WINTER– 16 EXAMINATION

Model Answer Subject Code: 17545

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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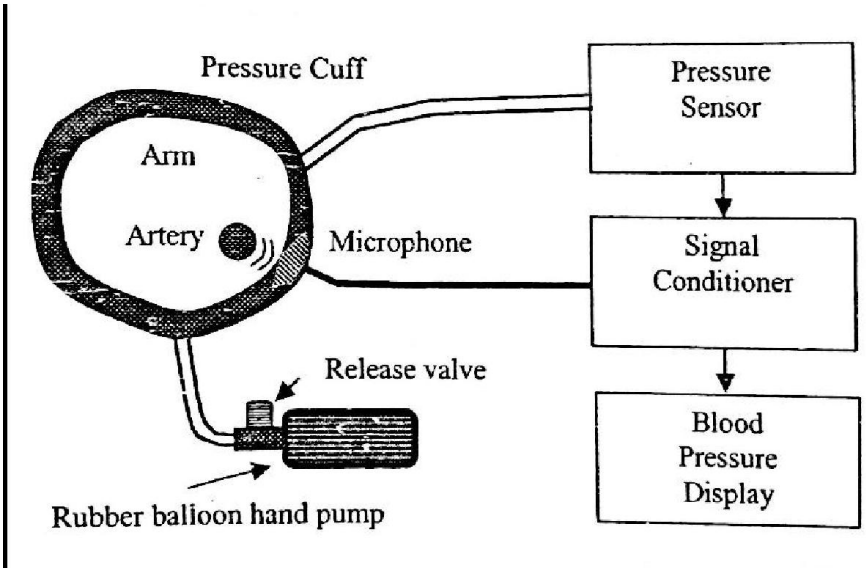
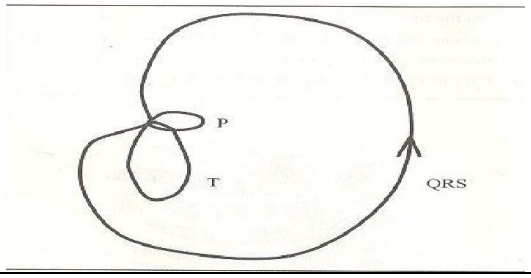
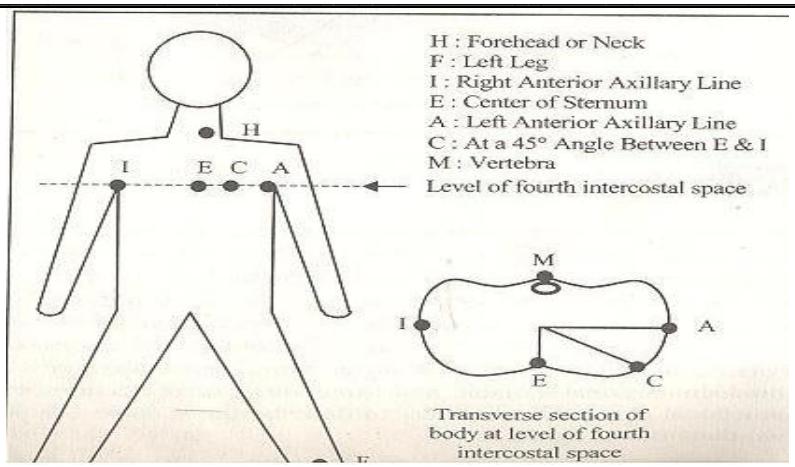
Q. No.	Sub Q. N.	Answer	Marking Scheme
1.	**A)**	**Attempt any three.**	**12**
	a)	**Describe digital blood pressure meter with suitable diagram.** **Ans :**  **Fig : Digital blood pressure meter** The block diagram of digital blood pressure meter is as shown in above figure. Mainly it consists of following blocks: - Cuff with microphone - Rubber balloon hand pump with release valve - Pressure sensor - Signal conditioner - Display In this meter, the cuff has to be inflated manually. The digital display indicates the digital value of pressure inside the cuff by sensing it through pressure sensor. Korotkoff sounds are automatically sensed by a microphone fixed inside the cuff when valve is released slowly.They are further processed by signal conditioner and compared with cuff pressure to display the values of systolic and diastolic blood pressure.	**02** **02**

	b)	**Explain Beer and Lamberts law.** **Ans :** **Beer and Lamberts law:** The beer Lambert law is the linear relationship between absorbance and concentration of an absorbing species. The general beer –lamberts law is usually written as $A = a \lambda * b * c$ Where A- Measured absorbance Aλ - Wavelength dependent absorptivity coefficient. b - Length. c - analyte path concentration. The beer lambert law is written as , $A=\varepsilon*b*c$	**04**
	c)	**Enlist technical specification of heart rate meter.** **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	**1 mark each**
	d)	**Explain concept of vector cardiography.** **Ans :** Vector cardiography 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.  	**04**



	B)	**Attempt any one.**	**06**
	a)	**Draw fault finding tree of ECG machine.** **Ans :**	**06**

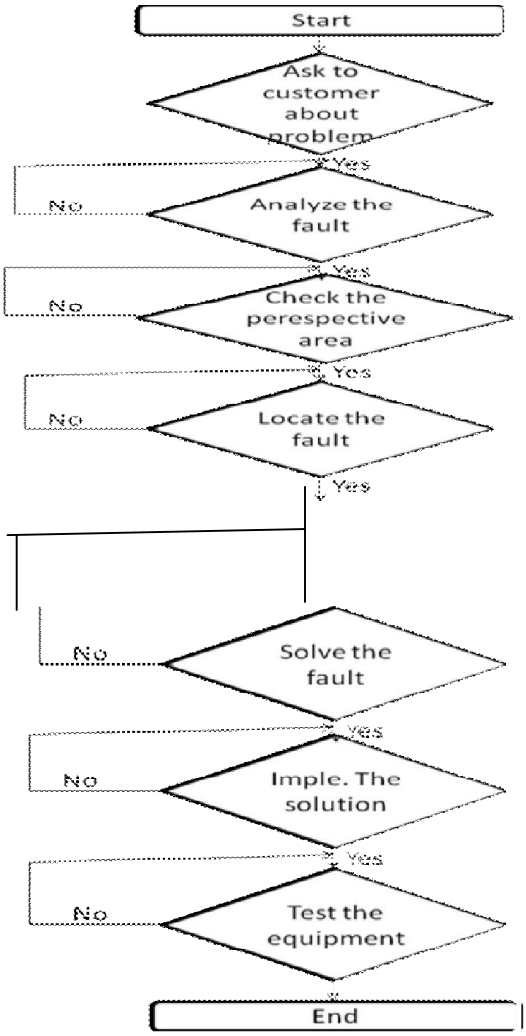


Fig : Fault finding tree of ECG machine.

b) Define EEG. Explain with neat sketch of preamplifier circuit of EEG.

Ans :

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 instrument which is used for recording of electrical activity of the brain, by suitably placing surface electrodes on the scalp is known as electroencephalograph ie. EEG. **02**

Preamplifier circuit of EEG :

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 amplifiers. 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 : **02**

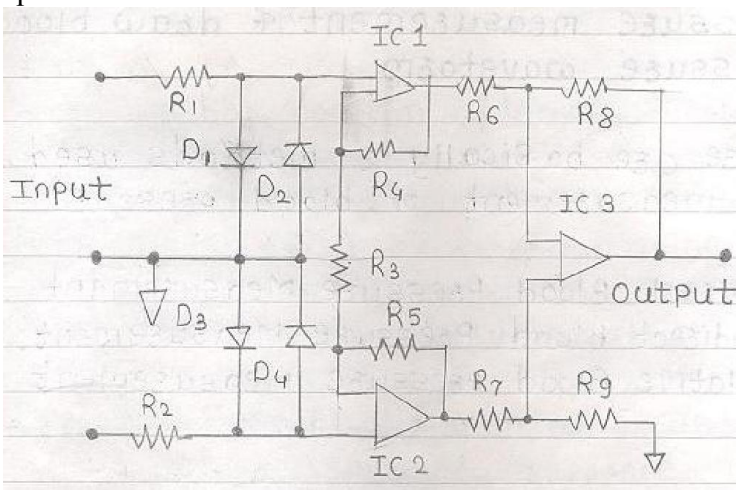
- Free selector
- Pattern selector

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.

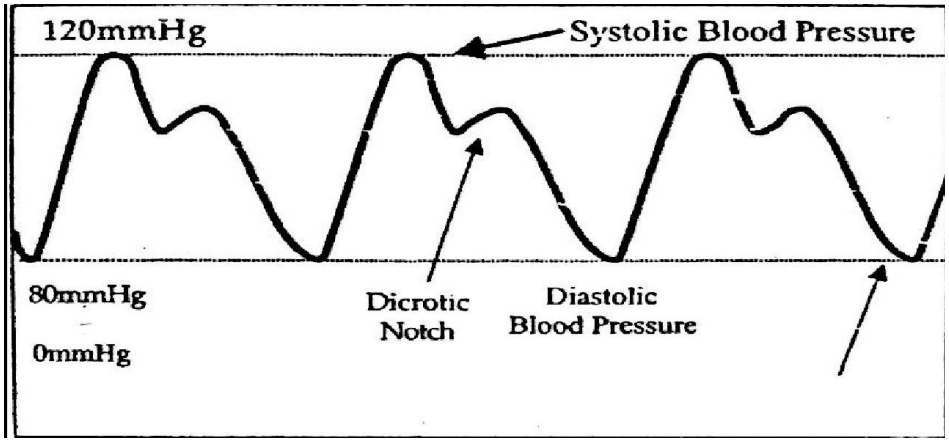
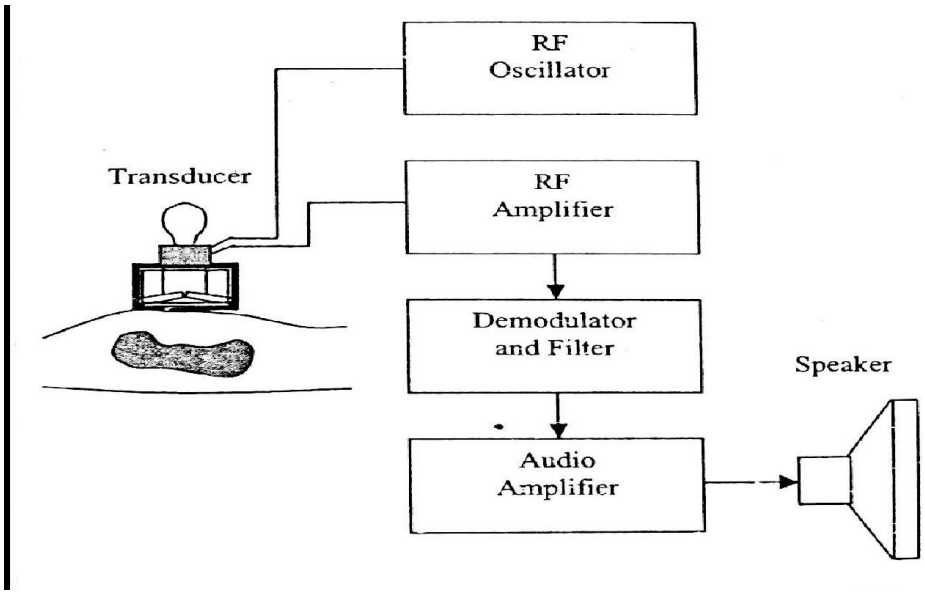
Pattern selector :-

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 channel by one switch operation without operating several free selectors. This pattern is very useful in routine EEG inspection.



02

Fig : Preamplifier circuit of EEG.

2.		**Attempt any four.**	**16**
	a)	**Explain BP waveform with neat sketch.** **Ans :**  **Fig : Blood Pressure waveform** Blood pressure represents the pumping activity of the heart. Blood Pressure is the force that the blood exerts on the walls of the blood vessels. The peak pressure of this wave is called systolic pressure and has value about 120-mm equivalent of mercury level. The low pressure of this wave is called diastolic pressure and has value about 80-mm equivalent of mercury level. There is slight back pressure built up as the valve closes, and due to the tapering of the circulatory system. This results into valley in the waveform which is called as dicrotic notch.	**02** **02**
	b)	**Draw a block diagram of ultrasonic FHR meter.** **Ans :**  **Fig: Fetal Heart Rate meter**	**04**

c) Explain principle of operation of pure tone audiometer. **04**

Ans :

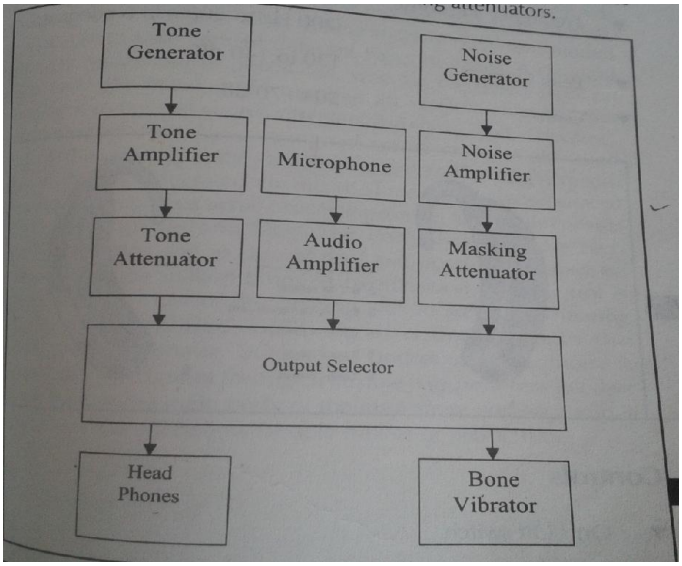


Fig : Pure tone audiometer.

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 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.

d) Describe 1 mV calibration circuit used in ECG machine.

Ans :

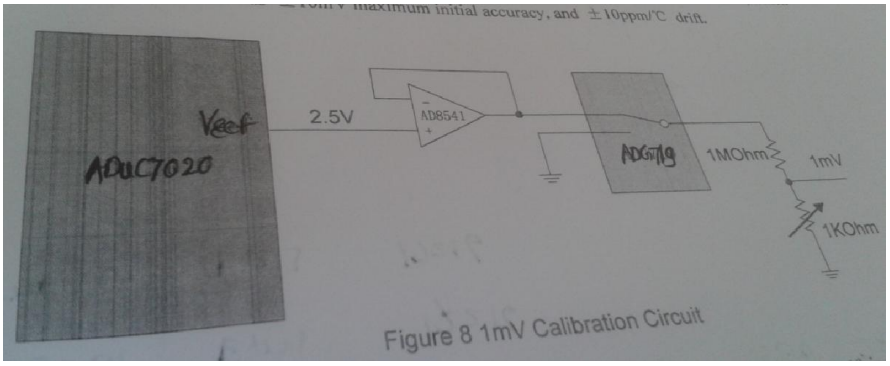


Fig : 1 mV calibration circuit used in ECG machine.

Description :

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

04

e) Explain with neat sketch, preamplifier circuit of EMG.

Ans :

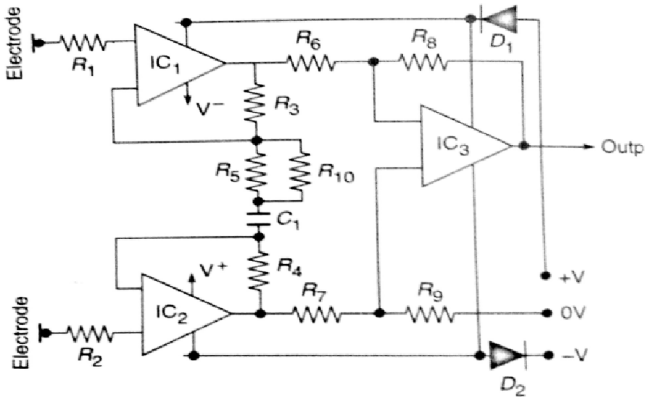


Fig : Preamplifier circuit of EMG.

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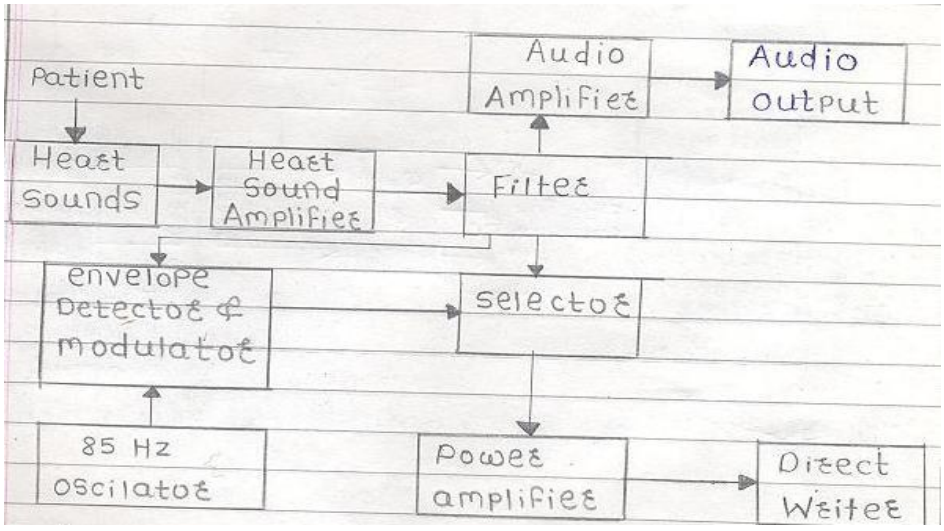
Fig shows circuit diagram of the preamplifier. The amplifier design provides for a flat frequency response between 10 Hz and 1 KHz with a CMRR of 100db at the mains frequency. The noise level was found to be 2mV rms and the input impedance greater than 10MΩ.The two ICs in the input stage act as voltage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

02

		further differential signal gain While rejecting common mode signals. The overall gain of the amplifier is 1000.	
	f)	**Explain operation of phonocardiograph machine.** **Ans :** Phonocardiograph is equipment used to record sound generated by heart during are 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 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.  **Fig : Phonocardiograph machine.**	**04**

3.		Attempt any four.	16
	a)	**Differentiate, direct and indirect blood pressure measurement technique.** **Ans :**	**1 mark each**

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)	**Draw and explain block diagram of heart rate meter.** **Ans :**	**02**

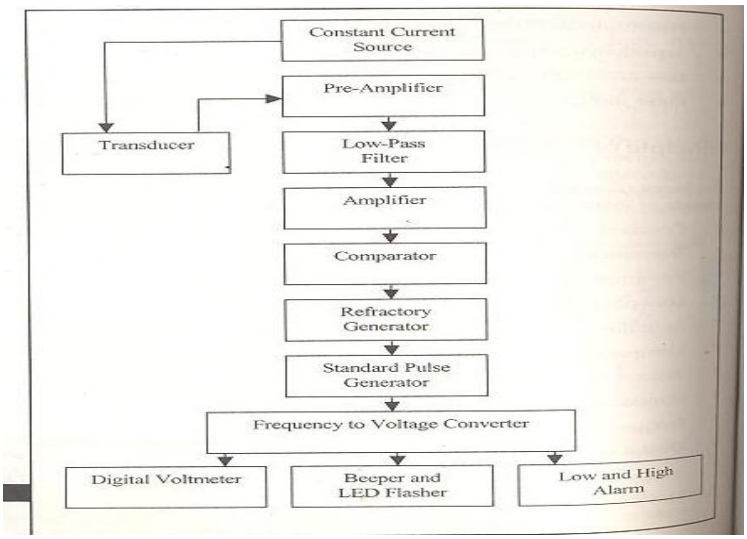
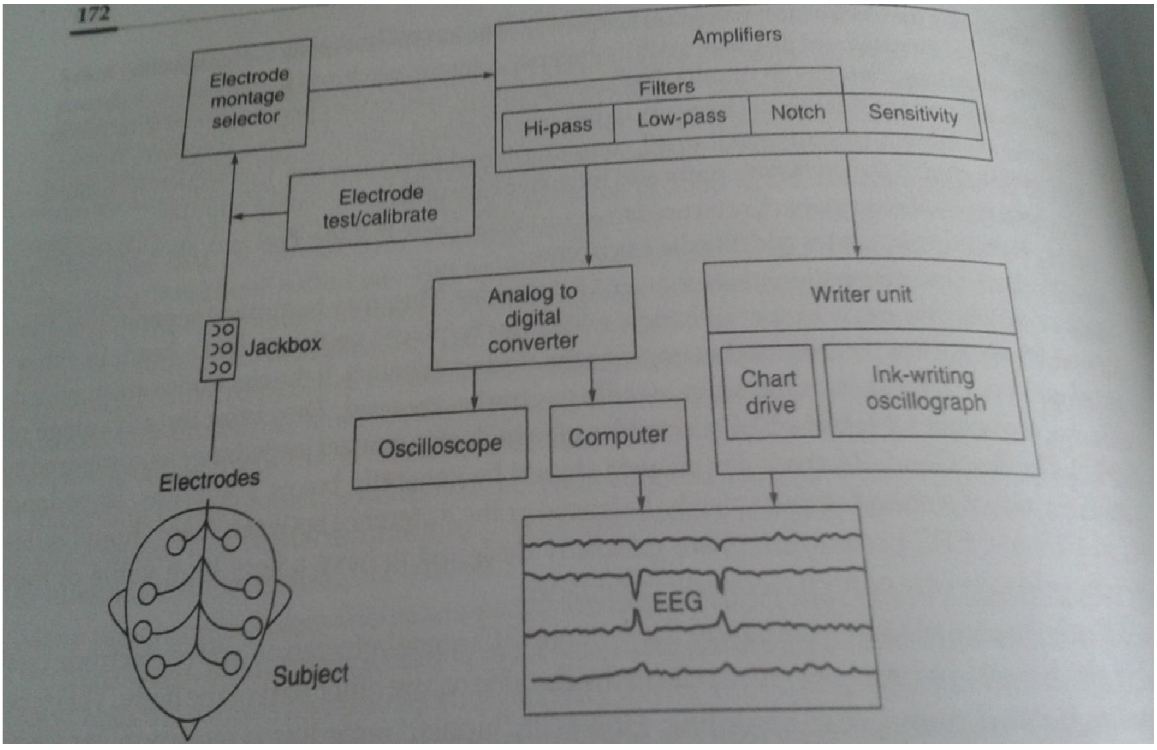
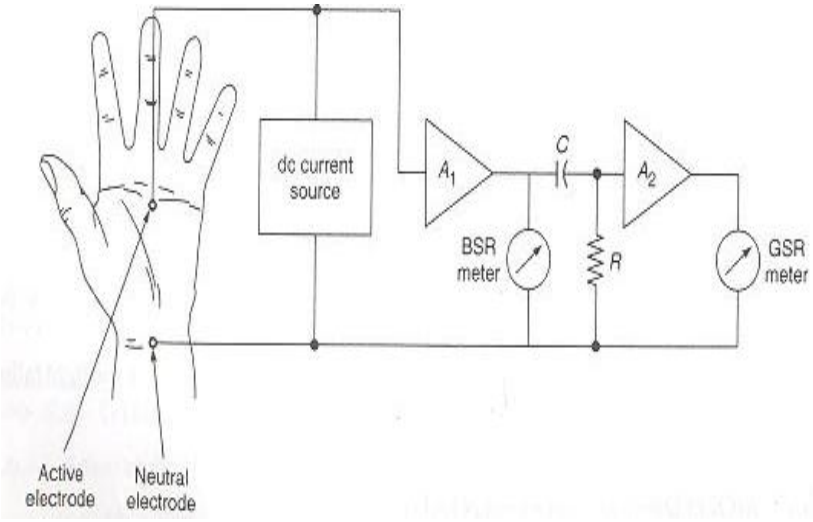


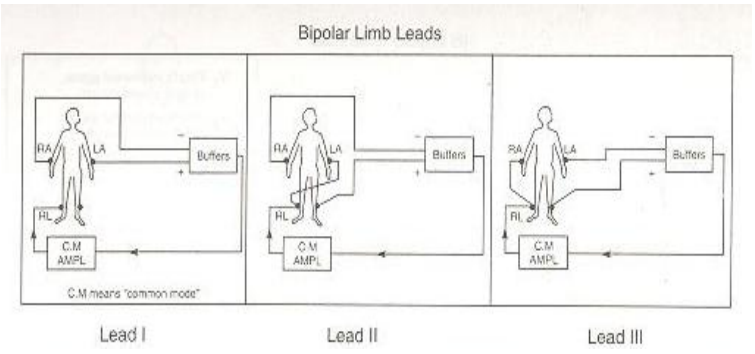
Fig : Block diagram of heart rate meter.

		Explanation: 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 heat 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.	**02**
	c)	**Draw with neat sketch, block diagram of EEG machine.** **Ans :**  **Fig : Block diagram of EEG machine.**	**04**

	d)	**Enlist technical specification of phonocardiograph.** **Ans :** 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.	**1 mark each**
	e)	**Write note on generation of ECG signal.** **Ans :** The recording of electrical activity associated with the functioning of the heart is known as ECG signal. ECG signal is periodical, rhythmically repeating signal synchronized by the function of the heart, which act as a generator of bioelectric events. The position of SA node in the heart from where the impulse responsible for the electrical activity of the heart originates. The potential field generated by SA node extends to the other parts of the heart. The wave propagates through the right and left atria. The action potential contracts arterial muscle and impulse spread through arterial wall to AV node. This corresponds to P wave in ECG graph. AV node delays the spread of excitation. Then bundle of His carries the action potential to the ventricles. The direction of impulse propagating in bundle of His is from the apex of the heart; ventricular contraction begins at the apex and processed upward through the ventricular walls. This results in the contraction of the ventricles which produce squeezing action which forces the blood out of the ventricles into arterial system. This corresponds to QRS complex in ECG graph. The repolarization of ventricles corresponds to T wave in ECG graph.	**04**
4.	**A)**	**Attempt any three.**	**12**
	a)	**Enlist technical specifications of respiration rate meter.** **Ans :** 1. Power- 230V AC & 50Hz or Battery. 2. Measuring Range- 0 to 50 breaths /minute. 3. Transducer- Nose (thermistor) or chest (strain gauge). 4. Display- 7 segment LED or LCD. 5. Respiration indication- Audio Beep LED.	**1 mark each**

	b)	**Draw block diagram of GSR meter.** **Ans:**  **Fig: Block diagram of GSR meter**	**04**
	c)	**Explain principle of operation of ECG machine.** **Ans:** **Principle of operation of ECG machine:** 1. Lead selector: It is used to select the appropriate lead configuration of electrode as per requirement of patient. 2. 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. 3. Recording mechanism of ECG machine consist of galvanometer, electrical motor, gear assembly, pinch roller, knife edge and recording stylus. **OR** **Principle of operation of ECG machine:** 1. DC Defibrillator Protection Circuit : At the input of the ECG machine along with ECG signal several unwanted signals appeared. 50HZ electrical interface. High frequency interface due to electro surgery, short wave diathermy. DC defibrillation shocks. To eliminate these unwanted signals and to protect the patient from leakage current, DC defibrillator protection circuit is used. It also protects the electronics of the instrument from high voltage electrical shocks given during the fibrillation of the patient's heart. 2. Buffer : A circuit which does not amplify a voltage but has very high input impedance and very low output impedance is called buffer amplifier.	**04**

		3.Wilson Network : The potentials picked up from the patient electrodes are taken to the Wilson Bridge. Wilson Bridge is a lead selection network for selection of particular lead.It performs a mixing or summing function and provides ECG connection for lead selection 4. Lead selector : In this, the electrodes are selected two by two according to the lead program. By means of capacitive coupling, the signal is connected symmetrically to the long tail pair differential preamplifier. 5. Preamplifier : The preamplifier is usually a 3-4 stage differential amplifier. It has sufficiently large negative feedback from end stage to first stage which gives a stabilizing effect. Preamplifier has CMRR = 80 dB, Gain = 1000. 6. Auxiliary Circuit : It provides 1mv calibration signal and automatic blocking of the amplifier during a change in the position of lead switch. 7. Power Amplifier : The power amplifier is generally of push-pull differential type. It consists of: 1) Low pass filter 2) High Pass filter 3) Notch filter. Power amplifier rejects the noise signal as well as amplifies the signal. 8. Bridge Output Circuit : Output of power amplifier is given to the pen motor through bridge output circuit. 9. Pen Motor : It is used to drive the stylus. Stylus will draw the graph on paper.	
	d)	**Explain principle of operation of EMG machine.** **Ans:** 1. Power Supply Section : It produces a number of regulated voltages, which are used tom supply analog and digital sections of the system. 2. Stimulator Section : It receives control signal from control section. The control section generates trigger pulses at definite intervals to initiate operation of nerve and muscle stimulator and controls stimulus repetition rate. 3. 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. 4. 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.	**04**

		5. 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.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.	
	B)	**Attempt any one.**	**06**
	a)	**Describe 12-lead configuration system of ECG machine.** **Ans :** 1. Bipolar lead. 2. Unipolar lead. 3. Unipolar chest lead. **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).  **Fig: Bipolar lead** **2. Unipolar lead:** In unipolar limb leads two of the limb leads are tied together and recorded with respect to the third limb. In lead AVR, the right arm is recorded with respect to common junction of the left arm and left leg electrodes. In lead AVL, the left arm is recorded with respect to the common junction of the right arm and left leg electrodes. In lead AVF, the left leg is recorded with respect to the two arm electrodes tied together.	**02**

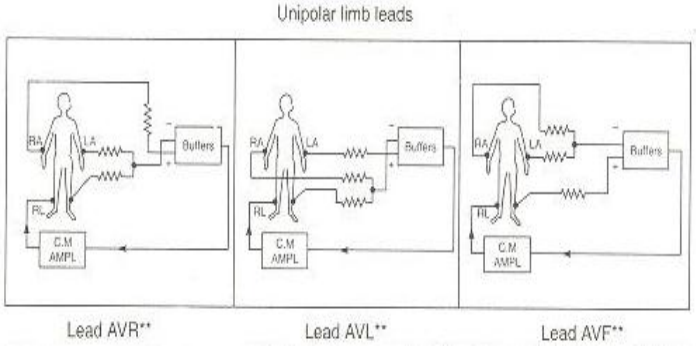


Fig: Unipolar lead — **02**

3. Unipolar 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. — **02**

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

b) Draw fault finding tree of EEG machine. — **06**

Ans:

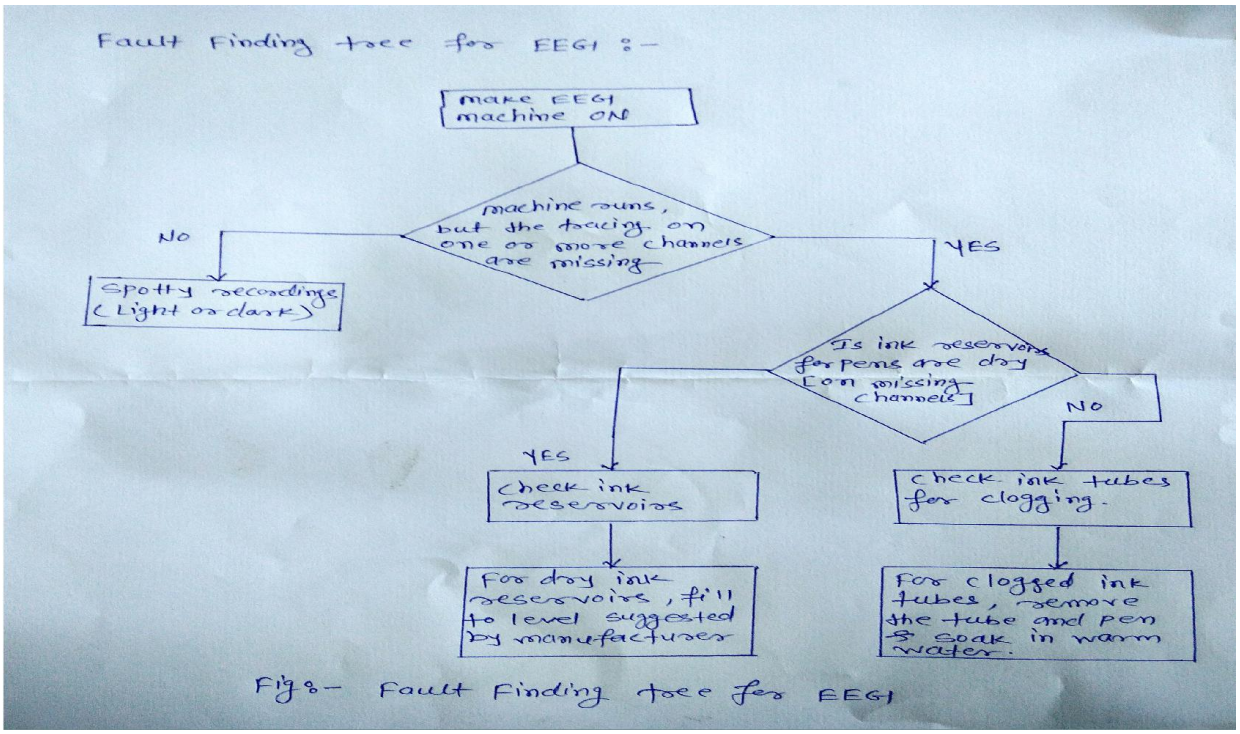
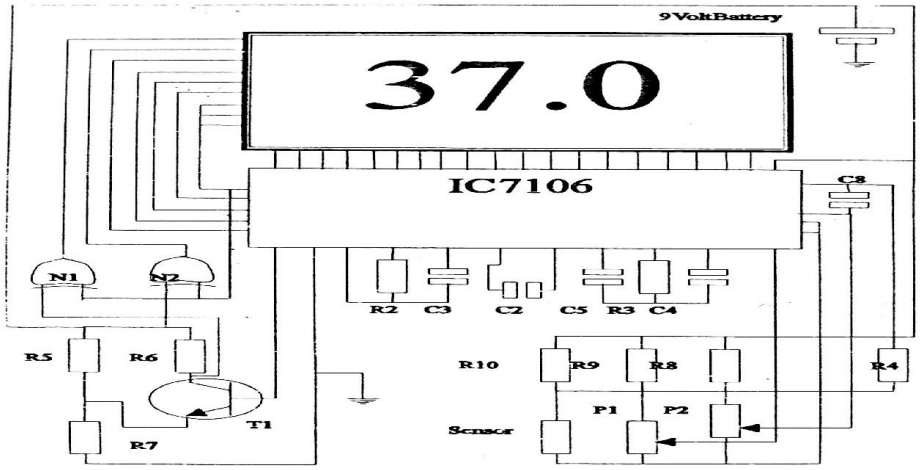
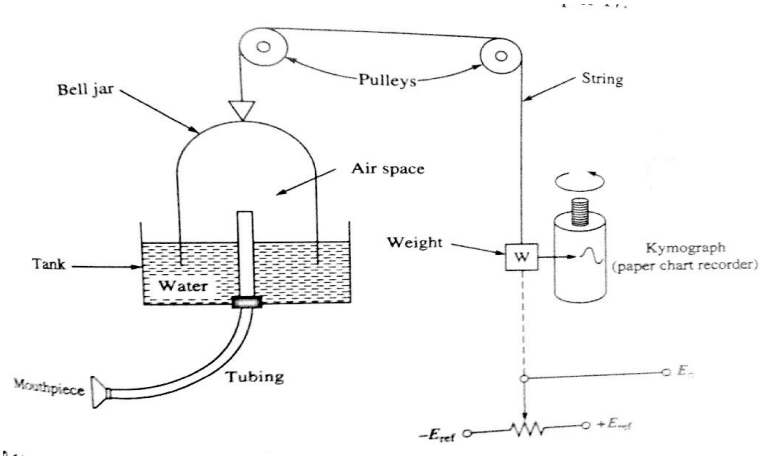


Fig :- Fault Finding tree for EEG

5.		**Attempt any four.**	**16**
	a)	**Draw block diagram of digital temperature meter.** **Ans:**  **Fig: Digital temperature meter**	**04**
	b)	**Explain with neat sketch, working principle of spirometer.** **Ans:**  **Fig: Spirometer** **Working :** The conventional spirometer is as shown is fig. This instrument uses a bell suspended from above in the tank of water. And air hose leads from mouth piece to the space inside of the bell above the water level. Weight is suspended from places a tension force on the string that exactly balances the weight of Bell at atmospheric pressure. When no one is breathing into the mouth piece therefore 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	**02** **02**

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.

c) Describe principle, operation of hearing aid. — **04**

Ans:

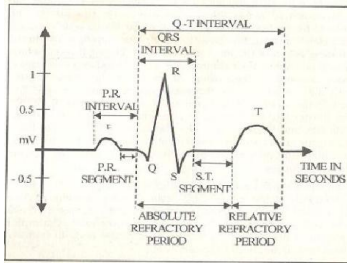
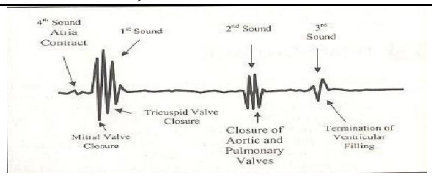
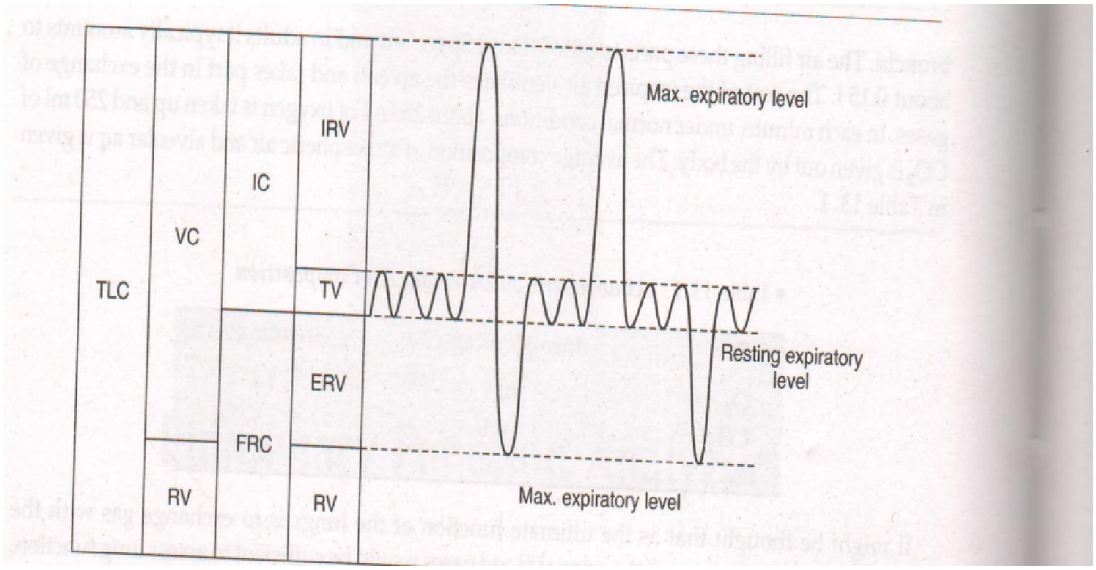
The simplified block diagram of hearing aids is shown in fig. The system works on single pen battery on button cell. Hearing aids are available as pocket conventional models. Today, dedicated integrated circuits are usually incorporated in hearing aid circuit as a signal processing device. It basically consist of an audio amplifier and filter. The basic functional parts include a microphone and associated preamplifier, an automatic gain control circuit, a set of active filters, a mixer and power amplifier and output transducer or receiver. The amplified audio signal is finally fed to the electromagnetic earphone.

In standard pocket units, earphone is attached to the instrument through flexible wire whereas in other units it is fixed in the main body of the instrument and audio is coupled to the ear via hallow flexible rubber or plastic rubber.

d) Compare between ECG and PCG. — **1 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 synchronized by heart function	These sounds provides an indication of heart rate and its rhythmicity.
The origin of ECG signal is SA node in the heart	The origin of PCG signal is pumping action of heart
It provides the recording of electrical activity in the form of PQRS waves.	It provides a recording of wave forms of heart sound.
Its output is in readable form	Its output is in audible form.

			To Pick ECG signal surface type of electrodes are used	To Pick PCG signal dynamic microphone or contact sensor microphone can be used as a transducer,	
			 ECG signal	 PCG signal	
	e)	**Draw any two respiratory parameter with their standard spirogram.** **Ans:**  **Fig: Respiratory parameter**			**02 marks each**
	f)	**List any two problems and state remedies to eliminate it, for EMG machine.** **Ans:**			**2 marks each**

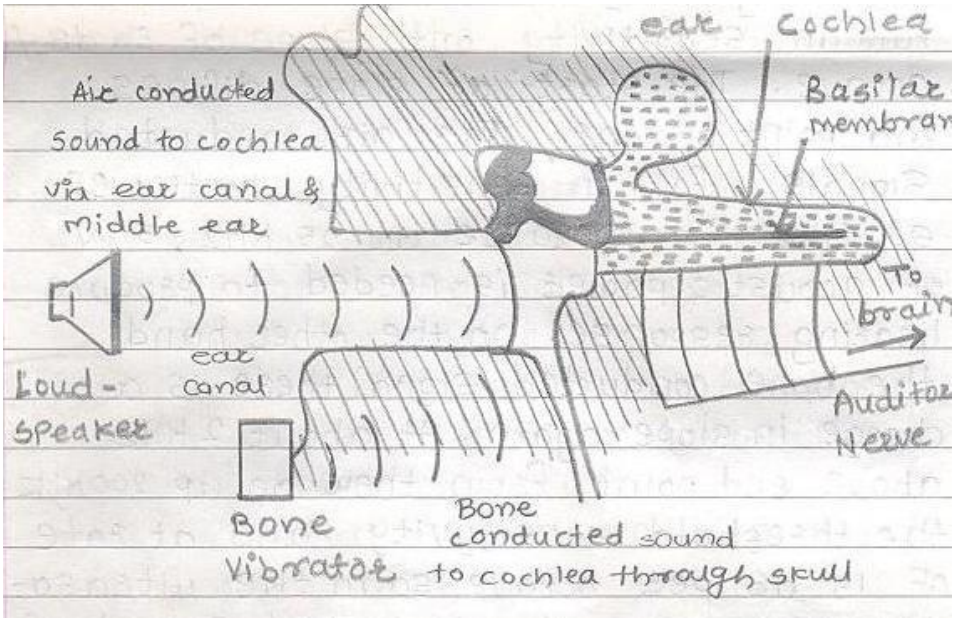
Problems (Faults)	**Action (Remedies)**
The Display Unit No Sig light is on.	There is no signal coming from the backpack. Check that the backpack is connected and the backpack DC OK light is on. If it is not ON then you probably have a broken coaxial cable — replace the cable with a spare and schedule the broken cable for repair as soon as possible
None of the front panel lights are on	Check the line cord and fuse — at a minimum

			the green POWER light should be on to show that AC power is applied to the unit and the DC Power Supply is operational. Note that there are no user adjustments inside the desktop interface unit. The internal power supply is auto-sensing and will select the correct AC voltage range - no user adjustment is required.	
			The system is functioning well but no EMG is recorded on any external device.	Check the connecting cable with an oscilloscope to ensure that the cable is correctly connected and that EMG signals are present at the input of the ADC sampling system.
			Some EMG channels work but others do not have any EMG signals	Check the analog signal connections from the back of the EMG machine desktop unit through to your measuring/recording system. 99% of all 'lost signal' complaints are due to problems with the analog signal cables and connectors.
		Table: Problems and remedies to eliminate it, for EMG machine.		
6.		**Attempt any four.**		**16**
	a)	**Enlist technical specification of ECG machine.** **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 11. Recorder: Hot stylus single channel galvanometer 12. Recording speed: 25 and 50 mm/second.	**1 mark each**
	b)	**With neat sketch, describe air and bone conduction.** **Ans:** Air conduction is transmission of sound through the external and middle ear to the internal ear. Bone conduction is referred to transmission of sound to the internal ear mediated by mechanical vibration of cranial bones and soft tissues. Most important diagnostic differential from the standpoint of functional hearing test is relationship between air & bone conduction acuity.	

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

It has been concluded from clinical observations that an approximate 60 db loss is the maximum air conduction impairment to be anticipated with middle ear defect. If air conduction loss in patient with apparently typical middle are pathology exceeds 60 db, it is likely that inner ear impairment is superimposed on middle ear lesion. The start of slope defines 'end point' of ear. For air conducted signals, fall in sensitivity continues so that for instance at 25 KHz, 5W of acoustic power is needed to produce hearing response. On the other hand the bone conducted signal there is a change in slope again at about 2KHz above end point. From then on up 200KHz the threshold sensitivity falls at rate of 15 db per octave. So in the ultrasonic region, a bone conducted signal of less than one electrical watt is audible. **02**

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



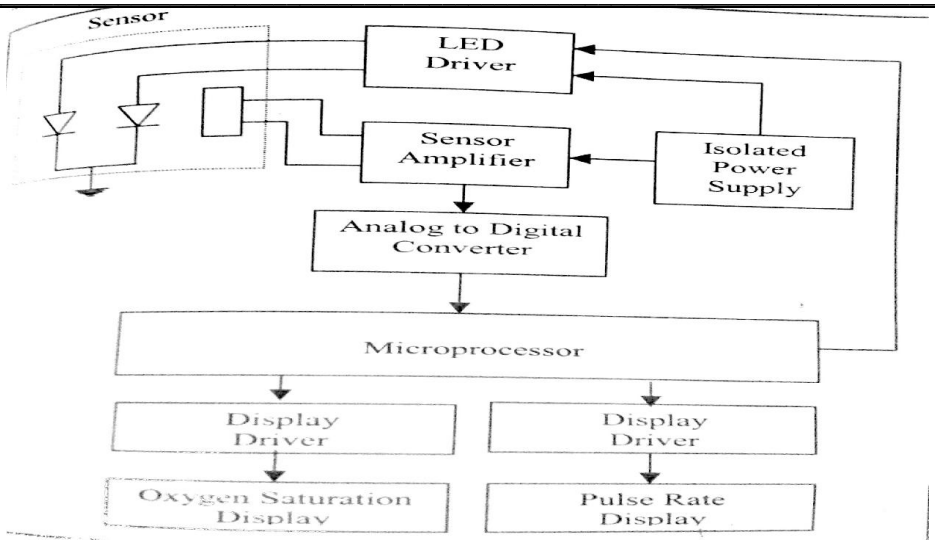
02

Fig: Diagram of air and bone conduction

c) Explain block diagram of pulse oxymeter.

Ans:

The sensor of pulse oxymeter consists of red and infrared 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 microprocessor also provides display outputs to the display drivers for the front panel display of oxygen saturation and pulse rate. **02**

		 **Fig: Block diagram of pulse oxymeter**	**02**
	d)	**Enlist technical specification of EMG machine.** **Ans:** Surface electrodes, Needle electrodes and fine-wire electrodes are used. Surface electrodes may be disposable or adhesive types. 1. Preamplifier with input impedance greater than 2 X 50 MΩ and CMRR greater than 90 dB up to 5 KHz 2. Pass band filter with low 3 dB point at 0.016 to 32 Hz and high frequency 6 dB point at 16 Hz to 32 KHz. 3. Oscilloscope readout is used for display. Sometimes a storage cathode ray tube is provided for retention of data or an oscilloscope camera is used. 4. Digital recording system for Patient data and heart rate. 5. Number of channels. 6. Audio output. 7. Sensitivity. 8. Calibration signal – 100 mV. 9. External stimulus like sound, visuals etc. 10. Time for which external stimulus is applied. 11. Power supply: single phase 230 V AC & DC Battery supply.	**1 mark each**
	e)	**What is audiometer? List types of audiometer. Also explain any one type of audiometer.** **Ans:** Audiometer is an instrument used for assessment of ear functions. Audiometer basically consists of an oscillator, driver, a pair of headphones, & bone vibrator. Its output is calibrated in terms of acoustic output frequency both these parameters are adjustable over the audio range. **Types of audiometer:** 1. Pure tone audiometer 2. Speech audiometer	**01** **01**

		1. Pure tone audiometer: Pure tone audio meter are used primary to obtain air conduction & bone conduction thresholds of hearing. These thresholds are used to plot ear process curve & diagnosis of hearing loss. Speech audiometer also used. Pure tone audiometers are very widely use for determining hearing loss. They generate tones of audible frequency. **OR** **2. Speech audiometer:** 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 audio logical rehabilitation management.	**02**