Summer– 15 EXAMINATION

Subject Code: **17545** **Model Answer** Page No: __01/21

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

SUMMER – 15 EXAMINATION

Subject Code: 17545 **Model Answer** **Page No: _2/ 21**

Q1 A) Attempt any THREE: **Marks12**

(a) Draw a block diagram of digital temperature meter and give four specification of it. **04**
(Diagram: 2 marks, ½ mark for each specification)

Answer:

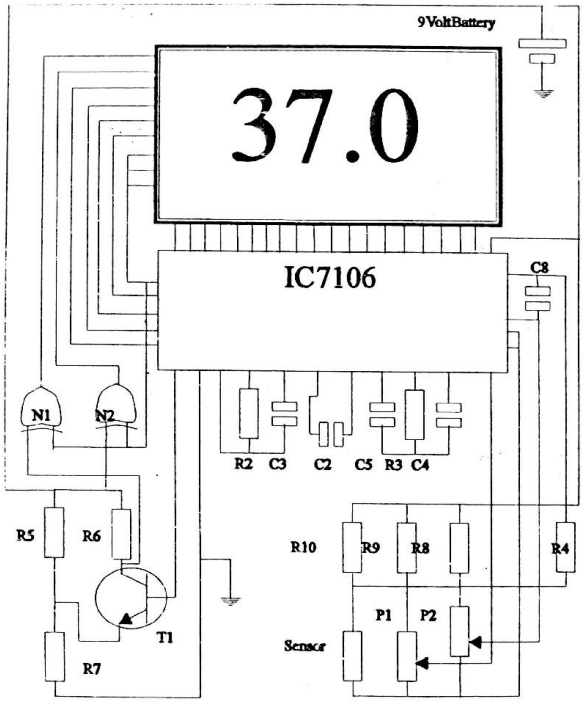


Fig:Digital Temperature Meter

Specifications:
1. Power: Battery-9 Volts
2. Resolution: 0.1
3. Transducer: Semiconductor
4. Display: 7 Segments LCD

(b) Explain blood pressure waveform. **04**
(Diagram: 2 marks, Description: 2 marks)

Answer:

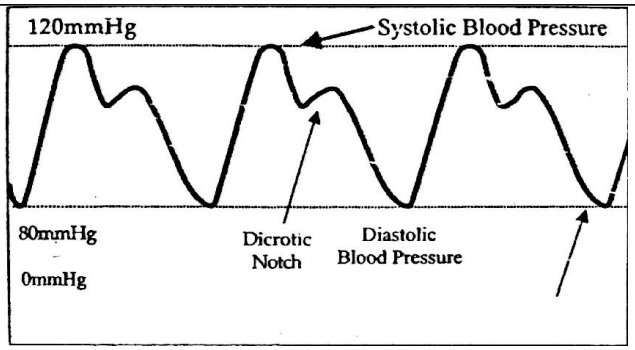


Fig:Blood Pressure waveform

Blood pressure represents the pumping activity of the heart.
Blood Pressure is the force that the blood exerts on the walls of the blood vessels.
The peak pressure of this wave is called systolic pressure and has value about 120-mm equivalent of mercury level.
The low pressure of this wave is called diastolic pressure and has value about 80-mm equivalent of mercury level.
There is slight back pressure built up as the valve closes, and due to the tapering of the circulatory system.
This results into valley in the waveform which is called as dicrotic notch.

(c) Illustrate the following methods of calculation of heart rate: **04**

i) Average **ii) Beat-to-beat**

(Average method: 2 marks, Beat-to-beat method: 2 marks)

Answer:

i) Average calculation:

This is the oldest and most popular technique.
An average rate (beats/min) is calculated by counting the number of pluses in a given time.
The average method of calculation does not show changes in the time between beats and thus does not represent the true picture of the heart's response exercise, stress and environment.

ii) Beat-to-beat calculation:

This is done by measuring the time (T), in seconds, between two consecutive pulses.
Then this time is converted into beats/min, using the formula beats/min=60/T.
This technique is accurately represents the true picture of the heart rate.

(d) Describe the generation of ECG signal. **04**

(Description: 4 marks)

Answer:

The recording of electrical activity associated with the functioning of the heart is known as ECG signal.
ECG signal is periodical, rhythmically repeating signal synchronized by the function of the heart, which act as a generator of bioelectric events.
The position of SA node in the heart from where the impulse responsible for the electrical activity of the heart originates.
The potential field generated by SA node extends to the other parts of the heart.
The wave propagates through the right and left atria.
The action potential contracts arterial muscle and impulse spread through arterial wall to AV node. This corresponds to P wave in ECG graph.

AV node delays the spread of excitation.
Then bundle of His carries the action potential to the ventricles.
The direction of impulse propagating in bundle of His is from the apex of the heart; ventricular contraction begins at the apex and processed upward through the ventricular walls.
This results in the contraction of the ventricles which produce squeezing action which forces the blood out of the ventricles into arterial system. This corresponds to QRS complex in ECG graph.
The repolarization of ventricles corresponds to T wave in ECG graph.

B) Attempt any ONE: **Marks 6**

(a) Draw and describe the block diagram of Wilsons n/w used in ECG m/c and explain its importance. **06**

(Diagram: 2 marks, Description & Importance: 04 marks)

Answer:

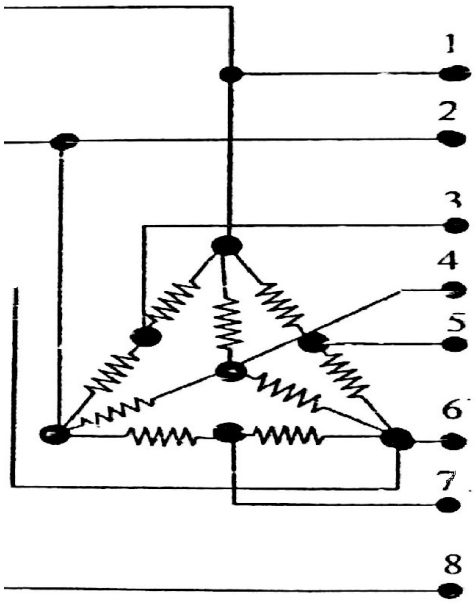


Fig:Wilson Network

The Wilsons network is present in input section of ECG machine.

The potentials which are picked from the patient electrodes are given to the Wilsons network.

The Wilsons Bridge is the lead selection network.

The Wilsons network performs mixing or summing function and thus provides ECG connections for lead selection.

The Wilsons network sums the various electrode voltages to achieve standard voltage for different ECG selection.

The MUX selects the appropriate lead voltages from resistor network.

(b) State the trouble shooting procedure and maintenance of EEG machine. **06**

(Trouble shooting procedure: 3 marks, Maintenance: 3 marks)

Answer:

Trouble shooting procedure:

Symptom	Reasons	Troubleshooting	Action
Machine runs, but the tracing on one or more channels is missing	1. Ink reservoirs for pens are dry [on missing channels]	1. Check ink reservoirs.	1. For dry ink reservoirs, fill to level suggested by manufacturer (usually below top rim). To overfill causes messy operation and can damage circuitry and mechanisms if allowed to drip (To fall in drops) into the machine.
	2. Ink tubes are clogged.	2. Check ink tubes for clogging.	2. For clogged ink tubes, remove the tube and pen and soak in warm water Use a fine wire to water. Gently push the clog through. Be certain not to punch a hole in the tube.
	3. Pen is not touching.	3. Check for upwardly bent pens-gently push pen onto paper with finger or pencil to observe any touching	3. For bent pens remove the pen in question and gently bend the pen downward. Be careful not to bend at right angles, as these pens are delicate and will crack.
Spotty recordings (light or dark).	1. Worn pens or incorrectly loaded paper.	1. Check paper loading.	1. For paper loading, perform manufacturer's procedure.
		2. And if proper, then check pen for worn tip (ink not feeding properly)	2. For worn pen tip, replace with manufacturer's part or equivalent.
Noisy or poor recording.	1. Lead connection or electronic or mechanical problems.	1. Place selector switches to standard calibration position and check for noise and improper operation.	1 For patient connection, physically inspect all electrodes and connectors to the machine.
		2. If calibration operation is normal, the problem is properly the patient connection.	2. For machine problem, internal repair will be necessary
		3. Grounded all EEG leads and check for straight line tracing (noiseless) and, If good, connect an EEG simulator, if available. Check for good tracings. If noise appears on the trace, the problem is properly inside the machine. Refer to the service manual for troubleshooting.	

Maintenance of EEG machine:

After data collection is complete, carefully remove cap and electrodes from patient.

Clean caps and electrodes after each use in a mild detergent (e.g., children's shampoo) with a toothbrush.

Take care not to bend or damage the lead wire. Also take care to keep the electrical connectors dry.

After gently scrubbing with a toothbrush to remove all traces of electrode gel, rinse the cap with water and the electrodes with distilled water.

Disinfect caps, electrodes, and combs after each use by soaking in disinfectant solution for 15 minutes.

After soaking, gently rinse with cool water.

Remove excess moisture from cap by wrapping in a towel and squeezing gently, and then lay to air dry.

Store the electrodes in a dark and dry place.

It is important that EEG equipment be properly and promptly cleaned after each participant.

In addition, proper storage is essential for extending the life and preserving the quality of the equipment.

The lead wires are made for moderate tension stress, so avoid tangling and contusing whenever possible.

With careful handling, a cap system will be serviceable for several years.

Never soak electrodes in saline solution or bleach them, as corrosion of connections will result.

Do not to autoclave or use other hot sterilization methods as the wire insulation can be damaged.

Q2. Attempt any FOUR: **Marks16**

(a) Explain digital blood pressure meter with the help of neat diagram. **04**

(Diagram: 2 marks, Description: 2 marks)

Answer:

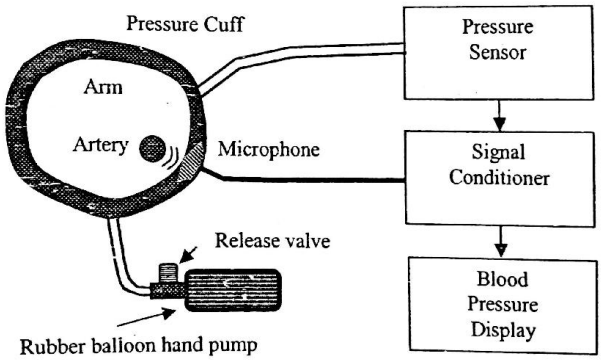


Fig: Digital Blood Pressure Meter

The block diagram of digital blood pressure meter is as shown in above figure.

Mainly it consists of following blocks:

- Cuff with microphone
- Rubber balloon hand pump with release valve

- Pressure sensor
- Signal conditioner
- Display

In this meter, the cuff has to be inflated manually.

The digital display indicates the digital value of pressure inside the cuff by sensing it through pressure sensor.

Korotkoff sounds are automatically sensed by a microphone fixed inside the cuff when valve is released slowly.

They are further processed by signal conditioner and compared with cuff pressure to display the values of systolic and diastolic blood pressure.

(b) Explain the concept of fetal heart rate with the help of neat diagram. 04

(Diagram: 2 marks, Explanation: 2 marks)

Answer:

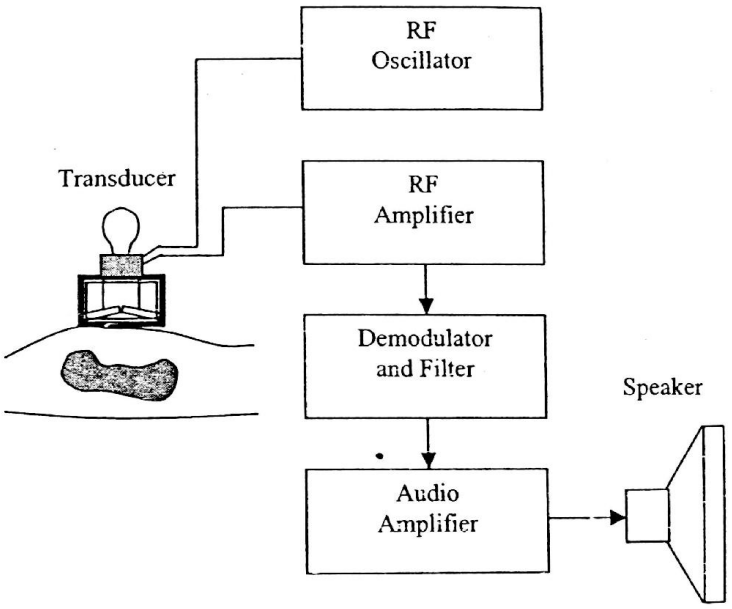


Fig: Fetal Heart Rate meter

The beating of the fetal heart inside the mother's womb can be detected by using ultrasonic fetal monitoring technique.

This is based on Doppler principal.

In this technique, a transducer containing both transmitting and receiving crystals is placed on the mother's abdomen.

A beam of low intensity ultrasound is transmitted into the body as a continuous beam.

Part of this ultrasound is reflected back from the internal structure i.e. moving heart of the fetal.

Ultrasound received from these from moving heart is slightly shifted in frequency from the transmitted ultrasound.

To process the signal, it is passed through demodulator and filter.

The difference in the frequency is converted into an audible signal which can be heard as a heartbeat.

(c) Draw block diagram of pure tone audiometer. Give the importance of microphone and amplifier. **04**

(Diagram: 2 marks, Importance of microphone and amplifier: 2 marks)

Answer:

Importance of microphone and audio amplifier: A microphone is used to produce an electrical signal from air pressure variations. Microphone needs to be connected to a preamplifier before the signal can be amplified with an audio power amplifier. Thus they are employed to have a communication between operator and patient.

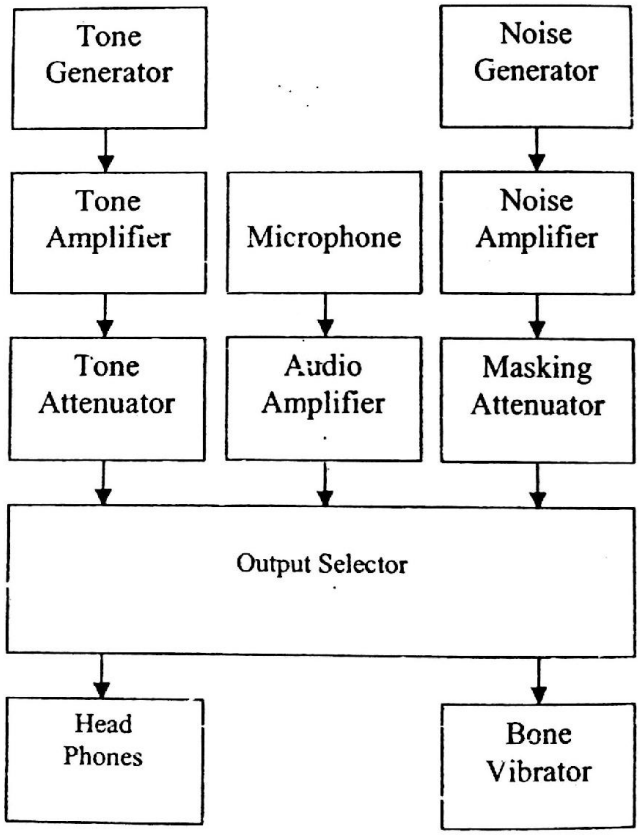


Fig: Pure tone Audiometer

(d) List eight technical specifications of ECG machine. **04**

Answer:

1. Power: A.C.230 volts, 50Hz and or Battery

2. Leakage current: Less than 10 mA with 230VAC

3. Isolation: 30MW minimum from patient to chassis at 50Hz

4. Input impedance: Greater than 20MW

5. Frequency response: 0.05 Hz to 100Hz

6. Noise: Less than 10 mV peak to peak

7. CMRR: Better than 80 dB

8. Sensitivity: 0.5, 1.0 & 2.0 cm/mV

9. Filter: 50 Hz notch filter

10. Lead selection: 12 lead system. Leads I, II, III, aVR, aVL, aVF and C

11. Recorder: Hot stylus single channel galvanometer

12. Recording speed: 25 and 50 mm/second

(e) Describe motor and sensory nerve conduction in EMG system. **04**

(Motor nerve conduction: 2 marks, Sensory nerve conduction: 2 marks)

Answer: Diagrams are optional

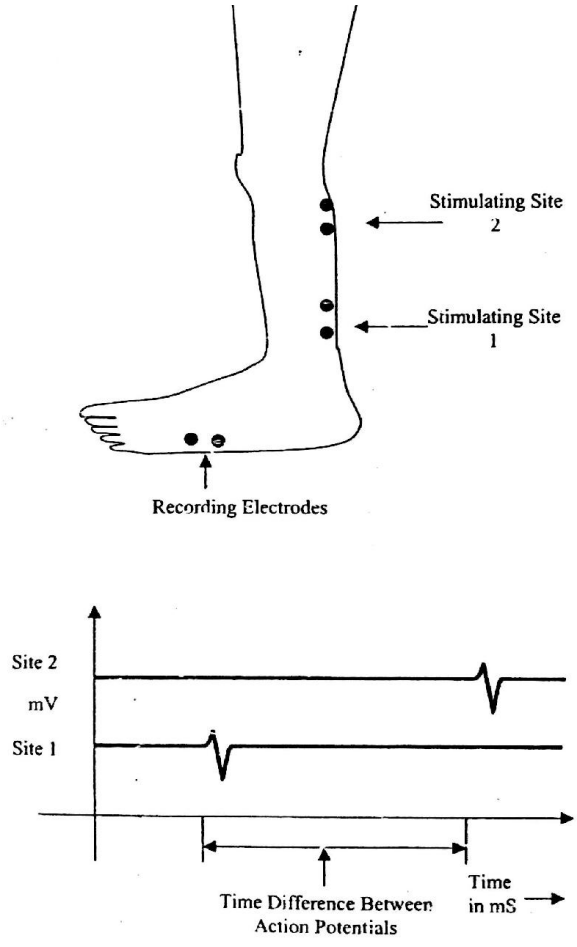


Fig (a) Motor nerve conduction

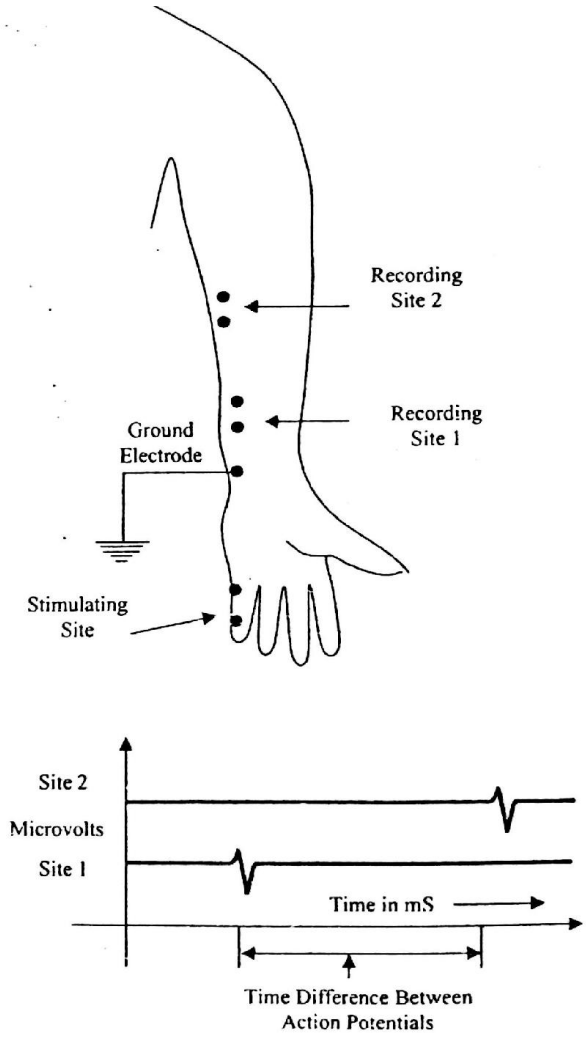


Fig (b) Sensory nerve conduction

Measurement of Motor nerve conduction:

Here, the peroneal nerve of the left leg is stimulated behind the knee and muscular response is detected in the foot, using surface electrodes.

A nerve impulse travels downward along with the motor nerve to the recording site on the muscle of the foot.

The stimulus should be repeated several times to ensure that the responses obtained are consistent.

Measuring the distance between the stimulating and recording site and dividing it by the latency can determine the nerve conduction velocity.

Using this technique, it is possible to measure nerve conduction velocity between several locations.

Measurement of Sensory nerve conduction:

Here, recording electrodes are placed at number of sites on the sensory nerve under test.

The ulner nerve of the hand is considered and the stimulus is applied at the little finger, which is a stimulation site.

Here the nerve impulse travels upward through the nerve and reaches at recording sites, after different time intervals.

In this case sensory nerve conduction velocity is measured as dividing the latency by the distance.

(f) Draw a block diagram of PCG machine and explain its operation. **04**

(Diagram: 2 marks, Explanation: 2 marks)

Answer:

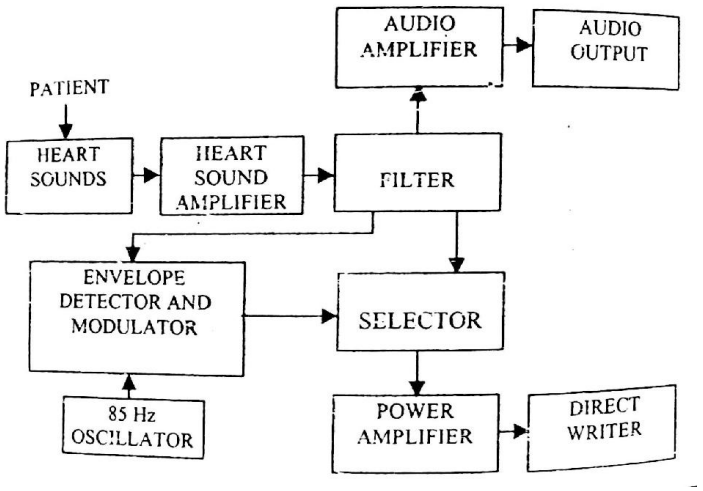


Fig: Phonocardiograph

The block diagram of PCG machine is as shown in above figure.

It consists of following blocks:

- Input heart sound
- Heart sound pre-amplifier
- Filter

- Audio amplifier
- Audio output
- Envelope detector and modulator
- Oscillator
- Selector
- Power amplifier
- Direct recorder

The input heart sound section receives the heart sound signals from the microphone placed on the patient's heart (chest).

Then it is feed to the heart sound amplifier.

Two types of microphones are used viz. contact and air coupled crystal.

Pre-amplifier amplifies the heart sounds to the desired level.

An audio amplifier and audio output section further amplifies these sounds to drive the head-phones.

The five steps filter employed here passes the selected band of heart sounds through selector to the power amplifier.

A direct writing hot stylus galvanometer is used to record heart sounds.

The murmurs are recorded with special electronic envelope detection method.

Q.3 Attempt any four. **Marks 16**

a) Give four technical specifications of sphygmomanometer. **04**

Ans: Pressure Range : 0 to 300 mmHg

Resolution : 1 mmHg

Pressure meter : Mercury manometer or pressure gauge

Pump : Rubber balloon hand pump

Cuff : Inflatable pressure cuff

b) Give four technical specification of heart rate meter. **04**

Ans:-

Power : 230 volts AC, 50 Hz, or Battery-9 volts
Measuring range : 0 to 300 Pulses/ minute
Transducer : Finger (Opto-electric)
Display : 7 Segment LED or LCD
Pulse indication : Audio beep and LED

c) List four different types of EEG signal and draw its waveform with respect to time. **04**

(List 02 Mark ,Waveform 02 Mark)

Ans: EEG Signals are mainly classified on the basis of freq
Normal freq range of the EEG 0.5Hz to 30Hz.
It divided into four bands.

1. Delta wave - Lower than 4Hz or 0.5 to 4Hz
2. Theta wave- 4 to 8 Hz
3. Alpha wave- 8 to 13 Hz
4. Beta wave- 13Hz to 30Hz

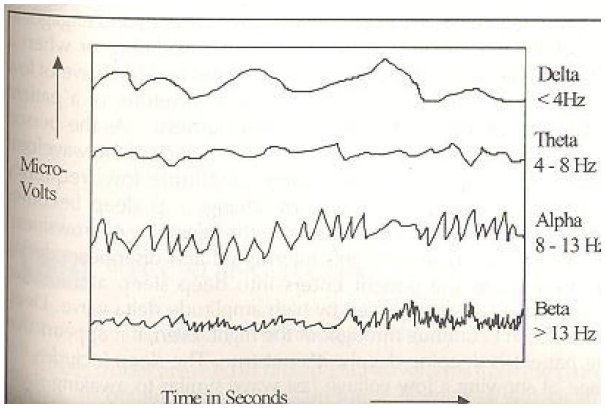
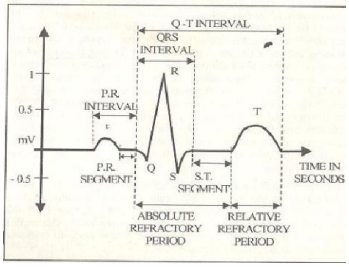
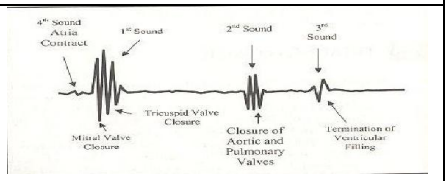


Fig:EEG signals

d) Distinguish between ECG and PCG (any four points) **04**

ECG	PCG
ECG : Electro cardio graph	PCG : Phonocardio graph
It is the recording of electrical activity of heart functioning	It is the recording of the sounds connected with the pumping action of heart.
It is rhythmically repeating signal synchronized by heart function	These sounds provides an indication of heart rate and its rhythmicity.
The origin of ECG signal is SA node in the heart	The origin of PCG signal is pumping action of heart
It provides the recording of electrical activity in the form of PQRS waves.	It provides a recording of wave forms of heart sound.
Its output is in readable form	Its output is in audible form.

To Pick ECG signal surface type of electrodes are used	To Pick PCG signal dynamic microphone or contact sensor microphone can be used as a transducer,
 ECG signal	 PCG signal

e) Explain the concept of vector cardiography. **04**

Vectorcardiography is the technique of analyzing the electrical activity of the heart by obtaining ECG's along three axes at right angles to one another. It display any two of these ECGs as a vector display on an X-Y oscilloscope. The display is known as a vector cardiogram (VCG).
Vector cardiogram displays the same electrical events simultaneously in two perpendicular axes. This gives a vectorial representation of the distribution of electrical potentials generated by the heart, and produces loop type pattern on the CRT screen. Usually a photograph is taken of each cardiac cycle. From such picture, the magnitude and orientation of the P,Q, R, S and T vector loops are determined.VCG illustrates the phase difference between the voltages and also the various leads from which it is derived. The major information that it provides is the direction of depolarization and repolarisation of the atria and the ventricle.

Q.4A) Attempt any three. **Marks 12**

a) Define following respiratory parameter: (01 Mark each) **04**

i) Tidal Volume: The volume of gas inspired or expired (exchanged with each breath) during normal quiet breathing is known as tidal volume.

ii) Expiratory Capacity: After normal inspiration the maximum amount of air that can be forced out is called expiratory capacity.

iii) Vital Capacity: The greatest volume of gas that can be inspired from the resting end expiratory position.

iv) Expiratory reserve Volume: The volume of gas remaining after a normal expiration less the volume remaining after a forced expiration.

b) State Galvanic skin reflex. Draw block diagram of GSR meter and explain its operation. **04**

Ans: Galvanic skin reflex (GSR) is a method of measuring the electrical resistance of the skin. It is also known by many other names such as electro dermal response psycho galvanic reflex (PGR) of skin conductance response (SCR) all these terms relate to one of more activities inside the sweat glands like a change in resistance and generation of potential. A decrease in the subjects resistance indicate arousal, whereas increase in resistance is indicated Relaxation.

GSR measurement is normally performed by measuring a resistance change this is done by detecting the change in impedance between two electrodes on the subject. Silver – silver chloride electrodes can be ased to measure GSR.To make measurement technique sensitive primary to resistance change and also to avoid use of DC currents, very low frequency AC technique are used in GSR measurement. A typical arrangement of electrode placement of GSR measurement is shown in fig GSR is due to the activity of the sweat glands .The BSR output is connect to RC network with a time constant of 3 to 5 seconds which enables the

measurement of GSR as change of the skin resistance. In some cases, instead of the change of skin resistance the change of the skin used. The range of potential changes is between 50mv and 70mv.

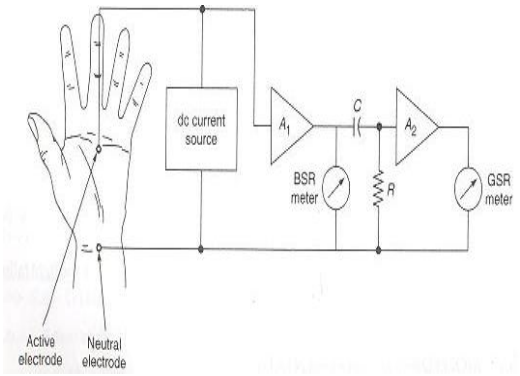


Fig:GSR meter

c) Draw and explain 1 mv calibration network in ECG machine. **04**

(Diagram 02 Mark, Description 02 Mark)

Ans:

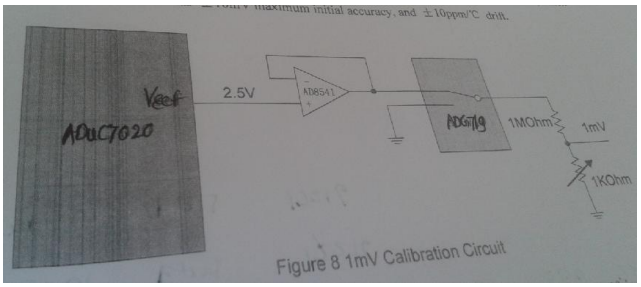


Fig: 1mv calibration circuit

Description:-1mV calibration signal is derived from the embedded reference of the processor ADuC7020, which is 2.5V. The reference has ±10mV maximum initial accuracy, and ±10ppm/℃ drift. As the 1mV accuracy, initial accuracy can be calibrated out, so the temperature drift is the most important factor, for patient monitors, the ambient temperature should be 15~35℃,Analog switch ADG719BRM is used to generate 1mV square waveform. ADG719 is a SPDT switch with a 5Ωmaxim on resistance. The frequency of the square wave is 2Hz. For the system robustness and easy to debug, a 10KΩ pull down resistor is added to set GND as the default setting.

d) State in brief the troubleshooting procedure of EMG machine. **04**

Ans:

Faults	**Action(Remedies)**
The Display Unit No Sig light is on.	There is no signal coming from the backpack. Check that the backpack is connected and the backpack DC OK light is on. If it is not ON then you probably have a broken coaxial cable — replace the cable with a spare and schedule the broken cable for repair as soon as possible

None of the front panel lights are on	Check the line cord and fuse — at a minimum the green POWER light should be on to show that AC power is applied to the unit and the DC Power Supply is operational. Note that there are no user adjustments inside the desktop interface unit. The internal power supply is auto-sensing and will select the correct AC voltage range - no user adjustment is required.
The system is functioning well but no EMG is recorded on any external device.	Check the connecting cable with an oscilloscope to ensure that the cable is correctly connected and that EMG signals are present at the input of the ADC sampling system.
Some EMG channels work but others do not have any EMG signals	Check the analog signal connections from the back of the EMG machine desktop unit through to your measuring/recording system. 99% of all 'lost signal' complaints are due to problems with the analog signal cables and connectors.

B) Attempt any one. **Marks 6**

a) List ECG recording techniques and explain any one in detail. **06**

(list 02 Mark, explain any one 04 Mark)

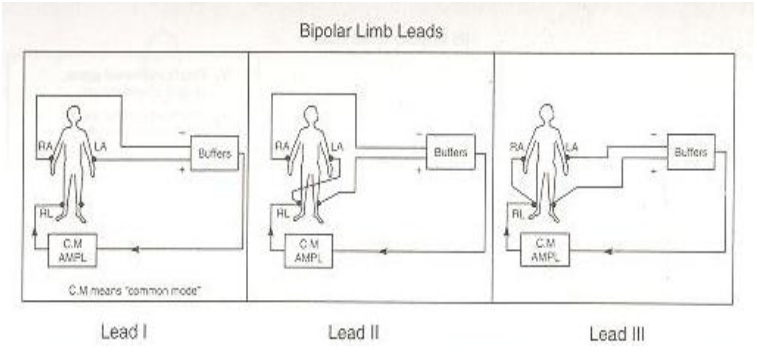
Ans: The ECG recording techniques are given below.

1. Bipoar lead.

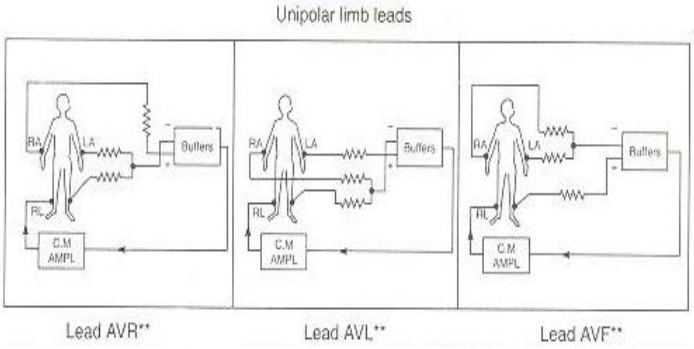
2. Unipolar lead.

3. Unipoar chest lead.

1. Bipoar lead: In bipolar leads, ECG is recorded by using two electrodes.
In standard lead I, the electrodes are placed on the right and the left arm (RA and LA).
In lead II, the electrodes are placed on the right arm and the left leg (RA and LL).
In lead III, the electrodes are placed on the left arm and the left leg (LA and LL).
In all lead connections, the difference of potential measured between two electrodes is always with reference to a third point on the body.
This reference point is conventionally taken as the right leg (RL).



2. Unipolar lead: In unipolar limb leads two of the limb leads are tied together and recorded with respect to the third limb. In lead AVR, the right arm is recorded with respect to common junction of the left arm and left leg electrodes. In lead AVL, the left arm is recorded with respect to the common junction of the right arm and left leg electrodes. In lead AVF, the left leg is recorded with respect to the two arm electrodes tied together.



3. Unipoar chest lead: The unipolar chest leads represent a difference between various position on the chest and an electrical neutral position established by resistance network from three limbs. These are also known as Wilson's leads.
They are listed below.

V1 = On fourth intercostals space at right edge of spectrum
V2 = On fourth intercostals space at left edge of spectrum.
V3 = On fifth rib between V2 & V4.
V4 = On fifth intercostals space on left mid calvicular line.
V5 = Between V4 & V6 on anterior left auxiliary line.
V6 = On left mid auxiliary line at level of V4.

b) State the generation of EEG signal and also state four technical specification of EEG machine. 06

(Generation of EEG signal 02 Mark, technical specification 04 Mark)

Ans: The brain generates rhythmical potentials which originate in the individual neurons of the brain. These potentials get summated as millions of cell discharge synchronously and appear as a surface waveform the recording of which is known as the electroencephalogram. The neurons are electrically polarized at rest. The interior of the neuron is at a potential of about – 70 mV relative to the exterior. When a neuron is exposed to a stimulus above a certain threshold, a nerve impulse is generated which spreads in the cell resulting in the depolarization of the cell. Shortly afterwards, repolarization occurs.

Technical specification:
1. Power : 230 volts AC, 50Hz.
2. No. of channels : 8 to 24.
3. Input impedance: Greater than 50MW.
4. Sensitivity : 0.5Mv/mm.
5. CMRR : Better than 90 db.
6. Chart speed : 1, 10, 15, 30,60mm/sec.
7. Leakage current: Less than 10µA.
8. Notch filter : 50Hz

Q.5 Attempt any four. Marks 16

a) Draw the block diagram of pulse oxymeter and state the function of each block. 04

(Diagram 02 Mark, Function 02 Mark)

Ans:-

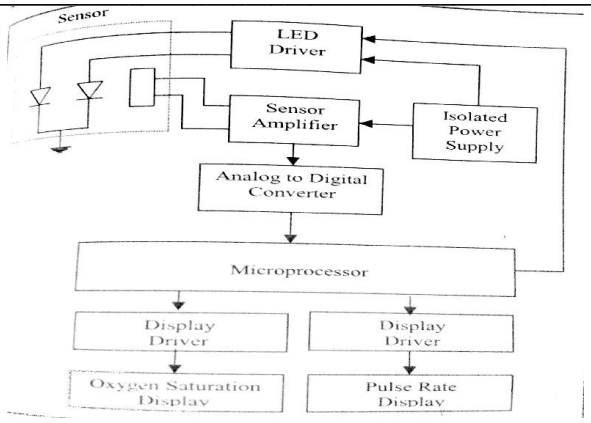


Fig: Pulse Oximeter

Description:

The sensor of pulse oximeter consists of red and infra red light sources and detector. The LED driver provides drive to red and infrared LED's.The red and infrared LED's are illuminated separately so that photo sensor output represents a signal firstly from one LED and then from the other. This allows signal processor circuitry to determine transmission of intensity of each wave length without interference from the LED. The sensor amplified provides necessary amplification to this signal. The signal is then converted into digital signal by an analog to digital converter. The microprocessor circuitry is under software control and determine the system timing and control logic. The micro processor also provides display outputs to the display drivers for the front panel display of oxygen saturation and pulse rate.

b) Explain the respiration rate meter with the help of block diagram. 04

(Diagram 02 Mark, Description 02 Mark)

Ans:-

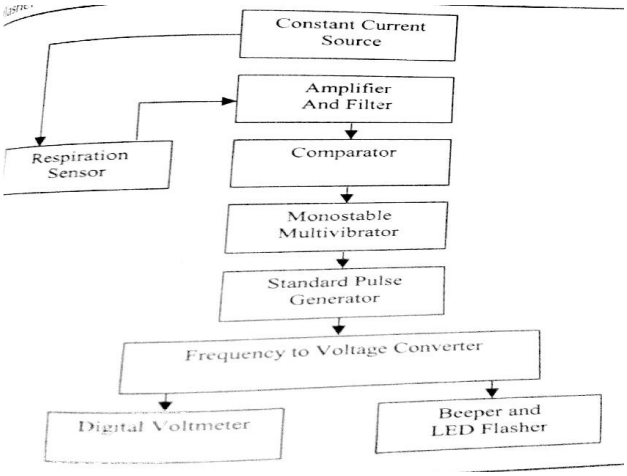


Fig: Respiration Rate meter

The first block of the respiration rate meter is respiration sensor. The respiration rate meter employs either nose or chest sensor to detect respiration. The nose sensor makes use of thermistor as its sensing device, where as the chest sensor uses strain gauge with elastic band as its sensing device. When a sensor is placed in the nasal cavity, cooling of the thermistor takes place each time to inspiration and expiration resulting in to change in resistance of the themistor .This change is converted into voltage pulse by passing constant current through the thermistor.These pulses are then amplified by an amplifier and passed through a low pass filter to eliminate noise. At this level they are compared with reference voltage set by threshold control in comparator and a trigger pulse is produced. From this trigger, the non-retrigger able monostable generates a large duration pulse of around 500ms and eliminates chances if triggering of multivibrator by noise or artifact. The standard pulse generator generates standard pulse, which is averaged to produce D.C voltage level proportional to the respiration rate. A digital voltmeter displays this as a respiration rate. To monitor the respiratory activity an audio beeper and LED flasher are usually employed.

c) With the help of suitable diagram explain the working principle of hearing aids. 04

(Diagram 02 Mark, Description 02 Mark)

Ans:- The simplified block diagram of hearing aids is shown in fig. The system works on single pen battery on button cell. Hearing aids are available as pocket conventional models. Today, dedicated integrated circuits are usually incorporated in hearing aid circuit as a signal processing device. It basically consist of an audio amplifier and filter.The basic functional parts include a microphone and associated preamplifier, an automatic gain control circuit, a set of active filters, a mixer and power amplifier and output transducer or receiver. The amplified audio signal is finally fed to the electromagnetic earphone. In standard pocket units, earphone is attached to the instrument through flexible wire whereas in other units it is fixed in the main body of the instrument and audio is coupled to the ear via hallow flexible rubber or plastic rubber.

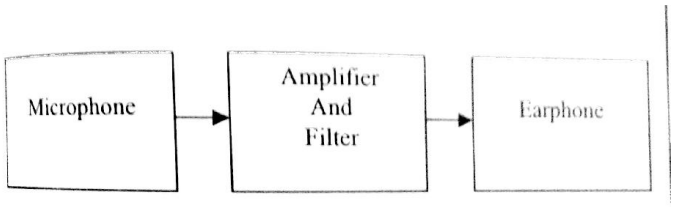


Fig: Hearing Aid

d) State the different types of heart sound and their significance. (02m + 02m) 04

Ans:- There are four basic sounds that occur during the sequence of one complete cardiac cycle.

1. The first heart sound is a low pitch sound. It has a frequency in the range of 30 to 45 Hz. This heart sound occurs at the termination of arterial contraction and at the onset of ventricular contraction. This heart sound occurs approximately at the time of the 'QRS' complex of the ECG complex.

2. The second sound is high pitch sound. It has frequency between 50 to 70Hz. It is caused by the closure of aortic and pulmonary valves, which release the blood for systemic and pulmonary circulation. The second heart sound occurs about the time of the end of the 'Wave of the ECG complex. It is louder than first heart sound

3. The third heart sound has a very low frequency, normally below 30 Hz. It is sometimes heard, especially in young adults. This sound occurs from 0.1 to 0.2 second after the second heart sound. It is due to the rush of blood from the atria into the ventricles, which causes turbulence and some vibration of the ventricular walls. This sound actually appears before the atrial contraction.

4. The fourth heart sound is called atrial heart sound, which is not audible but may be visible on graphic recording. This heart sound occurs when the atria actually do contract. The inaudibility of this heart sound is a result of low amplitude and low frequency of the vibration.

e) Explain the working principle of spirometer with the help of suitable block diagram. 04

(Diagram 02 Mark, Description 02 Mark)

Ans:-

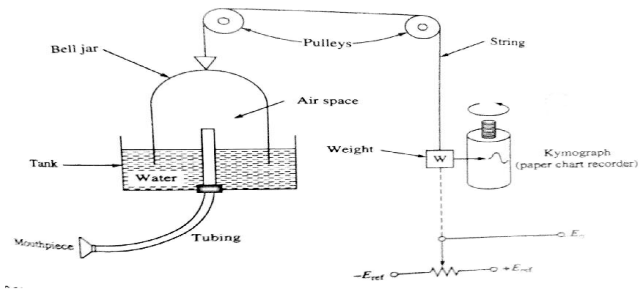


Fig: Spirometer

The conventional spirometer is as shown is fig. This instrument uses a bell suspended from above in the tank of water. And air hose leads from mouth piece to the space inside of the bell above the water level. Weight is suspended from places a tension force on the string that exactly balances the weight of Bell at atmospheric pressure. When no one is breathing into the mouth piece their for the Bell will be at the rest with fixed volume above the water level. But when the subject exhales the pressure inside the Bell increase above atmospheric pressure. Using the Bell to rise similarly when patient inhales the pressure inside the bell decreases The Bell will rise when press increases and drop when pressure decreases. The change in Bell pressure changes the volume inside the Bell which also causes the position Of the counter weight to change. We may record the volume change on a piece of graph paper attaching a pen to the counter weight or tension string. The chart Recorder is a rotary drum model called kymograph .At Rotates slowly at speed between 30 to 2000 mm/min.Some spirometer also offer as electrical output. Most frequently the electrical output is generated by connecting a pen and weight assembly to a linear Potentiometer. If precise positive and negative potentials connected to the ends of potentiometer. Then electrical signal will represent the same data as pen. When no one is breathing into the mouth piece. Eo will be zero when patient is breathing into the tube will take a value proportional to the volume and polarity that indicates inspiration or expiration.

f) Explain preamplifier circuit of EMG machine. **04**

(Diagram 02Mark, Description 02Mark)

Ans:- Fig shows circuit diagram of the preamplifier. The amplifier design provides for a flat frequency response between 10 Hz and 1 KHz with a CMRR of 100db at the mains frequency. The noise level was found to be 2mV rms and the input impedance greater than 10MΩ.The two ICs in the input stage act as voltage followers, which present the desired high input impedance to the electrodes. They are coupled via C_1 and R5 to provide a high differential signal gain. Capacitor C1 determines the low frequency performance of the circuit. It also eliminates the effects at the output of any dc offset due to IC1 and IC2 OR Any imbalance in electrode potential. The second stage IC3 provides further differential signal gain While rejecting common mode signals. The overall gain of the amplifier is 1000.

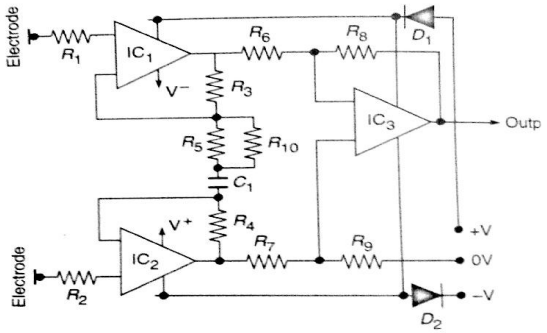


Fig: Preamplifier Circuit

Q.6 Attempt any four. **Marks 16**

a) Draw right leg drive circuit in ECG machine and state its importance.

(Diagram 02Mark, Importance 02 Mark)

Ans:-

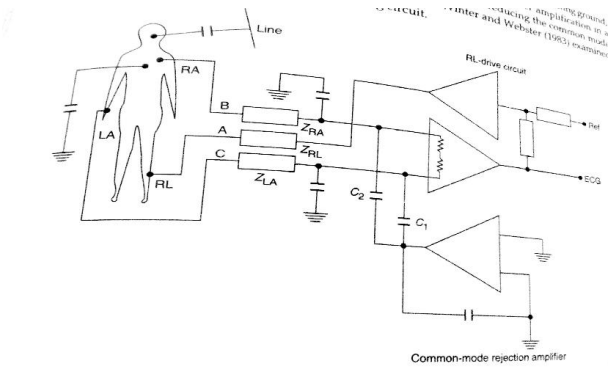


Fig:Right leg drive circuit

Importance: To minimize the common mode signal between the body of the patient and the floating ground a right leg drive circuit is used. The common mode signals after amplification in a preamplifier are inverted and fed back to the right leg electrode reducing the common mode voltage on the input with respect to the floating ground**.**

b) Draw and explain Bekesy audiometer with suitable diagram. 04

Ans:Variable sine wave oscillator: The oscillator generates test signal having frequency 125,250,500,1000,1500,2000,3000,4000,6000 and 8000 Hz . This sequence is first presented to the left ear masking right ear such that each tone for 30 seconds and then to the right ear masking left ear.
Modulator: From the oscillator, the test signal is fed to the modulator consisting of two modes. In the pulse mode the test signal is modulated giving a signal which is easily recognized by the patient. In the continuous mode the test signal is directly used for calibrating the audiometer.
Automatic Attenuator and Recorder: The signal from modulator is given to the automatic attenuator. The wiper of the pen drive of the X-Y recorder is attached to potentiometer in the attenuator. Depending upon the herring loss the peak of the curve is traced for particular frequency on the recorder.
Hand Switch: The pen drive is controlled via the logic control circuit by the hand switch, operated by the paitent.Pressing the switch increases the sound level in the earphone while releasing the switch decreases the sound level.
Buffer Amplifier: From the attenuator the signal is given to the buffer amplifier and then to the hearing aid. The buffer amplifier isolates the attenuator from the calibration circuit. During calibration the sound level of the test frequency is adjusted at the correct level corresponding the normal person.

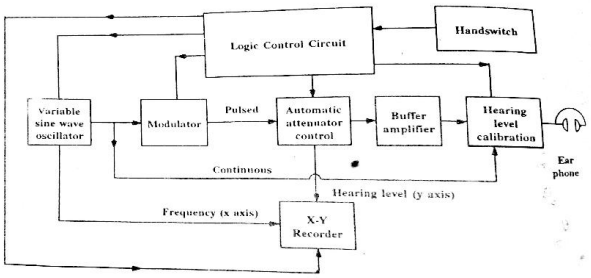


Fig: Beksey Audiometer System

c) State Beer and Lamberts law. Give four technical specification of pulse oxymeter. 04 (02m+02m)
Ans:-
Beer and Lamberts law: The beer Lambert law is the linear relationship between absorbance and concentration of an absorbing species. The general beer –lamberts law is usually written as

$$A=a\lambda*b*c$$

Where A-Measured absorbance
aλ-Wavelength dependent absorptivity coefficient.

b- Length.
c- analyte path concentration.

The beer lambert law is written as

$A=\varepsilon*b*c$

Technical specification of pulse oxymeter:

1. Power : 230 Volts AC, 50Hz, or Battery 4.5 Volts.
2. Spo2 Range : 0 to 100%.
3. Spo2 Accuracy : ± 2 digit at 70 to 100%.
4. Pulse rate range : 30 to 300 beats per minute.
5. Sensor : Optoelectronic (650nM and 805 Nm).

d) State the maintenance procedure of EMG machine. Draw EMG waveform label it. 04
(Maintenance 02 Mark, EMG waveform 02 Mark)

Ans:-1)Cleaning of EMG machine
2) Calibration of instrument.
3) Electrical safety instrument.
4)Check all Cables
5)Check other procedures recommended by manufacturer.
6) Mechanical inspection.

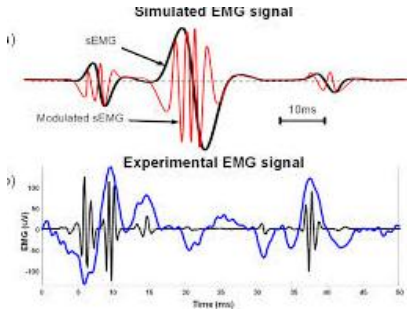


Fig: Experimental EMG signal

e) Describe air and bone conduction related to hearing mechanisms. 04

Ans:- Air conduction is transmission of sound through the external and middle ear to the internal ear. Bone conduction is referred to transmission of sound to the internal ear mediated by mechanical vibration of cranial bones and soft tissues. Most important diagnostic differential from the standpoint of functional hearing test is relationship between air & bone conduction acuity.

Clinical observation has shown that hard-of-hearing patients with middle ear disease usually have normal hearing by bone conduction, whereas patient with inner ear involvement have decreased bone conduction.

It has been concluded from clinical observations that an approximate 60 db loss is the maximum air conduction impairment to be anticipated with middle ear defect. If air conduction loss in patient with apparently typical middle are pathology exceeds 60 db, it is likely that inner ear impairment is superimposed on middle ear lesion.

The start of slope defines 'end point' of ear. For air conducted signals, fall in sensitivity continues so that for instance at 25 KHz, 5W of acoustic power is needed to produce hearing response. On the other hand the bone conducted signal there is a change in slope again at about 2KHz above end point. From then on up 200KHz the threshold sensitivity falls at rate of 15 db per octave. So in the ultrasonic region, a bone conducted signal of less than one electrical watt is audible.

There is a rapid drop in impedance of middle ear at high frequencies and very little of the acoustical energy fed to ear by air conduction is transmitted to cochlea. But bone conducted sound by passes middle ear. This to some extent explains the different threshold shapes at high frequency.