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

Medical Instrumentation Lab

HOD(ECE/BME)

List of Experiments

1. Design and analysis of biological pre amplifiers.
2. Plotting of human auditory response using audiometer.
3. Recording of ECG signal and analysis
4. Recording of EMG-Signal
5. Recording of EEG-Signal
6. Recording of various physiological parameters using patient monitoring system and telemetry units.
7. Measurement of pH and conductivity.
8. Study of ESU – cutting and coagulation modes
9. Study of characteristics of optical Isolation amplifier
10. Galvanic skin resistance (GSR) measurement

Ex No. 1 Design and analysis of biological pre amplifiers

AIM:

To construct, test, and perform biological pre-amplifier by using operational amplifier.

APPARATUS REQUIRED:

1. Op-amplifier Ic- 741

2. Resistor 1k ohm – 7

3. Dual RPS (0-30V)

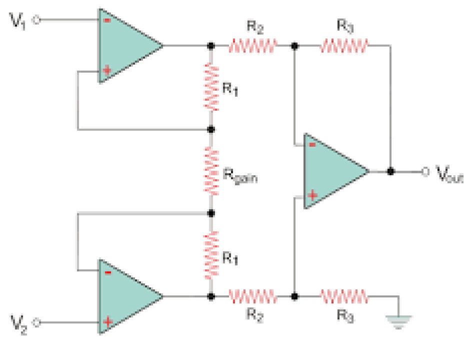
4. Bread board

5. Connecting wires

THEORY:

A Biological Pre- amplifier is an integrated circuit (IC) that is used to amplify a signal. This type of amplifier is in the differential amplifier family because it amplifies the difference between two inputs. The importance of a Pre- amplifierr is that it can reduce unwanted noise that is picked up by the circuit. The ability to reject noise or unwanted signals common to all IC pins is called the common-mode rejection ratio (CMRR). Instrumentation amplifiers are very useful due to their high CMRR. Other characteristics, such as high open loop
gain, low DC offset and low drift, make this IC very important in circuit design.

CIRCUIT DIAGRAM:



Gain calculation
Vo = (V2-V1) Av
Where Av = R4/R5 (1+(R1+R3/R2))

PROCEDURE:

1. Connections are made as per circuit diagram
2. Check the connection correctly
3. Avoid loose connection and switch the power supply

4. Note down the output values for the given input and check the practical value with theatrical calculation

TABULATION

Sr. no	V1 volts	V2 volts	Theoretical Output Vo volts	Practical output Vo volts
1 2 3 4 5				

RESULT:

The Biological pre- amplifier is designed and constructed and the output value was checked with theoretical calculation.

Ex No. 2 Plotting of human auditory response using audiometer.

AIM:

To test auditory responses and plot audiogram by using Audiometer.

APPARATUS REQUIRED:

1. Audiometer training kit
2. Head Phone
3. patient Switch
4. Probes
5. Connecting wires

Theory:

An audiometer is a machine used for evaluating hearing acuity. They usually consist of an embedded hardware unit connected to a pair of headphones and a test subject feedback button, sometimes controlled by a standard PC. Such systems can also be used with bone vibrators, to test conductive hearing mechanisms.

Audiometers are standard equipment at ENT (ear, nose, throat) clinics and in audiology centers. An alternative to hardware audiometers are software audiometers, which are available in many different configurations. Screening PC-based audiometers use a standard computer. Clinical PC-based audiometers are generally more expensive than software audiometers, but are much more accurate and efficient. They are most commonly used in hospitals, audiology centers and research communities. These audiometers are also used to conduct industrial audiometric testing. Some audiometers even provide a software developer's kit that provides researchers with the capability to create their own diagnostic tests.

An audiometer typically transmits recorded sounds such as pure tones or speech to the headphones of the test subject at varying frequencies and intensities, and records the subject's responses to produce an audiogram of threshold sensitivity, or speech understanding profile. The most common type of audiometer generates pure tones, or transmits parts of speech. Another kind of audiometer is the Bekesy audiometer, in which the subject follows a tone of increasing and decreasing amplitude as the tone is swept through the frequency range by depressing a button when the tone is heard and releasing it when it cannot be heard, crossing back and forth over the threshold of hearing. Bekesy audiometry typically yields lower thresholds and standard deviations than pure tone audiometry.

List of apparatus:

Sl. No.	Name of the equipment	Range / specification	Quantity
1	Audiometer	NA	1

Procedure:

Step 1: Connect the headphone to the ear of test subject

Step 2: switch on the power supply of audiometer

Step 3: Increase the intensity of the sound at different frequency and note the feedback from the user

Tabular Column

Sl No	Frequency	Intensity Levels
2	1000	
2	1200	
3	1500	

RESULT AND DISCUSSION:

The Audiotory reponses of the subject were studied and the Audiogram was plotted.

Ex. No 3: Generation and analysis of ECG wave using simulator

Aim:

To simulate ECG signal and analyze the signal parameters.

Apparatus Required:

ECG simulator, ECG Amplifier, Digital storage oscilloscope, connecting cables

Procedure

1. The ECG simulator is provided with 8 pattern selection
2. Connect the unit to mains.
3. Connect the simulator with ECG Amplifier
4. Connect the output of ECG amplifier to DSO.
5. Switch ON the Units.
6. Set the DSO setting to visualize the waveforms on DSO.
7. Note down the reading
8. Change the patterns to study different ECG waveforms

Theory:

The electrocardiogram is an instrument which records to electrical activity of heart. Electrical signals from the heart, characteristically placed the normal mechanical functions and monitoring of these signal has great clinical significance. Electrographs are used in authorization laboratories, coronary care units and for routine diagnostic applications in cardiology. The diagnostically useful frequency range is usually accepted as 0.05-150hz.

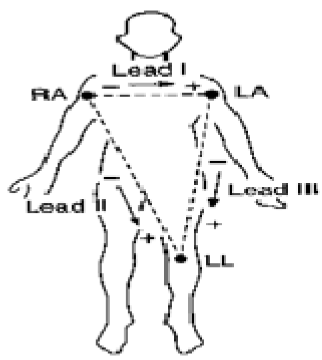
Einthoven Triangle:

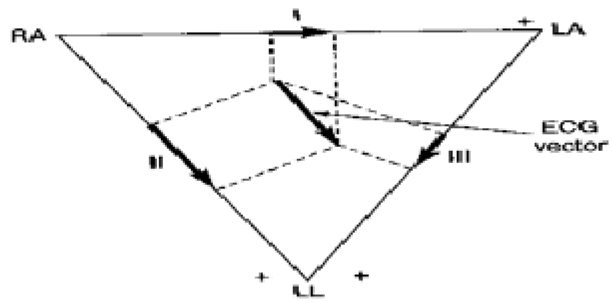
It starts the vector sum of the projection of the frontal phase cardiac to vector to the 3 axis of the Einthoven triangle will be zero.

Lead 1: Left arm and right arm

Lead 2: Left leg and right leg

Lead3: Left and right arm





Bipolar Leads:

ECG is recorded by using two electrodes such that the final trace corresponds to the difference of electrical potentials existing between them, they are called standard leads and have been universally accepted. They are also called as einthoven lead.

Unipolar Lead:

If the electrode is placed close to the heart , higher potentials can be obtained, that normally available at limbs. ECG is recorded between a single exploratory electrode and the central terminal, which has a potential corresponding to the centre of the body. The reference electrode is obtained by combination of several electrodes tied together at one point, it is of 2 types

1 Limb lead 2 Pericordial leads

LEAD 1

WAVE	AMP(V)	TIME(s)
P		
QRS		
T		

LEAD 2

WAVE	AMP(V)	TIME(s)
P		
QRS		
T		

Result:

The ECG was recorded and analyzed using simulator.

Ex No. 4. Recording of EMG using using EMG simulator

Aim

To record and analyze EMG signal using EMG simulator.

APPARATUS REQUIRED.

1. EMG simulator
2. Emg amplifier
3. DSO
4. Connecting Cables.

PROCEDURE

1. Connect the Biosignal amplifier to main supply.
2. Connect the EMG simulator to EMG amplifier
3. Switch on the Amplifier.
4. Connect the EMG amplifier out to DSO.
5. Switch ON the DSO.
6. Set Time/ Div knob ON THE mS division
7. Voltage division knob at 5Mv
8. Now vary the amplitude and frequency knob of EMG simulator
9. If any noise in signal check for proper ground.
10. Measure amplitude and frequency from the waveform.

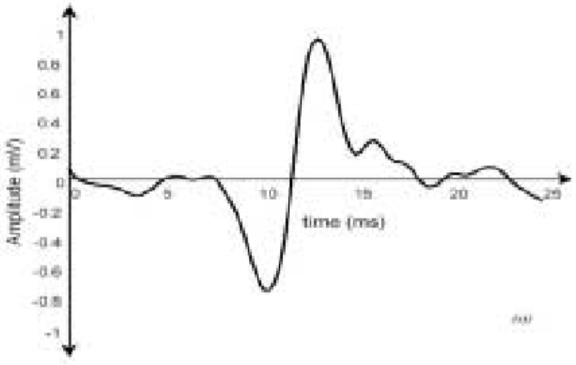


Figure 2-2: Action potential (AP) of one motor unit

THEORY

The muscle cells are roughly cylindrical, with diameters between 10 and 100 um but up to afew 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

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.

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.

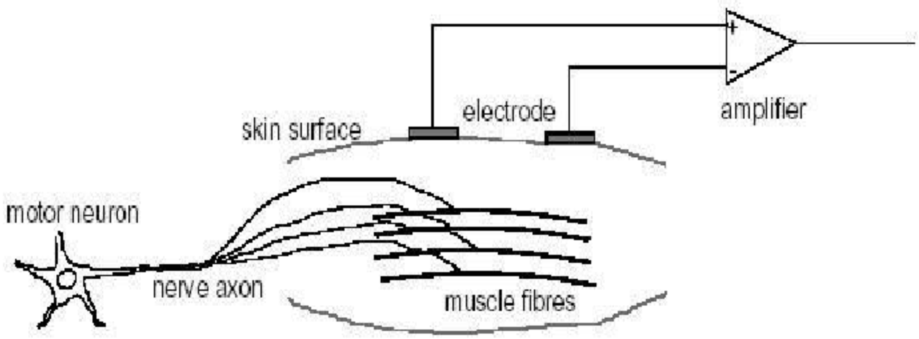


Figure 2-1: Detection of the motor unit action potential (MUAP)

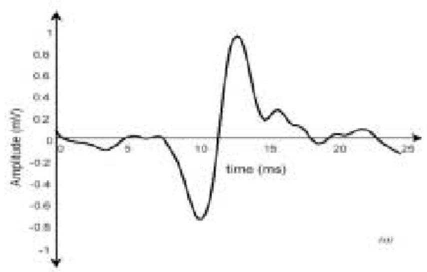


Figure 2-2: Action potential (AP) of one motor unit

RESULT:

The EMG signal is recorded and analyzed the waveform.

Ex. No. 5. Generation of EEG signals using EEG simulator.

Aim:

Generation of EEG signal using EEG simulator and measure the amplitude, frequency and to find the nature of the EEG.

APPARATUS REQUIRED:

1.EEG Simulator

2.EEG Amplifier

3. DSO

4. Connecting Cables

PROCEDURE

1. Connect the EEG Simulator to main

2. Connect the simulator output to eeg amplifier

3. Connect the EEG amplifier to DSO.

4. Switch ON the Units

5. Put the DSO on storage mode

6. Put the switch on DC mode

7. Time / Div Knob on the mS & S division

8. Voltage /Div Knob on the 5Mv

9. Now vary the amplitude as per requirement

10 If any noise on DSO, Check the ground

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.

EEG WAVE PATTERNS:

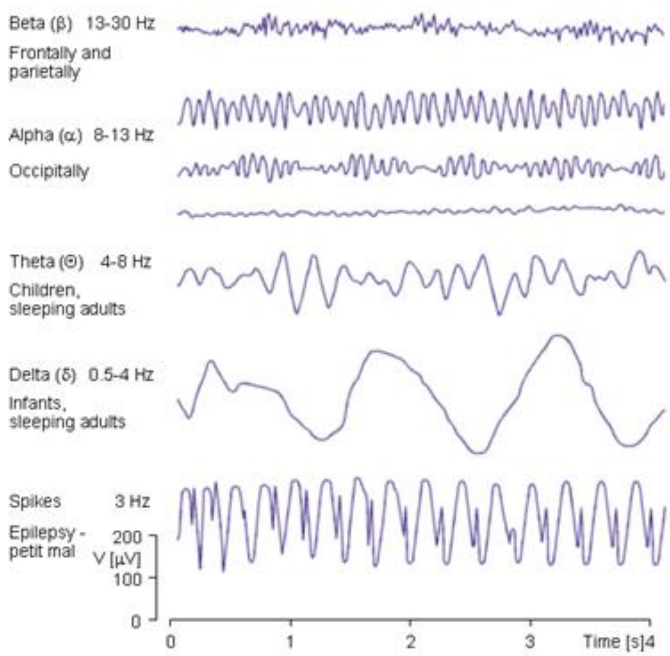
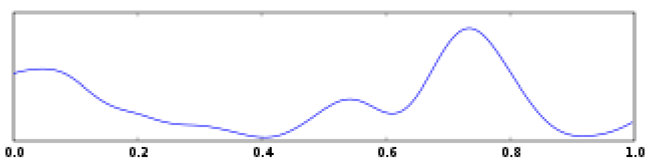


Fig. 13.5. Some examples of EEG waves.

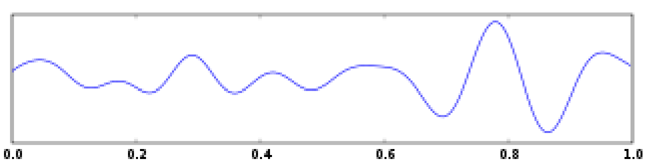
DELTA WAVE:

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.



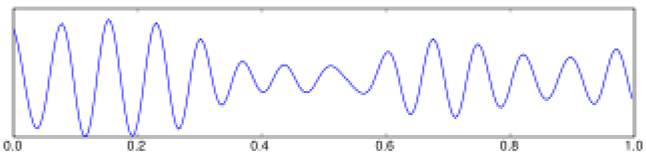
THETA WAVE:

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:

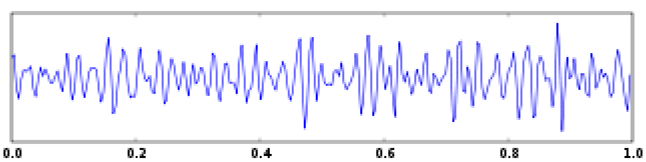
Alpha is the frequency range from 8 Hz to 12 Hz. Hans Berger named the first rhythmic EEG activity he saw, the "alpha wave. It emerges with closing of the eyes and with relaxation, and attenuates with eye opening or mental exertion. The posterior basic rhythm is actually slower than 8 Hz in young children.



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.



Tabular Column

WAVES	AMPLITUDE(V)	TIME(S)	FREQUENCY(Hz)
ALPHA			
BETA			
THETA			
DELTA			

Result:

Thus the EEG waves are studied and the amplitude and time for each waveforms are noted for a Subject

.

Ex NO. 6. Recording of various physiological parameters using patient monitoring system and telemetry units.

AIM:-

To display Blood pressure , Pulse rate , ECG , Respiration rate , temperature and SpO2 signals using patient monitor.

Apparatus Required:

Patient Monitoring SystemDisplay,

Leads

BP Cuff

Sensors

Electrodes.

THEORY:

Patient monitoring systems are used for measuring automatically the value of the patient's important physiological parameters during a surgical operation. The patient is deprived of several manual reaction mechanisms which normally restores abnormalities in his physical conditions or alert other people. Harm done to the patient can be prevented.

BLOCK DIAGRAM EXPLANATION:

ECG: The biopotential generated by muscles of heart results in ECG. The voltage difference at any two sites due to electrical activity of the heart is called "lead". There are basically two leads;

Unipolar leads
Bipolar leads

UNIPOLAR LEAD:

There are two types, one is limb lead in which two of the limb leads are tied together and recorded with respect to the third. The other one is pericardial lead which employs an exploring electrode to record the potential of the heart action on the chest at six different positions.

BIPOLAR LEAD:

ECG is recorded by using two electrodes such that the final trace corresponding to the difference of electrical potential existing between these two are called standard leads.

EEG:

The recorded representation of bio-electric potential generated by the neuron activity of

the brain is called EEG. Modern machines make the use of computerised EEG signal processing.

FREQUENCY ANALYSER:

It takes the low EEG wave mathematically , analyses them and breaks them into their component frequencies. Hence EEG signal is converted into simplified waveform called spectrum.

COMPRESSED ANALYSER:

The amplitude changes result in power of resulting frequency spectrum.

COMPRESSED SPECTRUM ARRAY:

In this format a series of computer smoothed spectral array are stretched vertically at several intervals. The origin of plot shifts vertically with time which produces dimensionalgraph

DSA:

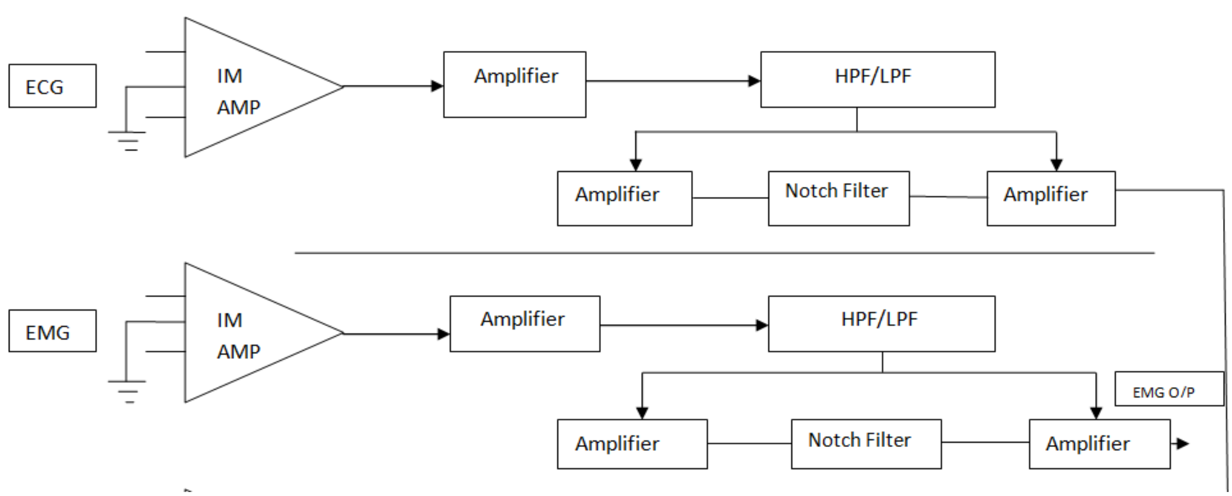
It displays power spectrum.

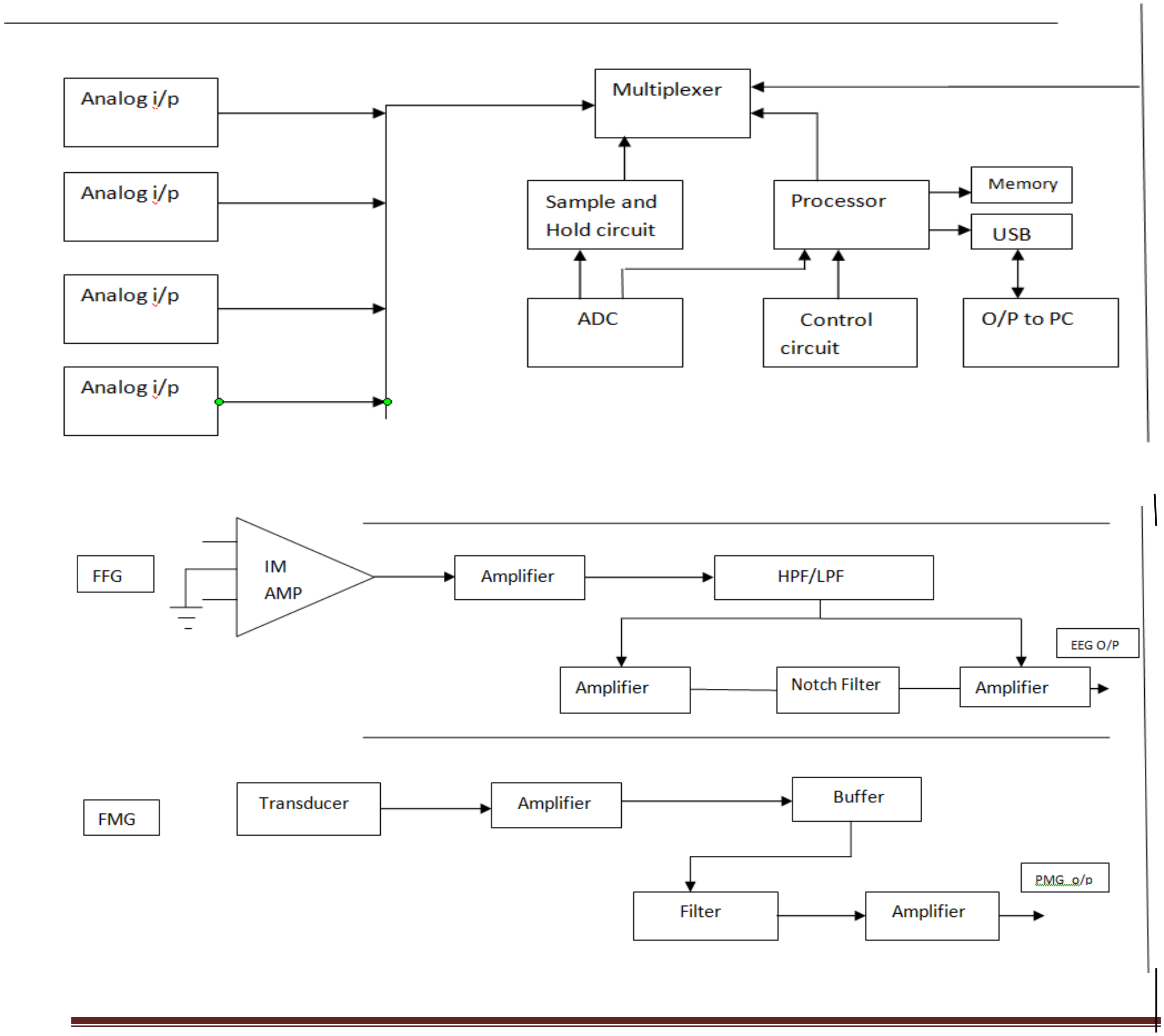
SAMPLING RATE:

Signal with high band width requires sampling to be carried out at high rate. A high sampling rate necessitates a large memory to store all the data. A sampling channel memory display system has sampling rate of 256 samples and multiple channel displays work as 100 samples.

PULSE RATE:

The pulse rate can be felt by placing the finger tip over the radial artery in the wrist. The pulse pressure and waveform are indicated for blood pressure and flow. The pulse gives a measure of pulse wave velocity which can be recorded and compared with ECG signal.





The method used for detection of pulse changes are:

a) Electrical impedance change
b) Strain gauge
c) Optical changes

OBSERVATION TABLE:

CASE I:

ECG (bpm)	NIBP (mmHg)		TEMP. (< F)	SPO2 %
	SYS.	DIA.		

CASE II:

ECG (bpm)	NIBP (mmHg)		TEMP. (< F)	SPO2 %
	SYS.	DIA.		

CASE III:

ECG (bpm)	NIBP (mmHg)		TEMP. (< F)	SPO2 %
	SYS.	DIA.		

RESULT:

Display of EEG, ECG, and EMG signals along with respective waveforms is studied and verified using the patient monitoring system.

Ex NO. 7. Measurement of pH using pH meter

AIM

To measure the pH of a given sample

APPARATUS REQUIRED:

pH meter

pH Electrode

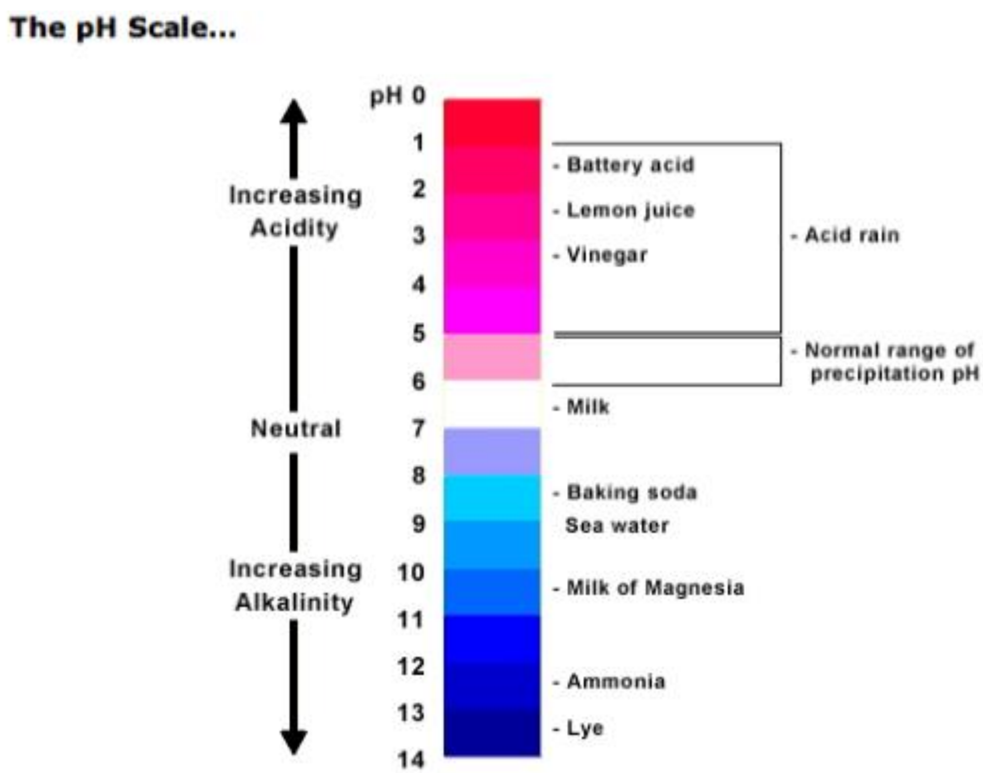
Duffer solution

Thermometer

THEORY:

Introduction: pH is a measure of the acidity of an aqueous solution. It is related to the concentration of hydrogen ion, H+. The pH scale can tell if a liquid is more acid or more base, just as the Fahrenheit or Celsius scale is used to measure temperature. The range of the pH scale is from 0 to 14 from very acidic to very basic. A pH of 7 is neutral. A pH less than 7 is acidic and greater than 7 is basic. Each whole pH value below 7 is ten times more acidic than the next higher value. The dissociation of water into hydrogen and hydroxide ions is the basis for the pH scale. The pH is related to the concentration of hydrogen ions by the formula, pH = -log[H+]. It is a logarithmic relationship. When the concentration of hydrogen ion changes by a factor of 10, the pH changes by a factor of 1. Many chemical processes are pH dependent and careful control of pH is important consideration. Solution pH is an important property that is measured by means of a pH meter.

A pH meter and its electrodes form a sensitive electrochemical device that will allow an accurate, reproducible, and reliable measurement of the pH of a solution (see Figure 1). A pH meter is essentially a voltmeter that measures the voltage of an electric current flowing through a solution between two electrodes. There is a direct relationship between the voltage and the pH of a solution. As a result, the meter on the instrument is calibrated directly in pH units. Two electrodes are required. One of them is called a glass electrode. This electrode is sensitive to the concentration of H+ ions in the solution. The other electrode is called the reference electrode and its operation is independent of the composition of the solution. The two electrodes are sometimes combined into a single entity called a combination electrode.



Formula:
Ph= - log(H+)

Figure 1. pH meter and a schematic diagram of a glass electrode.

PROCEDURE:

1. Prepare buffer solution of PH4 and Ph 9.2 by dissolving the respective buffer tablets
2. Measure the temperature of the buffer solution and adjust the temperature to penetrate.
3. Dip the electrode in the buffer solution.
4. Swich on the pH meter.
5. Push the Ph/Mv switch to ph positive and STBV/READ switch to read position and adjust CAL control to set on the read out and wait for 30 seconds
6. Set STBV/READ switch to STBV position to move the container with pH and buffer solution.
7. Wash the electrode with distilled water and clean with tissue paper.

PH MEASUREMENT OF GIVEN SAMPLE:

1. Measure the temperature of the given sample and set the temperature control and immersed electrode in the given sample.
2. Set the Ph/Mv switch to Ph position and STBV/READ switch to read position and wait for 30 seconds.
3. The pH value of the sample will be displayed in the read out.

Tabulation:

Sl.no	**sample**	**pH**
1	Sample 1	4
2	Sample 2	9.2
3	Sample 3	7

RESULT:
The PH value of the given solution was measured.

ExNo.8. Study of ESU – cutting and coagulation modes

AIM:

Heat energy is applied to the painful area which speeds up the cellular metabolism and increasesthe blood flow.

APPARATUS REQUIRED:

*Shortwave diathermy unit.

*Pad electrodes.

*Ultrasound diathermy unit.

*Surgical diathermy unit.

DESCRIPTION:

Diathermy involves heating deep muscular tissues. When heat is applied to the painful area, cellular metabolism speeds up and blood flow increases. The increased metabolism and circulation accelerates tissue repair. The heat helps the tissues relax and stretch, thus alleviating stiffness. Heat also reduces nerve fiber sensitivity, increasing the patient's pain threshold.

There are three methods of diathermy. In each, energy is delivered to the deep tissues, where it is converted to heat. The three methods are:

- Shortwave diathermy: The body part to be treated is placed between two capacitor plates. Heat is generated as the high-frequency waves travel through the body tissues between the plates. Shortwave diathermy is most often used to treat areas like the hip, which is covered with a dense tissue mass. It is also used to treat pelvic infections and sinusitis. The treatment reduces inflammation. Most machines function at 27.33 megahertz.

- Ultrasound diathermy: In this method, high-frequency acoustic vibrations are used to generate heat in deep tissue.
- Surgical diathermy:The use of electrocautery for coagulation or cauterization, as for sealing a blood vessel, resulting in local tissue destruction

Diathermy is also used in surgical procedures. Many doctors use electrically heated probes to seal blood vessels to prevent excessive bleeding. This is particularly helpful in neurosurgery and eye surgery. Doctors can also use diathermy to kill abnormal growths, such as tumors, warts, and infected tissues.

RESULT :

The diathermy machine and their applications along with the types of diathermy machine were studied.

ExNo.9. Study of Opto-isolation amplifier

AIM

To measure pulse rate and to study the characteristics of opto isolation amplifier.

Apparatus required

1 Transducer : 1 with 1.5 meter, EP pin

2. Mains Cord : 1 Three pin with Socket

3. Test Probe : 2 2mm set.

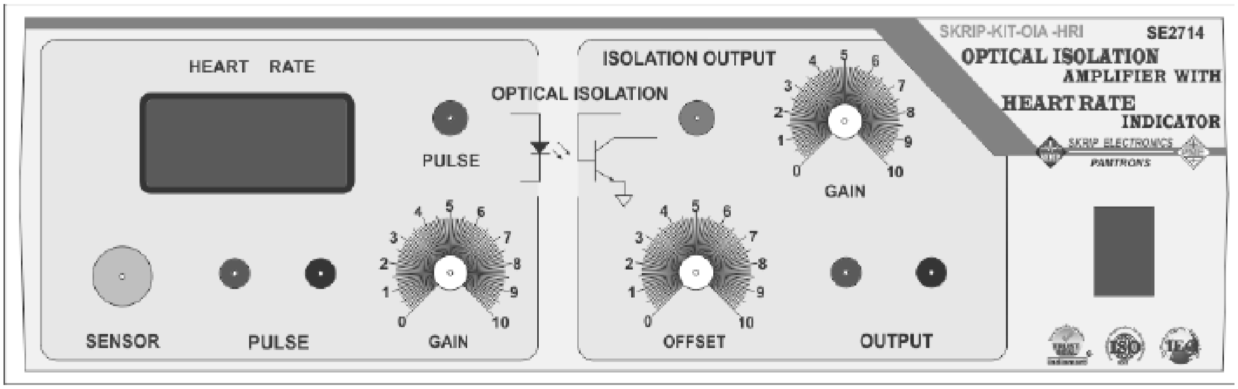
4. Opto isolation Kit.

5. DSO

6. Connecting Cables

Installation Procedure

1. Connect the instrument to the mains.



2. Connect the Transducer to system

Insert the transducer plug into the transducer socket.

3. Use storage Oscilloscope.

    1. Now switch ON DSO.

    2. Put the DSO on storage mode,

    3. Mode switch at DC position, Probe on 'X1' position.

    4. Time / Div Knob on the 50mS Division. (Change the position as per signal)

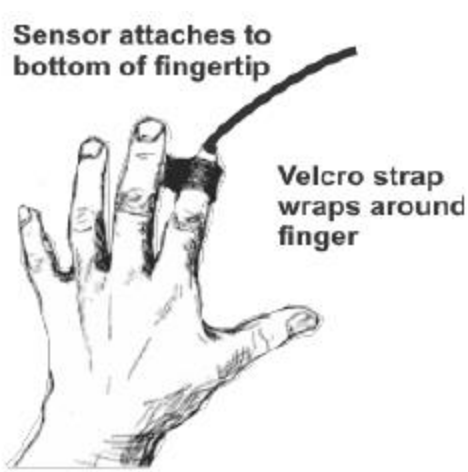
    5. Voltage / Div Knob on the 5V. (Change the position as per signal)

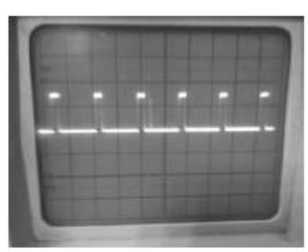
4. Now connect the DSO to the instrument.

Connect DSO probe to instrument at Pulse output 2mm red socket & Black socket Ground.

5. Putting the sensor

Put the finger on transducer & wrapped with Velcro around the finger. The transducer should not be too tight. Make arrangement of transducer as we get proper pulse. If there is any moments not get the proper readings. There are reading ± 2 digits up & down. Adjust threshold/Gain control if Pulse is not proper.





6. See signal Pattern on DSO

If Pulse not properly, adjust threshold control knob.

7. Display shows the Heart Rate. Red LED is indication of Heart Pulse. This same to Optical Isolation amplifier.

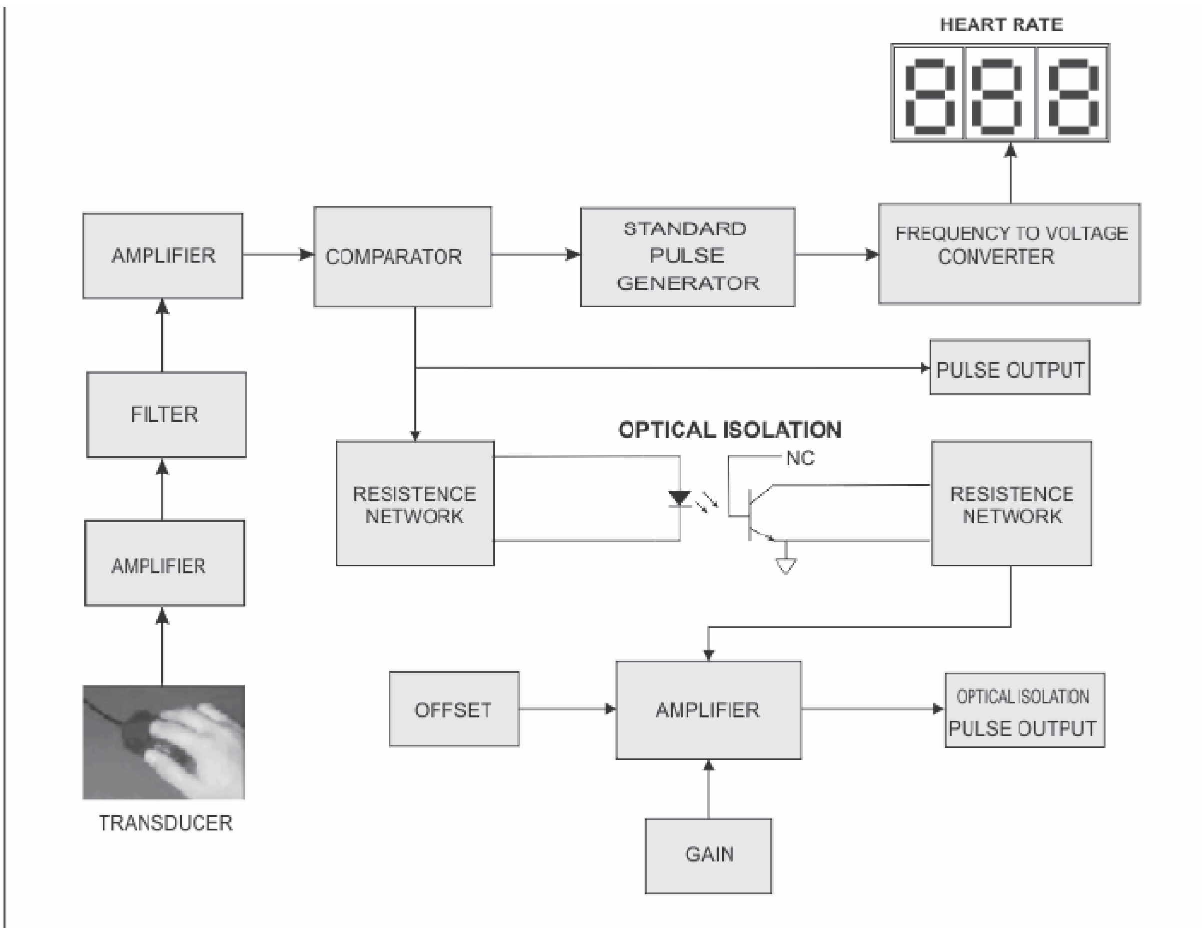
No movement, person must in rest position

8. Check the ground; if not proper make arrangement for that.

9. Now DSO Connect at isolation Output.

Green LED indication of Pulse output of Isolation amplifier. Red LED ON Green OFF & Pulse from Positive to Ground.

BLOCK DIAGRAM



Optical Isolation Amplifier Using Heart Pulse

MEASUREMENT OF PULSE RATE

Plethysmography is a non-invasive method for studies of the heart rate. This pulse wave will result in a change in the volume of arterial blood with each pulse beat. This change in blood volume can be detected in peripheral parts of the body such as the fingertip or ear lobe using a technique called Photo plethysmography. The device that detects the signal is called a plethysmography.

Heart rate measurement indicates the soundness of the human cardiovascular system. The transducer consists of a Red LED that transmits an LDR through the fingertip of the subject, a part of which is reflected by the blood cells. The reflected signal is detected by a sensor. The changing blood volume with heartbeat results in a train of pulses at the output of the sensor, the magnitude is too small.

FORMULA

The Pulse to Pulse interval measures the period of heart beat is denoted by the following

formula.

HR=60/T BPM

T=Pulse to pulse Interval in Second. (P-P)

Where HR is the heart rate measured in beat-per-minute (BPM), interval

measured in millisecond (ms). For example, if P-P is 800 ms, the heart rate is 75 BPM.

TABULAR COLUMN

Sl.No	Subject	Pulse time ms	Calculated HR	HR Display
1				
2				
3				
4				
5				

THEORY

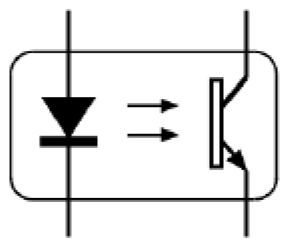
Opto-isolators or Opto-couplers, are made up of a light emitting device, and a light sensitive device, all wrapped up in one package, but with no electrical connection between the two, just a beam of light. The light emitter is nearly always an LED. The light sensitive device may be a photodiode, phototransistor, or more esoteric devices such as thyristors, TRIACs etc.

The opto-coupler is a component that contains the two elements required for an opto-isolator:

Light emitter: The light emitter is on the input side and takes the incoming signal and converts it into a light signal. Typically the light emitter is a light emitting diode.

Light detector: The light detector within the opto-coupler or opto-isolator detects the light from the emitter and converts it back into an electrical signal. The light detector can be any one of a number of different types of device from a photodiode to a phototransistor, photodarlington, etc.

Opto-coupler symbol:

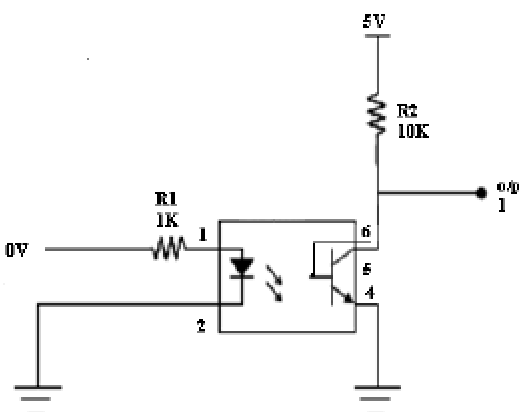


The symbol shows the LED, which is normally used as the light emitter. The opto-coupler symbol also shows the receiver, often a phototransistor or photodarlington, although other devices including light sensitive diacs, etc may also be used. The relevant device type is shown within the optocoupler circuit symbol.

Application of MCT2E:

It is a combination of 1 LED and a transistor. Pin 6 of transistor is not generally used and when light falls on the base-emitter junction then it switches and pin5 goes to zero.

MCT2E Opto-Coupler - Circuit



When logic zero is given as input then the light doesn't fall on transistor so it doesn't conduct which gives logic one as output.

When logic 1 is given as input then light falls on transistor so that it conducts, that makes transistor switched ON and it forms short circuit this makes the output is logic zero as collector of transistor is connected to ground.

RESULT

The Characteristics of opto-isolation amplifier was studied and Pulse rate was measured.

Ex No.10. Galvanic skin resistance measurements

AIM: To measure and display the galvanic skin resistance variations of skin.

APPARATUS REQUIRED:

1. GSR Simulator
2. GSR instrument
3. Electrode
4. DSO

PROCEDURE:

1. Connect the GSR meter to the main supply
2. Connect the resistance simulator to GSR meter
3. Set the resistance in simulator to 10 k ohms
4. Adjust the GSR meter to zero.
5. Increase the resistance value in simulator
6. Record the GSR meter and tabulated
7. Increase the resistance in simulator step wise and measure the deflection and tabulated.
8. Connect the electrodes in finger

9 Connect the output of electrodes to GSR meter

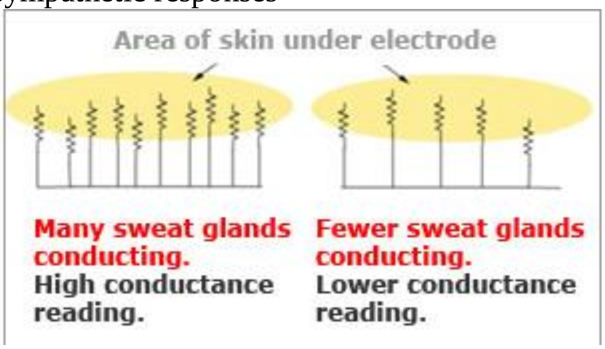
10. Measure the resistance change
11. Ask the patient for different emotions and record the change in GSR value.
12. Connect the DSO with GSR meter
13. Get the waveform of chages in GSR with respect to time.

THEORY:

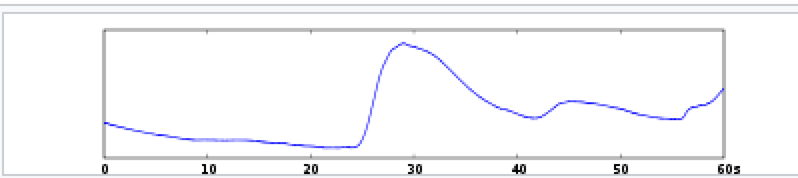
Human skin offers resistance to electric current just like a resistor do in an electronic circuit. This transient change in the electrical conductivity of the skin followed by an arousal or oriented response is referred to as **Galvanic skin response or GSR** .The skin acts as a resistive layer and readily passes electric current. In normal Skin tone, the resistance varies from **25 Kilo Ohms to a few Mega Ohms**. This permits little current to pass through it. Sweating in the high emotional

state or stress causes increased blood flow to the skin and reduces the skin resistance and increases its electrical conductivity.
Electrodermal activity (**EDA**), is the property of the human body that causes continuous variation in the electrical characteristics of the skin. Historically, EDA has also been known as **skin conductance**, **galvanic skin response** (**GSR**), **electrodermal response** (**EDR**), **psychogalvanic reflex** (**PGR**), **skin conductance response** (**SCR**), **sympathetic skin response** (**SSR**) and **skin conductance level** (**SCL**). The long history of research into the active and passive electrical properties of the skin by a variety of disciplines has resulted in an excess of names, now standardized to **electrodermal activity** (**EDA**).

The traditional theory of EDA holds that skin resistance varies with the state of sweat glands in the skin. Sweating is controlled by the sympathetic nervous system,[4] and skin conductance is an indication of psychological or physiological arousal. If the sympathetic branch of the autonomic nervous system is highly aroused, then sweat gland activity also increases, which in turn increases skin conductance. In this way, skin conductance can be a measure of emotional and sympathetic responses

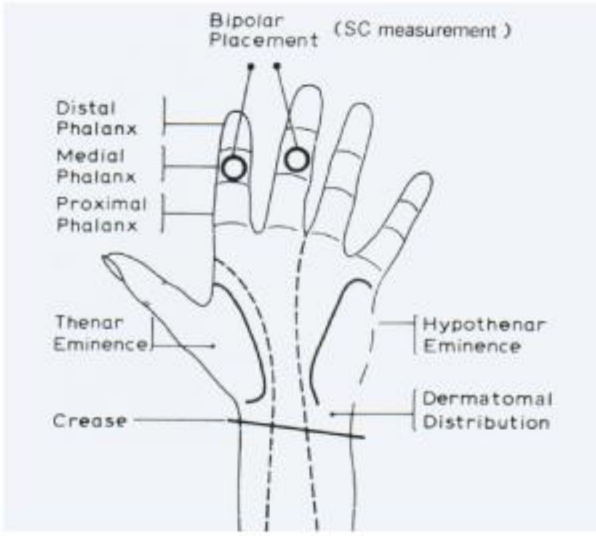


Procedure: Skin conductance (SC) is normally measured with 8mm diameter silver/silver chloride electrodes positioned on the medial phalanx of the index and middle fingers held in position by double sided sticky electrode collars. A non-saline jell is used. SC response (SCR) provides an indication of arousal.
Electrode placement for measurement of GSR is as shen in the fig. The output of electrode is given the op amp input as shown in the circuit diagram.
The output of the amplifier if given to CRO to display the variations of skin resistance with respect to time. The sample waveform is as shown in the figure



A sample GSR signal of 60 seconds duration

Electrode placement diagram:



Tabular Colum Basal Skin Resistance -

Sl.no	Simulator Skin resistance	Theoretical GSR	Measured GSR
1			
2			
3			
4			
5			

RESULT:

The galvanic skin resistance was recorded and analyzed the GSR for various emotions.