



## Summer – 16 EXAMINATION

Subject Code:17545

Model Answer Page No: 1/22

### **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- 16 EXAMINATION

Subject Code: 17545

Model Answer

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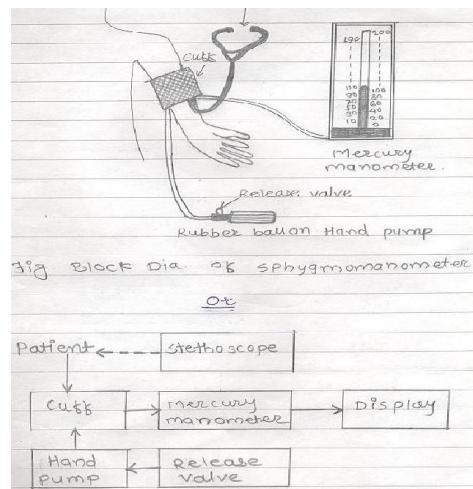
Q.1A Attempt any Three.

(12)

a) Draw the diagram of sphygmomanometer and state its working principle.

(Diagram- 02 mark, 02 marks for state principle.)

Ans:



**Working Principle:** 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 aspects 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 made 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

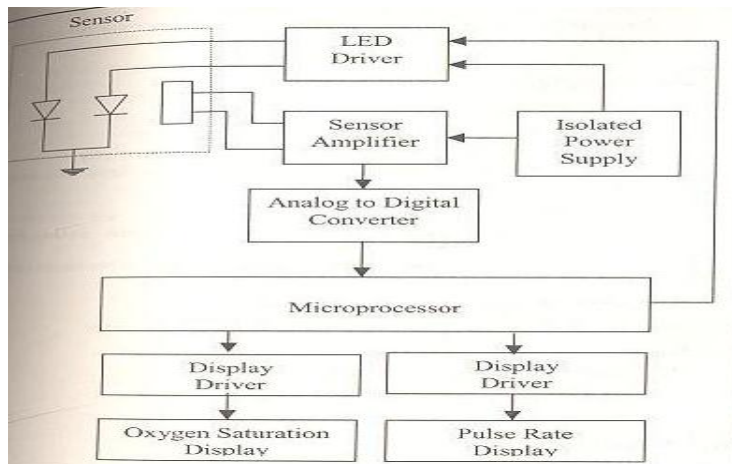


**b) State working principle of pulseoximeter.**

(Working principle- 02 marks, Diagram- 02 marks)

**Ans: 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 determines 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.



**c) List four technical specification of heart rate meter. (01marks for each)**

**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

**d) State the concept of vector cardiograph.**

**Ans:**

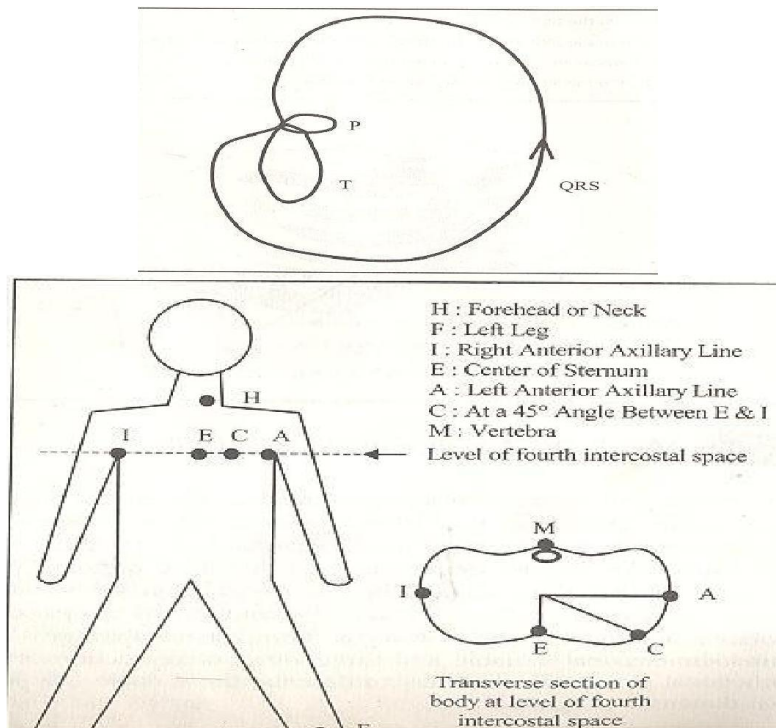
**Description**

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 displays 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 repolarization of the atria and the ventricle.



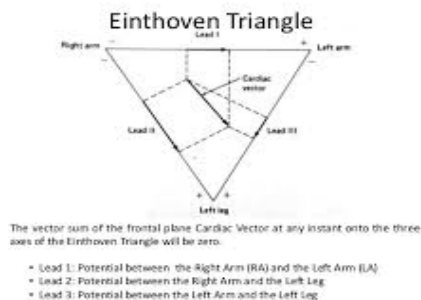
B) Attempt any one

(06)

a) State and draw Einthoven's triangle of potential difference across the heart. Also show bipolar lead connection.

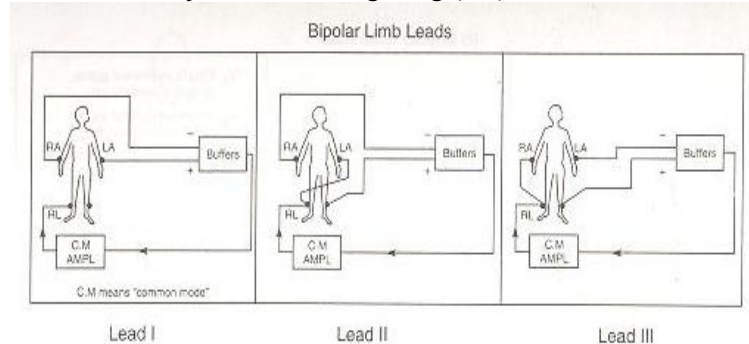
(Draw Einthoven's triangle-01 marks; State -02 marks; bipolar lead connection -03 marks)

**Ans: Einthoven's triangle** 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.



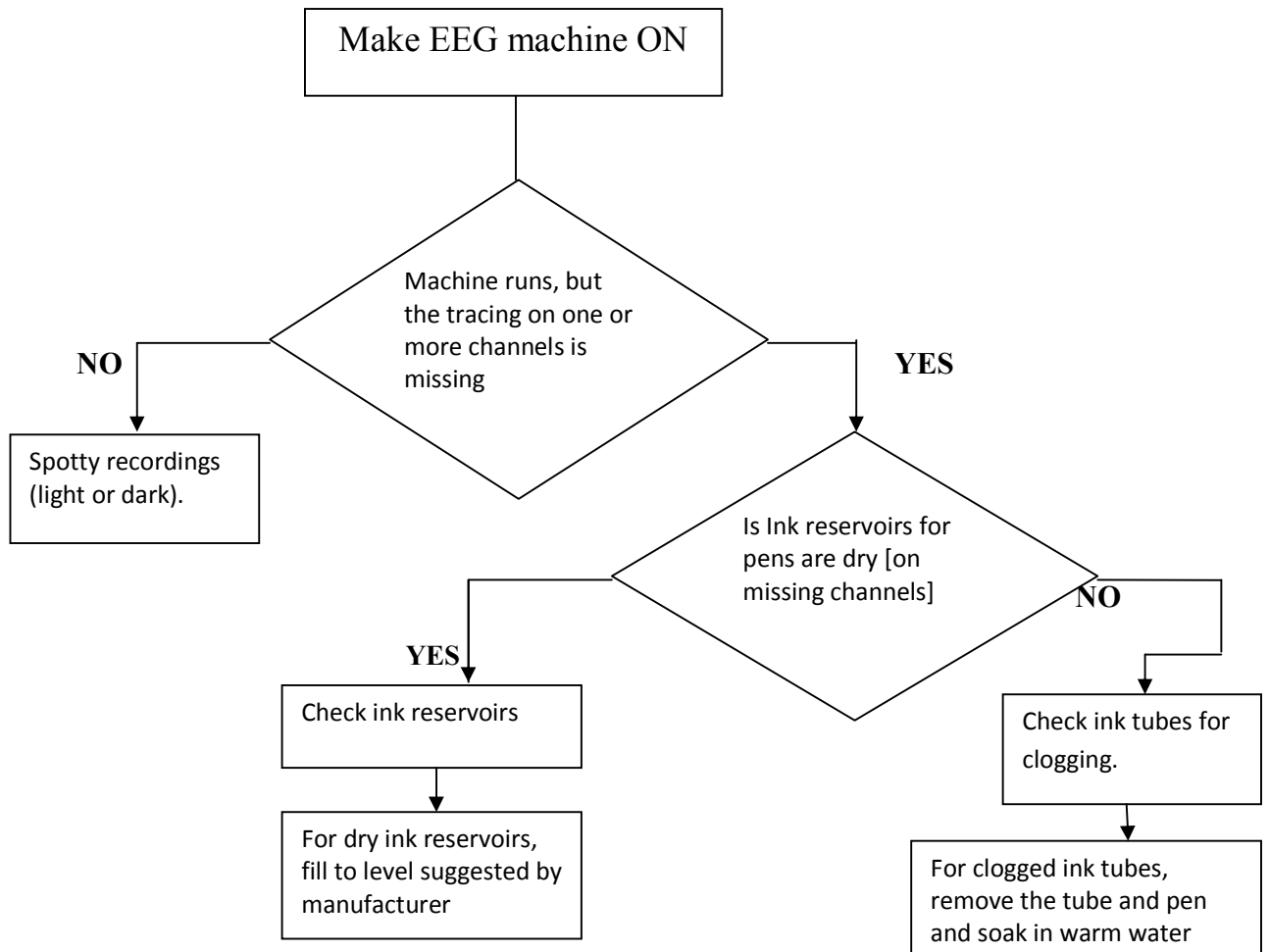


**1. Bipolar lead:** In bipolar leads, ECG is recorded by using two electrodes. In standard lead I, the electrodes are placed on the right and the left arm (RA and LA). In lead II, the electrodes are placed on the right arm and the left leg (RA and LL). In lead III, the electrodes are placed on the left 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).



b) Draw fault finding tree for EEG.

Ans:





Q.2. Attempt any four of the following.

16 mark

a) Draw block diagram of direct blood pressure measuring system and state it's working principle  
(Diagram – 02 marks ; Description 02 Marks)

Ans: Working Principle:

In this technique a catheter & an electronic transducer to sense the blood pressure. .

In this technique measure the blood pressures in the artery or particular part of the body.

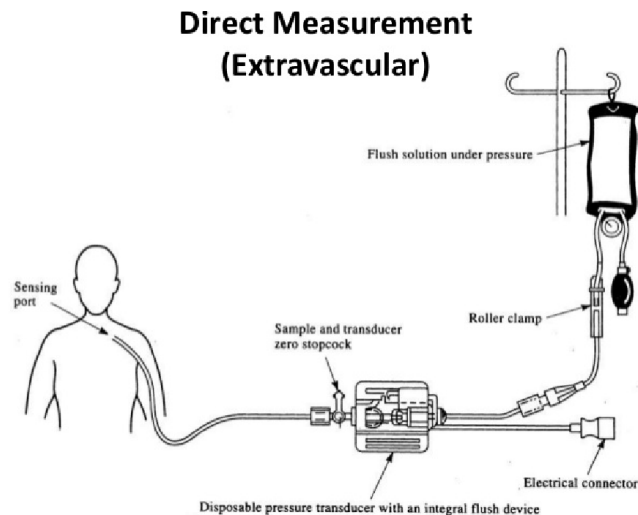
The advantage of this system is that pressure is continuously monitored beat-by-beat, and a waveform (a graph of pressure against time) can be displayed .

This technique provides much more reliable information.

This technique is more complicated.

. Here the catheter is connected to a three way stopcock and then to a pressure sensor.

It is filled with a saline heparin solution. It must be flushed with solution every few minutes to prevent blood clotting at the tip.



b) List four technical specification of respiration rate meter.

(1 mark each)

- Ans: 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.



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5. Respiration indication: Audio beep and LED.

c) List the importance of microphone amplifier and earphone in hearing aid and suggest which types of deficiencies of human body it can overcome.

(Importance -01 mark each, Deficiencies- 02 marks )

Ans:

1) Importance of microphone amplifier: A small microphone picks up the sounds and turns them into an electric current.

An amplifier circuit (containing one or more transistors) increases the strength of the current.  
A small button battery powers the amplifier circuit and other components.  
The amplified current drives a small loudspeaker.

2) Importance of earphone: The amplified current drives a small loudspeaker.

The loudspeaker plays its sound into a tube called the ear hook.  
The ear hook plays the sound through the ear mold into your ear canal.  
Sound waves of greatly increased volume travel to your inner ear.

Following deficiencies could be covered with the help of hearing aid.

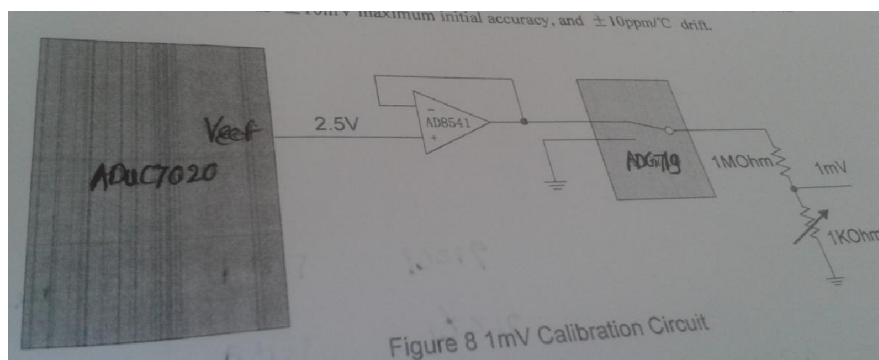
1) The path between your outer ear and your brain can be blocked or damaged in many different places and in a number of different ways, so people can become deaf or lose some or all of their hearing for lots of different reasons.

2) One of the most common types of hearing loss happens when the hairs in the cochlea become damaged. If there are fewer hairs, sounds produce less stimulation in your brain—so things need to be louder for you to hear them. That's where hearing aids come in. They can't help everyone with impaired hearing, but they can often make a difference to hearing problems caused by a loss of cochlear hair cells, medically known as sensor neural hearing loss

d) Describe 1mV calibration network in ECG machine with suitable diagram.

(Draw- 02 marks; Working 02 marks)

Ans:





**Description:**

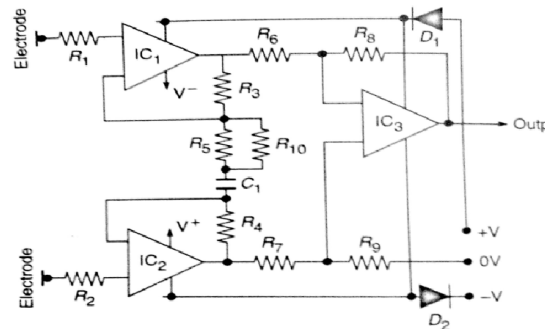
1mV calibration signal is derived from the embedded reference of the processor ADuC7020, which is 2.5V. The reference has  $\pm 10\text{mV}$  maximum initial accuracy, and  $\pm 10\text{ppm}/^\circ\text{C}$  drift. As the 1mV accuracy, initial accuracy can be calibrated out, so the temperature drift 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  $5\Omega$  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.

e) Draw preamplifier circuit of EMG and describe it.

(02 marks for diagram ; 02 marks for description)

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  $10\text{M}\Omega$ . 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  $R_5$  to provide a high differential signal gain. Capacitor  $C_1$  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.



f) List four technical specifications of phonocardiography

(01 mark for each)

Ans: Some of the important technical specifications of Phonocardiograph are given below:

- Power -230 volts AC, 50 Hz
- Transducer-Dynamic, microphone or contact sensor microphone or air coupled pulse pickup microphone
- Frequency response-0.05 Hz to 1000 Hz for contact sensor 20 Hz to 2000 Hz for dynamic microphone
- Filter: 25 – 100 Hz  
50- 100 Hz  
100-750 Hz  
250 – 1200 Hz and  
500 – 1400 Hz
- Modulation frequency: 85 Hz
  
- Chart speeds: 50 and 100 mm/sec.

Q.3 Attempt any four

(16)





**a) State the concept of relative BP measurement.**

**Ans:** It is also known as plethysmography

\*Relative blood pressure measurement method is not used for actual blood pressure measurement but to have an idea about the blood flow in the particular part of the body.

\* It is practically not possible to measure the blood pressure in the extremities, like fingers, forehead, etc. using direct or cuff type system.

\*This system is also known as plethysmography.

\*Plethysmography is the art of monitoring physical changes. Here, it detects the blood volume changes in the extremities.

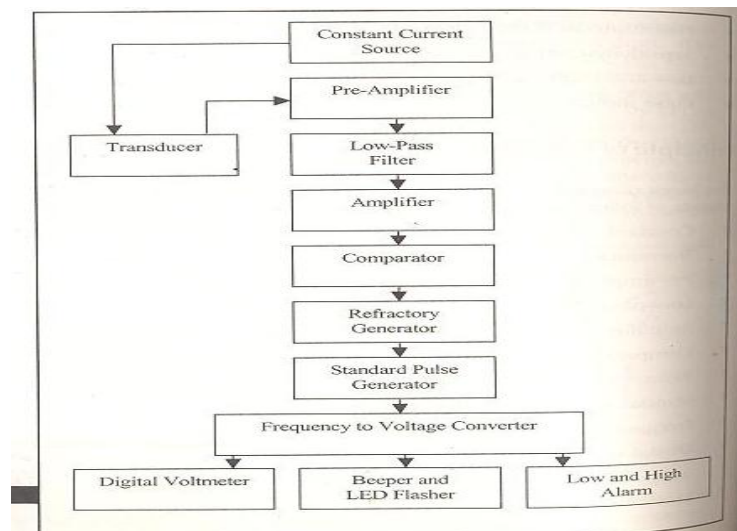
\*This technique is also used to sense the peripheral pulse for purpose of pulse rate monitoring. In this system a sensor is placed around the finger or on the forehead to detect the blood volume changes

\* An instrument which senses these, changes & monitors the information in the form of waveform and pulse rate is called plethysmograph.

**b) Draw the block diagram of heart rate meter and describe it.**

**(Draw 02 marks;Describe 02 marks)**

**Ans:**



**Description:**

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 the 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 retrigger able constable 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.

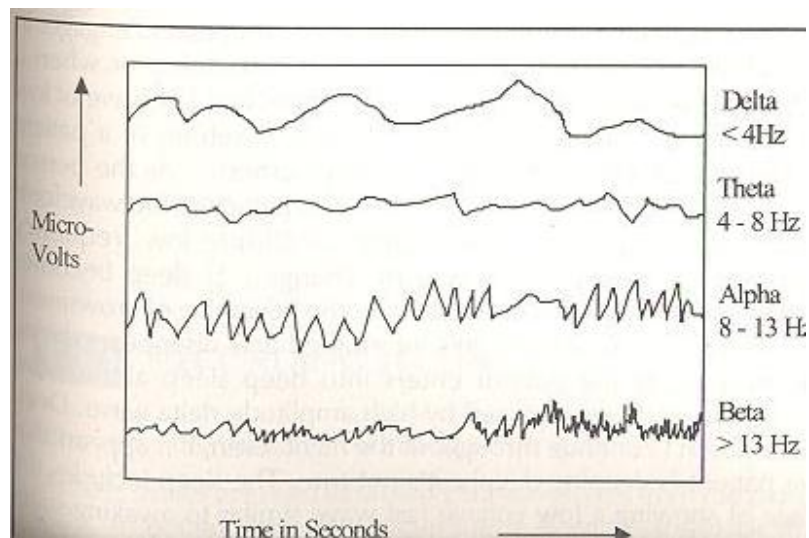


To monitor each heart beat usually a beeper is employed.  
The last block is heart rate alarm circuit. This block is heart rate alarm circuit. This block consists of two comparators, one for low and another for high pulse rate.

c) **Draw different EEG signals with respect to time.**

**(01 mark for each)**

**Ans:**



d) **How four sounds are produced during one complete cardiac cycle?**

**(01 mark for each sound)**

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

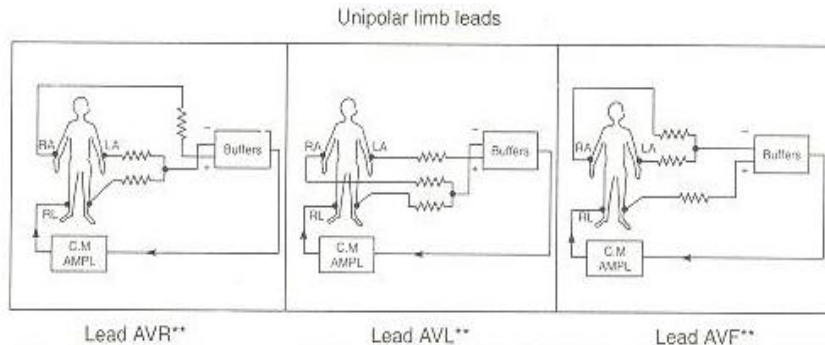
1. The first heart sound is a low pitch sound. It has a frequency in the range of 30 to 45 Hz. This heart sound occurs at the termination of arterial contraction and at the onset of ventricular contraction. This heart sound occurs approximately at the time of the 'QRS' complex of the ECG complex.
2. 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.



e) Draw unipolar limb leads connection in ECG

(Draw -04 marks)

Ans:

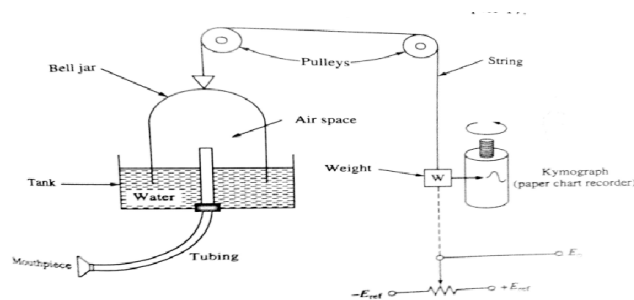


4. A) Attempt any three:

a) Draw the diagram of spirometer and give its working principle.

(Diagram -02 Mark, Working -02 Mark)

Ans:



The conventional spirometer is as shown in fig. This instrument uses a bell suspended from above in the tank of water. An air hose leads from the mouthpiece to the space inside the bell above the water level. A weight is suspended from the places a tension force on the string that exactly balances the weight of the bell at atmospheric pressure. When no one is breathing into the mouthpiece, the bell will be at rest with a fixed volume above the water level. But when the subject exhales, the pressure inside the bell increases above atmospheric pressure. Using the bell to rise similarly when the patient inhales, the pressure inside the bell decreases. The bell will rise when pressure increases and drop when pressure decreases. The change in bell pressure changes the volume inside the bell, which also causes the position of the counterweight to change. We may record the volume change on a piece of graph paper by attaching a pen to the counterweight or tension string. The chart recorder is a rotary drum model called a kymograph. It rotates slowly at a speed between 30 to 2000 mm/min. Some spirometers also offer an 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 are connected to the ends of the potentiometer, then an electrical signal will represent the same data as the pen. When no one is breathing into the mouthpiece, the output will be zero when the patient is breathing.

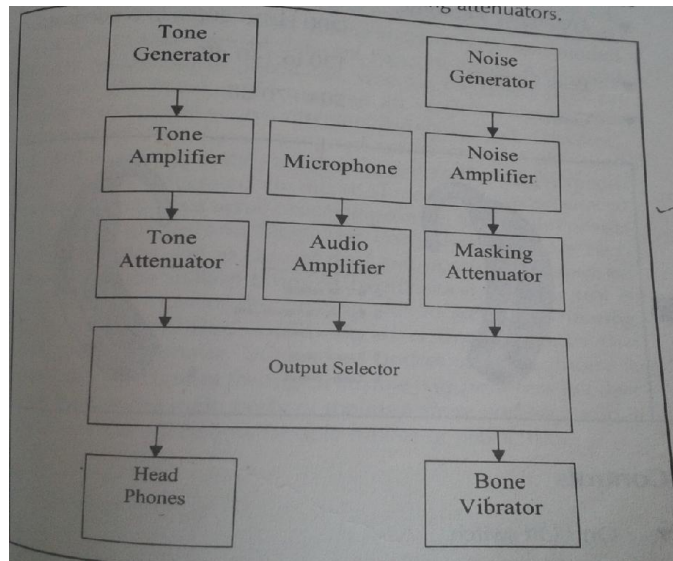


into the tube will take a value proportional to the volume and polarity that indicates inspiration or expiration.

**b) Draw block diagram of pure tone audiometer and state function of each block.**

**(Diagram -02 Marks, Description -02 Marks)**

**Ans:**



A block diagram of pure tone audiometer is shown in fig. 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 switches either headphones or bone vibrator as per the test to be performed. It also helps to



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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

**c) List six unipolar chest leads.**

**Ans: 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.

**d) Describe generation of EMG signal.**

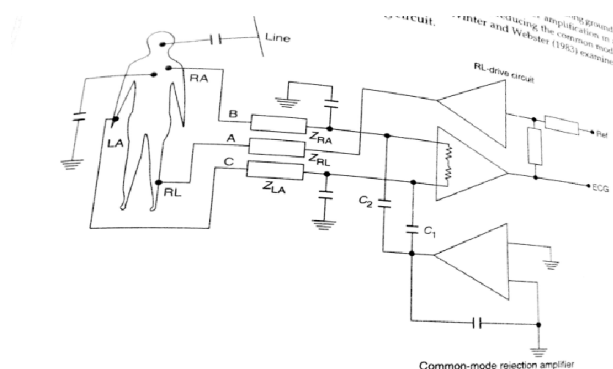
**Ans: Generation of EMG signal:** The contraction of the skeletal muscle results in the generation of action potentials in the individual muscle fibers, a record of which is known as electromyogram. In the skeletal muscle repolarization takes place much more rapidly as compare to cardiac muscle. Since 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.

**B) Attempt any one:**

**a) Draw circuit of isolated input section of ECG and explain i) Right led drive circuit ii) Wilson's network circuit.**

( each diagram-02 marks; explain-02 marks)

**Ans: i) Right led drive circuit**

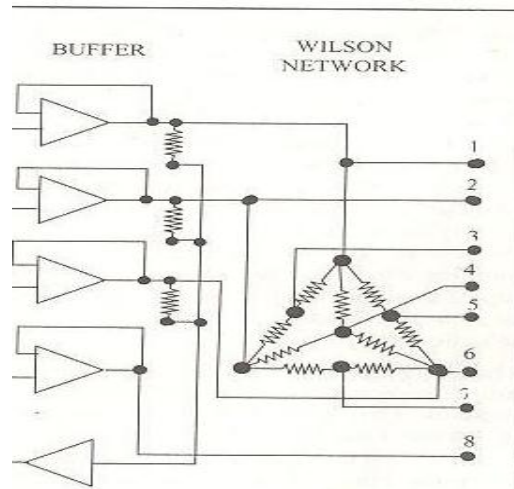




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To minimize the common mode signal between the body of the patient and the floating ground a right leg drive circuit is used. The common mode signals after amplification in a preamplifier are inverted and fed back to the right leg electrode reducing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

ii) Wilson's network circuit.

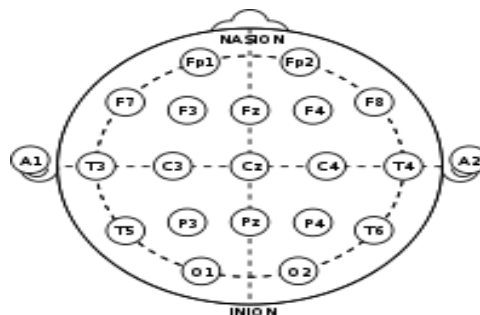


Description: The potentials picked up from the patient electrodes are taken to the Wilson bridge that is lead selection network for selection of particular lead. Four buffers are used with the leads RA, LA LL and C to provide high input impedance to the ECG electrodes and low impedance to the lead selection network. Signal components from all these leads are added together via equal value resistors and applied to the right leg drive, who drives the right leg electrode, attached to the patient. The floating circuit provides a means of reducing the interference caused by common mode signal appearing at the buffer inputs and floating ground. The Wilson network performs a mixing of summing function and thus provides ECG connections for lead selection.

b) Draw figure of 10 – 20 method of EEG electrode and list them.

(Figure-04 Marks; list 03 Marks)

Ans:





**List of electrode:**

A= Ear lobe.

C=central.

P=parietal

F= frontal.

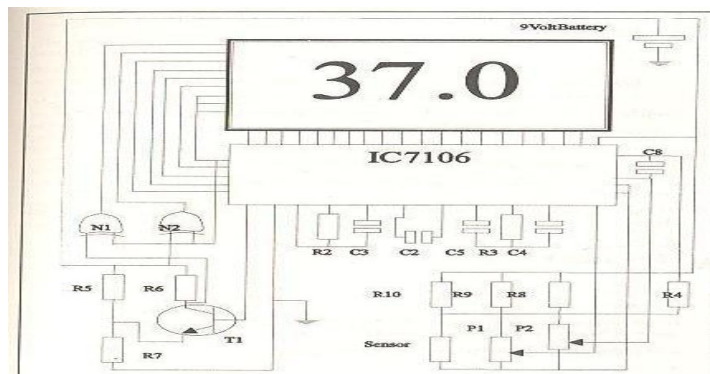
Fp=frontal polar.

O=occipital.

**5. Attempt any four:**

**a) Draw block diagram of digital temperature meter and explain function of each block.**

**Ans:**



Description: The 7106 IC is used for this indicator. It consists of an Analog to Digital converter, clock generator reference voltage source, BCD to 7 segment decoders, latch display drivers; automatic zero correction and polarity indication. The voltage developed across the sensor is measured as a temperature. The input voltage from the sensor charges the capacitor C4 for a fixed period of time. Then the capacitor discharges, the rate at which the capacitor is discharged being determined by the reference voltage. The actual time it takes for the capacitor to discharge fully is then proportional to the input voltage level. During the discharge period, pulses from an oscillator are stored in a counter, the number of pulses dependent upon the time. The contents of the counter are then displayed on the LCD the oscillator frequency of the IC which is determined by R2 & C3. This frequency at 3 samples per second determines the number of samples taken in every second.

The IC ensures a zero setting before each measurement automatically.

The temperature measurement stage employees three voltage dividers; R10/R11, R8/P1, and R9/P2.

The junction of the first divider containing the sensor and R11 is connected to the IN HI input of the IC Variable terminals of the P1 and P2 are connected to the IN LO input and REF HI input respectively.

In effect the circuit measures the differential voltage between the one side of the sensor and the variable terminal of P1. As the reference voltage of the IC is also derived from the R9/P2 any measurement is completely independent. R4 and C6 act as an input smoothing filter.



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The IC 7106 directly drives the display. Gates N1 and N2 activate the low battery indication and decimal point respectively.

The transistor T1 is employed for battery voltage detection. This activates the N1 gate, when battery voltage drops below 7.2 volts.

The circuit works on a battery of 9 volts and draws current about 2 mA. Its response time is about 2 to 3 minutes.

**b) List four technical specification of spirometer.**

**( 01 Mark each)**

**Ans:** 1. Volume Measurement: Flow integration

2. Flow range: 15L /sec

3. Volume range: 0 – 8 liters

4. Measurement time: 0 – 30sec.

5. Power source: Li / Ion rechargeable battery pack

6. Storage: 150 patients

**c) Draw block diagram of GSR meter and describe it.**

**(Block diagram-02 Marks; Description-02 Marks)**

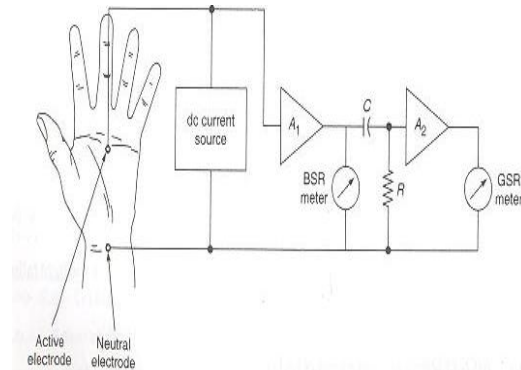
**Ans:** Galvanic skin reflex (GSR) is a method of measuring the electrical resistance of the skin. It is also known by many other names such as electro dermal response psycho galvanic reflex (PGR) of skin conductance response (SCR) all these terms relate to one of more activities inside the sweat glands 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 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.





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**d) Compare between ECG and PCG (any 4 points)**

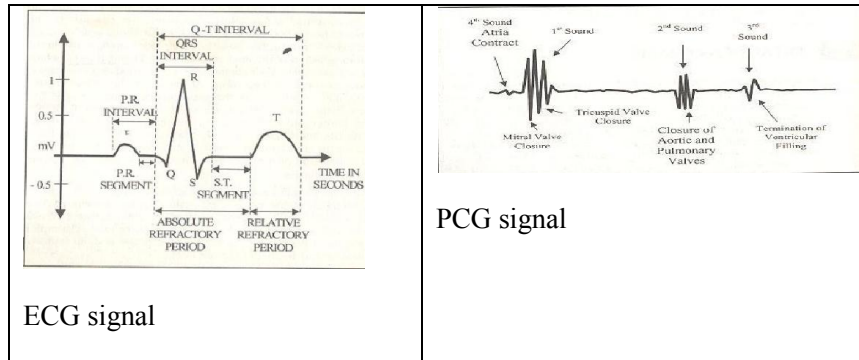
**(01 Mark each)**

**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,



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e) Define following respiratory parameter i) the residual volume ii) Expiratory capacity iii) Inspiratory reserve volume iii) Vital Capacity

( 01 mark each)

**Ans: i) the residual volume:** The volume of air remaining in the lungs after a maximal exhalation.

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

**iii) Inspiratory reserve volume:** The maximal amount of additional air that can be drawn into the lungs by determined effort after normal inspiration.

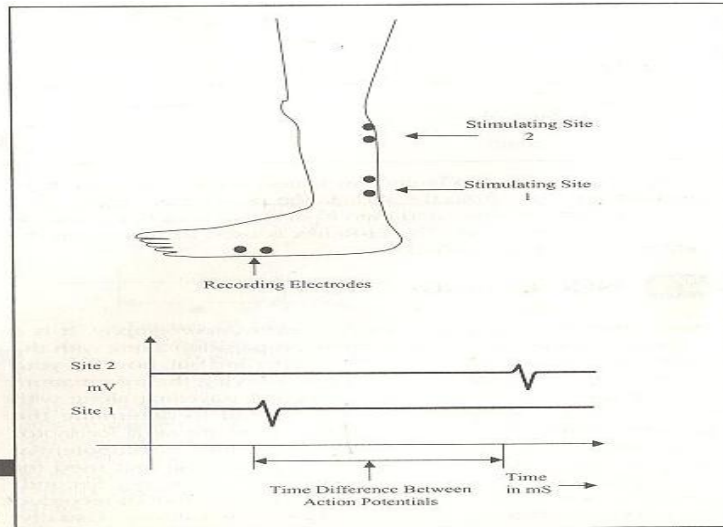
**iii) Vital Capacity:** The greatest volume that can be inspired from the resting end expiratory position.

**f) State and explain motor and sensory nerve conduction wrt EMG.**

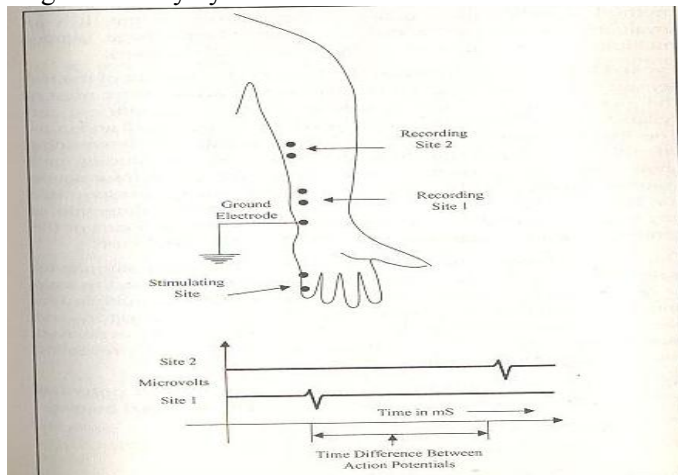
**Ans:** The Motor nerve Conduction Velocity is measured from Stimulus site to the muscle as shown in fig. The peroneal nerve of the left leg is stimulated behind the knee and muscular response is detected in the foot using surface electrodes. A nerve muscle travels downward along with the motor nerve 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



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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 upword through the nerve and reaches at recording sites after different time intervals.The Sensery nerve Conduction velocity is measured in the same way as motor nerve dividing the latency by the distance.



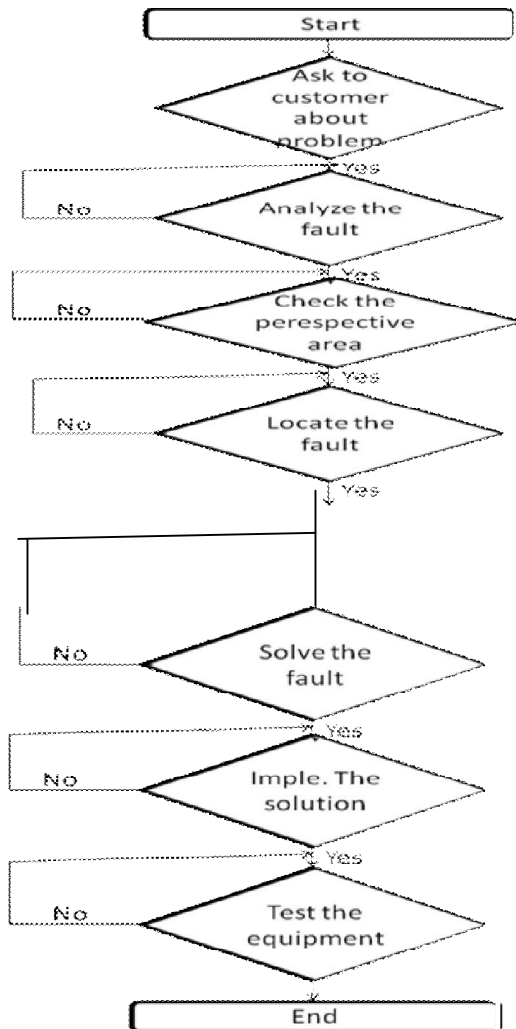
6. Attempt any four:

a) Draw fault finding path tree for ECG machine.

Ans:



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b) Sketch the Ear response for conduction through air and conduction through bone.

Ans:



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c) State Beer's and Lamberts law.

(Beer and Lamberts law- 02 Mark; equation- 02 Marks)

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

$a \lambda$ -Wavelength dependent absorptivity coefficient.

b- Length.

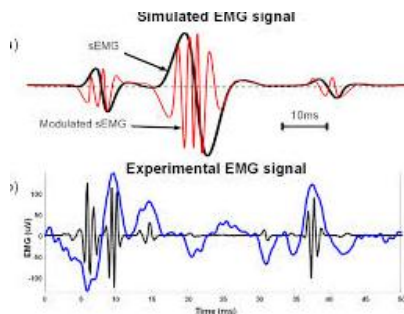
c- analyte path concentration.

The beer lambert law is written as

$$A = \epsilon * b * c$$

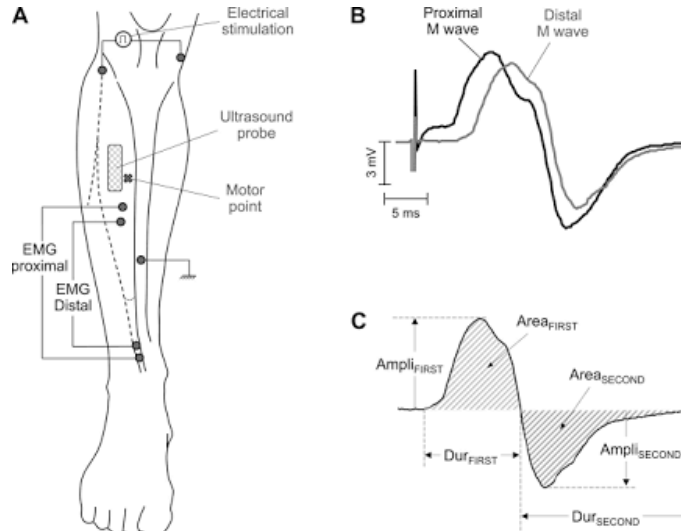
d) Sketch response and diagram of i) EMG generated ii) EMG generated by electrical simulation during voluntary.  
( 02 Marks each diagram)

Ans: i) EMG generated





ii) EMG generated by electrical stimulation during voluntary.



Note: Any relevant diagram should be considered.

e) List any 4 applications of audiometer.

Ans:

1. An audiometer is device used to evaluate hearing loss during an audiology test.
2. An audiometer exam tests your ability to hear sound.
3. Screening babies and young children for hearing problem that might interfere with their ability to learn, speak, or understand language.
4. To screen for hearing loss in people who are repeatedly exposed to loud noises or who are taking certain antibiotic medicines, such as gentamicin.