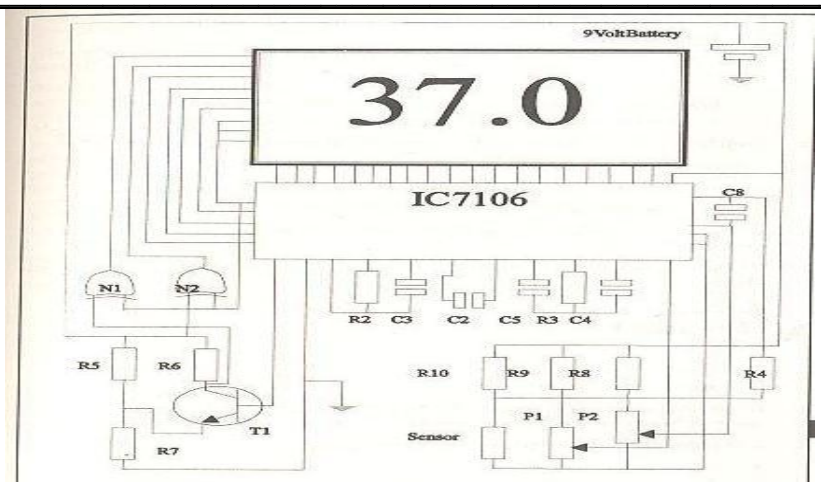
WINTER– 2017 EXAMINATION

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.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1.	(A)	**Attempt any THREE**	12
	a)	**Give technical specifications of digital blood pressure meter.** **Ans : (Any 4)** 1. Method: Oscillatory 2. Mode: Manual / Automatic / Continuous 3. Measurement Range: 10-270 mmHg (Max: 280 mmHg) 4. Automatic Measurement Interval: 1,2,3,4,5,10,15,30,60,90 mins 5. Resolution: 1 mmHg 6. Alarm: Systolic, Diastolic 7. Mean Alarm Range: 10-270 mmHg 8. SPO2 Measurement Range: 0-100% 9. Resolution: 1% 10. Accuracy: 70-100%, ±2% ; 0-69% 11. Range: 25-250 bpm 12. Resolution: 1 bpm 13. Accuracy: ±2bpm or ±2% (Select Larger) 14. Alarm Range: 0-254 bpm 15. Power: 2 "AA", 1.5 V Alkali Battery	04
	b)	**Draw a block diagram of digital temperature meter and describe it.**	



02

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.

02

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.

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

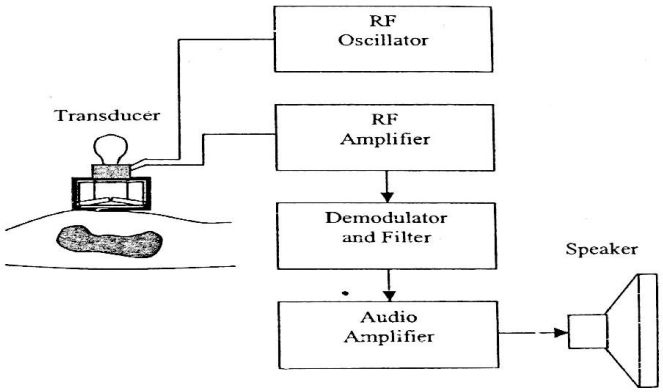
The transistor T1 is employed for battery voltage detection. This activates the N1 gate, when battery voltage drops below 7.2 volts.

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

c) Draw a block diagram of Ultrasonic FHR meter.

Ans:

04



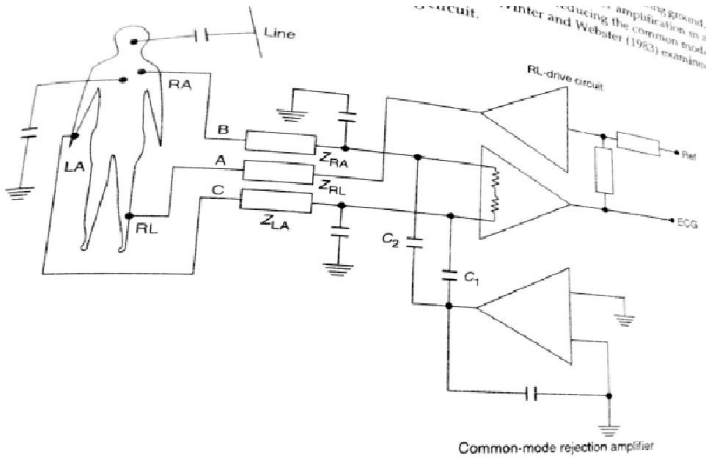
d) Describe the generation of ECG signal. — **04**

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. And the repolarization of ventricles corresponds to T wave in ECG graph.

(B) Attempt any <u>ONE</u> — **06**

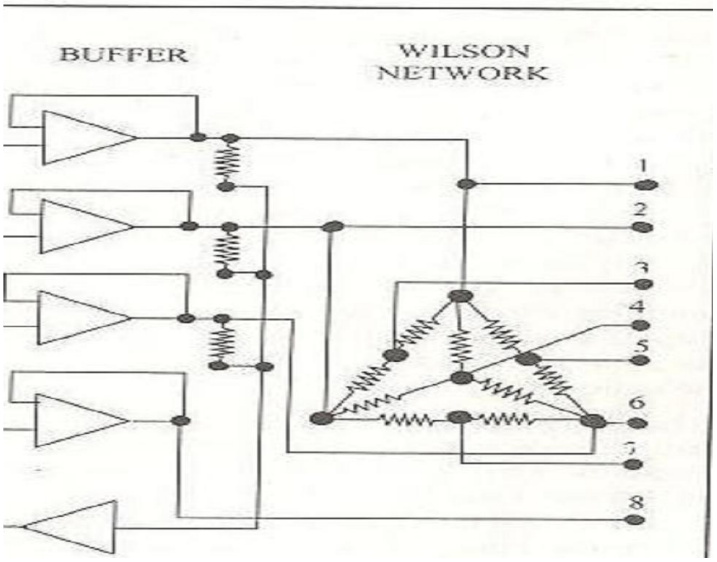
a) Draw right leg drive circuit and Wilson's network used in ECG machine and explain it in detail. — **03**

Ans:



Right leg drive circuit

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 fedback to the right leg electrode reducing the common mode voltage on the input with respect to the floating ground.

		 **Wilson's network** 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.	**03**
	b)	**Write steps for maintenance of EEG machine (any six).** **Ans:** **Maintenance of EEG machine:** 1 Cleaning of EEG machine. 2 Check Calibration of instrument. 3 Check Electrical safety instrument. 4 Check all Cables. 5 Mechanical inspection of instrument 6 Check the power supply to the machine. 7 Check the movement and speed of the paper. 8 Check knobs for Lead selection. 9 Check the electrodes. 10 Check the patient cable for any damage. 11 Check the electrode junction box. 12 Check other procedures recommended by manufacturer. 13 Check the proper grounding of the machine 14 After data collection is complete, carefully remove cap and electrodes from patient. Clean caps and electrodes after each use 15 Store the electrodes in a dark and dry place. It is important that EEG equipment be properly and promptly cleaned after each participant. **Consider Any other relevant maintenance techniques**	**06**
2.		**Attempt any <u>FOUR</u>**	**16**
	a)	**Describe Sphygmomanometer with suitable diagram.** **Ans:**	

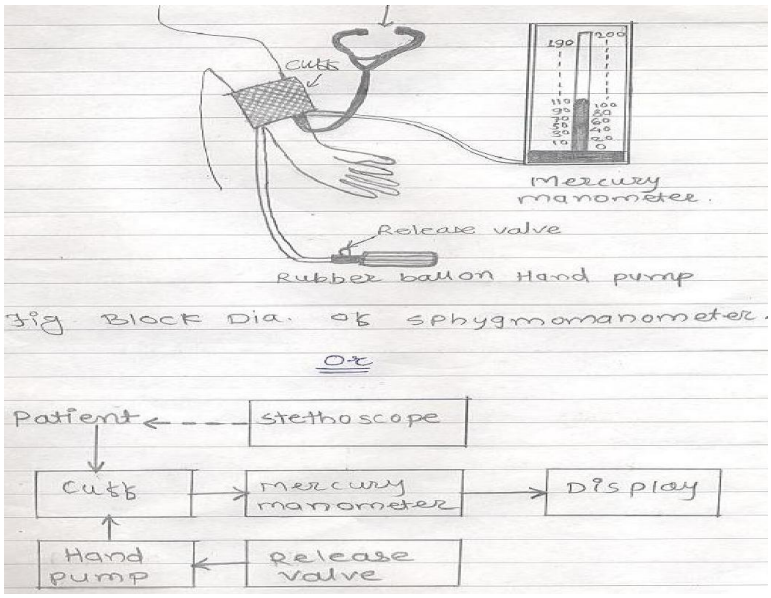


fig Block Dia. of sphygmomanometer.

Or

02

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.

02

Controls & Indicators :-
Hand pump
Release Valve
Blood pressure display

It consists of an inflatable pressure cuff and mercury manometer that measures the pressure in cuff. The pressure cuff consists 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.

b) Describe various methods used for calculation of heart rate.

Ans:

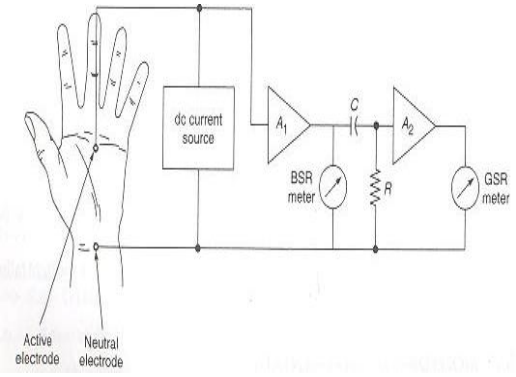
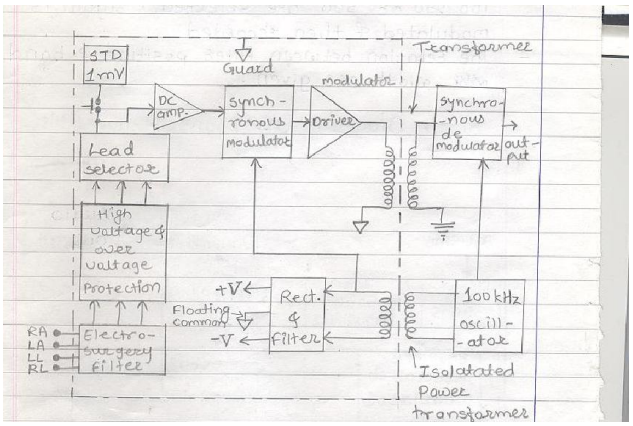
Methods of measure heart rate are given below.

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

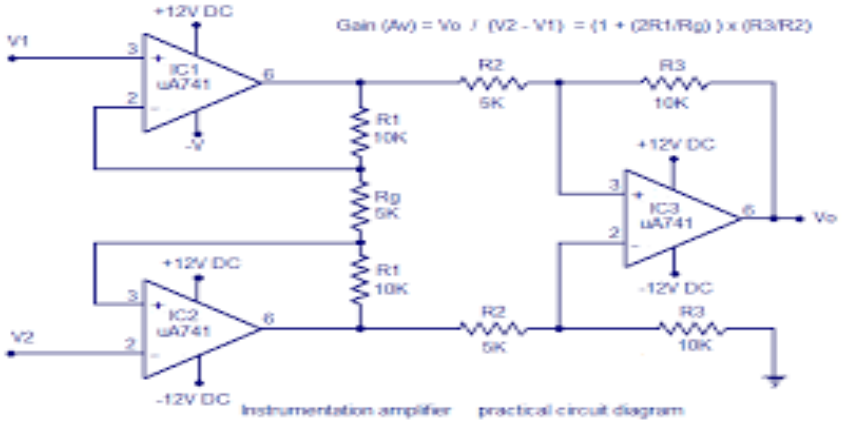
1. Average calculation:-

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

04

		2. Beat-to-beat calculation:- This is done by measuring the time(T), in seconds, between two consecutive pulses, and converting this time into beats /min=60/T. This technique accurately represents the true picture of the heart rate. **3. Combination of beat –to-beat calculation with averaging: -** This is based on a four or six beats average. The advantage of this technique over the averaging techniques is its similarity with the beat- to-beat monitoring system.	
	c)	**Suggest biomedical equipment used to measure skin resistance. Draw and describe its block diagram.** **Ans:** 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.  **Fig:GSR meter**	**02** **02**
	d)	**Draw and explain preamplifier circuit used in ECG machine.** **Ans:**  	**02**

OR



The input section of ECG machine consist of DC Defibrillation protection circuit, buffers right leg drive, lead selection network i.e. Wilson bridge floating preamplifier and 1 mv calibration network. The potential picked up from patient electrodes are taken to the Wilson bridge that is lead selection network for selection particular lead. Wilson network performs mixing or summing function and thus provides ECG connection for lead selection. These signals are then amplified using preamplifier. A preamplifier consists of differential amplifier and 1 mv calibration network CMRR and gain of this preamplifier are in the range of 80 dB and 1000 respectively. A 1 mv calibration voltage is introduce here through CAL button to calibrate and test the instrument before each use. Preamplifier is electrically isolated from the rest of the circuitry and the earth by using either opto coupler or transformer to protect patient from leakage current.

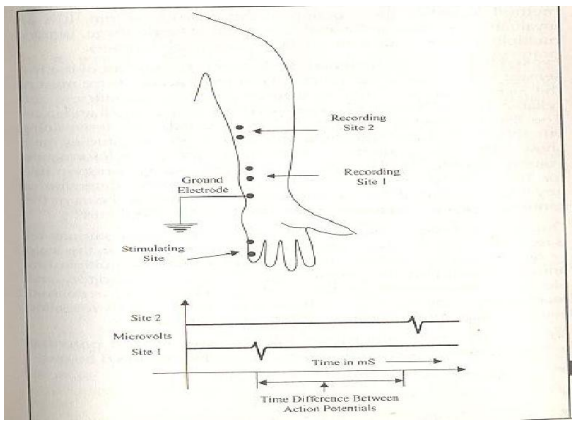
02

e) Describe the concept of sensory nerve conduction with suitable diagram.

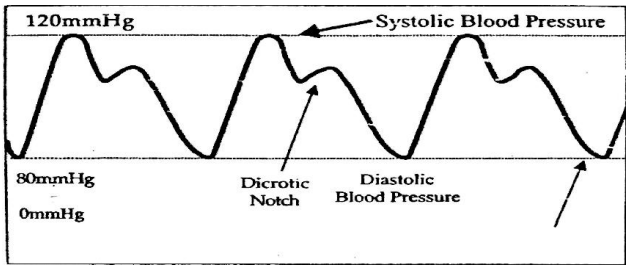
Ans:

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.

02



02

	f)	**Give four technical specifications of PCG machine.** **Ans**: 1.Power-230 volts AC, 50 Hz 2.Transducer-Dynamic, microphone or contact sensor microphone or air coupled pulse pickup microphone 3.Frequency response-0.05 Hz to 1000 Hz for contact sensor 20 Hz to 2000 Hz for dynamic microphone 4.Filter: 25 – 100 Hz 50- 100 Hz 100-750 Hz 250 – 1200 Hz and 500 – 1400 Hz 5.Modulation frequency: 85 Hz 6.Chart speeds:50 and 100 mm/sec.	**04**
3.		**Attempt any <u>FOUR</u>**	**16**
	a)	**Draw and explain blood pressure waveform.** **Ans:**  **Fig: Blood pressure waveform** 1. Blood pressure represents the pumping activity of the heart. 2. Blood Pressure is the force that the blood exerts on the walls of the blood vessels. 3. The peak pressure of this wave is called systolic pressure and has value about 120-mm equivalent of mercury level. 4. The low pressure of this wave is called diastolic pressure and has value about 80-mm equivalent of mercury level. 5. There is slight back pressure built up as the valve closes, and due to the tapering of the circulatory system. 6. This results into valley in the waveform which is called as dicrotic notch.	**02** **02**
	b)	**Give any four technical specifications of Heart Rate Meter.** **Ans:** 1. Power: 230 volts AC, 50 Hz, or Battery-9 volts 2. Measuring range: 0 to 300 Pulses/ minute 3. Transducer: Finger (Opto-electric) 4. Display: 7 Segment LED or LCD 5. Pulse indication: Audio beep and LED	**04**
	c)	**Describe various recording techniques of EEG.** **Ans:** **1. Unipolar or Monopolar recording:** In this method an electrode is made common to all channels. Ears are connected together to form reference common electrode. 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.	**04**

2. Average recording: In this technique one input lead of all amplifiers is taken to the common point of a summing network. The summing network is formed by equal resistances of high value.
3. Bipolar recording: In bipolar recording method different channels are connected in series between electrode pair. This method records the potential difference between two electrodes on the scalp.

d) Show the relationship between ECG, PCG, and arterial B.P. with neat waveforms. — **02**

Ans:

The pumping cycle may be expressed in the fig. as fallow after the p-wave on the ECG in fig. The atrium contracts and ventricle relax at rest. These forces blood through tricuspid valve from the right atrium (RA) into the right ventricle (RV) and through the mitral valve from the left atrium (LA) into the left ventricle (LV) during this action the pulmonary and aortic valve are kept closed by the high pressure in the pulmonary artery and the aorta the ventricles therefore fill with venous blood following the QRS complex of the ECG. The ventricle contract while the atria are at rest these contractions is strong enough to flow blood through the pulmonary valve, to the pulmonary artery and into the lungs. At the same time the blood is forced through the aortic valve into the symmetric arteries as indicated in fig.

The sound associated to the opening of the aortic valve is the first heart sound. This action causes the blood pressure to rise to its peak value in the arteries called systole in fig. During the T-wave of the ECG the ventricles being to relax and the pressure in them falls below the aortic pressure level. The higher pressure in the aorta forces the aortic valve closed this closed rapid its cases the sound detectable with a stethoscope called second heart sound. It also causes a characteristics notch in the pressure pulse called the dicrotic notch. The ventricle then rest and the aortic pressure falls to its minimum value called diastole. The cardiac cycle then repeats at a normal heart rate of approximately 75/beats per min.

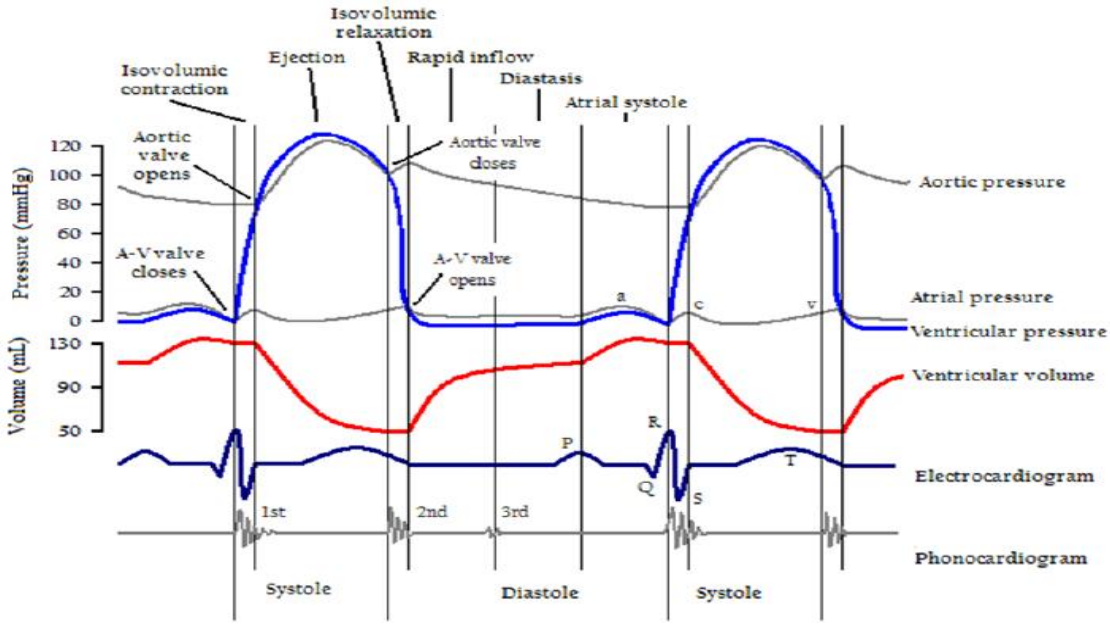
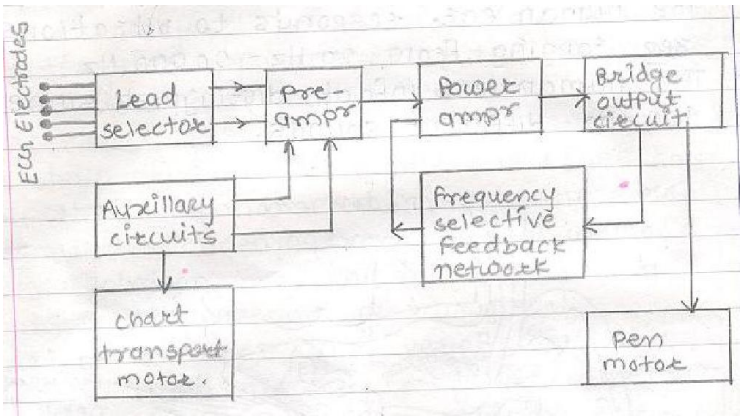


Fig: ECG, PCG, and arterial B.P. waveforms — **02**

	e)	**Draw block diagram of ECG machine and explain it in detail.** **Ans:**  **Fig: Block diagram of ECG machine** **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 and 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. **Buffer:** A circuit which does not amplify a voltage but has very high input impedance and very low output impedance is called buffer amplifier. **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 **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. **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. **Auxiliary Circuit:** It provides 1mv calibration signal and automatic blocking of the amplifier during a change in the position of lead switch. **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. **Frequency Selective Network:** It is R-C network. It is used for frequency selection. It provides necessary damping of the pen motor. ECG signal has limited bandwidth. Hence frequency selection is important factor for ECG machine. **Bridge Output Circuit:** Output of power amplifier is given to the pen motor through bridge output circuit. **Pen Motor:** It is used to drive the stylus. Stylus will draw the graph on paper.	**02** **02**
4.	**(A)**	**Attempt any <u>THREE</u>**	**12**
	a)	**Describe working principle of Spirometer with suitable diagram.** **Ans:** 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 there for the Bell will be at the rest with fixed volume above the water level. But when the subject exhales the pressure inside the Bell increase above atmospheric pressure. Using the Bell to rise similarly when patient inhales the pressure inside the bell decreases The Bell will rise when press increases and drop when pressure decreases. The change in Bell pressure changes the volume inside the Bell which also causes the position of the counter weight to change. We may record the volume change on a piece of graph paper attaching a pen to the counter weight or tension string. The chart Recorder is a rotary drum model called kymograph .At rotates slowly at speed between 30 to 2000 mm/min. Some spirometer also offers 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. **02**

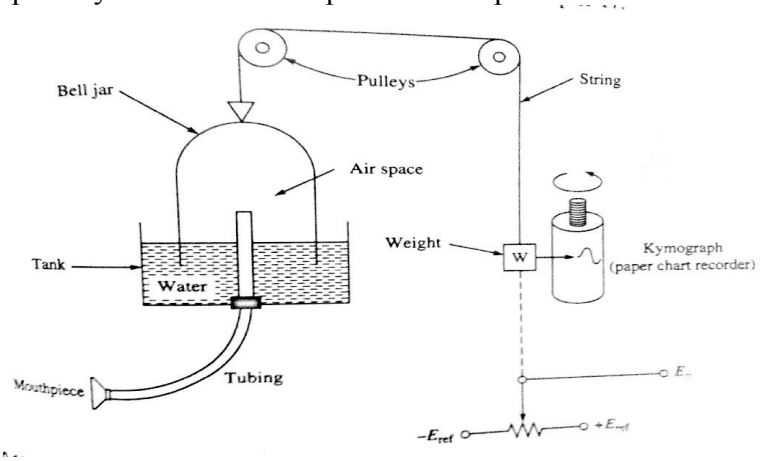


Fig: Spirometer **02**

b) Draw block diagram of Pure Tone Audiometer and explain its each block.

Ans:

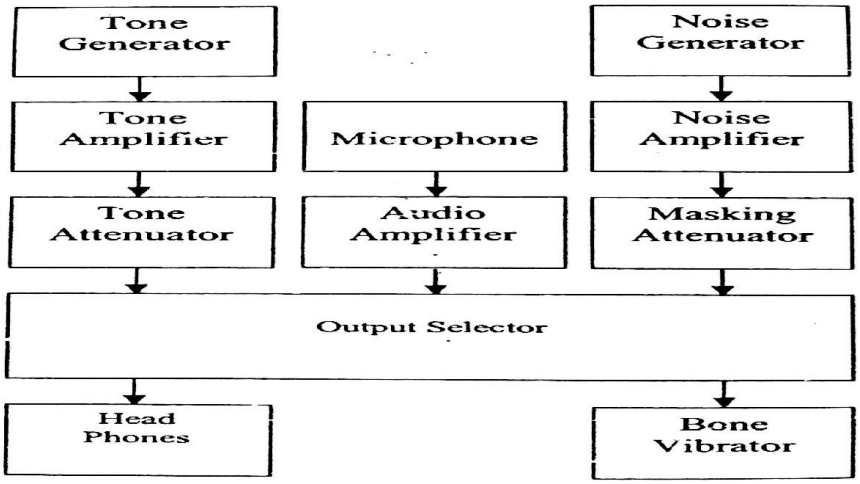


Fig: Block diagram of Pure Tone Audiometer **02**

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. An 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. **02**

c) Draw unipolar and bipolar lead configurations for ECG.

Ans:

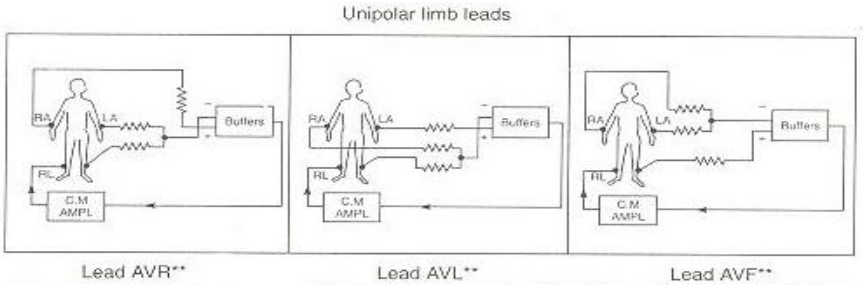


Fig: Unipolar lead configurations for ECG **02**

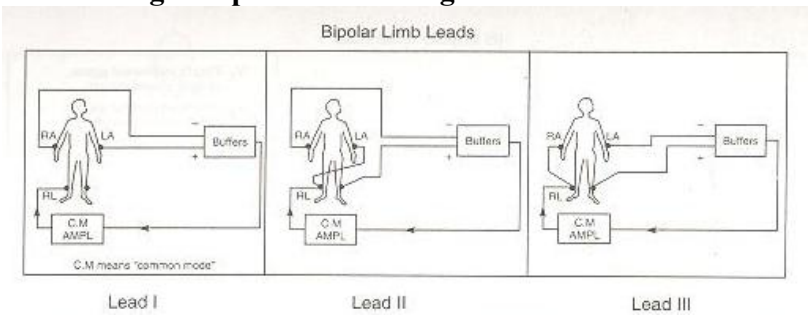
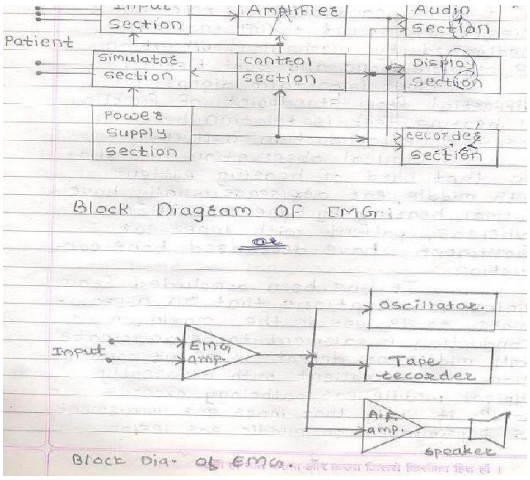


Fig: Bipolar lead configurations for ECG **02**

d) Explain block diagram of EMG Machine.

Ans:



Power Supply Section: **04**

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

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.

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.

Amplifier Section:

It amplifies the signal to a desired level. A multiple step filter employed here allows only a signal of selected bandwidth to pass to next circuit i.e. ADC in control section.

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.

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.

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) State the steps for maintenance of ECG Machine (any six). — **06**

Ans: (Any Six)

1. Cleaning of ECG machine.
2. Check the power supply to the machine.
3. Check Calibration of instrument.
4. Check the position of stylus.
5. Check the movement and speed of the paper.
6. Check the Heat provided to the stylus (if thermal paper is used)
7. Check knobs for Lead selection.
8. Check the proper grounding of the machine.
9. Check all Cables.
10. Check other procedures recommended by manufacturer.
11. Mechanical inspection.

(Consider any other relevant specifications)

b) i) Mention any four possible faults which can occur in EEG machine and give its solution to rectify it. — **04**

Ans:

Faults	Solution
1. Machine runs, but the tracing on one or more channels is missing.	1. Check ink reservoirs. 2. Check ink tubes for clogging. 3. Check for upwardly bent pens-gently push pen onto paper with finger or pencil to observe any touching.
2. Spotty recordings (light or dark).	1. Check paper loading. 2. And if proper, then check pen for worn tip (ink not feeding properly)
3. Noisy or poor recording.	1. Place selector switches to standard calibration position and check for noise and improper operation. 2. If calibration operation is normal, the problem is properly the patient connection. 3. Grounded all EEG leads and check for straight line tracing (noiseless) and, If good, connect an EEG simulator, if available. Check for good tracings. If noise appears on the trace, the problem is properly inside the machine. Refer to the service manual for troubleshooting.
4. Machine does not ON.	1. Check the supply, replace if necessary. (Mains switch gets ON.) 2. Check and replace the fuse if necessary.

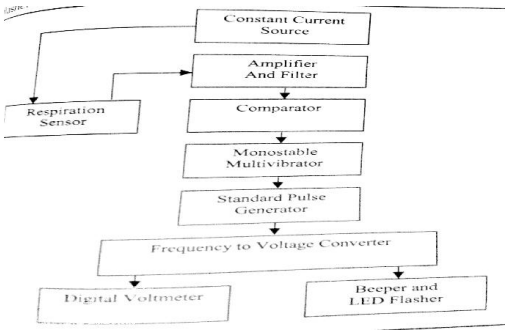
Table: Possible faults which can occur in EEG machine and give its solution

ii) Give any two technical specifications of EEG Machine. — **02**

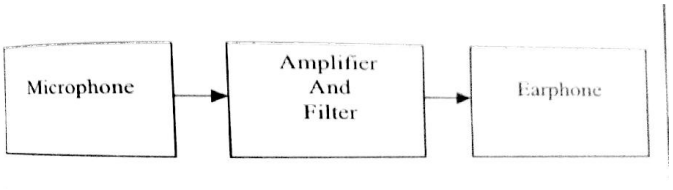
Ans:

Technical specifications (any 2)

1. Power : 230 volts AC, 50Hz.
2. No. of channels : 8 to 24.
3. Input impedance: Greater than 50MW.

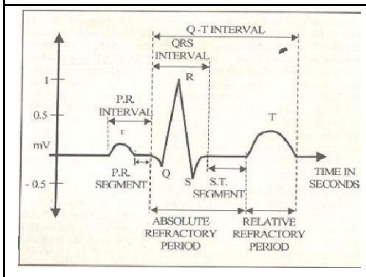
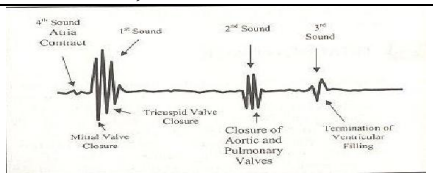
		4. Sensitivity : 0.5Mv/mm. 5. CMRR : Better than 90 db. 6. Chart speed : 1, 10, 15, 30,60mm/sec. 7. Leakage current: Less than 10μA. 8. Notch filter : 50Hz	
5.		**Attempt any <u>FOUR</u>**	**16**
	a)	**List technical specifications of Pulse Oximeter. (any four).** **Ans :** **1.** Power : 230 Volts AC, 50Hz, or Battery 4.5 Volts. 2. Spo2 Range : 0 to 100%. 3. Spo2 Accuracy : ± 2 digit at 70 to 100%. 4. Pulse rate range : 30 to 300 beats per minute. 5. Sensor : Optoelectronic (650nM and 805 Nm).	**04**
	b)	**Describe working principle of respiration rate meter.** **Ans :**  **Fig: Respiration Rate meter** **OR Any other relevant diagram** The first block of the respiration rate meter is respiration sensor. The respiration rate meter employs either nose or chest sensor to detect respiration. The nose sensor makes use of thermistor as its sensing device, where as the chest sensor uses strain gauge with elastic band as its sensing device. When a sensor is placed in the nasal cavity, cooling of the thermistor takes place each time to inspiration and expiration resulting in to change in resistance of the themistor .This change is converted into voltage pulse by passing constant current through the thermistor. These pulses are then amplified by an amplifier and passed through a low pass filter to eliminate noise. At this level they are compared with reference voltage set by threshold control in comparator and a trigger pulse is produced. From this trigger, the non-retrigger able monostable generates a large duration pulse of around 500ms and eliminates chances if triggering of multivibrator by noise or artifact. The standard pulse generator generates standard pulse, which is averaged to produce D.C voltage level proportional to the respiration rate. A digital voltmeter displays this as a respiration rate. To monitor the respiratory activity an audio beeper and LED flasher are usually employed.	**04**
	c)	**Draw block diagram of Hearing aid and describe it.** **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	**02**

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.



02

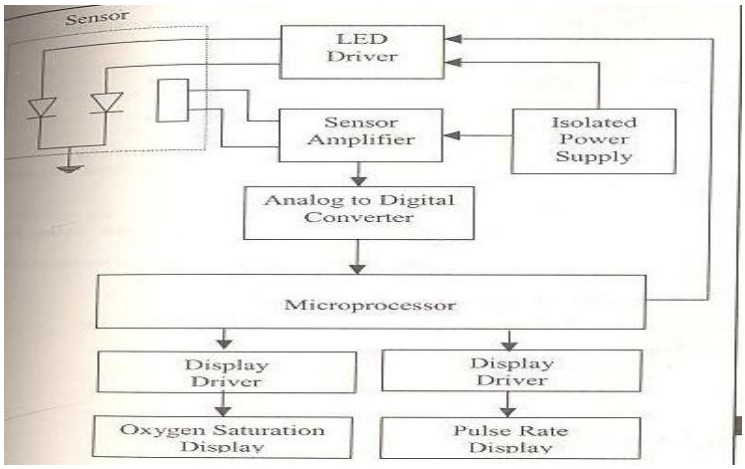
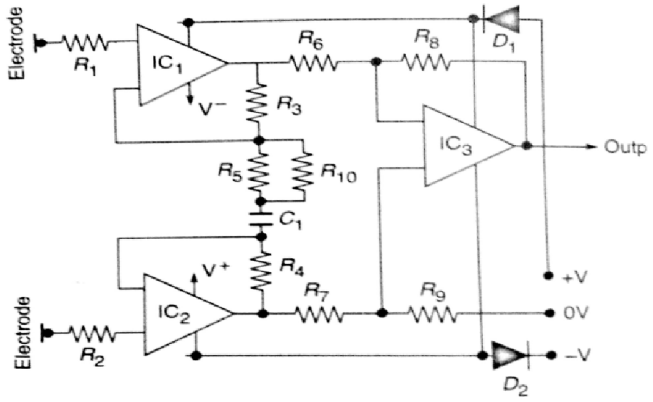
d) Compare ECG with PCG.
Ans: (Any 4 points)

ECG	**PCG**
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

04

	e)	**Define any four respiratory parameters.** **Ans :** **1.Tidal Volume**:- The volume of gas inspired or expired (exchanged with each breath) during normal quiet breathing is known as tidal volume. 2 **Minute Volume**:- The volume of gas exchanged per minute during quiet breathing It is 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. 4 **Inspiratory Reserve volume**: - The volume of gas which can be inspired from a normal. It is the maximum volume of air that can be inspired after normal inspiration It is about 3050ml 5 **Expiratory reserve volume**:-The volume of gas remaining after a normal expiration less the volume remaining after a forced expiration. 6 **Residual Volume: -** The volume of gas remaining in the lungs after a forced expiration. 7 **Functional Residual Capacity (FRC)**:- The volume of gas in the lungs after normal expiration. 8 **Total Lungs Capacity (TLC)**:-The volume of gas in the lungs at the point of maximal inspiration. 9 **Vital Capacity (VC):-** The greatest volume that can be inspired from the resting end expiratory position. 10 **Inspiratory Capacity(IC):-** The maximum volume that can be inspired from the resting end expiratory position. Dead Space:- Dead space is the functional volume of the lung that does not participate in gas exchange.	**04**
	f)	**Describe generation of EMG signal.** **Ans:** 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.	**04**
6.		**Attempt any <u>FOUR</u>**	**16**
	a)	**Mention any four possible faults which can occur in ECG Machine and give its solution to rectify it.** **Ans** 1.ECG trace too dark • Check thermal writing stylus adjustments which affect quality of tracing • Check stylus pressure • Check stylus heat control knob on front panel and set the knob by rotating it anticlockwise as it decreases the stylus heat. 2.ECG trace too light • Check thermal writing stylus adjustments which affect quality of tracing • Check stylus pressure and set pressure as recommended. • Check stylus heat control knob on front panel (set the knob by rotating it clockwise as it increases the stylus heat)	**04**

		3. ECG signal is noisy • Preamplifier faulty (Replace preamplifier board or faulty components) • Loose patient plug connection (Inspect and rectify) 4. ECG baseline is shifting • Abrade skin • Stop patient movement • Check ground connections • Use same type of electrode at all sites • Check for proper cable • Check for static build-up 5. ECG trace not available • Check gain control for proper setting. • Check brightness control for proper setting. • Check lead selector switch. Make certain it is in the "on" position. • Are the electrodes dry? If so, replace. • Is the correct patient cable being used? • Check the lead wires and cables for damage. Use a continuity tester. • Check connections: a. Is the patient cable fully inserted into the monitor? b. Are the lead wires fully inserted into the patient cable? c. Are the lead wires securely attached to the electrodes? • Are the electrodes securely attached to the patient? Is additional skin prep necessary? • Suggest that a technician check monitor function according to the manufacturer's specifications. 6. Machine not getting switched on • No power from mains socket (Check power switch is on. Replace fuse with correct voltage and current rating if blown. Check mains power is present at socket using equipment known to be working.) • Electrical cable fault (Contact electrician for rewiring if power not present. Try cable on another piece of equipment. Contact electrician for repair if required) **(Consider any other relevant fault)**	
	b)	**List technical specifications of pure tone audiometer. (any four)** **Ans :** 1. Power : 230 volts AC, 50Hz 2. Pure tone frequency : Air conduction 125 Hz to 10KHz Bone Conduction 125 Hz to 4 KHz 3. Attenuator range : -10 dB to values given above in steps of 5 dB each 4. Automatic pulsing : 0.25 Sec, 0.5 Sec, 1 Sec, 2 Sec 5. Masking : Wide band 6. Outputs: Left, Right, Left and Right, Bone, Free field 7. Display: LED digital display	**04**

	c)	**Draw and explain block diagram of pulse oximeter.** **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.  **Fig: Block diagram of pulse oximeter**	**02** **02**
	d)	**Draw and explain preamplifier circuit of EMG Machine.** **Ans**  **Fig : Preamplifier circuit of EMG.** 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	**02** **02**

		C1 determines the low frequency performance of the circuit. It also eliminates the effects at the output of any dc offset due to IC1 and IC2 OR Any imbalance in electrode potential. The second stage IC3 provides further differential signal gain While rejecting common mode signals. The overall gain of the amplifier is 1000.	
	e)	**Describe the concept of air and bone conduction.** **Ans :** **Bone conduction** is referred to transmission of sound to the internal ear mediated by mechanical vibration of cranial bones and soft tissues. Most important diagnostic differential from the standpoint of functional hearing test is relationship between air & bone conduction acuity. Clinical observation has shown that hard-of-hearing patients with middle ear disease usually have normal hearing by bone conduction, whereas patient with inner ear involvement have decreased bone conduction. It has been concluded from clinical observations that an approximate 60 db loss is the maximum air conduction impairment to be anticipated with middle ear defect. If **air conduction** loss in patient with apparently typical middle are pathology exceeds 60 db, it is likely that inner ear impairment is superimposed on middle ear lesion. The start of slope defines 'end point' of ear. For air conducted signals, fall in sensitivity continues so that for instance at 25 KHz, 5W of acoustic power is needed to produce hearing response. On the other hand the bone conducted signal there is a change in slope again at about 2KHz above end point. From then on up 200KHz the threshold sensitivity falls at rate of 15 db per octave. So in the ultrasonic region, a bone conducted signal of less than one electrical watt is audible. There is a rapid drop in impedance of middle ear at high frequencies and very little of the acoustical energy fed to ear by air conduction is transmitted to cochlea. But bone conducted sound by passes middle ear. This to some extent explains the different threshold shapes at high frequency.	**04**