WINTER– 14 EXAMINATION

Subject Code: **17545** **Model Answer**

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.

Q.1 . a) ATTEMPT ANY THREE OF THE FOLLOWING (12)

i**) Draw neat diagram of indirect blood pressure measurement. & describe it.**

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 Value

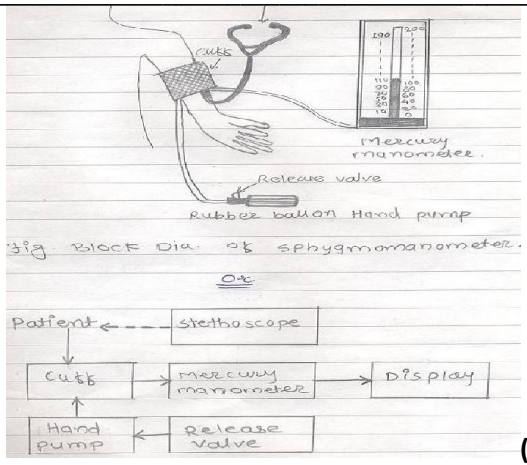
Blood pressure display

Principle of Operation It consist 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.

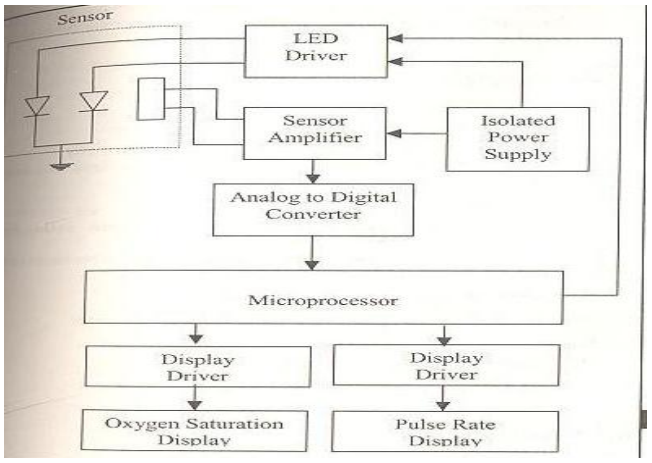
(02 marks)



(02 marks)

ii) With neat block diagram of pulseoximeter describe it's working

Ans:



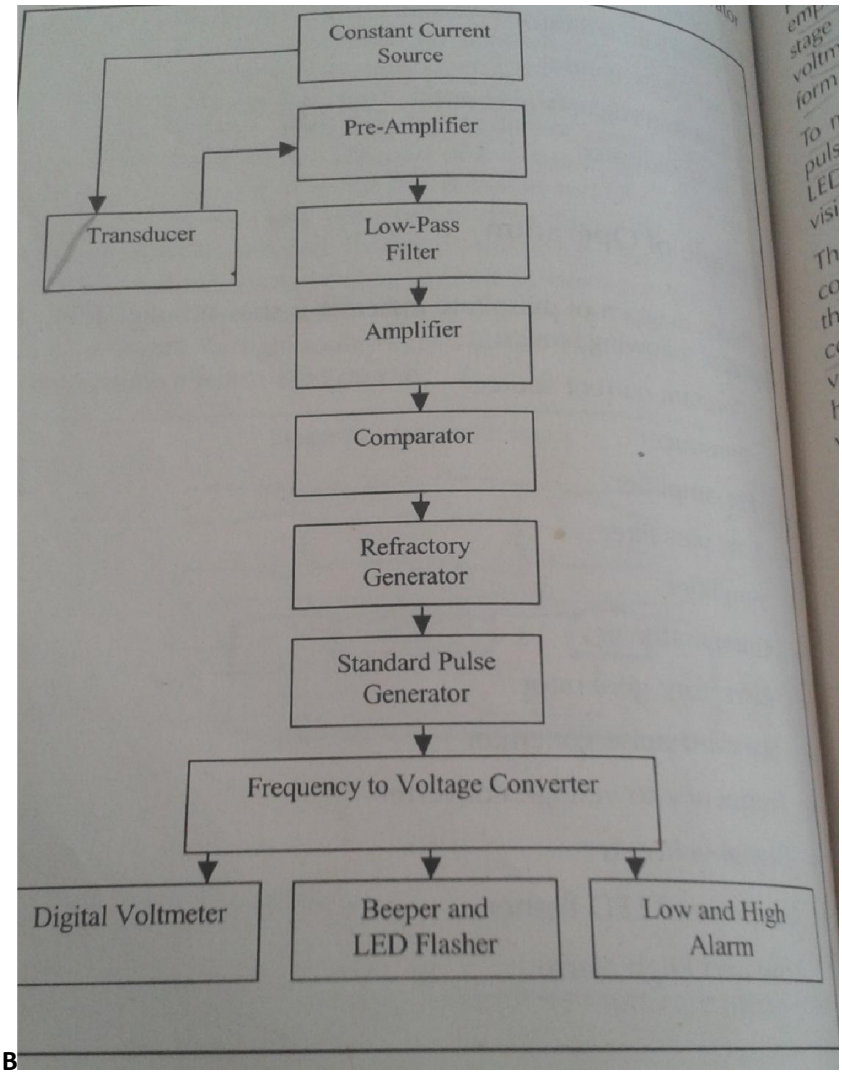
(02 marks)

Description : **(02 marks)**

- 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.

iii)Draw a diagram of heart rate meter & describe it

Block Diagram **(02 MARKS)**



B

Description:(02 MARKS)

- The first block is constant current source. This provides constant current to the LED to get a stable light output**.**
- The transducer or sensor consist of LED or LDR. It senses the heartbeat by sensing amount of blood present in the capillaries and convert it in to electrical pulses.
- Pre amplifier amplifies these pulses.
- Low pass filter eliminates the unwanted high frequency noise and amplifier provides further amplification. The amplifier has automatic gain control, which takes care of different levels of pulse amplitudes.
- Comparator compares amplified pulse with reference voltage and a trigger pulse is produced.
- Refractory generator is a nontriggrable monostable mulivibrator of period around 200mS.The electrical pulse which represents heartbeat only triggers this multivibrator.
- Pulse generator generates standard of pulse around 100ms.duration for each heartbeat. These standard pulses are act as input to frequency to voltage converter which produces DC voltage proportional to heartbeat.
- Digital voltmeter monitors heart rate or pulse rate.

- To monitor each heart beat usually a beeper is employed.
- Alarm circuit provides audible and visible alarm .

iv) Describe the significance of vector cardiography.

ANS: (04 MARKS)

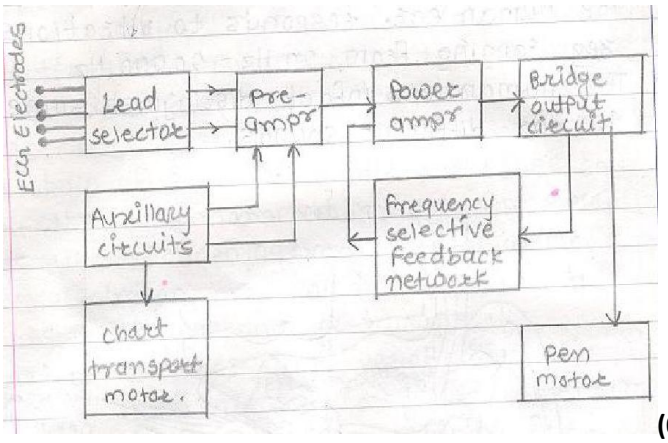
- Vectorcardiography is the technique of analyzing the electrical activity of the heart by obtaining ECG's along three axes at right angles to one another.
- It display any two of these ECGs as a vector display on an X-Y oscilloscope.
- Vector cardiogram displays the same electrical events simultaneously in two perpendicular axes. This gives a victoria 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 repolarization of the atria and the ventricle.

Q.1. b**) ATTEMPT ANY ONE OF THE FOLLOWING . (6)**

i) **Draw block diagram of ECG machine &Describe it. Also describe standard ECG waveform.**

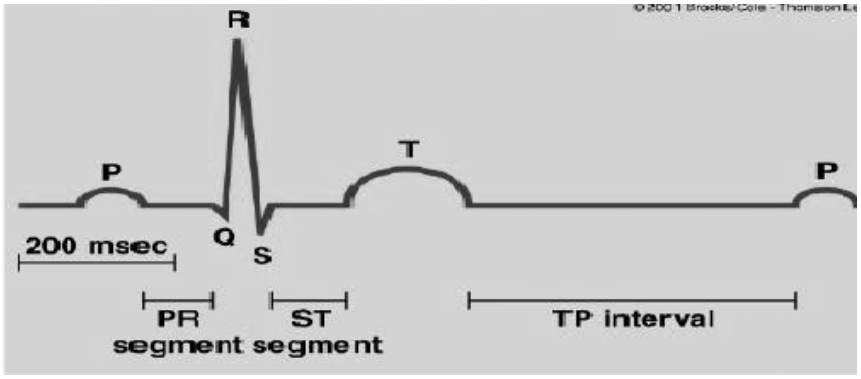
Description: (02 MARKS)

- Lead selector: It is used to select the appropriate lead configuration of electrode as per requirement of patient.
- Preamplifier: the lead picks the desired ECG signal it is amplified with the help of preamplifier which provides high gain. High sensitivity to the signal. It is electrically isolated from rest of the circuitry and earth by using either opto-coupler or transformer to protect the patient from leakage current. Bias for this amplifier is derived through DC to Dc converter.
- Recording mechanism of ECG machine consist of galvanometer, electrical motor, gear assembly, pinch roller, knife edge and recording stylus.



(02 MARKS)

Description of standard ECG waveform. (02 MARKS)



- P Wave = Atrial depolarization QRS complex= Ventricular depolarization

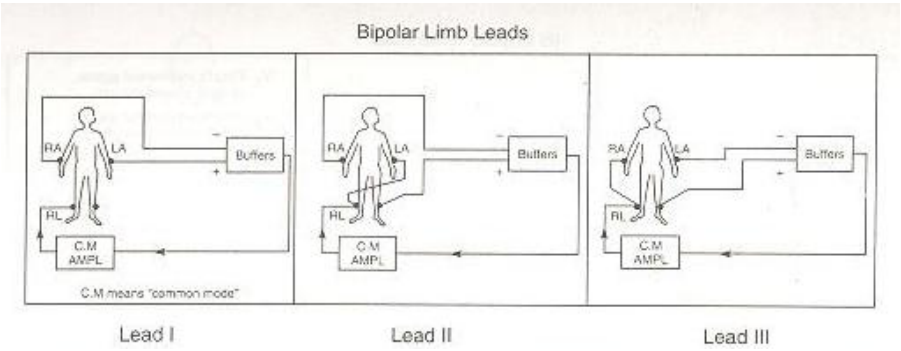
ST segment= Time during which ventricles are contracting and emptying

T wave= Ventricular repolarization TP interval= Time during which ventricles are relaxing and filling

ii) **Draw figure of bipolar leads configuration. &explain Einthoven's triangle with lead I,II,III**

ANS:

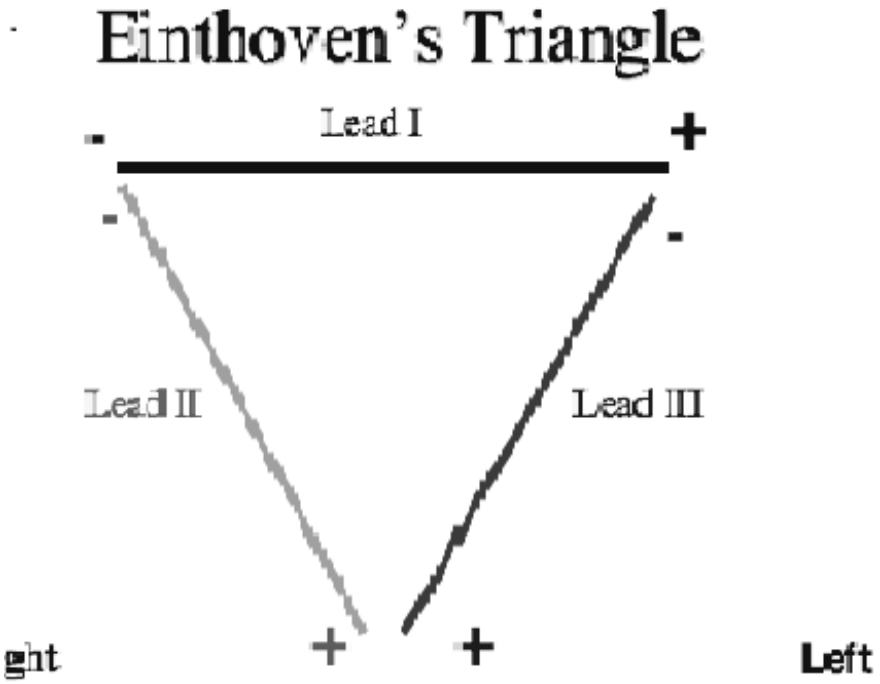
Bipolar Lead Configuration



Sr.No.	Lead symbal	Lead Name	Electrode location & polarity	
			+	-
01	I	Lead I	LA	RA
02	II	Lead II	LL	RA
03	III	Lead III	LL	LA

(02 Marks)

- **Einthoven's triangle** **(04 MARKS)**
- is an imaginary formation of three limb leads in a triangle used in electrocardiography, formed by the two shoulders and the pubis.
- The shape forms an inverted equilateral triangle with the heart at the center that produces zero potential when



the voltages are summed.

- **Lead I** – This axis goes from shoulder to shoulder, with the negative electrode placed on the right shoulder and the positive electrode placed on the left shoulder.

$$I = LA - RA$$

- **Lead II** – This axis goes from the right arm to the left leg, with the negative electrode on the shoulder and the positive one on the leg.

$$II = LL - RA$$

- **Lead III**- This axis goes from the left shoulder (negative electrode) to the left leg (positive electrode).

$$III = LL - LA$$

Q.2.) ATTEMPT ANY FOUR OF THE FOLLOWING

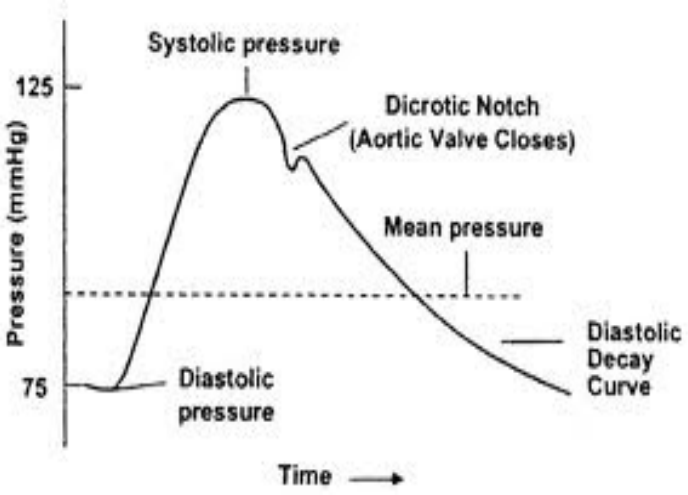
a) **Draw blood pressure waveform and define the following terms.**

i)Systolic Blood Pressure

ii)Diastolic Blood Pressure

ANS:

(02 MARKS)



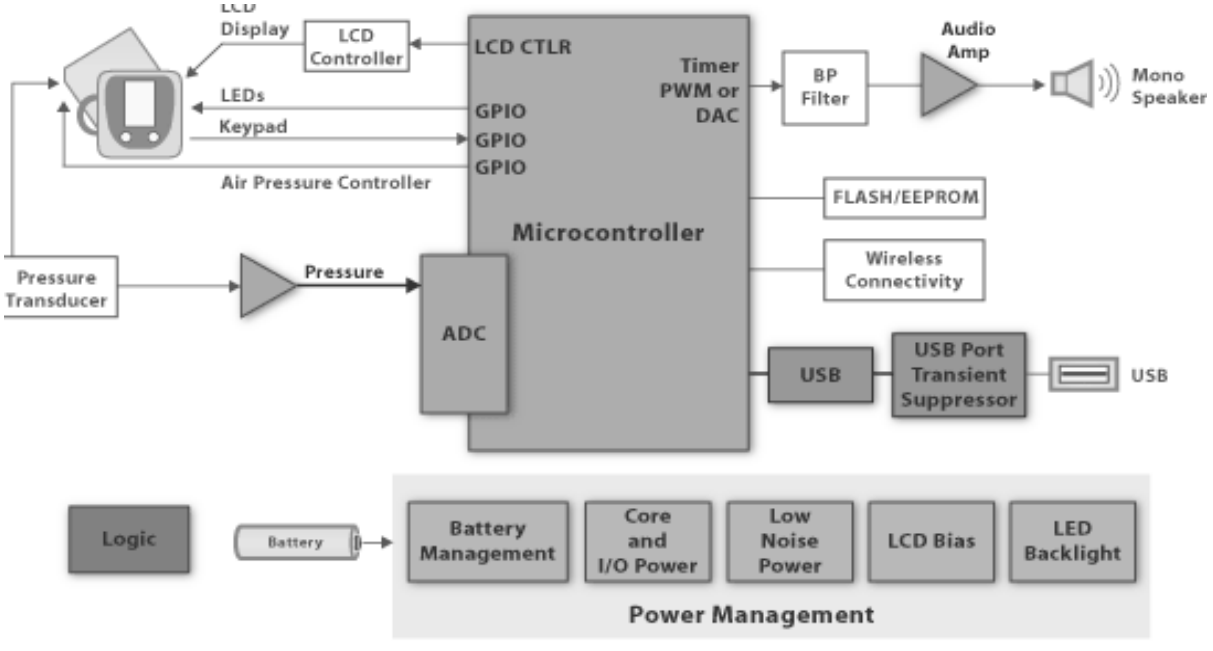
(02MARKS)

1. **Systolic pressure** is peak **pressure** in the arteries, which occurs near the end of the cardiac cycle when the ventricles are contracting
2. **Dichrotic notch** is the sudden drop in pressure after systolic contraction. This drop is caused by the flow back of blood in the arteries when the valve is still in closing up phase.

b)Draw and describe operation of digital blood pressure meter in details.

ANS: **(02MARKS)**

Also refer any other relevant diagram



Block Diagram Description . **(02 MARKS)**

- Blood pressure monitors can use Korotkoff, Oscillometry, or Pulse Transit Time methods to measure blood pressure.
- They employ a pressure cuff, pump, and transducer to measure blood pressure and heart rate in three phases: Inflation, Measurement, and Deflation
- . They include an LCD, selection buttons, memory recall, power management, and USB interface.
- **The pressure transducer** produces the output voltage proportional to the applied differential input pressure.
- The output voltages of the pressure transducer range from 0 to 40 mV, which need to be amplified so that the output voltage of **the DC amplifier** has a range from 0 to 5V. Thus, we need a high-gain amplifier
- . Then the signal from the DC amplifier will be passed on to **the band-pass filter.** The DC amplifier amplifies both DC and AC component of the signal.
- **The filter** is designed to have large gain at around 1-4 Hz and attenuate any signal that is out of the pass band. The AC component from filter is important for determining when to capture the systolic/diastolic pressures and heart rate of the patient.
- The final stage of the front end is an **AC coupling stage**, after which the signal is sent to analog to digital converters, and digitized.
- The digital measurements of pressure and heart rate are performed by the **microprocessor**. Measurements results are stored in EEPROM or FLASH memory as a data log that can be uploaded to a PC via USB.
- The analog circuit is used to amplify both the DC and AC components of the output signal of pressure transducer so that we can use the MCU to process the signal and obtain useful information about the patient's health.

c)List four technical specification of audiometer. (Any four 04 MARKS)

ANS: Some important technical specification of an impedance audiometer are given below.

- Power :- 230 volts A.C., 50Hz & or battery
- Outputs :- Left, Right, Left & Right, Bone, Free field.
- Pure Tone frequency:-

  Air conduction

Frequency in Hz	dB
125	60
250	90
500	100
1000	100
1500	100
2000	100
3000	100
4000	100

6000	100
8000	50
10000	70

Bone conduction

Frequency in Hz	dB
125	30
250	40
500	50
1000	50
1500	50
2000	50
3000	50
4000	50

- Attenuator Range :- 10Db to value given above in steps of 5DB each.
- Automatic pulsing :- 0.25sec, 0.5 Sec, 1 Sec, 2sec.
- Masking :- Wide band.
- Masking Attenuator :- 0.100DB in 10DB steps.
- Display :- Led Digital Display.

d).**List Eight technical specification of ECG machine (any eight 04 MARKS)**

ANS: i) Power : 230m volts AC, 50 hz

ii)Leakage Current: Less than 10mA. With 230 v. AC.

iii)I/p impedance: Greater than 20MW

iv)Frequency Response:0.05Hzto 100HZ.

v)Noise: Less than 10 mV peak to peak.

vi)CMRR: Better than 80 db,

vii)Sensitivity:0.5,1.0,&2.0cm/mV.

viii)Filter: 50 HZ notch Filter.

Ivv)Recording speed :25&50mm/second.

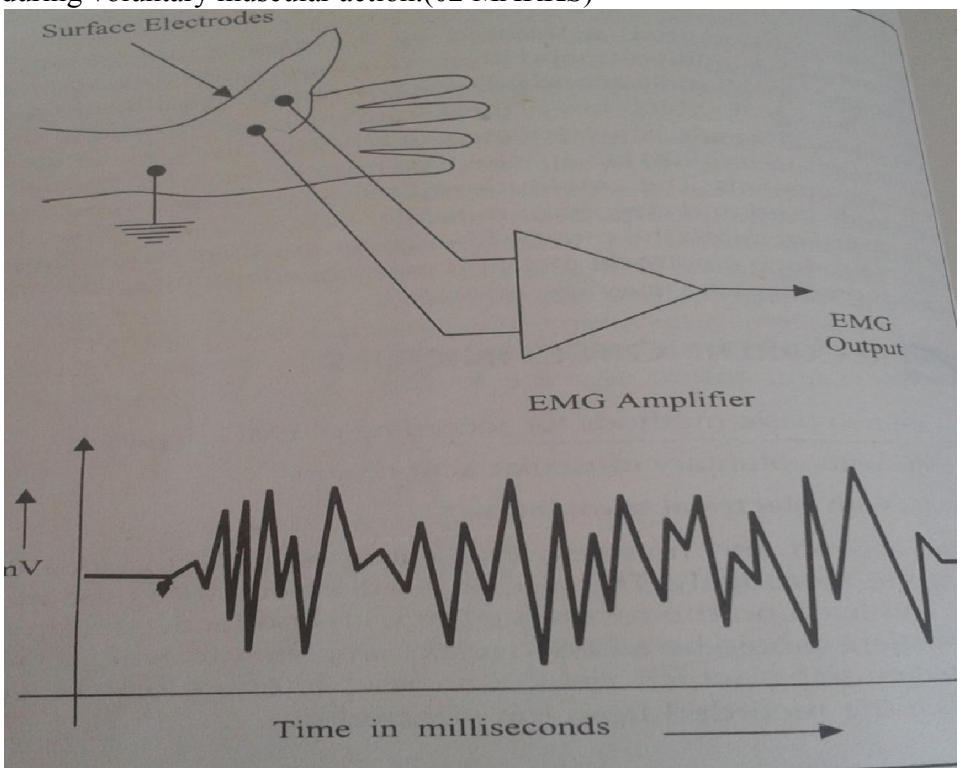
vv)Recorder: Hot stylus single channel galvanometer.

e**) List methods of EMG generation. Describe any one in detail with neat labeled diagram**

ANS: There are two basic methods(02 MARKS)

1. EMG with voluntary muscular action
2. EMG with electrical stimulation.

EMG generated during voluntary muscular action.(02 MARKS)

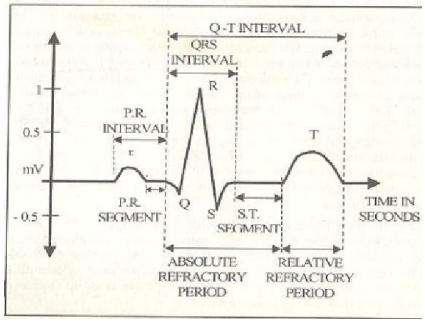
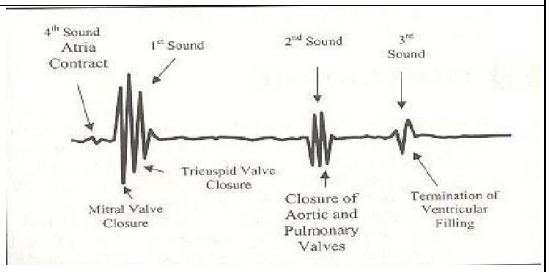


Description :

- The EMG produced during voluntary muscular action may spread over a period of 100ms.or more and can have number of spikes or train of spikes.
- In mild contraction of a muscle, it is possible to identify an action potential of even single motor unit.
- The quantity of electrical activity produced by voluntary muscular action depends on strength of contraction.
- Since it is difficult estimate the quantity from an observation of the EMG waveform on the screen of oscilloscope the absolute integral the EMG is used as a measure of this quantity.
- As EMG information is in audible range it is often presented in audible form.

f) **Compare ECG and PCG (any four points)** **(04 MARKS)**

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 provides 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,
 ECG signal	 PCG signal

Q.3 Attempt any FOUR of the following. (16)

a) Differentiate between direct and indirect blood pressure measurement technique (any four points).

Ans:- **(1 Mark each= 04)**

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 measures 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) List and describe the methods of measure heart rate.

Ans:-Methods of measure heart rate are given below.**(1 Mark)**

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

1. **Average calculation:- (1 Mark)**
   This is the oldest and most popular technique. An average rate (beats/min) is calcuted 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:- (1 Mark)**

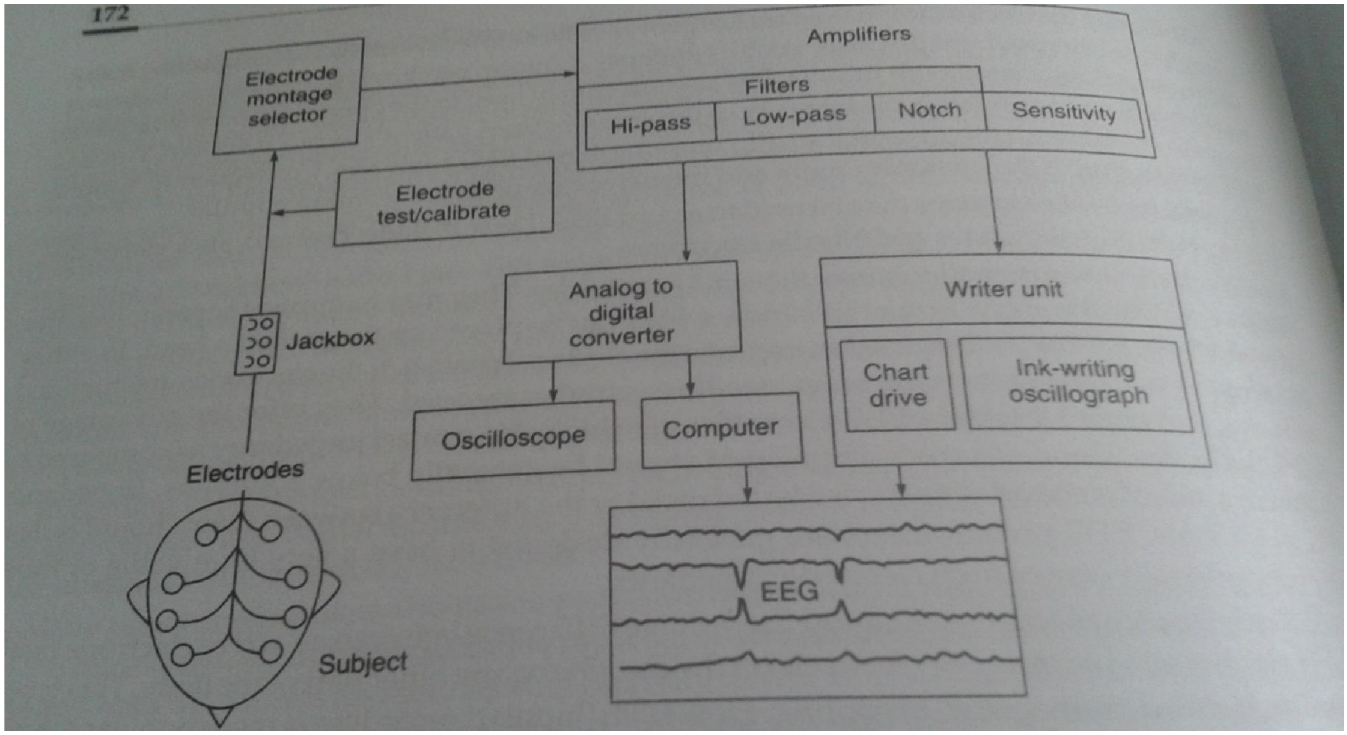
   This is done by measuring the time(T), in seconds, between two consecutive pulses, and converting this time into beats /min=60/T. This technique accurately represents the true picture of the heart rate.

3. **Combination of beat –to-beat calculation with averaging: -(1 Mark)**

   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.

c) Draw block diagram of EEG machine and describe it.

Ans **(2Mark)**



(02Mark)

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, accoupled, 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 minimise 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 tunned at 50Hz so as to eliminate mains frequency interference.

Noise:-EEG amplifier 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 have 32 channels although 8 or 16 channels are more common.

d) Describe four heart sounds generated by heart with respect to its origin.

Ans: -There are four basic sounds that occur during the sequence of one complete cardiac cycle. **(1 Mark each= 04)**

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.

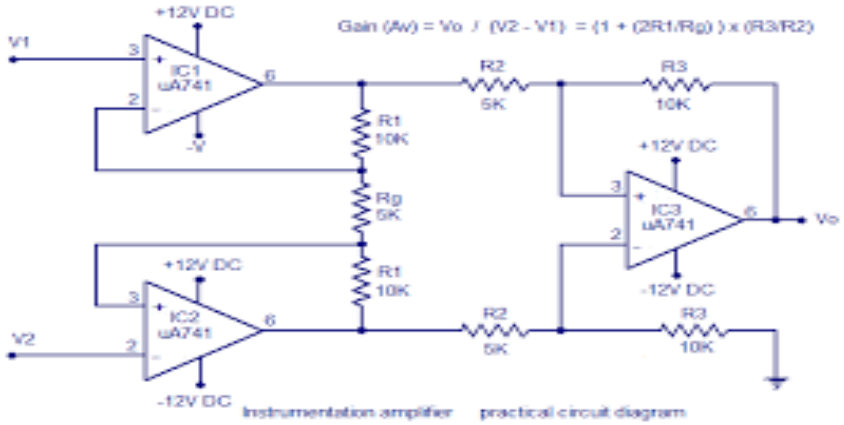
2. The second sound is high pitch sound. It has frequency between 50 to 70Hz. It is caused by the closure of aortic and pulmonary valves, which release the blood for systemic and pulmonary circulation. The second heart sound occurs about the time of the end of the 'Wave of the ECG complex. It is louder 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 an ECG preamplifier using op-amp and mention four application of ECG preamplifier.

Ans:- Following Fig. shows the pre-amplifier circuit of ECG machine**(02 Mark)**



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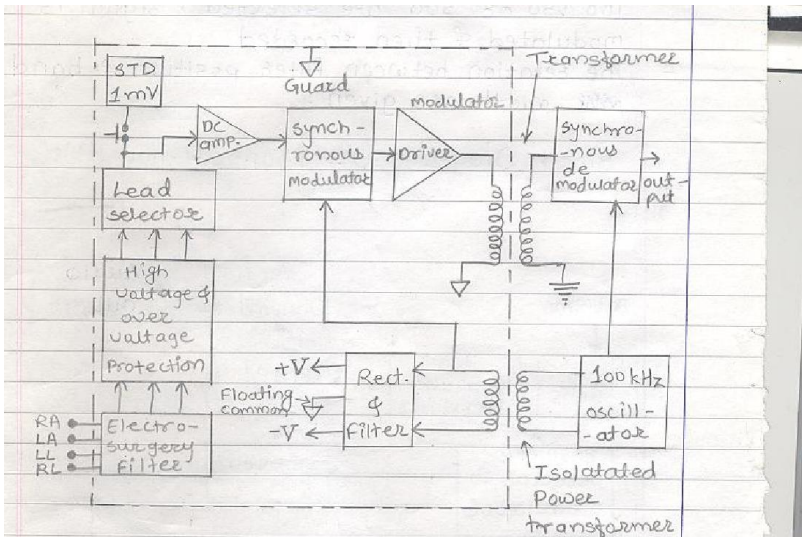


Application:- **(1/2 Mark each)**

1. It converts relatively weak electrical signals from the heart to signals that can be output to a monitoring system.
2. It gives stabilizing effect.
3. It provides high input impedance to keep the current drawn from the system being measured low.
4. It provides a high Common Mode Rejection Ratio (CMRR) will be used to receive the desired signal.

Q.4 Attempt any THREE of the following.(12)

i) List technical specification of respiration rate meter.

Ans:- **(1 Mark each=4)**

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

2. Measuring range: 0to 50 Breaths.

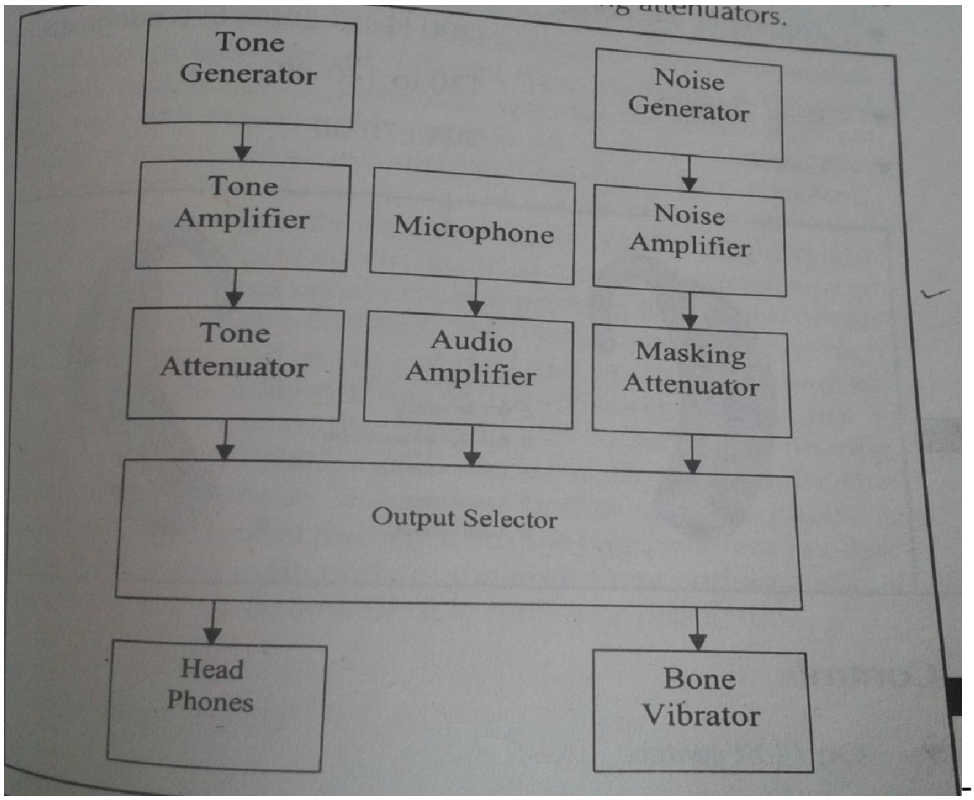
3. Transducer : Nose (Thermistor) or chest (strain gage).

4. Display : 7 segment LED or LCD.

5. Respiration indication: Audio beep and LED.

ii) Draw block diagram of pure tone audiometer and describe it.

Ans:(02 Mark)



A block diagram of pure tone audiometer is shown in fig. It consists of following block: **.(02 Mark)**

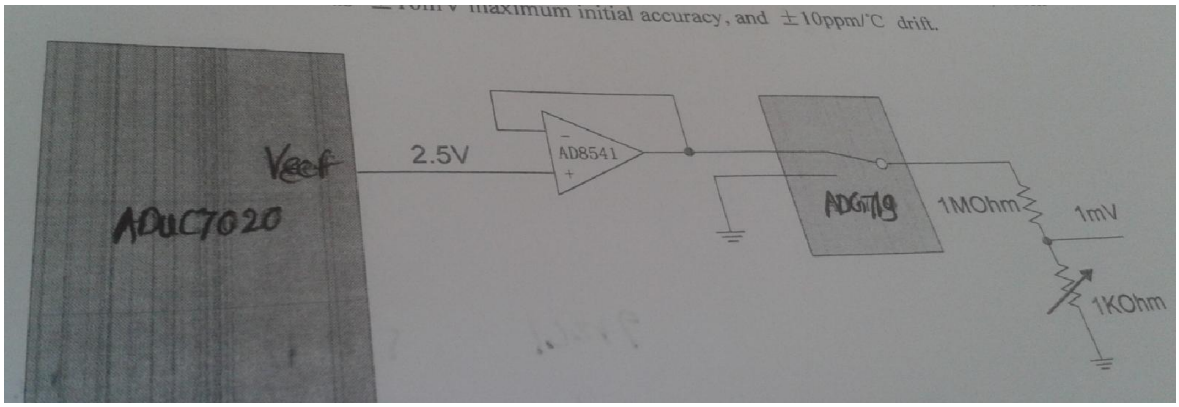
1. Tone generator
2. Noise generator.
3. Tone amplifier.
4. Noise amplifier.
5. Tone attenuator.

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 amplifies amplify these signals to the desired level. A attenuator is usually 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 .Head phones 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.

iii) Describe 1 mV calibration n/w in ECG machine with suitable diagram.

Ans:- **(02 Mark)**



Description:- **(02 Mark)**

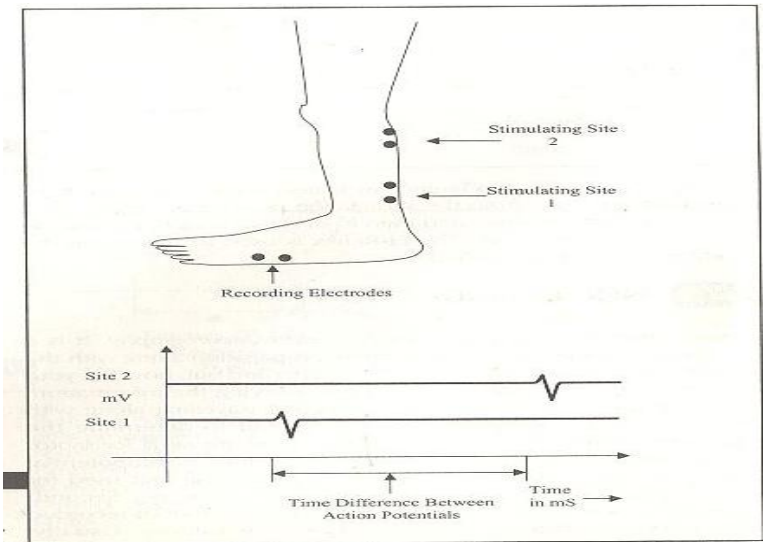
1mV calibration signal is derived from the embedded reference of the processor ADuC7020, which is 2.5V. The reference has ±10mV maximum initial accuracy, and ±10ppm/℃drift. As the 1mV accuracy, initial accuracy can be calibrated out, so the temperature drift is the most important factor, for patient 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.

iv) Describe motor and sensory nerve conduction.

Ans:-Motor Nerve Conduction Velocity:-**(2 Mark)**

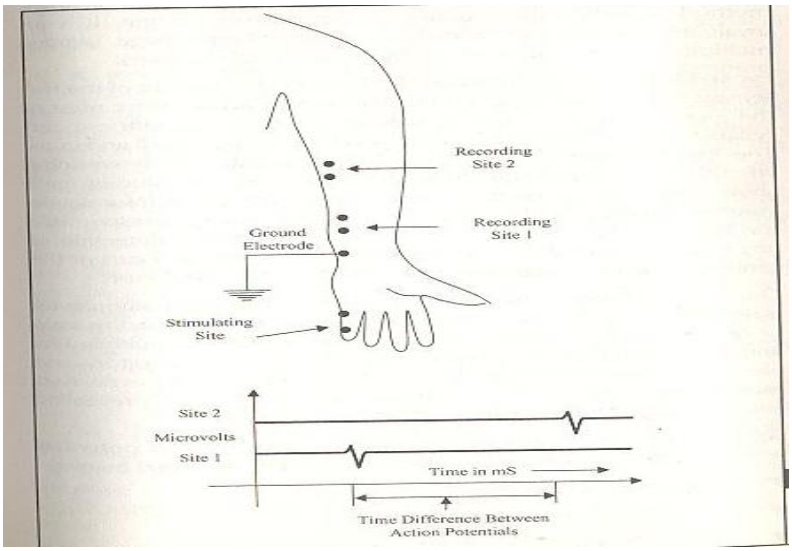
The Motor nerve Conduction Velocity is measured from Stimulus site to the muscle as shown in fig. The peroneal nerve of the left leg is stimulated behind the knee and muscular response is detected in the foot using surface electrodes. A nerve muscle travels downward along with the motor nerve to the 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 determine the nerve conduction .It is possible to measure the motor nerve Conduction velocity between several locations.



Sensory Nerve Conduction Velocity:-**(2 Mark)**

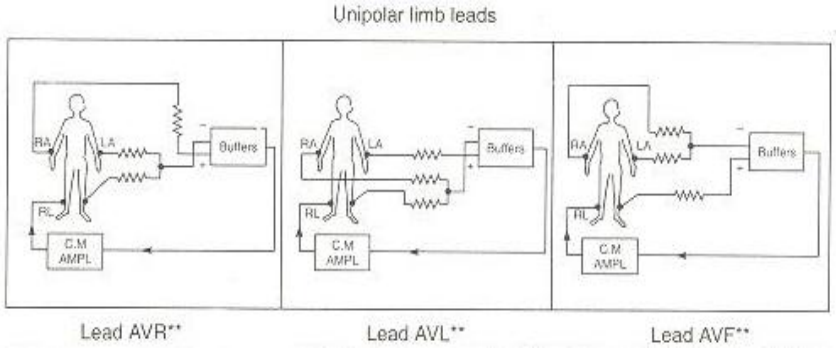
Sensory nerve conduction velocity is measured by similar technique used for nerve as shown in fig. Recording electrodes are placed at no. of sites on the sensory nerve under test. In this example an nerve of the hand is considered as shown in fig. And the stimulus is applied at the little finger which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



b) Attempt any ONE of the following.(6)

i) Draw figure showing unipolar limb lead configuration and describe it.

Ans:- **(03Mark)**



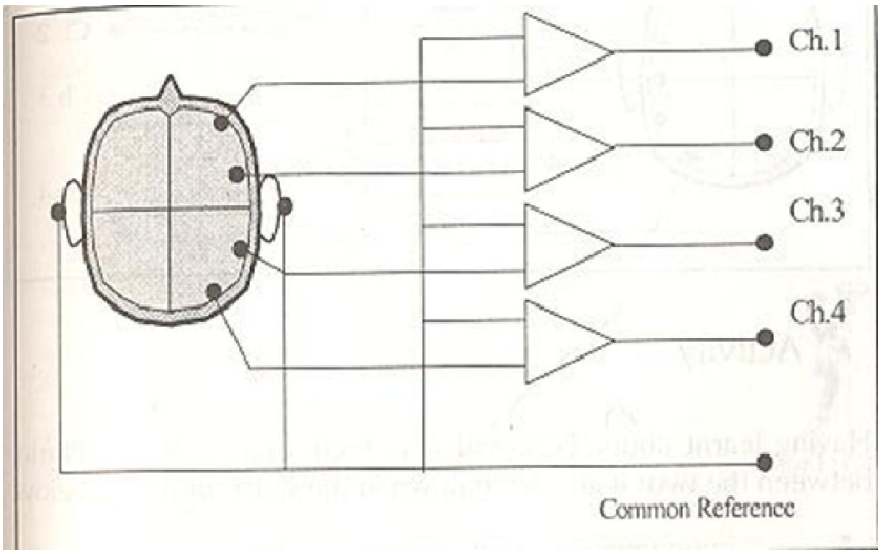
Description : **(03Mark)**

Unipolar leads : 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.

ii) Draw and recording technique of EEG signals.

Ans:-Three different recording methods are used in the routine EEG recording**.**

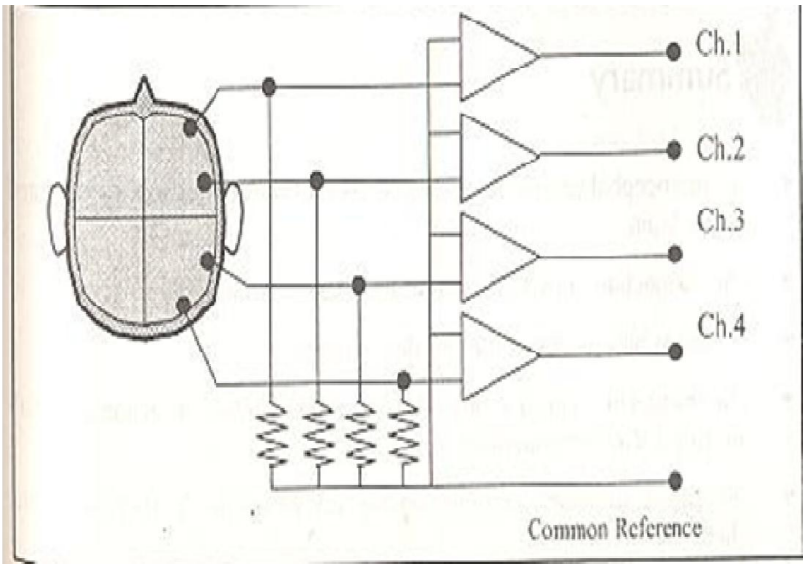
1. **Unipolar or Monopolar recording:- (1 Mark)**
   In this method on electrode is made common to all channels. Ears are connected together to form reference common electrode as shown in fig. Apart from ears, sometimes nose tip ,jaw neck and head tops are also used as reference points. This method is used to record an active potential at only one point on the scalp. The electrode from which no active potential at comes in is called as reference electrode and the electrode from which an active potential comes in is called an active electrode.
   (1 Mark)



2. Average recording:- **(1 Mark)**

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.

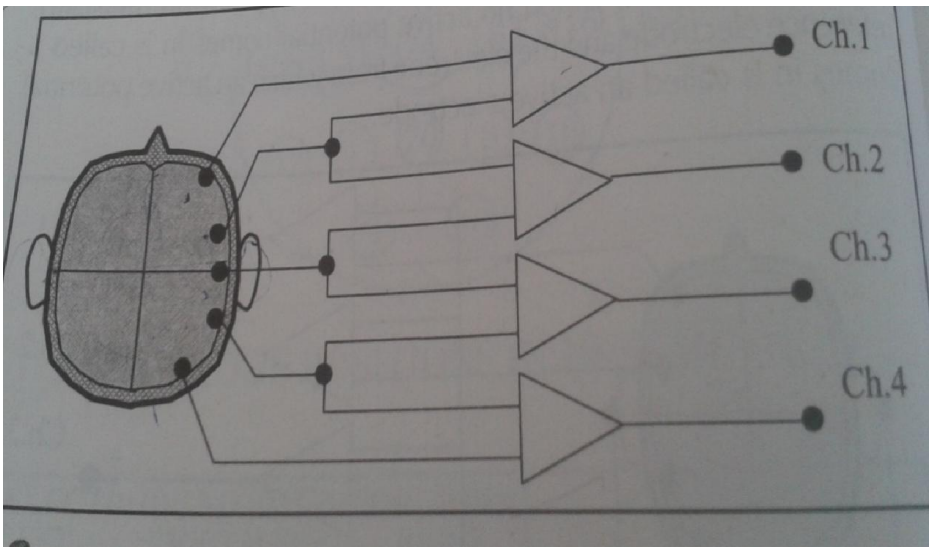
(1 Mark)



3. Bipolar recording:-(1 Mark)

In bipolar recording method different channels are connected in series between electrode pair as shown in fig. This method records the potential difference between two electrode on the scalp.

(1 Mark)



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Q5 Attempt any four **16**

a) Describe systemic and skin temperature(2m+2m)

Two basic types of temperature measurements can be obtained from human body1.Systemic temperature 2.Skin surface measurement

Systemic temperature _ is temperature of internal regions of body.Body maintains systemic temperature as controlled balance between the heat generated by the active tissues and the heat lost by the body to the ambient.This temperature is constant throughout the body.Systemic temperature is accomplished by temperature sensing devices placed in mouth under armpits or in rectum (37 C healthy person).The under arm temperature is one degree lower,whereas the rectal temperature is one degree higher than mouth reading.

Skin or surface temp – is function of surface circulation, environmental temperature & air circulating around the area (range 30– 35degree C).Thus is a balance between heat received and heat spent.Skin temperature can vary several degrees from one point to another point.The factors that affect the skin temperature are ambient temperature,covering of fat at capillaries of skin and blood circulation pattern at that point.Skintemp.measurements can be used to find defects in blood circulation system. Measurements can be made by small flat thermistor probes.Infrared thermometer can be used to measure the skin temperature.

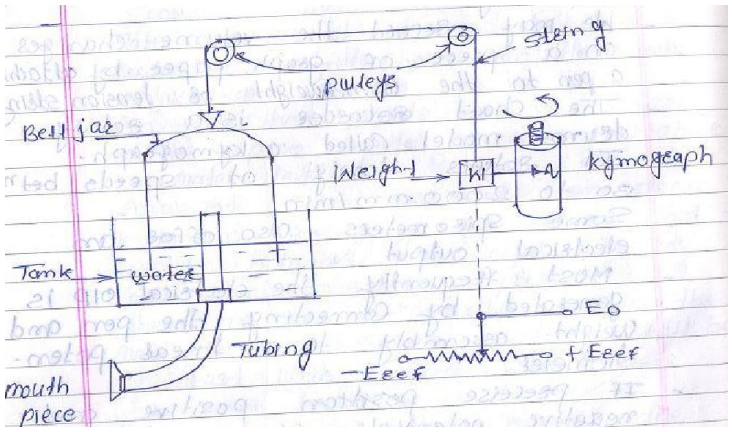
b)Give the function of spirometer and describe it with neat labelled diagram(function1m+ description2m+diagram1m)

Ans.:- function: The air flow volume in and out of lungs is measured by a device called spirometer and the recording of lung volumechanges with time is known as the spirogram.

Description: The conventional spirometer is as shown in fig below .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.

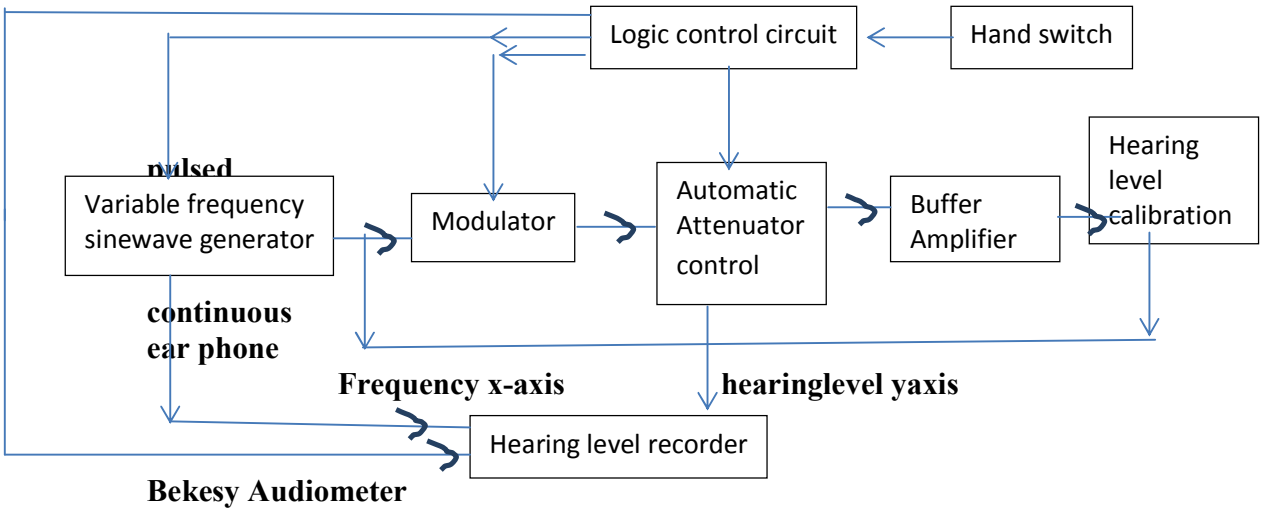
Using the Bell to rise Similarly when patient inhales the pressure inside the bell decreases The Bell will rise when press increases and drop when pressure decreases.The change in Bell pressure change the volume inside the Bell which also causes the position Of the counter weight to change.We may record 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 offeras 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.



Spirogram setup

c)Draw block diagram of Beksey audio-meter and state the function of each block.(2m+2m)



OR any other relevant diagram

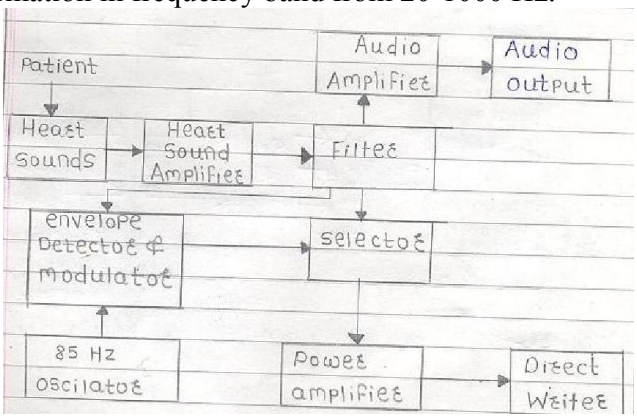
This block diagram consists of

1)variable sine wave oscillator.It has ability to generate 125hz,250hz, 500hz,1000, 1200, 2000,3000 ,4000,6000,and 8000hz signal. 2)A modulator is used to modulate the variable frequency sinusoidal as pulses so that the patient can easily recognize the tone.3)Attenuator is used to attenuate the signal to desired level.4)Hand switch is there to increase or decrease the magnitude of the sound.5)Buffer amplifier is included between attenuator and hearing level calibrator.6) An x-y recorder is connected to potentiometer of attenuator.A standard continuous signal is used to calibrate the recorder7)Logic control circuit makes the coordination accordingly with every block.8)hearing level recorder records data and gets the audiogram chart of patient under audiometry.

d)Draw block diagram of PCG machine and explain it(2m+2m)

Ans.:-

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



Phonocardiogram Block Diagram

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 are 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 signals 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.

e)Define any four respiratory parameters with neat diagram (any four parameters wrt diagram 1mark each)

1.Tidal volume(TV)- the volume of gas inspired or expired (exchanged with each breath) during normal quite breath is known as Tidal volume.

2.Minute Volume (MV) - the volume of gas exchanged per minute during quite breathing. Its equal to the tidal volume multiplied by the breathing rate.

3.Alveolar Ventilation (AV) - the volume of fresh air entering the alveoli with each breath. Alveolar Ventilation = (Breathing rate) X (Tidal volume – dead space)

4.Inspiratory reserved Volume (IRV) - The volume of gas which can be inspired from the normal end-tidal volume. IRV= VC – (TV + FRC)

5.Expired Reserve Volume (ERV) - the volume of gas remaining after a normal expiration less the volume remaining after a forced expiration. ERV= FRC - RV

6.Residual Volume (RV) - the volume of gas remaining in the lungs after a forced expiration.

7.Functional Residual capacity (FRC) - the volume of gas remaining in the lung after normal expiration.

8.Total Lung Capacity (TLC) - the volume of the gas in the lungs at the point of maximal inspiration. TLC = VC + RV

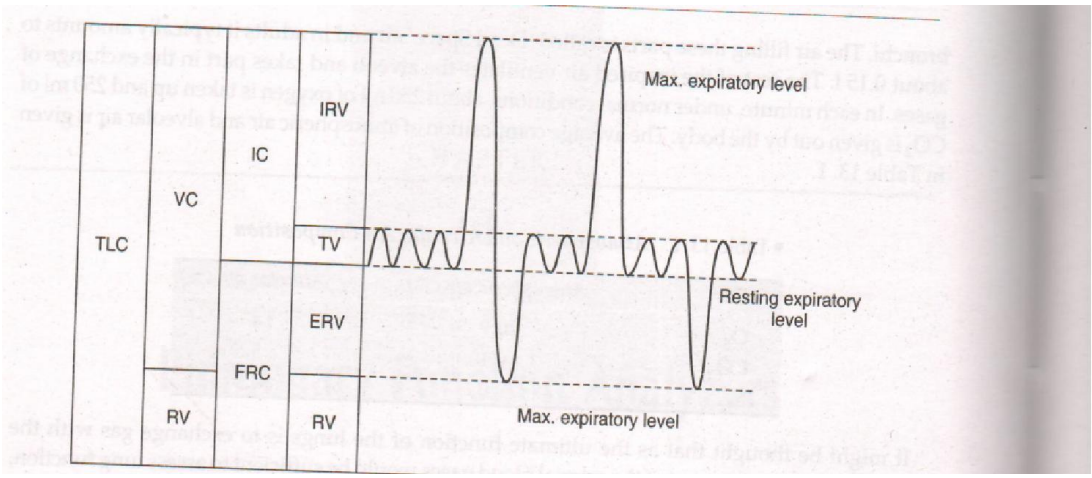
9.Vital Capacity (VC) - the greatest volume of gas that can be inspired by voluntary effort after maximum expiration, irrespective of time.

10.Inspiratory Capacity (IC) - the maximum volume that can be inspired from the resting end expiratory position.

Diagram:

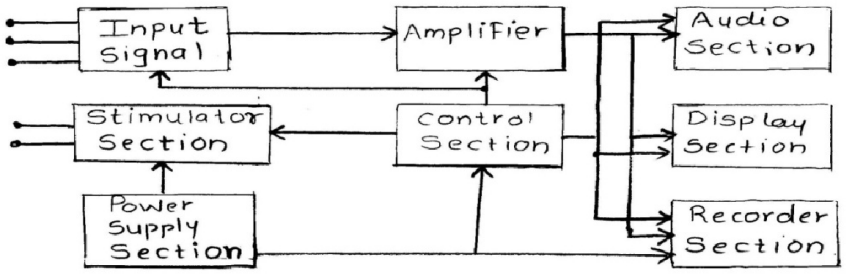
11.Dead space- Dead space is the functional volume of the lung that does not participate in gas exchange

Diagram:



Volume and capacities of lungs

f)Draw block diagram of EMG machine and state the function of each block. (2m+2m)



Block diagram EMG machine

1.Power Supply Section:

It produces a number of regulated voltages, which are used to supply analog and digital sections of the system

1. Stimulator Section:

It receives control signal from control section.

The control section generates trigger pulses at definite intervals to initiate oeration of nerve and muscle stimulator and controls stimulus repetition rate.

2. Input Section:

The input section of the EMG equipment consists of electrode junction box, calibration network and pre-amplifier.

The EMG signals received from the patient are fed to the pre amplifier in electrode junction box. It is a buffer amplifier which has high input impedance, low noise and low output impedance.

A calibration network applies a rectangular voltage 100mV to the input of amplifier section when a calibration button is pressed to test the recorder and generate reference waveform.

3. Amplifier Section

It amplifies the signal to a desired level.

A multiple steps filter employed here allows only a signal of selected bandwidth to pass to next circuit i.e ADC in control section.

4. Control Section

It consists of central processing unit, keyboard memory, interfacing unit etc.

After processing the signal in control section, it is again converted to analog converter and fed to CRT.

5. Display section:

Normally CRT type displays are used with EMG machine. The display has two modes :

Continuous and triggered.

The control section also generates two cursors on the CRT screen to perform measurements on the waveform.

6. Recorder Section :

A power galvanometer with hot stylus is used as a recorder in EMG. In EMG system a low frequency signal is generated using a processor to suit frequency response of galvanometer and recorded.

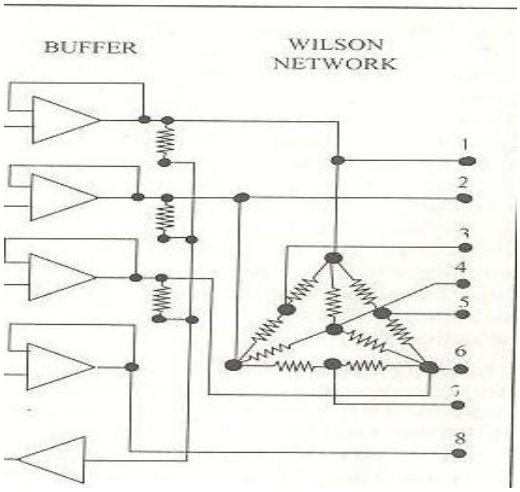
7. Audio Section:

Being the EMG signals are in audible frequency range, an audio amplifier and speaker are incorporated in EMG machines.

Audio amplifiers of 2 to 7 watts are very commonly used in EMG machines.

Q6 Attempt any four 16

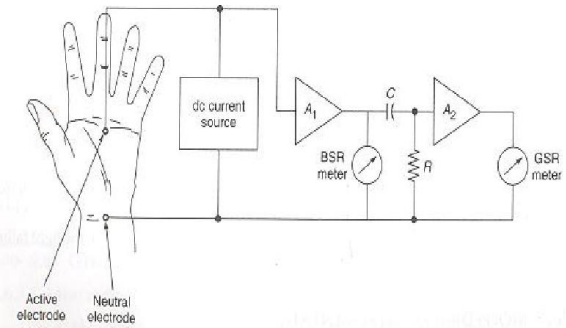
a) Draw Wilson's N/W circuit in ECG M/c and state its importance.(2+2)



Importance :

Wilson network sums the various electrode voltages to achieve the standard voltages for different ECG selection. The multiplexer selects the appropriate lead voltages form register network.Wilson network performs a mixing of summing function and thus provides ECG connections for lead selection

b)Draw block diagram of GSR meter and describe it (2m+2m)



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 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.

c)List technical specifications of digital temperature meter(any 4 for 4 marks)

Ans. :Important technical specifications of temperature meter are as follows

1Power: Battery-9volts

2Measuring range: 0 – 42 degress centigrade

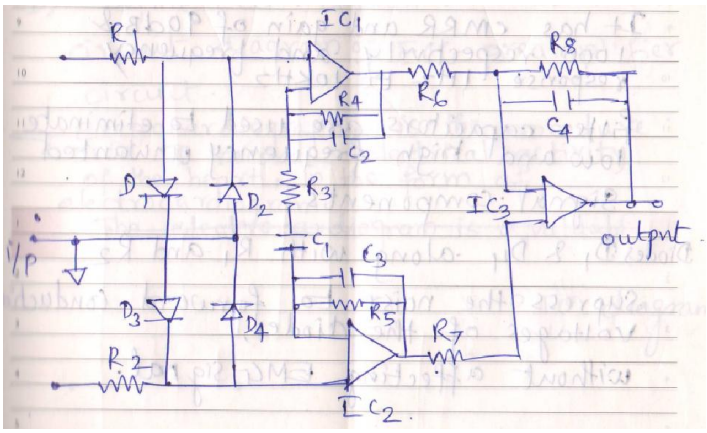
3. Resolution : 0.1

4.Accuracy:0.1%(30 to 42 degree cent.)

5.Transducer: semiconductor

6.Display :seven segment LCD

d)Draw preamplifier circuit of EMG machine and give application of EMG pre-amplifier (Draw 2m+ application 2m)



The input section of EMG equipment consists of electrode junction box calibration network and preamplifier.

The EMG signals received from the patient are fed to the preamplifier in the electrode junction box.

A typical circuit diagram of EMG preamplifier is shown in fig above.

Application :

EMG pre- amplifiers are used to produce exceptionally clean waveforms even during human movements while recording. The preamplifier is located near to the entrance.It receives direct input of very small bioelectric signals,and is exposed to influence of noises thus it is designed in such way that it eliminates AC induction interference,polarization voltage generated by electrode and internal noise.

It employs three operational amplifiers and forms an instrumentation amplifier.It has CMRR and gain of 90 db& 1000 respectively and frequency response 1 Hz to 10 KHz.Filter capacitors are used to eliminate low and high frequency unwanted signal components.Diodes D1 & D4 along with R1 and R2 suppress the noise to forward conduction voltages of the diodes, without affecting EMG signals.

e) Describe impedance audiometer and and the speech audiometer.(2m+2m)

1.)Impedance audiometer :

Primary purpose of impedance audiometer is to determine the status of tympanic membrane and the middle ear via tympanometery or known as acoustic immitancetest.Secondary purpose is to evaluate acoustic reflex pathway which include seventh and eighth cranial nerves and brain stem.Thus impedance audiometry is a measurement of energy or air pressure which involves the external auditory canal, the eardrum,ossicular chain,7^{th},8^{th} cranial nerve and brain stem.

2)Speechaudiometery:

Speech audiometers are used to determine speech reception thresholds.Tests are conducted with spoken voices to prescribe the hearing aids.A cassette player or CD player is used to play the recorded speech. Live voice facilities are incorporated in the microphone amplifiers for communication purposes.Thus they provide information regarding discomfort and tolerance to speech stimuli and information on word recognition abilities.speech audiometers also facilitates audiological rehabilitation managemaent.