system. On the system there is gain facility provided to select the gain. Also there is BNC socket to connect the system to the storage CRO or Computer or Recorder (For recorder check the technical specification). Use only storage CRO, so the signal is visualised properly. The signal level is from 0.1 to 5V & depends on the sensitivity.

TYPICAL EOG WAVEFORM:



Typical EOG signals for eye movements (a) Horizontal EOG: look left, right then left again (b) Vertical EOG: look up, down and then up again

RESULT:
The EOG signal is recorded and measured.

Ex. No 4. Recording of Electromyogram (EMG)

AIM:

To record and analyze the electrical activity of muscle using EMG signal.

EQUIPMENTS REQUIRED:

a) EMG Amplifier
b) High Pass Filter
c) General Amplifier
d) Audio Amplifier
e) Level Indicator Linear
f) Electrodes
g) Battery
h) Charger

THEORY

Muscle Physiology

The skeletal muscles implement our body movements. They are attached to adjacent bones via tendons, and function to induce movement at the joint formed where the two bones meet. Skeletal muscle comprises the largest single organ of the body. Each of these individual muscles is composed of single cells or fibers embedded in a matrix of collagen.

The muscle cells are roughly cylindrical, with diameters between 10 and 100 um but up to a few centimeters long. They may be arranged in parallel and bound by a connective tissue envelope into a homogeneous bundle. A myofiber is a multinucleated single muscle cell. It's basically water with some dissolved ions separated from the extra-cellular space that is mostly water with some dissolved ions. It generates a potential difference across its cell membrane by having different concentrations of ions.

The fibers are excitable cells. Excitation signals are received at the synapse. Then a rapid depolarization occurs and is coupled with a contraction. It's a process during which electrochemical events occur. The action potentials are propagated along the sarcolemma, or cell membrane, toward the end of the fiber and downward from the surface into the transverse tubular system. The propagation of the action potential along a nerve or muscle fiber includes the flow of ions and gives rise to extra-cellularly recordable potential gradient. These potential gradients, moving in both time and space, constitute the electricity as recorded from active muscle fibers. Thus the small currents are generated prior to the generation of muscle force.

The myofibers are the smallest complete contractile systems and are arranged in functional units called motor units. A motor unit is simply the cell body (motor neuron), its axon and all of the muscle fibers that it innovates (attaches to provide the signal for contraction). Each motor unit has a characteristic innervation ratio that is the number of muscle cells (muscle fibers) controlled by one neuron. The number of muscle fibers belonging to a single motor unit varies widely from muscle to muscle. One whole muscle has many motor units.

Acquisition of EMG

As the brain's signal for contraction increases, it both recruits more motor units and increases the "firing frequency" of those units already recruited. All muscle cells within one motor unit become active at the same time. By varying the number of motor units that are active, the body can control the force of the muscle contraction. When individual motor contract, they repetitively emit a short burst of electrical activity known as the motor unit action potential (MUAP). It is detected by electrodes on the surface of the skin in proximity of the motor. The detection is illustrated in the following figure.

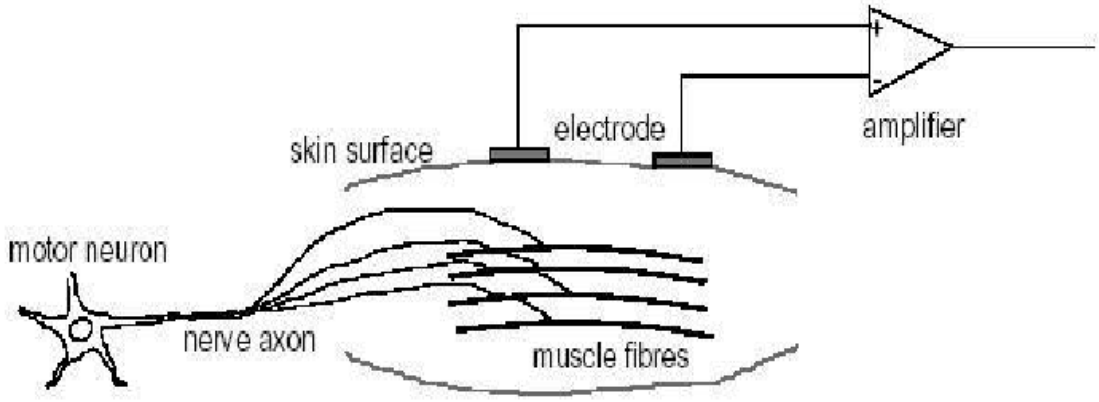


Figure 2-1: Detection of the motor unit action potential (MUAP)

The function unit of a muscle is the motor. All the fibers which belong to one motor are activated at the same time. The motor unit action potential (MUAP) is the electrical response to the impulse from the axon. A MUAP looks like the following figure.

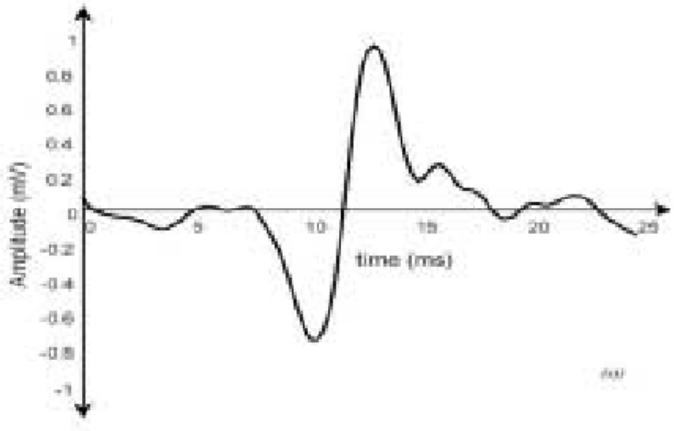
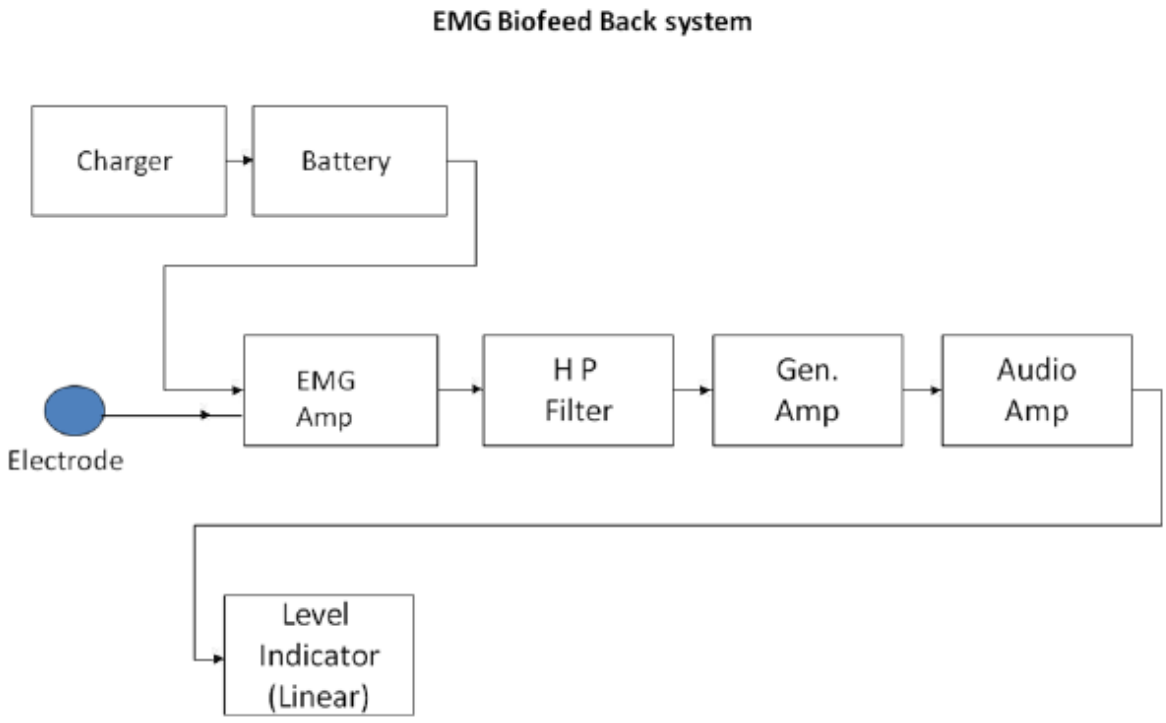


Figure 2-2: Action potential (AP) of one motor unit

The primary factors that determine the shape of a MUAP are the diameter and geometrical arrangement of the muscle fibers, the tissue filtering effect, and the properties of the recording electrode and instrumentation.
The contraction of a muscle recruits a number of motors during a period of time. When several motor units are active (the timing of the electrical burst between distinct motor units is mostly uncorrelated), a random interference pattern of electrical activity results. The time between successive bursts is somewhat random for each motor unit.
EMG technology enables us to record the action potentials from an entire muscle or a large portion of it by putting electrodes on the surface on the skin. It is a summation of the interfered motors' MUAP, which is also the summation of small currents from the fibers belonging to variant motors. Therefore it looks quite different with MUAP. The following Figure shows how the detected EMG signals and its spectrum appear. We can observe that the EMG signal of greatest amplitude is detected by put the electrode at proper locations on the surface the muscle.

BLOCK DIAGRAM:



BLOCK DIAGRAM DESCRIPTION:

EMG Amplifier

The amplitude of the EMG signal depends upon the type and placement of electrodes used and the degree of muscular exertion. Generally EMG signals range from 0.1 to 0.5mV which is a weak signal hence it has to be amplified. This amplification is done by the EMG amplifier. Here the gain of the EMG amplifier is 1000 and the output is1 V pk to pk per mV of input.

High Pass Filter
A high-pass filter, allows high frequencies well but attenuates frequencies lower than the filter's cutoff frequency. The actual amount of attenuation for each frequency is a design parameter of the filter. It is sometimes called a low-cut filter. Here the HPF has a cut off frequency of 70Hz and a Minimum input voltage 1V Pk to Pk

Audio Amplifier
Audio amplifier amplifies low power audio signals to a required level. Audio amplifier used in this application has a frequency range of 0-10KHz.
Level Indicator Linear
The level indicator displays the level of contraction of the muscle.

PROCEDURE:
1. Connect the modules as per the block diagram.
2. Switch 'ON' the battery
3. Connect the subject to EMG amplifier through Ring electrodes.
4. Observe the output in the level indicator.

RESULT:
The EMG signal is recorded and analyzed the waveform.

Ex. No. 5. SHORTWAVE DIATHERMY (SWD)

Aim:

To study the working of Shortwave Diathermy

OPERATING PROCEDURE:

1. Connect two condenser pads in output socket. Place the two electrodes around the patient's body where treatment is to be given.

2. Connect the mains cable & switch ON the unit. Power ON switch must glow.

3. Set the timer for desired period.

4. Adjust the voltmeter up to red mark with the help of voltage regulator.

5. Set power control to the desired position, generally position 2 or 3 of control is sufficient.

POWER SETTINGS:

The power required for treatment is adjusted by varying the POWER CONTROL knob and TUNING knob as follows,

1. Set the POWER CONTROL knob to position 1.

2. Rotate the TUNING knob rightwards. This will result in the current meter showing an increase in current.

3. Set the TUNING knob at a position corresponding to maximum current indication in the meter.'

4. Any further rotation will result in reduction of current in the meter.

If the Power to be applied to the patient is to be increased , rotate the TUNING KNOB TO EXTREME left position , place the POWER CONTROL position to the next position and repeat the above steps.

Theory:

Short Wave diathermy current is a high frequency alternating current. The heat energy obtained from the wave is used for giving relief to the patient. Its frequency is 27,120,000 cycles per second and the wavelength is 11 metre.

A shortwave diathermy unit is a device designed to generate radiofrequency radiation and transfer it,via cables and electrodes, to the area to be treated. The units can be operated in either a continuous wave or pulsed mode but both produce heat in deep tissue.

TWO FORMS OF SHORTWAVE DIATHERMY:

The units can be operated in either Continuous mode or Pulsed mode

Two basic types of electrodes (applicators) are in use: ƒCapacitor-type ƒInductor type.

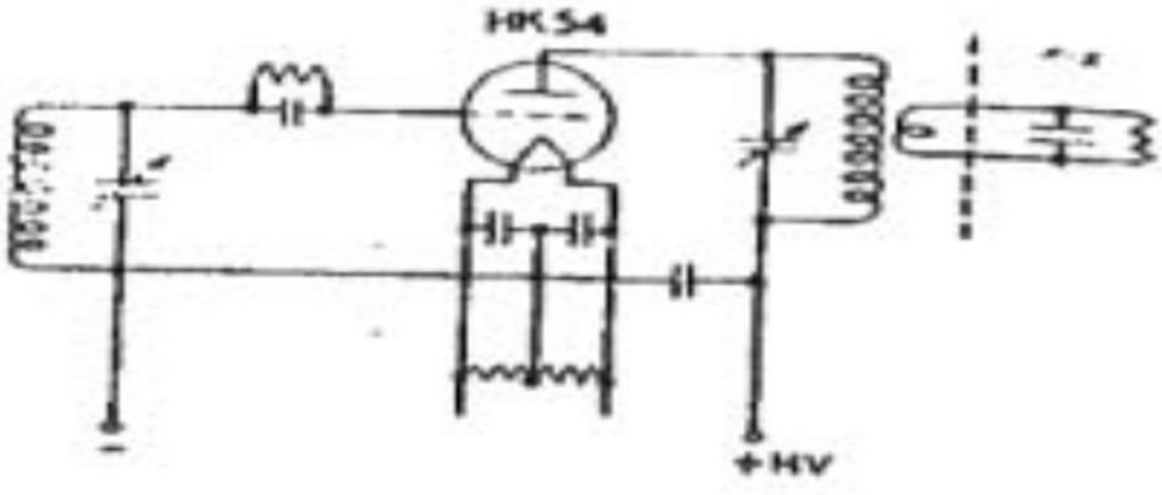
In the first case tissue heating is basically due to the radiofrequency electric field, while for the inductive electrodes (coils), heating occurs by a combination of electric field effects and currents induced in the tissue by the magnetic field. The heating profile of the two mechanisms is somewhat different. These devices are capable of generating a sufficiently high level of radiation that there may be cause for concern for the safety of the gonads and, in the case of pregnant patients, the foetus. Improper use of the machine may result in burns and/or scalds and deep tissue or organ damage. It must be noted that the level of radiation present in the vicinity of a diathermy unit may be increased by the presence of nearby metallic objects or other units or by reflection from the wall. Care must be taken to ensure that the shortwave radiation does not cause interference with other equipment.

SWD is most commonly used for thermotherapy at a frequency of 27.12 MHz.

WORKING OF SHORT WAVE DIATHERMY:

Shortwave diathermy heats the tissue by causing oscillations of electromagnetic energy of high frequencies. The physiologic effects of temperature occur at the site of the application and in distant tissue.

Circuit diagram of shortwave diathermy



The local effects occur due to the elevated local temperature which is associated with increased local blood flow, capillary dilatation and capillary permeability. It results in higher level tissue metabolism and more rapid transfer of nutritional ingredients to the end organs and tissues. It promotes faster healing. Short wave heat increases connective tissue elasticity, reduces muscle spasm, and sedates the nerve endings to change the pain threshold. Distant changes from the heated target location include reflex vasodilatation and reduction of muscle spasm, increase in body temperature, respiratory and pulse rates and decreased blood pressure. Diathermy increases white blood cell concentration in the area of chronic inflammation.

TREATMENT:

Before administering the treatment the operator should:

•ensure that the thermal sensitivity of the patient is not impaired by analgesics,

•ensure that the patient has removed all metallic objects (rings, watches, metal rimmed glasses, etc.) from the treatment area,

•Remove toweling or clothing from the treatment area,

•ensure that the skin is dry,
•ensure that if the patient is wearing a hearing aid, it is removed, asks the patient to report immediately any symptoms experienced during the treatment except mild, comfortable warmth,

•ensure that the cables are correctly connected to both the machine and the applicator, not rest the applicator or cables over metal surfaces, align the applicator accurately to ensure an appropriate pattern of heating,
•ensure that the testes are not directly irradiated and that care is taken to minimize indirect irradiation, •ensure that the cables leading to the applicator are not placed in the vicinity of the patient's non targeted tissue,
•ensure that the chair or other patient support is not metallic and that other large metallic objects are kept at least three meters from the electrodes and cables. After activating the unit the operator should:
•remain at least 1 m from the electrodes and 0.5 m from the cables during treatment,
•ensure that the patient maintains the correct position and remains cooperative,
•not leave the patient during the treatment, unless the patient has been supplied with an emergency
•cut-off switch and the patient is reliable,
•not allow the patient to touch the unit,
•ensure that no other person is in the vicinity of the unit or of the applicator during the treatment, in accordance with the administrative controls established by the user.

TREATMENT TIME:

Initial Stage : 5-10 minutes
Moderate Stage :10-20 minutes
Severe State :20-30 minutes

ADAVANTAGES:

1.Relaxation of the muscles
2.Effective in bacterial infections
3.Relief of pain

DISADVANTAGES:
1.Burns
2.Scalds (Boils)
3.Overdose
4.Shock
5.Electric Sparking
6. Faintness

RESULT:-

The working principle of shortwave Diathermy is studied

Ex .No. 6. SURGICAL DIATHERMY

AIM

To study and analyse the functioning and safety aspects of surgical diathermy.

APPARATUS REQUIRED:

1. Electrosurgical machine with mains cord
2. Patient plate with cable
3. Foot switch with cable
4. Bicoag forceps with cable
5. Active electrode with cable
6. Electrode set

TECHNICAL SPECIFICATION:

Power supply : 230/50Hz
Frequency : 600 KHz
Mode : Cut, Coag, Bicoag

Output

1. Cut :250 watt+10%
2. Coag :200 watt+10%
3. Bicoag :70 watt+10%

Control : Cut, Coag, Bicoag and volume

Output sockets: Patient plate, foot switch and active

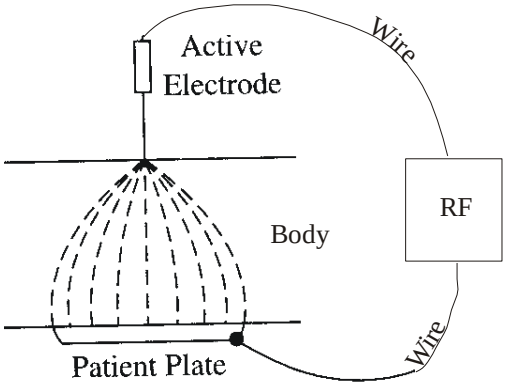
Alarm : Patient plate open audible and visible alarm.

THEORY:

An electrosurgical machine is an alternating current source (0.4-3 MHz) that operates at a radio frequency.The surgeon uses the electrosurgical machine to cut tissue and cauterize bleeding vessels.

Two electrodes are connected to the RF power generator.One electrode is active and has a very small cross sectional area (100 cm^2) with respect to other electrode.The current flowing into the patient cable is same as the current flowing into active electrode.The current density is difference between the two electrodes, the

PRINCIPLE OF SURGICAL DIATHERMY



TABULATION:

S.No	Electrode Type	Soap	Ammeter(mA)	Voltmeter(mV)

tissue beneath patient plate heat up slightly, while the tissue underneath the active electrode is heated to destruction. In bipolar mode electrode doesnot require a patient plate. In unipolar two electrodes are active and patient plate.Bipolar system both electrodes and there is no patient plate.

The principle of electrosurgery is as follows. The total current through the body is determined by the voltage and the total impedance between the electrodes. The generation of heat per unit unit volume of tissue ρ/V (W/m^3) is given by

$$\rho/V = \rho i^2$$

where ρ is resistivity (Ωm) including electric losses and i is current density (A/m^2).

As a means of incising tissue, electrosurgery has the advantage that bleeding is diminished due to the coagulation of the vessels. In addition some micro organisms are killed by heat.

PROCEDURE:

1. Connect the instrument to the mains.
2. Connect the foot switch,active electrode,Bipolar electrode and patient cable to the instrument.
3. Put all knobs at zero position and then switch on the machine.
4. Press the foot switch in cut and coagulation mode so as to get different audio with indication.
5. For lab purpose soap is used as patient.
6. Remove active and patient cable when operating in bipolar mode.Operate bipolar only in coagulation mode.
7. The knife electrode is used for cutting and ball electrode is used for coagulation whereas, needle electrode can be used for microsurgery as well as fine points to be coagulated.

SAFETY MEASURES

1. Check the power line voltage and frequency. If the line voltage deviate from specified value use a voltage stabilizer
2. Use three pin socket with proper grounding. Keep the equipment free from vibration shock.
3. Do not touch the equipment with hand with liquids, blood, saline, gel, etc.
4. Before switching on the instrument, normal and safe operation of machine as well as the correct and complete connections of cords and wires

RESULT:

Surgical diathermy was studied and analyzed.

Ex. No 7. Ultrasound blood flow meter.

AIM:
To measure the blood flow using ultrasound, in order to identify arteries and veins.

APPARATUS REQUIRED:
- Power supply
- Transmitter
- Receiver
- Speaker

OPERAT ING PROCEDURE:

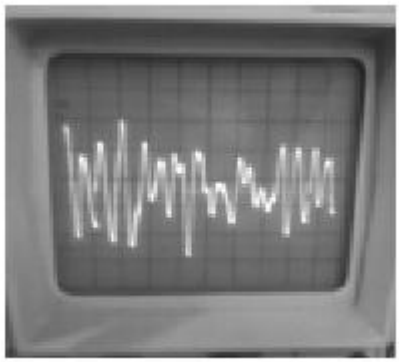
1. Connect instrument to the mains.

2. Connect the Transducer to system, Make Instrument ON.

3. Now switch ON DSO.DSO on storage mode. Mode switch at DC position

4. Time / Div Knob on the mS Division. Volt / Div Knob on the 0.5V. (Change the position as per signal)

5. Now connect the DSO to the instrument. Apply the Gel on the Body & Transducer; Now Connect the Transducer to Body. Hear the Flow sound of Blood. (Transducer placement is very important for proper sound)



6. Now vary the audio or adjust DSO Voltage / Div & Time / Div as per requirement.

7. Check the ground; if not proper make arrangement for

PRINCIPLE OF WORKING:

The principle of ultrasound blood flow measurement is the visualization and measurement of blood flow velocity by the shift in frequency of a continuous ultrasonic wave. The sensor used here is piezoelectric crystal. This sensor acts both as the transmitter and receiver. The ultrasonic waves transmitted by the transmitter are reflected by the motion of blood and is received by the receiver but here the received frequency is Doppler shifted.The Doppler frequency shift is a measure of the size and direction of the flow velocity. It is based on the analysis of echo signals from the erythrocytes in the vascular structures. The relationship between blood velocity and frequency is given by

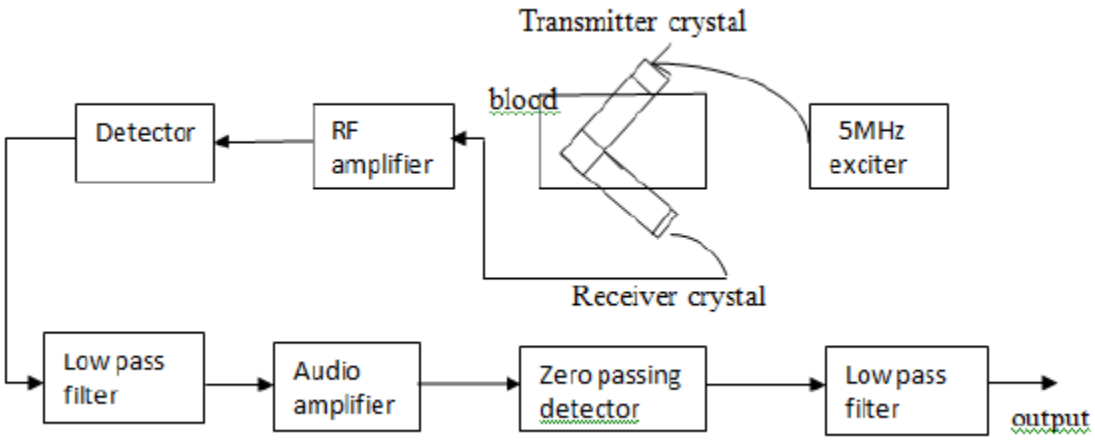
$$V=(\Delta f.C)/(2f\cos\theta)$$

Where v=blood flow velocity C=velocity of sound in blood

f=transmitted frequency, θ=angle of inclination of the incident wave to the direction of flow

PROCEDURE:

The sensor which is ultrasonic transducer is non-invasively placed on the subject's wrist. This sensor has the transmitter and receiver. The transmitted signal gets Doppler shifted. Because of the Doppler effect, the frequency of these echo signals changes relative to the frequency to which the probe transmits. The incident ultrasound is scattered by the blood cells and the scattered wave is received by the receiver. This frequency shift is proportional to the velocity of the scatterers. Alteration in frequency occurs first as the ultrasound arrives at the scatterer and second as it leaves the scatterer. This Doppler shifted frequency wave can be viewed in the Cathode Ray Oscilloscope by properly connecting the output of the speaker to the CRO probes. To any one channel the probes are connected and the time period and offset are adjusted to get the Doppler frequency shifted wave with appropriate amplitude. The output wave can thus be traced out. Also when the output of the receiver is connected to the speaker we will be able to listen to the sound of the blood flow in arteries and veins.



RESULT:

Thus arteries and veins are identified with ultrasound blood flow meter.

Ex. No 8. Biotelemetry

AIM:

To understand the transmission and reception of biological signal using a telemetry system.

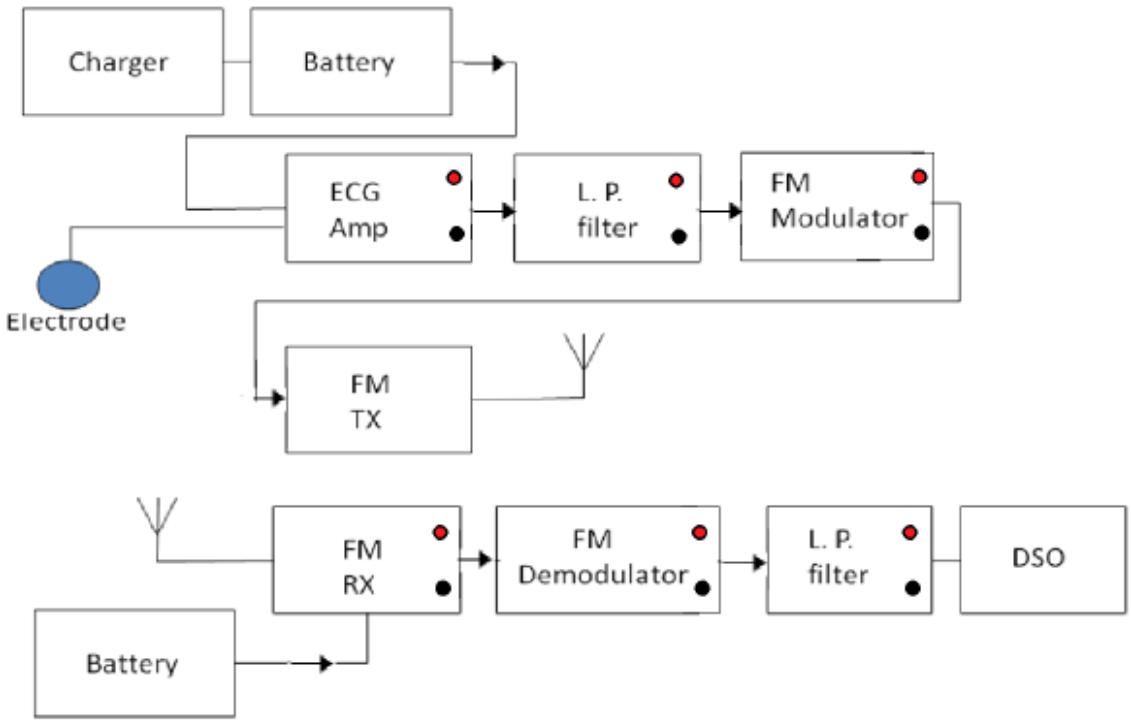
EQUIPMENTS REQUIRED:

ECG Amplifier
Low Pass Filter – 2 Nos.
FM Modulator
FM Transmitter
FM Receiver
FM Demodulator
Charger
Battery – 2 Nos.
Electrodes

THEORY:

Telemetry is a system of sending data, usually measurements, over a distance. Telemetric data may be physical, environmental or biological. Telemetry is typically used to gather data from distant, inaccessible locations, or when data collection would be difficult or dangerous for a variety of reasons. In telemetry, specialized instruments carry out measurements of physical quantities, and store or transmit the resulting signal, often after some initial signal processing or conversion. Biotelemetry is the electrical measuring, transmitting, and recording of qualities, properties, and actions of organisms and substances, usually by means of radio transmissions from a remote site. There are single channel and multi channel telemetry systems. For a single channel system, a miniature battery operated radio transmitter is connected to the electrodes of the subject. This transmitter broadcasts the biopotential over a limited range to a remotely located receiver, which detects the radio signals and recovers the signal for further processing. In this situation there is a negligible connection or stray capacitance between the electrode circuit and rest of the system. The receiving system can even be located in a room separate from the subject.

BLOCK DIAGRAM:



BLOCK DIAGRAM DESCRIPTION:

ECG Amplifier

ECG has amplitude of only about 1 mV, so to detect it an amplifier is required. The ECG amplifier used here has a Gain of 1000 and CMRR of more than 80dB.

Low Pass Filter

A low-pass filter allows low-frequency signals but attenuates (reduces the amplitude of) signals with frequencies higher than the cutoff frequency. When the ECG is amplified, the noise is amplified too, and often swamps the ECG signal. The noise is usually of a higher frequency than the ECG. So the noise can be reduced by low-pass filtering.

FM Modulator

Modulation is used to embed a message (voice, image, data, etc.) on to a carrier wave for transmission. A bandlimited range of frequencies that comprise the message (baseband) is translated to a higher range of frequencies. The bandlimited message is preserved, i.e. every frequency in that message is scaled by a constant value. Here the incoming ECG signal is modulated at around 110MHz. The modulated ECG signal is given to the FM Transmitter.

FM Transmitter

FM Transmitter sends a signal (typically 4-20mA) from a process location to a central location for control and monitoring. Here FM transmitter transmits the modulated ECG signal.

FM Receiver

A receiver receives its input through an antenna. It receives the modulated signal from the transmitter. The receiver then passes on the information to the FM Demodulator where the ECG signal is demodulated to obtain the original ECG signal.

FM Demodulator

Demodulation, in radio is the technique of separating a transmitted audio frequency signal from its modulated radio carrier wave. Here the modulated ECG signal is demodulated at a frequency of around 100Hz and the original ECG signal is recovered.

PROCEDURE:

Connect the modules as per the block diagram.
Switch ON the battery.
Connect the ring electrodes to the subject.
View the transmitted signal (for example Pulse rate) on the display of receiver.
The various outputs from each of the modules can be viewed on the DSO by connecting the output banana pin to the desired module.

Tabulation:

SL. No.	Name of the person	Pulse rate. Beats/min
1 2 3		

RESULT:

Thus we understood the transmission and reception of biological signal using a telemetry system