



Winter- 15 EXAMINATION

Subject Code: **17545**

Model Answer

Page No: __01_/ 26

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.

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Model Answer

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Q. 1.A) Attempt any THREE

(12)

a) State concept of blood-pressure, with proper waveform.

(Diagram-02 Mark, Description-02 Mark)

Ans:

Blood pressure:

Blood pressure is a measure of the pressure of the blood against the walls of a blood vessel. Clinically, blood pressure is usually measured in the brachial (arm) artery.

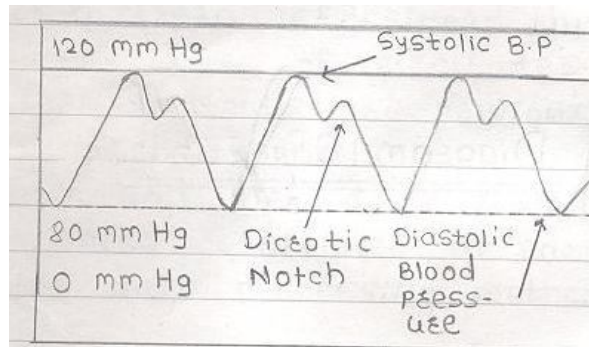


Fig : Waveform of blood-pressure

b) Draw labeled block diagram of digital temperature meter.

(04)

Ans:

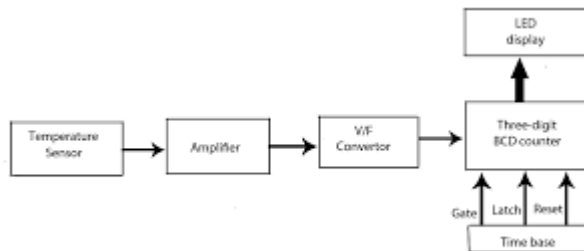


Fig : Block diagram of Digital Temperature Meter.



c) Give different methods for calculation of heart rate. Describe any one.

(04)

(02 marks for methods, 02 marks for description of one method)

Ans:-

Methods of measure heart rate are given below.

1. Average calculation.
2. Beat-to-beat calculation.
3. Combination of beat –to-beat calculation with averaging.

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

2. Beat-to-beat calculation:-This is done by measuring the time(T), in seconds, between two consecutive pulses, and converting this time into beats /min= $60/T$. This technique accurately represents the true picture of the heart rate.

3. Combination of beat –to-beat calculation with averaging:- This is based on a four or six beats average. The advantage of this technique over the averaging techniques is its similarity with the beat- to-beat monitoring system.

d) List four technical specifications of ECG machine.

(04)

(01 Mark each)

Ans:

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

Q. 1 B) Attempt any one:

(06)

a) i) Draw labeled block diagram of ECG machine.

(03)

Ans:

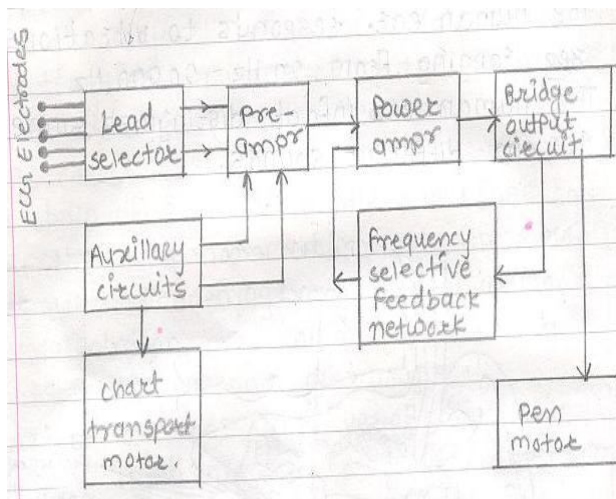


Fig : Block diagram of ECG machine

ii) List the maintenance steps followed in ECG machine.

(03)

Ans:

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

b) Describe generation of electroencephalography signal. Draw and Explain pre - amplifier circuit of EEG machine. (06)

(Generation of EEG 02 marks , Diagram and explain 04 marks)

Ans:

Generation of EEG:

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.

Pre - amplifier circuit of EEG machine :

Input box contain a buffer amplifier, a circuit of high input impedance, low noise and low output impedance to prevent interference by external noise. Three operational amplifiers are employed here to form an instrumentation amplifier. It has CMRR and gain of 90DB & 10 respectively l& frequency response. D.C. to 100Hz.

The gain of this amplifier is kept low to avoid saturation due to D.C. potential. The electrical signal coming from the electrode junction box is connected to the electrode selector. The electrode selector works as a combining device which connects electrode attached to the bead to input of amplifier of each channel. When the electrode selector switch is pressed, the internal electronic switch operates and connects electrodes to the input of amplifier.

Normally two types of electrode are used :

- Free selector.
- Pattern selector.

- Free Selector :-

This is used to change the montage or combination of electrodes as desired by the doctor. In this case combination for each channel can be easily changed on the spot.

- Pattern selector :-

This is used to sequentially change the montage generally; pattern is assigned the predetermined combination of electrodes. The pattern contents are previously determined in each hospital. The combination method of electrode positions is also determined in each hospital or by the data processing method adopted by doctors. The predetermined combination made in an EEG is changed for all channels by one switch operation without operating several free selectors. This pattern is very useful in routine EEG inspection.

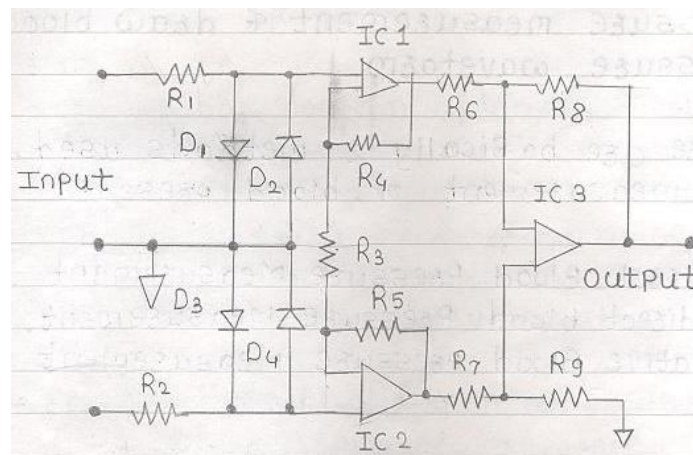


Fig : Pre - amplifier circuit of EEG machine.

Q.2. Attempt any four.

(16)

a) With neat diagram describe indirect method for BP measurement.

(04)

(Diagram- 02 Marks, Description -02 Marks)

Ans :

In routine clinical tests, blood pressure is usually measured by means of an indirect method using a sphygmomanometer. This method is easy to use and can be automated. Only systolic and diastolic arterial pressure readings can be obtained. Blood pressure is most often measured and most intensive study parameters in medical and physiological practice. The determination of only its max and min level during each cardiac cycle supplemented by information about other physiological parameters is an invaluable diagnostic aid to assess the muscular condition and certain accepts of cardiac performance. The blood is pumped by left heart into the artery due to the load resistance of arterials & precapillaries, it losses most of its pressure and returns to heart at low pressure reached during cardiac ejection is called as systolic pressure and maximum pressure occurring at end of ventricular relaxation is called diastolic.

Controls & Indicators:-

Hand pump

Release Valve

Blood pressure display

Principle of Operation:-

It consists of an inflatable pressure cuff and mercury manometer that measures the pressure in cuff. The pressure cuff consist of rubber bladder inside fabric covering. It is mode in such a way that it can be wrapped around the upper arm and fastened with either hooks or Velcro fastener. A rubber balloon hand pump with release valve is connected to the cuff via rubber tube to inflate the cuff. The cuff inflated manually with help of hand pump and deflated slowly through needle release valve provided to the pump.

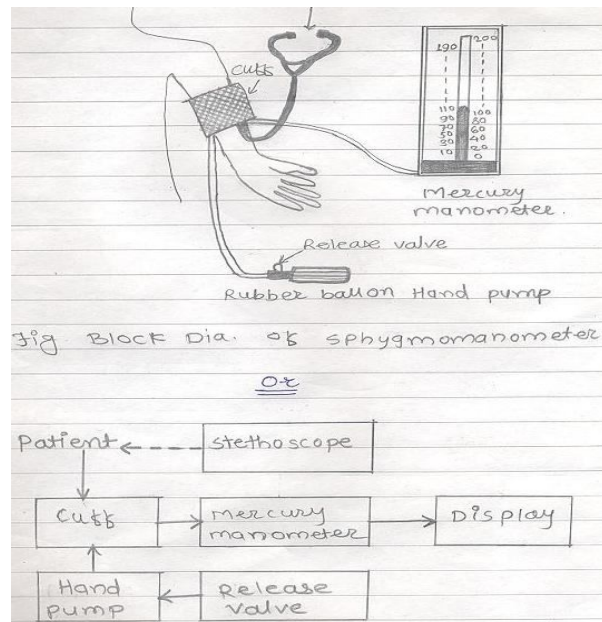


Fig : Indirect method for BP measurement

b) Draw a neat labeled diagram of heart - rate meter and give its working in brief. (04)

(Diagram 02 Marks ,Working 02 Marks)

Ans:

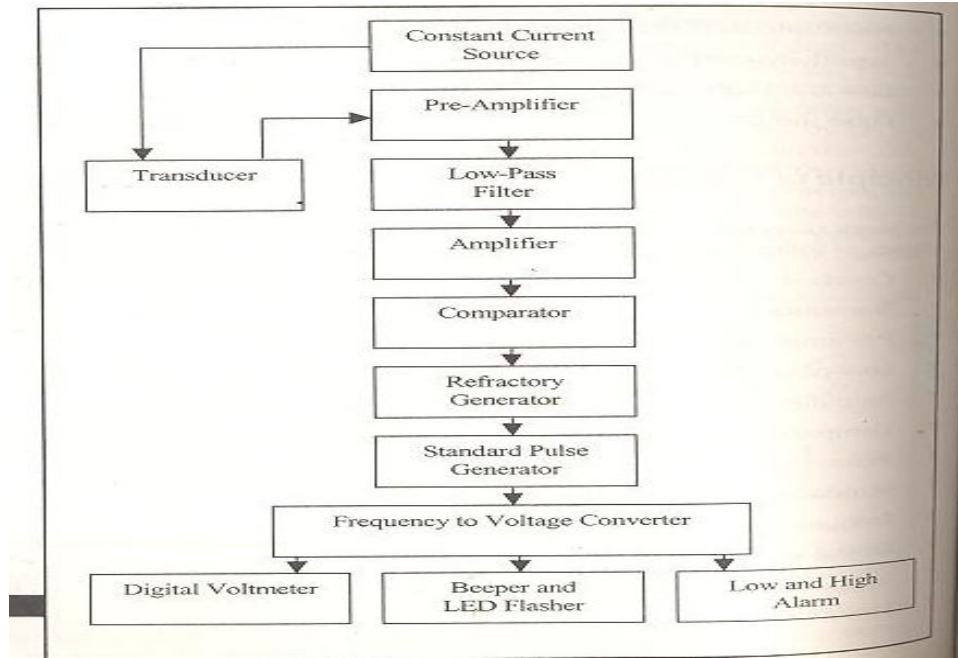


Fig : Heart - rate meter

The first block is constant current source. This provides constant current to the LED to get a stable light output.

The transducer or sensor consists of LED and LDR. Transducer senses the heart beat by sensing the amount of blood present in the capillaries and converts it into the electrical pulse. This pulse is taken to the pre amplifier for amplification. Pre amplifier provides necessary amplification this electrical pulse.

The low pass filter eliminates the unwanted high frequency noise and the amplifier provides further amplification. Thus a large amplitude pulse is generated here for each heart beat. Further to this an amplified pulse is compared with reference voltage in comparator and a trigger pulse is produced. This pulse is taken to the refractory generator. Refractory generator is a non retriggerable monostable multivibrator. It rejects the noise pulse or an artifact. The next block is standard pulse generator this is also a non retriggerable monostable multivibrator. This block employs an active low pass filter for this purpose. The output of this stage is D.C. voltage. This voltage is given to the input of digital voltmeter that monitors it as a heart rate in digital form.

To monitor each heart beat usually a beeper is employed. The last block is heart rate alarm circuit. This block is heart rate alarm circuit. This block consists of two comparators, one for low and another for high pulse rate.

- c) With neat diagram describe principle of operation of GSR meter.
(Diagram- 02 marks, Principle of operation- 02 Marks)

(04)

Ans:

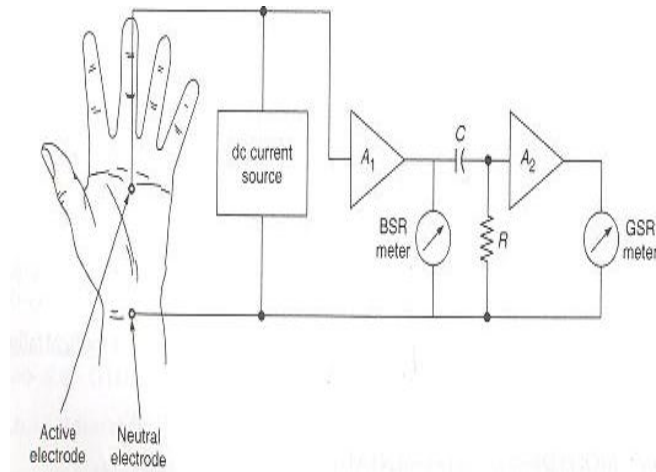


Fig : GSR meter.

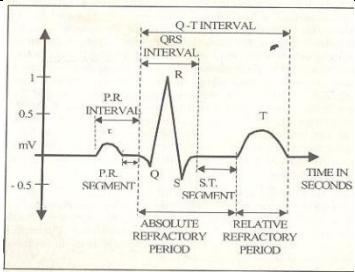
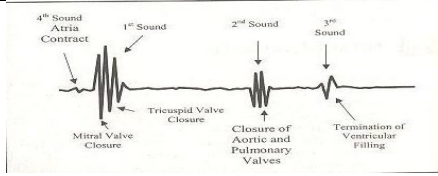
Galvanic skin response:-

Galvanic skin response (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 used 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.

d) Distinguish between ECG and PCG. (04 pt.)
(01 Mark each)

(04)

Ans :

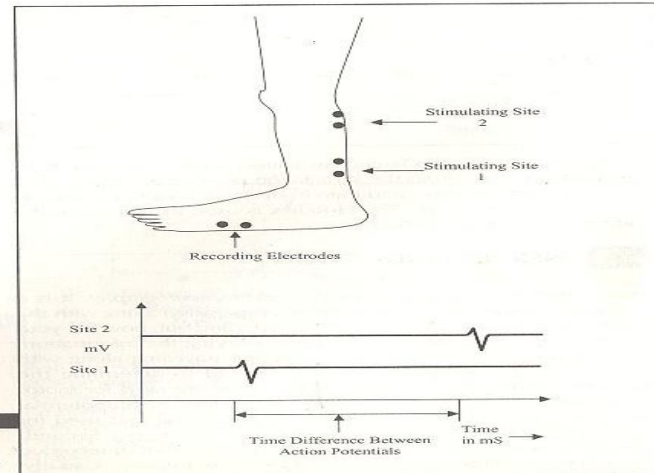
ECG	PCG
ECG : Electro cardio graph	PCG : Phonocardio graph
It is the recording of electrical activity of heart functioning	It is the recording of the sounds connected with the pumping action of heart.
It is rhythmically repeating signal synchronize by heart function	These sounds provide an indication of heart rate and its rhythm city.
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,
 <p style="text-align: center;">ECG signal</p>	 <p style="text-align: center;">PCG signal</p>

e) Give the procedure to measure sensory and motor nerve conduction velocity with suitable diagram. (04)

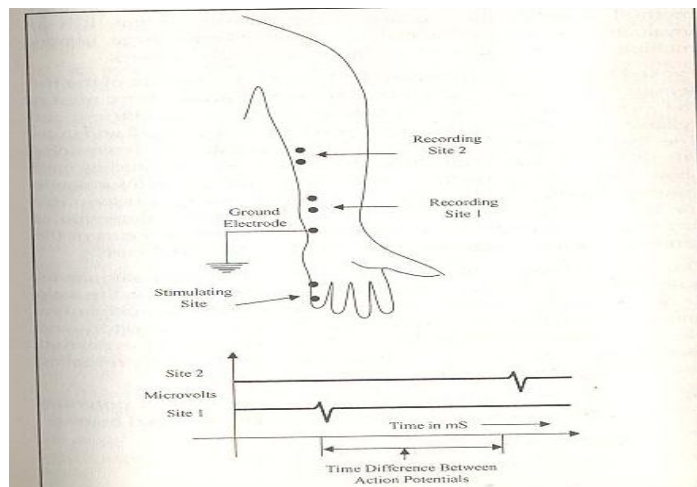
(02 Marks for each method)

Ans:

The Motor nerve Conduction Velocity : The Motor nerve Conduction Velocity is measured from Stimulus site to the muscle as shown in fig. 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 muscle travels downward along with the motor nerve to the recording site on the muscle of a 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 dermine the nerve conduction .It is possible to measure the motor nerve Conduction velocity between several locations



Sensory Nerve Conduction Velocity :- Sensory nerve conduction velocity is measured by similar technique used for nerve as shown in fig. Recording electrodes are placed at no. of sites on the sensory nerve under test. In this example an nerve of the hand is considered as shown in fig. And the stimulus is applied at the little finger which is a Stimulation site .The nerve impulse travels upward through the nerve and reaches at recording sites after different time intervals. The Sensory nerve Conduction velocity is measured in the same way as motor nerve dividing the latency by the distance





f) Give significance of heart sound.

(04)

(01 mark for each sound)

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.

Q.3 Attempt any four.

(16)

a) Difference between direct and indirect method of BP measurement. (04 pt)

(04)

(01 mark for each)

Ans :

Direct blood pressure measurement	Indirect blood pressure measurement
1. In this technique a catheter & an electronic transducer to sense the blood pressure.	1. It is the most consist of pneumatic cuff, mercury manometer or pressure gage, hand pump with release valve and stethoscope.
2. In this technique measure the blood pressures in the artery or particular part of the body.	2. In this technique measures the blood pressures only certain regions (upper arms or thigh).
3. The advantage of this system is that pressure is continuously monitored beat-by-beat, and a waveform (a graph of pressure against time) can be displayed.	3. In this technique the blood pressures is not continuously monitored and a waveform cannot be displayed

4. This technique provides much more reliable information	4. This technique is less informative.
5. This technique is more complex.	5. This technique is simple.

b) Describe ultrasonic FHR meter with neat diagram.

(04)

(Diagram-02 Marks, Description -02 Marks)

Ans :

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.

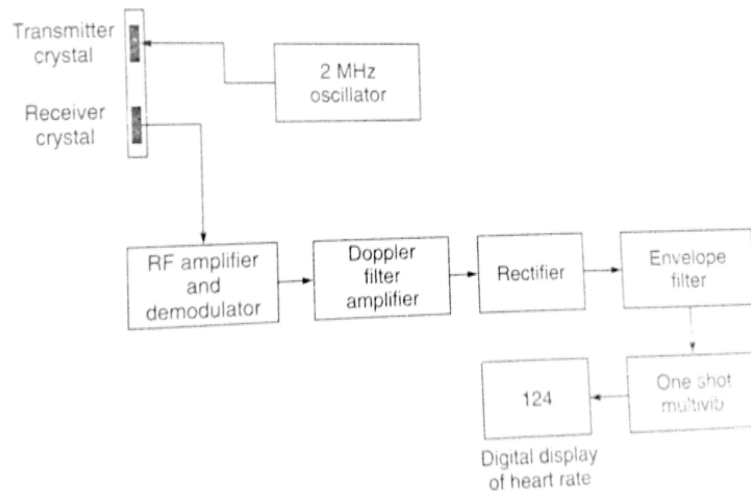


Fig : Ultrasonic FHR meter

c) State different recording technique in EEG . Describe average recording technique.

(04)

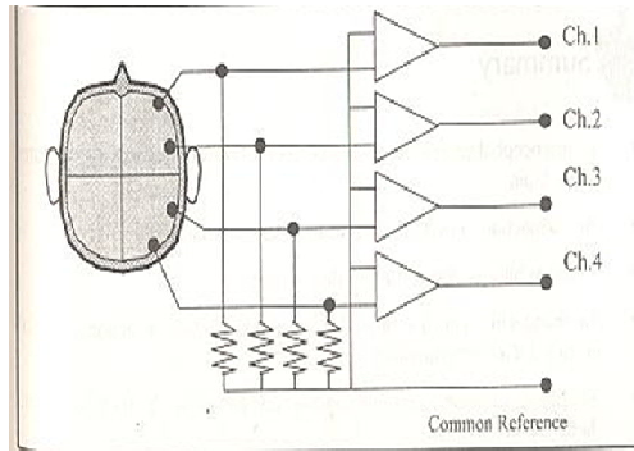
(State- 02 Marks, Description- 02 Marks)

Ans:

Three different recording methods are used in the routine EEG recording.

1. Unipolar or Monopolar recording.
2. Bipolar recording.
3. Average recording:-

Average recording:- In this technique one input lead of all amplifiers is taken to the common point of a summing network. The summing network is formed by equal resistances of high value.



d) With neat diagram describe phonocardiography.

(04)

(Diagram- 02 marks, Description -02 Marks)

Ans:

Phonocardiograph is equipment used to record sound generated by heart during is physiological phenomenon. When provides diagnostic information in frequency band from 20-1000 Hz.

Principle of Operation: Phonocardiograph has 9 Section

- Input heart sound.
- Heart sounds pre-amplifier.
- Filter
- Audio amplifier
- Audio Output.
- Envelop detector and modulator
- 85 Hz oscillation
- Power amplifier &
- Direct recorder
- Direct recorder

The input sound section receive heart sound signal from the microphone placed on patient's heart and feeds the heart sound amplifier. Two types of microphone are used in PCG. Contact or dynamic microphones for phonocardiography and air coupled crystal microphones for pulse wave phonocardiography. A latest contact microphone has frequency response from 20Hz -1KHz.5 Steps filter employed here passes the selector band of heart sounds to power amplifier. Heart sounds & murmurs contain frequencies between 20Hz-2KHz.Standard galvanometer record can record the frequency, which is below 100Hz.

But phonocardiograph a direct writing hot stylus galvanometer is used to record heart sound & murmurs with special electronic detection method that extracts the shape, timing duration, amplitude of heart sound over entire 20Hz-2KHz spectrum. Signal's envelope is detected & modulated with 85 Hz frequency, which is generated by 85Hz oscillation. The modulated signal has frequency component of only 85Hz & envelope of acquired heart sound to record the signal using hot stylus galvanometer. At filter positions 25 & 50 being selected band has lower frequency it is recorded directly. On the other hand when filter positions. 100, 250 or 500 are selected signal is modulated & then recorded.

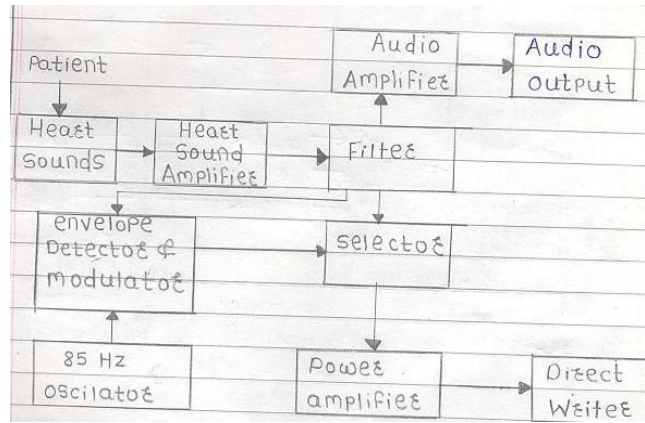


Fig : Phonocardiograph

e) List technical specifications of ECG machine. (any 04)

(04)

(01 mark each)

Ans:

1. Power-230V AC 50HZ, Battery.
2. CMMR-Better than 80db.
3. Sensitivity-0.5, 1.0 &2.0 cm/mv
4. Filter-50HZ notch filter.
5. Lead selection -12lead system Lead I, II, III, avR, avL, avF & Chest lead.
6. Noise-Less than 10mv peak to peak
7. Frequency response-0.05HZ to 100HZ.
8. Leakage current-Less than 10mA with 230V AC.

Q.4 A) Attempt any three.

(12)

a) Give concept of heart rate and fetal heart rate also list the meter to measure the same.

(04)

(Concept of heart rate and fetal heart rate-02 Mark , list of meter-02 Mark)

Ans:

Heart rate: Heart rate is rate rate at which the heart beats per minute. It is controlled by the frequency at which the natural pacemaker generates electrical impulses. Due to pumping of the heart heartbeats for around 72 beats/times in a min. This beating of heart in a min is called heart rate of the patient. Heart rate is derived by amplification of ECG signal and by measuring either the average or instantaneous time intervals between two successive R peaks.

Fetal heart rate: The beating of the fetal heart inside the mother's womb can be detected from about 11th week of gestation in most of the subject. The normal fetal heart rate range is considered to be between 120 -160 beats per minute. Fetal heart rate levels below 120 beats per minute are labeled as bradycardia and rates greater than 160 beats per minute are leveled as tachycardia.

List of meter:

1. Heart rate meter.
2. Fetal heart rate meter.

b) With neat diagram explain pure tone audiometer.

(04)

(Diagram 02 Marks, Description 02 Marks)

Ans:

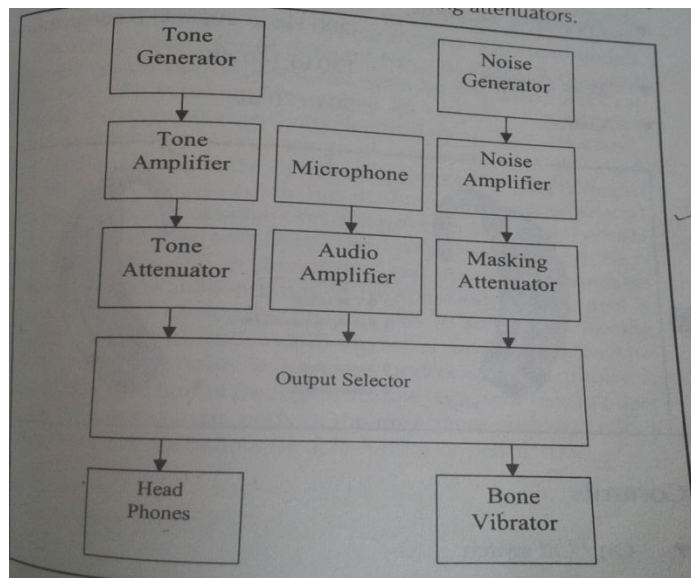


Fig : Block diagram of Pure Tone Audiometer

It consists of following block:

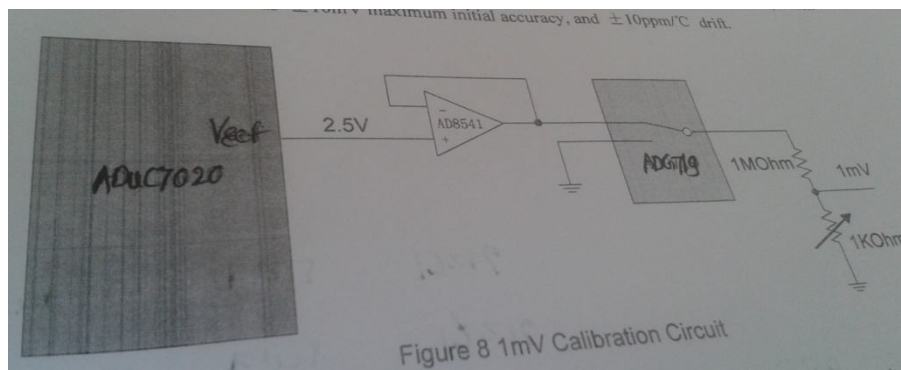
1. Tone generator.
2. Noise generator.
3. Tone amplifier.
4. Noise amplifier.
5. Tone attenuator.
6. Masking attenuator.
7. Output selector.
8. Head phones.
9. Bone vibrator.
10. Microphone.
11. Audio amplifier.

Tone generator is a LC oscillator, which generates tone of frequencies between 125 Hz to 10 kHz in eleven steps. Noise generator is used to inject certain amount of noise or masking in another ear during measurement of air conduction threshold. This noise is wide band noise. Noise is generated usually by making use of semiconductor diode. Tone and noise amplifiers amplify these signals to the desired level. An attenuator is usually a rotary switch or electronically controlled up and down electronic switch. The output selector block switch either headphone or bone vibrator as per the test to be performed. It also helps to select the ears for testing and masking. Most of the headphones used in audiometer are dynamic type. Headphones and bone vibrators are used to measure air and bone conduction threshold respectively. Microphone and audio amplifier are employed to have a communication between operator and patient. Seven segment LED digital displays are used to continuously indicate the setting of frequency and tone & masking attenuators.

c) With neat circuit diagram give working of 1mV. Calibration ckt. used in ECG machine. (04)

(Diagram-02 marks, Description-02 marks)

Ans:



Description:

1mV calibration signal is derived from the embedded reference of the processor ADuC7020, which is 2.5V. The reference has $\pm 10\text{mV}$ maximum initial accuracy, and $\pm 10\text{ppm}/^\circ\text{C}$ 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 $15\sim 35^\circ\text{C}$. Analog switch ADG719BRM is used to generate 1mV square waveform. ADG719 is a SPDT switch with a 5Ω maximum on resistance. The frequency of the square wave is 2Hz. For the system robustness and easy to debug, a $10\text{K}\Omega$ pull down resistor is added to set GND as the default setting.

d) Draw and Explain pre amplifier circuit of EMG Machine.

(04)

(Diagram-02 marks, Description-02 marks)

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 C₁ 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

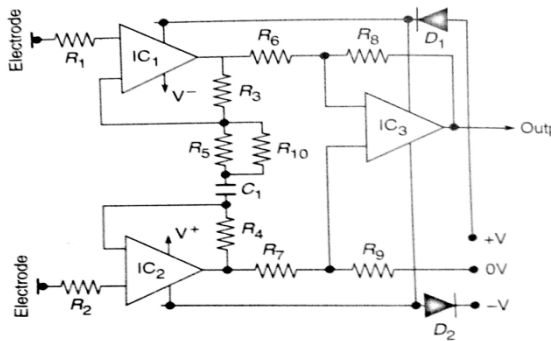


Fig : Circuit Diagram of the Preamplifier

B) Attempt any One.

(06)

a) Draw block diagram of EEG machine and describe its operation.

(06)

(Diagram-03 marks, Description-03 marks)

Ans:

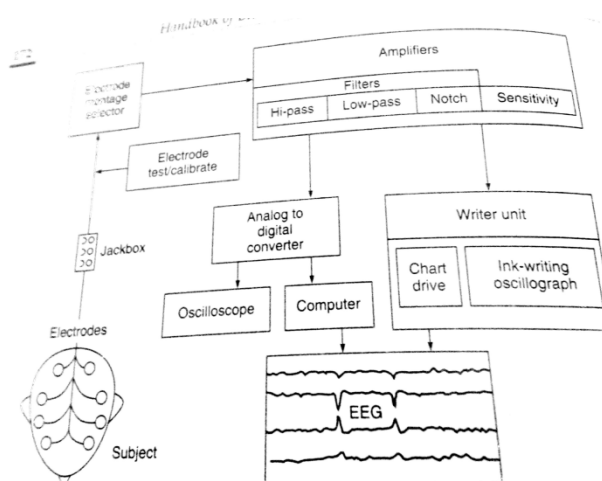


Fig : Block diagram of EEG machine



Montages: -A pattern of electrodes on the head and channels they are connected to is called montage. The reference electrode is generally placed on non active site such as forehead or earlobe. EEG electrode arranged on the scalp according to a standard known as 10/20 system.

Electrode Montage selector:-EEG signals are transmitted from the electrodes to the 10-20 system and then to the montage selector. The montage selector on analog EEG machine is a large panel containing switches that allow the user to select which electrode pair will have signals subtracted from each other.

Preamplifier: -Every channel has an individual, multistage, ac coupled, very sensitive amplifier with differential input and adjustable gain in wide range. Its frequency response can be selected by single- stage passive filter. The preamplifier used in electroencephalograph must have high gain and low noise characteristics because the EEG potential are small in amplitude. Amplifier must have very high common mode rejection to minimize stray interference signals from power and other electrical equipment.

Sensitivity control:- The overall sensitivity of EEG machine is the gain of the amplifier multiplied by sensitivity of the writer. EEG machine has two types of gain control. One is continuously variable and it is used to equalize the sensitivity of all channels. Other controls operate in steps either decreasing or increasing the sensitivity of channel by known amounts.

Filters:-when recorded by surface EEG make contain muscle artifacts due to contraction of scalp & neck muscle which override the brain and skull. The artifacts are large and sharp the most effective way is to ask the subject to relax but it is not always successful. These artifacts are generally removed by low pass filter. The filter on an EEG machine has a served selectable position. Some EEG machines have notch filter tuned at 50Hz so as to eliminate mains frequency interference.

Noise:-EEG amplifiers are selected for minimum noise level, which is expressed in terms of an equivalent input voltage. 2micro volt is often stated as acceptable.

Writing Part:-The writing part of an EEG machine is usually of the ink type direct writing recorder. The best types of pen motors used in EEG machines have a frequency response of about 90Hz. The ink jet recording system, which gives a response up to 1000Hz.

Paper Drive:-This is provided by synchronous motor. An accurate and stable paper drive mechanism is necessary. Several paper speeds available like 15,30 and 60 mm/s.

Channels:-EEG is recorded simultaneously from an array of several electrodes. They are connected to separate amplifier and writing system. Some EEG has 32 channels although 8 or 16 channels are more common.

b) An ECG machine is received with following problems state the remedies to eliminate it.

(06)

i) ECG trace not available.

ii) ECG trace too light.

iii) ECG trace too dark.

iv) ECG baseline is shifting.

v) Machine is not getting switched on.

vi) ECG signal is noisy.



Ans:

i) ECG trace not available :

1. Try with battery power only. If the recording improves then problem is with grounding. Check the grounding.
2. Power the machine from another outlet with proper electrical ground.

ii) ECG trace too light :

1. Adjust the printing head temperature or position
2. Clean the printing head with head cleaner. If no improvement, replace the printing head.
3. Check the paper roller and replace if not smooth

iii) ECG trace too dark :

1. Adjust the printing head temperature or position.
2. Check voltage on the heat oscillator

iv) ECG baseline is shifting :

1. Check the Preamplifier boards if faulty replace it.
2. Check the control boards if faulty replace it.

v) Machine is not getting switched on :

1. Check the fuse.
2. Check the cable.
3. Check the battery.

vi) ECG signal is noisy :

1. Replace preamplifier board or its faulty component.
2. Loose patient plug connection.



Q.5 Attempt any Four.

(16)

a) List technical specification of :

(04)

i) Pulse oximeter.

ii) Digital temperature meter.

Ans:

i) Pulse oximeter :

(Any four 1/2 mark each)

(02)

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).

ii) Digital temperature meter :

(02)

(Any four 1/2 mark each)

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

b) List technical specifications of respiration rate meter and explain meaning of any two.

(04)

(List any four technical specification - 02 Mark, Explain - 02 Mark)

Ans:

1. Power : 230V AC, 50Hz, or Battery.

It means machine required 230 volts to get start.

2. Measuring range : 0 to 50 Breaths.

It means it measures the respiration rate up to 50 breaths.

3. Transducer : Nose (Thermistor) or chest (strain gage).

It uses thermistor or strain gauge as a sensors.

4. Display : 7 segment LED or LCD.

It uses seven segments LED or LCD to display the respiration rate.

5. Respiration indication: Audio beep and LED.

It means each respiration is indicated by LED or audio beep.



c) Define in brief concept of Galvanic Skin Reflex. List four technical specification of meter used to measure the same. (04)

(Concept-02 Marks , Specification-02 Marks)

Ans:

Galvanic skin response :- Galvanic skin response (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)

Specification :

1. Skin resistance range 1,000 ohms - 3,000,000 ohms.
2. Variable frequency range 0 to 40,000 Hz.
3. 9 volt battery. Battery current in use < 2.0 mA.
4. 2.5mm output jack for 8 ohm earphone and output meter.
5. Protected Pin input jack for thermistor and electrodes

d) State significance of heart sounds in detail.

(04)

(01 mark each)

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) Draw and Explain block diagram of spirometer.

(04)

(Diagram-02 marks, Description-02 marks)

Ans :

The conventional spirometer is as shown in 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 raise 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

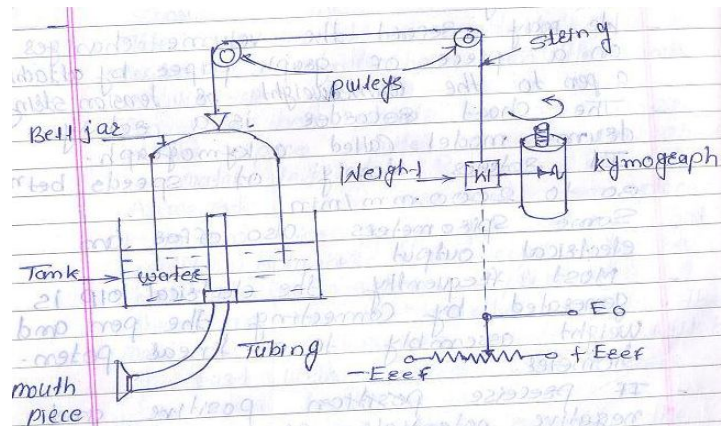


Fig : Spirometer.

f) How EMG signal is generated. Explain motor and sensory nerve conduction.

(04)

(Generation-02 marks, motor and sensory nerve conduction-02 marks)

Ans :

Generation of EMG signal :

The contraction of the skeletal muscle results in the generation of action potentials in the individual muscle fibers, a record of which is known as electromyogram. In the skeletal muscle repolarization takes place much more rapidly as compare to cardiac muscle. Since most EMG measurements are made to obtain an indication of the amount of activity of a given muscle, or a group of muscles, rather than of an individual muscle fiber the EMG pattern is usually a summation of the individual action potentials from the fibers constituting the muscle or muscles being studied.



The Motor nerve Conduction Velocity :

It is measured from Stimulus site to the muscle as shown in fig. 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 muscle travels downward along with the motor nerve to the recording site on the muscle of a 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 .It is possible to measure the motor nerve Conduction velocity between several locations.

Sensory Nerve Conduction Velocity :

It is measured by similar technique used for nerve. Recording electrodes are placed at no. of sites on the sensory nerve under test. In this example a nerve of the hand is considered as shown in fig. And the stimulus is applied at the little finger which is a Stimulation site.The nerve impulse travels upward through the nerve and reaches at recording sites after different time intervals. The Sensory nerve Conduction velocity is measured in the same way as motor nerve dividing the latency by the distance

Q.6 Attempt any four.

(16)

a) Give and Explain front panel of ECG machine.

(04)

(Any four 01 Mark each)

Ans:

- 1. AC**– Light will be on when the power cord is plugged into AC power. This also indicates that the battery, if installed, is charging.
- 2. Stop**- Halts any cardiograph function.
- 3. 1 mv calibration knob**: Calibration of ECG Machine.
- 4. Sensitivity (gain control)**: Sequentially changes the limb and chest lead sensitivity from 5, z+ 10, 3 20, * 5 mm/mV.
- 5. Filter**: Turns the Baseline Wander and Noise filters on or off.
- 6. Paper speed knob**: Sequentially changes the chart speed from 5, j 10, =+ 25, 3 50, =+ 5 mm/second.
- 7. Auto**: Starts an Auto ECG recording.
- 8. Manual**: Starts a Manual ECG recording.
- 9. Low battery**: This light indicates that the cardiograph must be plugged in to recharge the battery.
- 10. On /Standby**: Switches the cardiograph between on and Standby. Standby means the, cardiograph is off but it is still keeping the battery charged as long as the cardiograph is plugged into AC power.

b)

(04)

i) List two technical specification of hearing aid.

(02)

(1 Mark each)

Ans:

1) Power – Battery – 1.5v, AA type pencil cell.

Battery - Mercury (1.35v) or silver oxide (1.5v) or manganese (1.5v) in behind the ear units.

2) Electronics – solid state, IC based

3) Frequency Response – 100 Hz to 8000Hz

4) Peak output – 130 to 140 dB.

5) Gain – 50 to 70 dB.

ii) Draw labeled block diagram of hearing aid.

(02)

Ans:

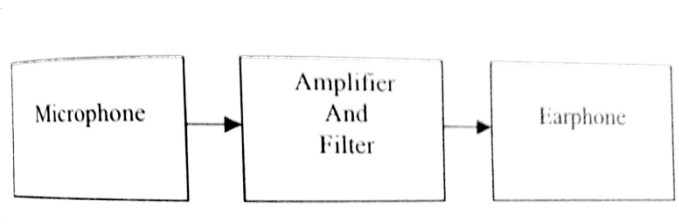


Fig : Block diagram of hearing aid

c) State significance of SpO_2 in blood. Draw labelled diagram of pulse oximeter.

(04)

(Significance of SpO_2 - 02 Marks , Diagram-02 Marks)

Ans:

Significance of SpO_2 in blood :

Blood oxygen saturation level (SpO_2) is a measure of the amount of oxygen carried in the hemoglobin. SpO_2 is expressed as a percentage of the maximum amount of oxygen that hemoglobin in the blood can carry. Since hemoglobin accounts for over 90% of oxygen in blood, SpO_2 also measures the amount of oxygen in blood. Since each hemoglobin molecule can transport 4 oxygen molecules, if 100 hemoglobin modules carry 396 oxygen molecules, SpO_2 is rated at 99%. SpO_2 for a normal healthy person at sea level should be at or above 94%. SpO_2 refers to the oxygen saturation level obtained using pulse oximetry.

Diagram Pulse Oximeter :

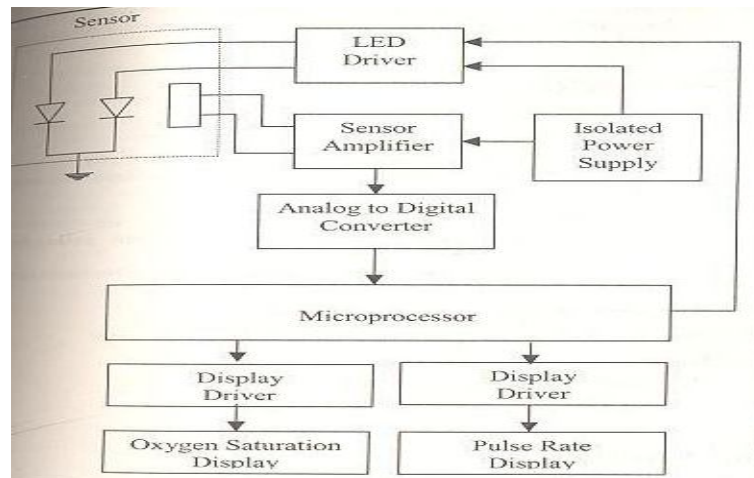


Fig : Pulse Oximeter.

d) Draw a neat diagram of EMG machine.

(04)

Ans:

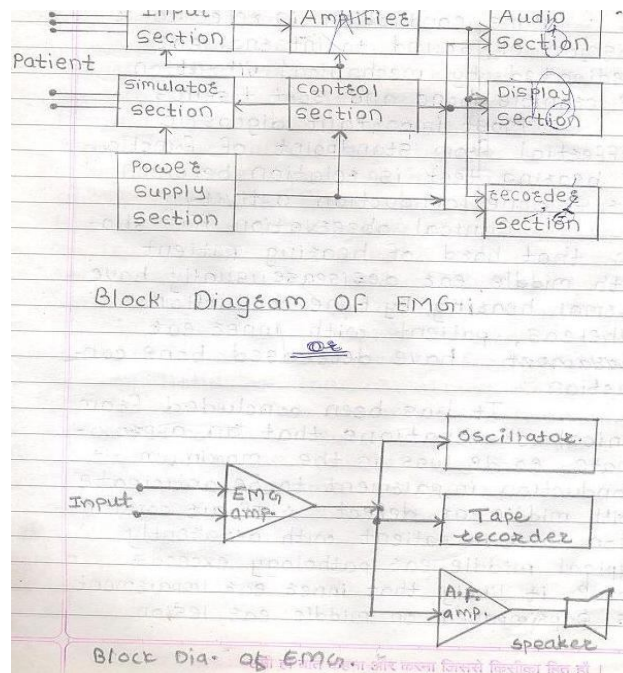


Fig : EMG machine.



e) State the concept of speech audio meter and impedance audiometer.

(04)

(Speech audio meter-02 Marks, Impedance audiometer-02 Marks)

Ans:

Speech audio meter :

Speech audiometers are used to determine speech reception threshold. In the case of speech audiometer the tests are carried with spoken voices to prescribe the hearing aids. It is sometimes necessary to carry out tests with spoken voices. These tests are particularly important before prescribing hearing aids and in determining the deterioration of speech understanding of patients. They incorporate a good quality tape recorder, which can play recorded speech. A double band tape recorder is preferred to interface the two channel audiometer units. Masking noise is supplied by the noise generator.

Impedance audiometer :

The primary purpose of impedance audiometry is to determine the status of the tympanic membrane and middle ear via tympanometry. The secondary purpose of this test is to evaluate acoustic reflex pathways, which include cranial nerves (CN) VII and VIII and the auditory brainstem. This test cannot be used to directly assess auditory sensitivity, although results are interpreted in conjunction with other threshold measures.