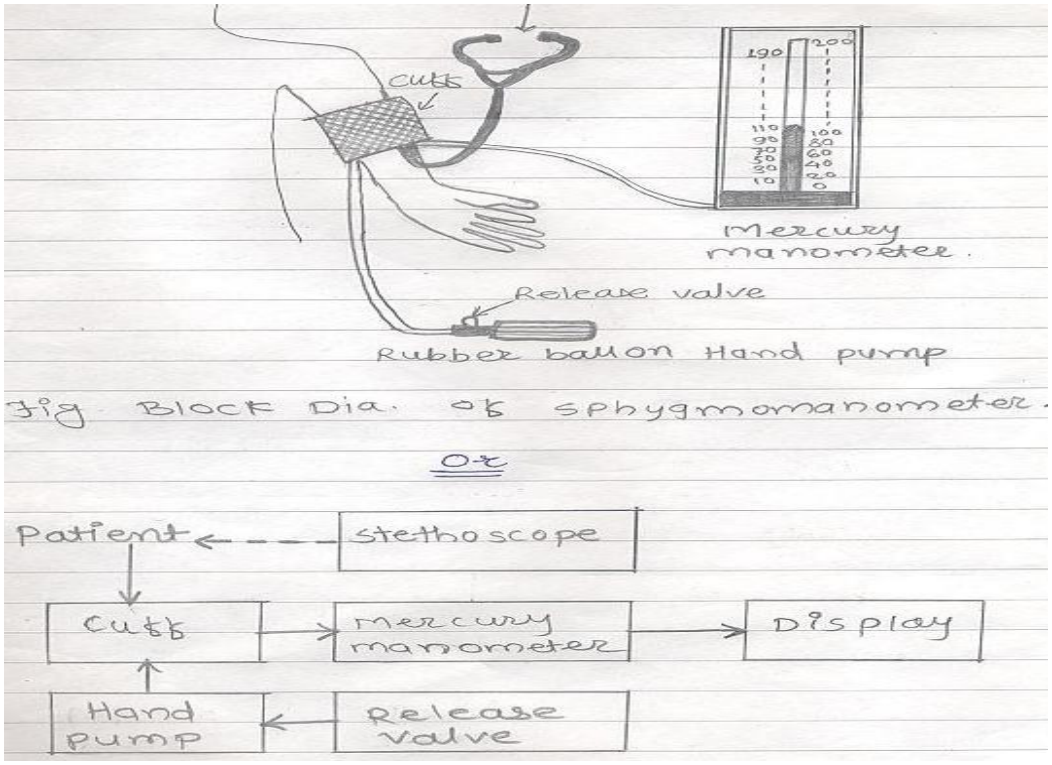
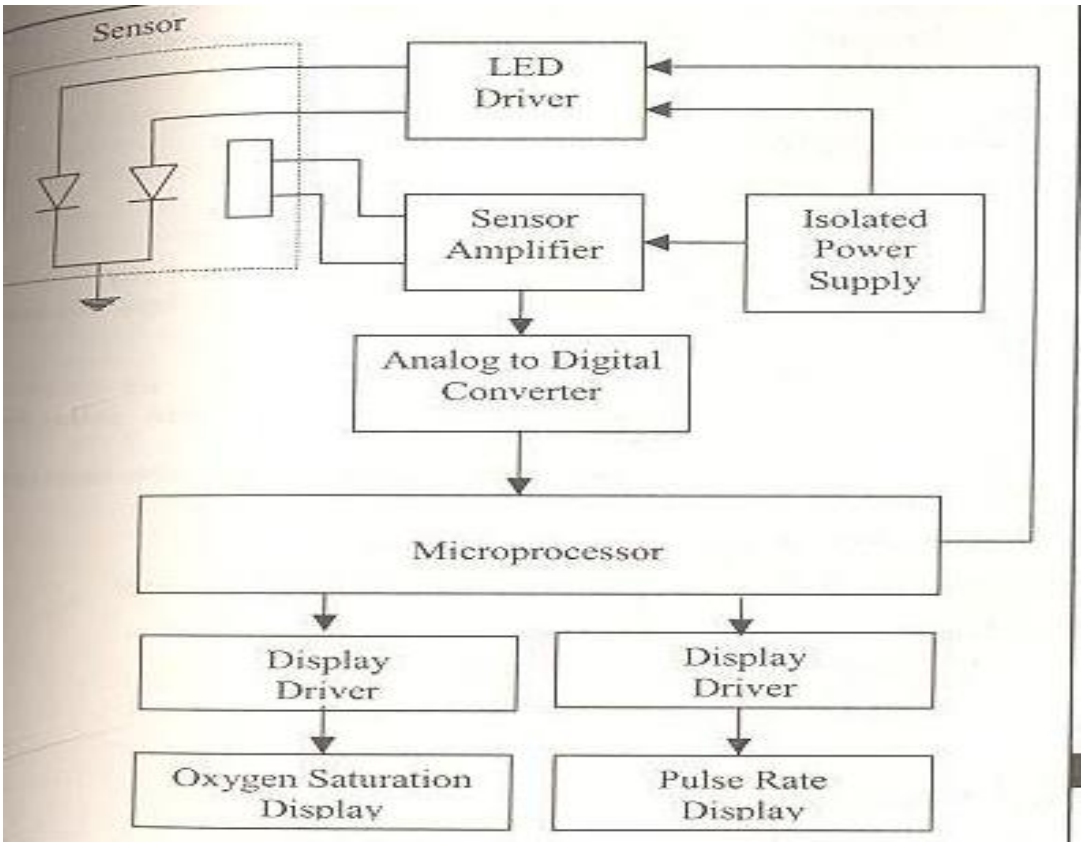
WINTER– 2018 EXAMINATION

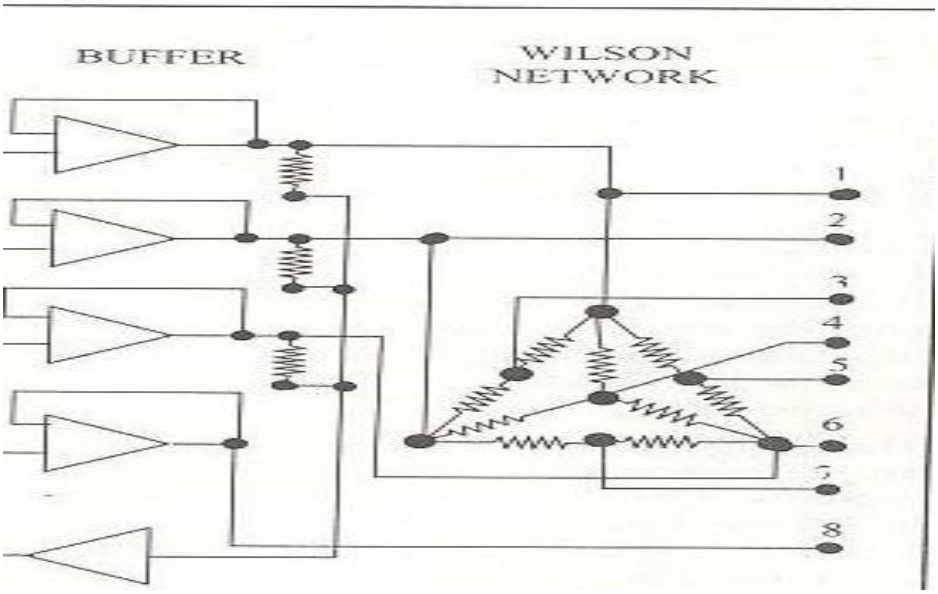
Model Answer **Subject Code:** 17545

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	**Define the term "blood pressure". Draw the block diagram of sphygmomanometer.** **Ans:** **Definition of blood pressure:** Blood pressure is the pressure of blood applied against the arterial walls resulted due to the force generated by contraction of left ventricle. And conducted through arteries of entire body.	02
		 **Fig: block diagram of sphygmomanometer**	02

	b	**Draw a labeled block diagram of pulse oximeter and state the function of each block.** **Ans:**  **Fig: Block diagram of pulse oximeter** 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 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** **02**
	c	**Illustrate following methods to measure the heart rate:** **i. Average** **ii. Bit to bit** **Ans:** **Average:** 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**.** **Beat-to-beat:** 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.	**02** **02**

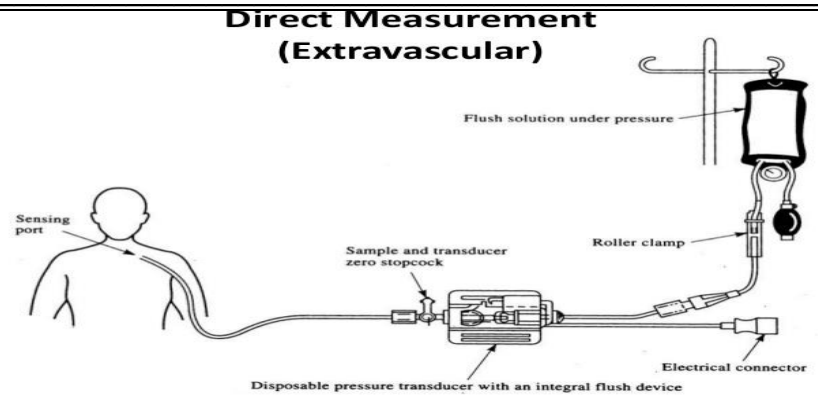
	d	**Draw and explain Wilson's network in ECG machine.** **Ans:**  **Fig: Wilson's network in ECG machine** The potentials picked up from the patient electrodes are taken to the Wilson bridge that is lead selection network for selection of particular lead. Four buffers are used with the leads RA, LA LL 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, which 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. Wilson network sums the various electrode voltages to achieve the standard voltages for different ECG selection. The multiplexer selects the appropriate lead voltages form register network.	**02** **02**
	B	**Attempt any <u>ONE</u>**	**06**
	a	**State and explain generation of ECG signal and list any four technical specifications of ECG machine.** **Ans:** **Generation of ECG signal:** 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.	**02**

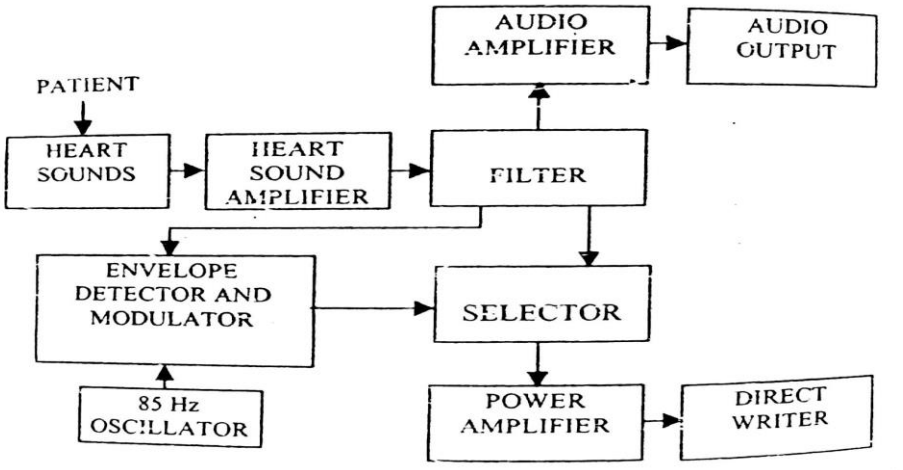
		Technical specifications of ECG machine: 1. Power: A.C.230 volts, 50Hz and or Battery 2. Leakage current: Less than 10 mA with 230VAC 3. Isolation: 30MW minimum from patient to chassis at 50Hz 4. Input impedance: Greater than 20MW 5. Frequency response: 0.05 Hz to 100Hz 6. Noise: Less than 10 mV peak 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	**04**
	b	**Write possible faults of EEG machine and write their possible solutions (any three).** **Ans:**	**06**

Faults	Solution
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.
Spotty recordings (light or dark).	1. Check paper loading. 2. And if proper, then check pen for worn tip (ink not feeding properly)
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.
Machine dose not ON.	1. Check the supply, replace if necessary. (Mains switch gets ON.) 2. Check and replace the fuse if necessary.

Table: Faults and solutions of EEG machine

2.		**Attempt any <u>FOUR</u>**	**16**
	a	**Describe direct blood pressure measurement with neat diagram.** **Ans:** **Direct blood pressure measurement:** 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.	**02**

		 **Fig: Direct blood pressure measurement**	**02**
	b	**List the technical specifications of heart rate meter (any four).** **Ans:** **Technical specifications of heart rate meter:** 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	**Give the importance of tone generator, noise generator, headphone and bone vibrator in pure tone audiometer.** **Ans:** **Tone generator:** It is a LC oscillator, which generates tone of frequencies between 125 Hz to 10 kHz in eleven steps. **Noise generator:** It 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. **Headphone and bone vibrator:** These are used to measure air and bone conduction threshold respectively.	**04**
	d	**State and explain vectocardiography.** **Ans:** Vectocardiography 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 vectocardiogram (VCG).Vectocardiogram 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**
	e	**Describe motor and sensory nerve conduction in EMG machine.** **Ans:** **Motor nerve conduction:** Motor nerve conduction velocity is measured from stimulus site to the muscle. 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	**02**

		be repeated several times to ensure that the responses obtained are consistent. Measuring the distance between the stimulating and recording site and dividing it by the latency can determine the nerve conduction .It is possible to measure the motor nerve Conduction velocity between several locations. **Sensory Nerve Conduction:** Sensory nerve conduction velocity is measured by similar technique used for nerve. Recording electrodes are placed at no. of sites on the sensory nerve under test. In this example a nerve of the hand is considered as shown in fig. And the stimulus is applied at the little finger which is a Stimulation site .The nerve impulse travels upward through the nerve and reaches at recording sites after different time intervals. The Sensory nerve Conduction velocity is measured in the same way as motor nerve dividing the latency by the distance.	**02**
	f	**Draw and explain block diagram of phonocardiograph.** **Ans:**  **Fig: Block diagram of phonocardiograph** Phonocardiograph is equipment used to record sound generated by heart during is physiological phenomenon. When provides diagnostic information in frequency band from 20-1000 Hz. Phonocardiograph has 9 Sections are 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 is below 100Hz. But phonocardiograph a direct writing hot stylus galvanometer is used to record heart sound & murmurs with special electronic detection method that extracts the shape, timing duration, amplitude of heart sound over entire 20Hz-2KHz spectrum. Signal's envelope is detected & modulated with 85 Hz frequency, which is generated by 85Hz oscillation. The modulated signal has frequency component of only 85Hz & envelope of acquired heart sound to record the signal using hot stylus galvanometer. At filter positions 25 & 50 being selected band has lower frequency it is recorded directly. On the other hand when filter positions. 100, 250 or 500 are selected signal is modulated & then recorded.	**02** **02**

3. **Attempt any FOUR** **16**

a **Compare direct and indirect blood pressure measurements (any two points of each).** **04**

Ans:

Direct blood pressure measurement	Indirect blood pressure measurement
In this technique a catheter & an electronic transducer to sense the blood pressure.	It is the most consist of pneumatic cuff, mercury manometer or pressure gage, hand pump with release valve and stethoscope.
In this technique measures blood pressures in the artery or particular part of the body.	In this technique measures the blood pressures only certain regions (upper arms or thigh).
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.	In this technique the blood pressures is not continuously monitored and a waveform cannot be displayed
This technique provides much more reliable information	This technique is less informative.
This technique is more complex.	This technique is simple.

Table: Compare direct and indirect blood pressure measurements

b **Draw and explain block diagram of ultrasonic FHR meter.** **02**

Ans:

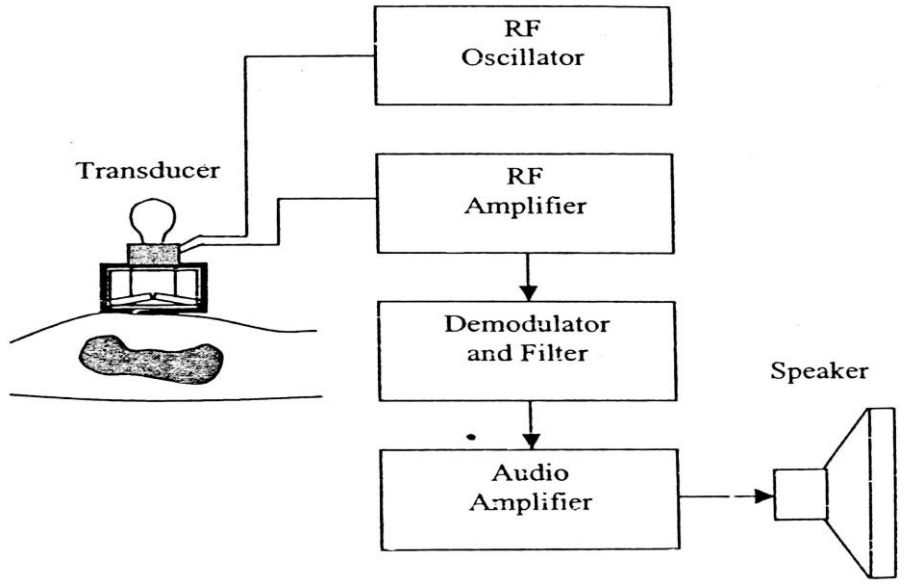


Fig: Ultrasonic FHR meter

The beating of the fetal heart inside the mother's womb can be detected by using ultrasonic fetal monitoring technique. This is based on Doppler principal. In this technique, a transducer containing both transmitting and receiving crystals is placed on the mother's abdomen. A beam of low intensity ultrasound is transmitted into the body as a continuous beam. Part of this ultrasound is reflected back from the internal structure i.e. moving heart of the fetal. Ultrasound received from these from moving heart is slightly shifted in frequency from the transmitted ultrasound. To process the signal, it is passed through demodulator and filter. The difference in the frequency is converted into an audible signal which can be heard as a heartbeat. **02**

c **List any four technical specifications of EEG machine.** **04**

Ans:

Technical specifications of EEG machine:

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

d **Compare ECG and PCG (any two points of each).** **04**

Ans:

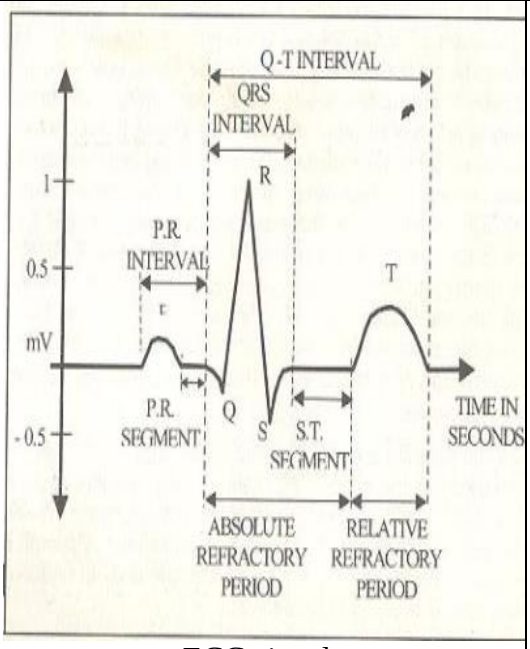
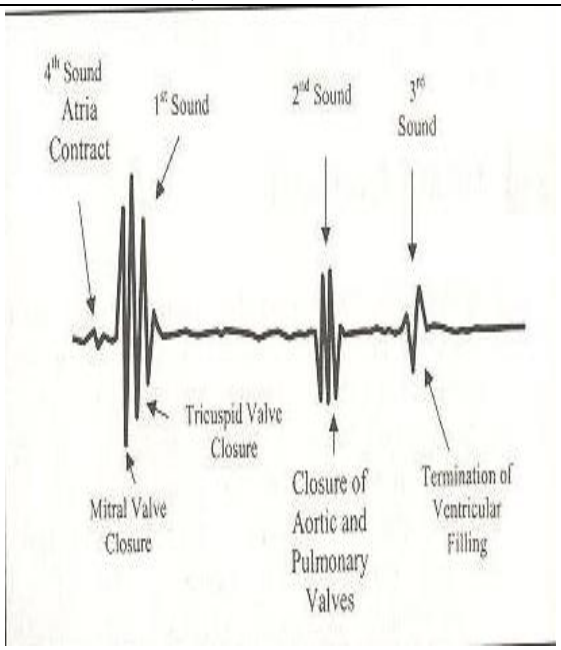
ECG	PCG
ECG : Electro cardio graph	PCG : Phono cardio graph
It is the recording of electrical activity of heart functioning	It is the recording of the sounds connected with the pumping action of heart.
It is rhythmically repeating signal synchronize by heart function	These sounds provide an indication of heart rate and its rhythm city.
The origin of ECG signal is SA node in the heart	The origin of PCG signal is pumping action of heart
It provides the recording of electrical activity in the form of PQRS waves.	It provides a recording of wave forms of heart sound.
Its output is in readable form	Its output is in audible form.
To Pick ECG signal surface type of electrodes are used	To Pick PCG signal dynamic microphone or contact sensor microphone can be used as a transducer,
	
ECG signal	PCG signal

Table: Compare ECG and PCG

	e	**With the help of block diagram, explain working of ECG machine.** **Ans:**	

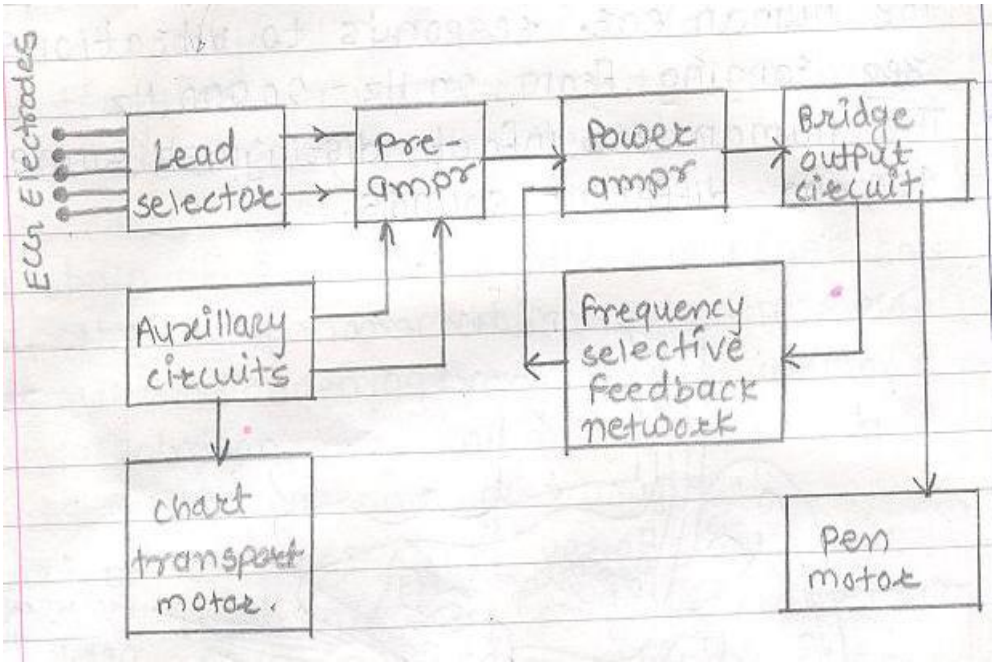


Fig: Block diagram of ECG machine — **02**

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. — **02**

Preamplifier: The preamplifier is usually a 3 to 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.

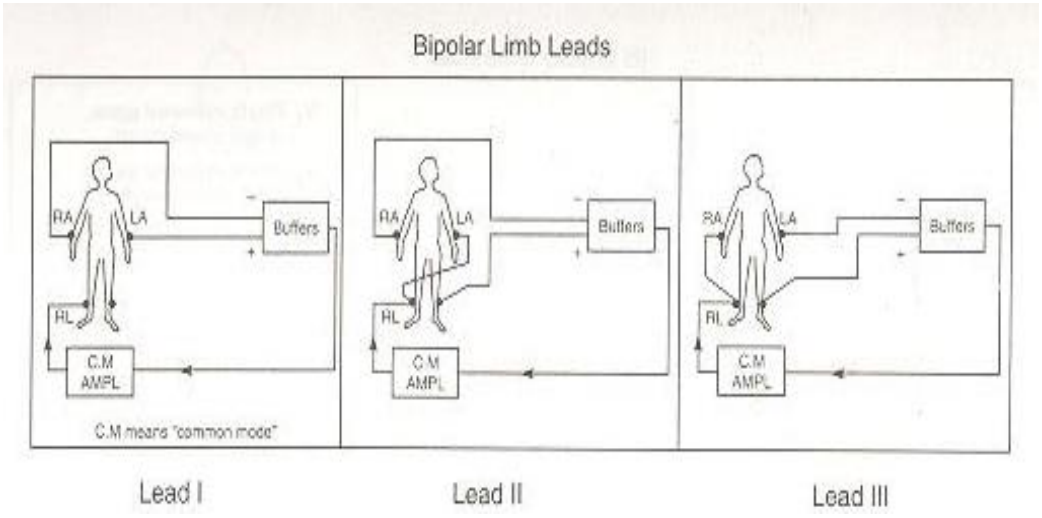
Auxiliary Circuit: It provides 1mv calibration signal and automatic blocking of the amplifier during a change in the position of lead switch.

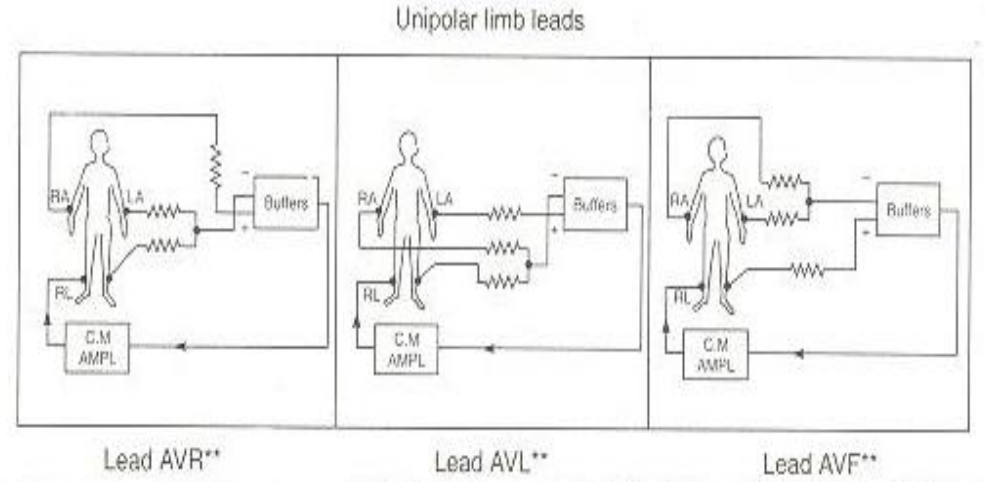
Power Amplifier: The power amplifier is generally of push-pull differential type. It consists of: 1) Low pass filter 2) High Pass filter 3) Notch filter. Power amplifier rejects the noise signal as well as amplifies the signal.

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.

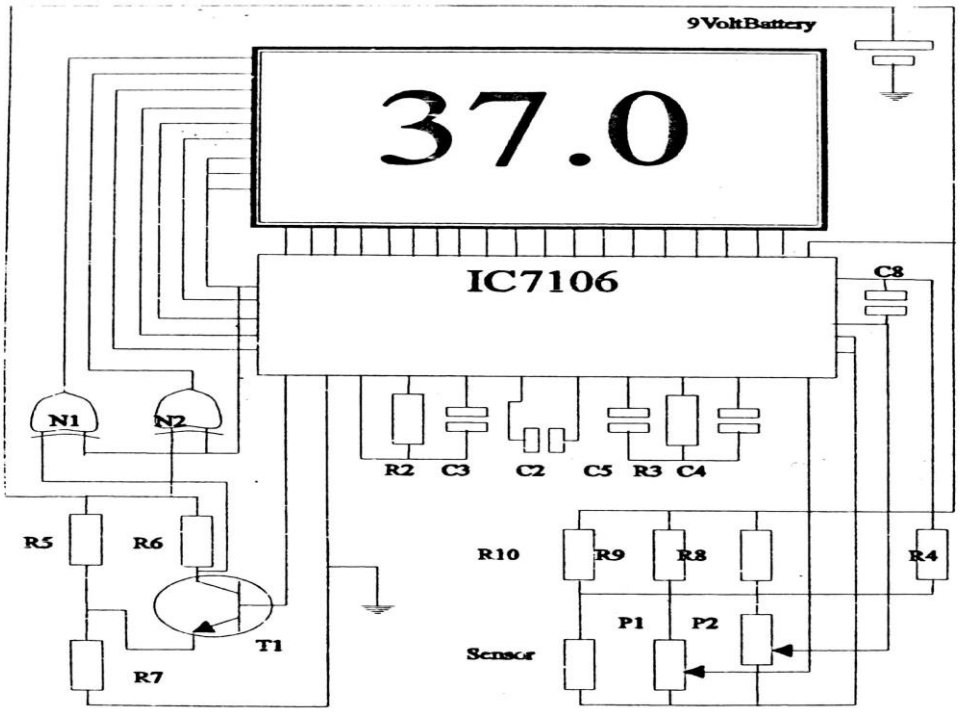
Bridge Output Circuit: Output of power amplifier is given to the pen motor through bridge output circuit.

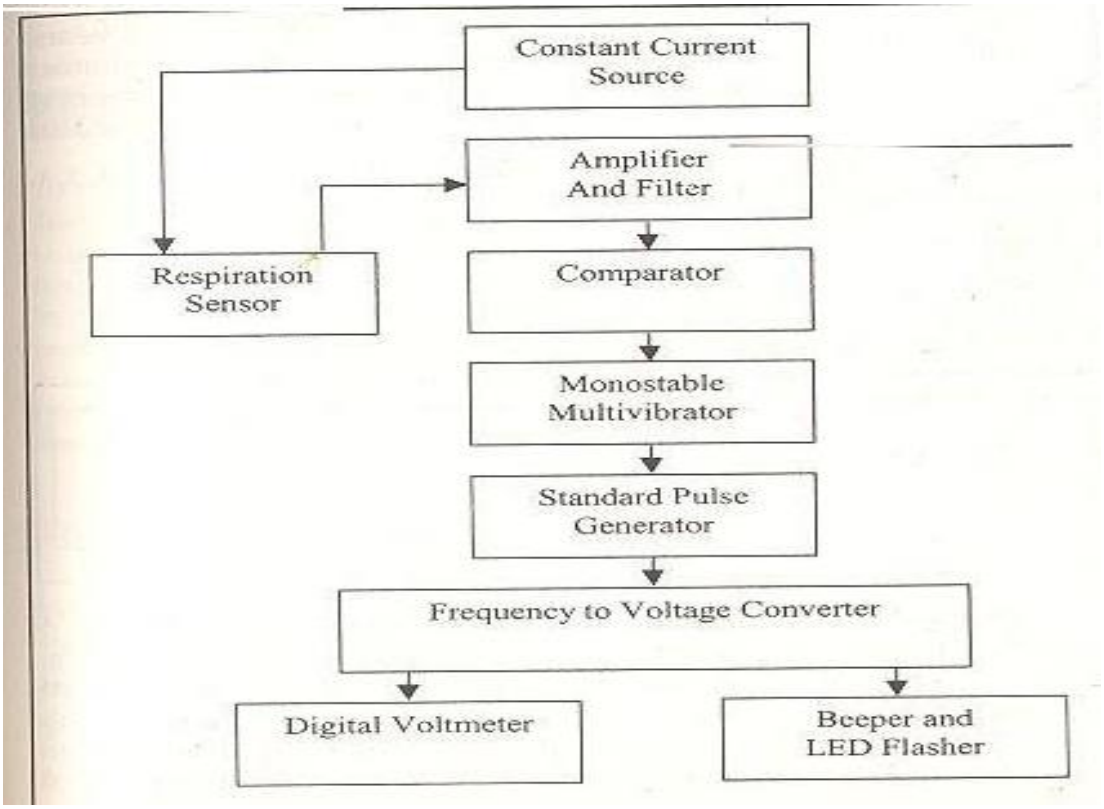
Pen Motor: It is used to drive the stylus. Stylus will draw the graph on paper.

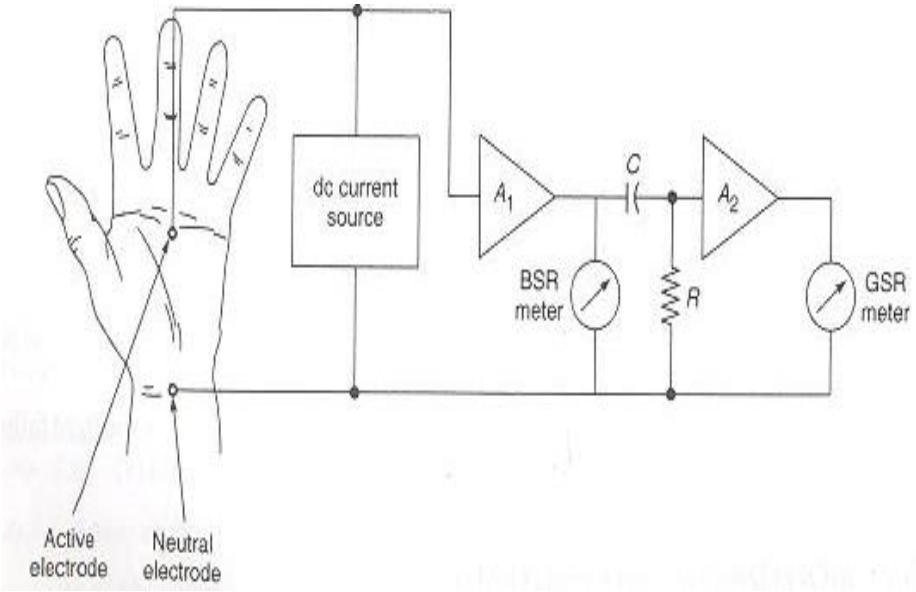
4.	**A**	**Attempt any <u>THREE</u>**	**12**
	a	**State any one application of spirometer and list any three lung volume and capacity.** **Ans:** **Applications of spirometer:** 1. Measuring the volume of air inspired and expired by the lungs. 2. A spirometer measures ventilation, the movement of air into and out of the lungs. 3. Diagnose certain types of lung disease (such as asthma, bronchitis, and emphysema). 4. Find the cause of shortness of breath. 5. Check lung function before someone has surgery. 6. Measure progress in disease treatment. **Lung volume and capacity:** 1. Inspiratory reserve volume (IRV) 2. Tidal volume (TV) 3. Expiratory reserve volume (ERV) 4. Residual volume (RV) 5. Vital capacity (VC) 6. Inspiratory capacity (IC) 7. Functional residual capacity (FRC) 8. Total lung capacity (TLC)	**01** **03**
	b	**List any four technical specifications of audiometer.** **Ans:** **Technical specifications of audiometer:** 1. Power: 230 volts A.C., 50Hz & or battery 2. Outputs: Left, Right, Left & Right, Bone, Free field. 3. Attenuator Range: 10Db to value given above in steps of 5DB each. 4. Automatic pulsing: 0.25sec, 0.5 Sec, 1 Sec, 2sec. 5. Masking: Wide band. 6. Masking Attenuator: 0.100DB in 10DB steps. 7. Display: Led Digital Display.	**04**
	c	**With neat labeled sketch, describe lead configuration which can be obtained using limb electrode in ECG.** **Ans:**  **Fig: Bipolar limb leads**	**01**

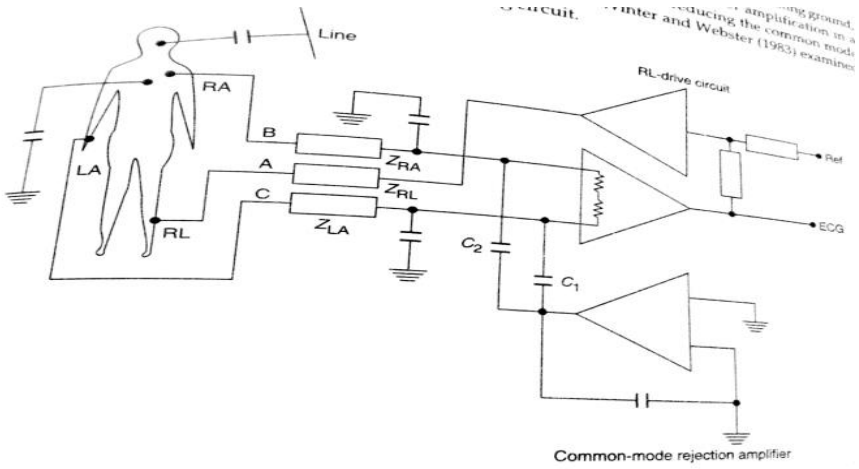
		Bipolar limb leads: In bipolar leads, ECG is recorded by using two electrodes. In standard lead I, the electrodes are placed on the right and the left arm (RA and LA). In lead II, the electrodes are placed on the right arm and the left leg (RA and LL). In lead III, the electrodes are placed on the left 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).	**01**
			**01**
		Fig: Unipolar limb leads	
		Unipolar limb leads: In unipolar limb leads two of the limb leads are tied together and recorded with respect to the third limb. In lead AVR, the right arm is recorded with respect to common junction of the left arm and left leg electrodes. In lead AVL, the left arm is recorded with respect to the common junction of the right arm and left leg electrodes. In lead AVF, the left leg is recorded with respect to the two arm electrodes tied together.	**01**
	d	**State and explain 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 study.	**04**
	B	**Attempt any <u>ONE</u>**	**06**
	a	**Mention any six faults that may occur in ECG machine and state its solution.** **Ans:** **ECG trace too dark** 1. Check thermal writing stylus adjustments which affect quality of tracing 2. Check stylus pressure 3. Check stylus heat control knob on front panel and set the knob by rotating it anticlockwise as it decreases the stylus heat. **ECG trace too light** 1. Check thermal writing stylus adjustments which affect quality of tracing 2. Check stylus pressure and set pressure as recommended.	

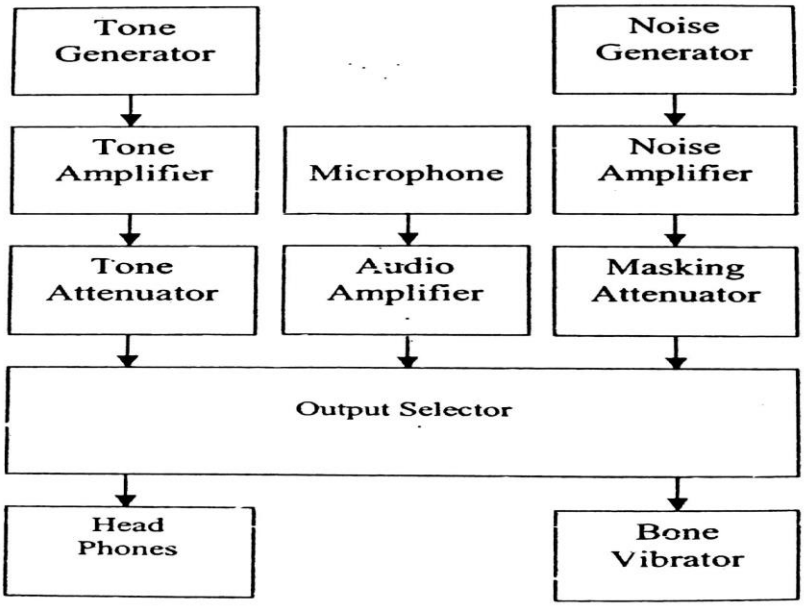
		3. Check stylus heat control knob on front panel (set the knob by rotating it clockwise as it increases the stylus heat) **ECG signal is noisy** 1. Preamplifier faulty (Replace preamplifier board or faulty components) 2. Loose patient plug connection (Inspect and rectify) **ECG baseline is shifting** 1. Abrade skin 2. Stop patient movement 3. Check ground connections 4. Use same type of electrode at all sites 5. Check for proper cable 6. Check for static build-up **ECG trace not available** 1. Check gain control for proper setting. 2. Check brightness control for proper setting. 3. Check lead selector switch. Make certain it is in the "on" position. 4. Are the electrodes dry? If so, replace. 5. Is the correct patient cable being used? 6. Check the lead wires and cables for damage. Use a continuity tester. 7. 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 8. Securely attached to the electrodes? Are the electrodes securely attached to the patient? 9. Suggest that a technician check monitor function according to the manufacturer's specifications. **Machine not getting switched on** 1. 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.) 2. Electrical cable fault (Contact electrician for rewiring if power not present. Try cable on another piece of equipment. Contact electrician for repair if required)	**06**
	b	**How EEG signal can be generated? Describe EEG spectrum.** **Ans:** **Generation of EEG signal:** The brain generates rhythmical potentials which originate in the individual neurons of the brain. These potentials get summated as millions of cell discharge synchronously and appear as a surface waveform the recording of which is known as the electroencephalogram. The neurons are electrically polarized at rest. The interior of the neuron is at a potential of about – 70 mV relative to the exterior. When a neuron is exposed to a stimulus above a certain threshold, a nerve impulse is generated which spreads in the cell resulting in the depolarization of the cell. Shortly afterwards, repolarization occurs. **EEG spectrum:** EEG Signals are mainly classified on the basis of frequency. The normal frequency range of the EEG 0.5 Hz to 30 Hz. It divided into four bands. 1. Delta wave: Lower thon 4 Hz or 0.5 to 4 Hz 2. Theta wave: 4 to 8 Hz 3. Alpha wave: 8 to 13 Hz 4. Beta wave: 13 Hz to 30 Hz	**02**

		Delta wave: These occurs only once in every 2 or 3 seconds. These occur in deep sleep in premature babies and in very serious organic brain diseases. **Theta wave:** These are recorded from the parietal and temporal regions of the scalp of children. These also occur during emotional stress in some adults particularly during disappointment and frustration. **Alpha wave:** They found in normal person when they are awake in quiet, resting state. They occurs normally occipital region. These have amplitude of 20-200µv **Beta wave:** These are recorded from the parietal and frontal regions of the scalp. These divided into two types as beta I which is inhibited by cerebral activity and beta II which is excited by mental activity like tension. EEG recording is used to analyze diseases like epilepsy, brain injury, tumors, consciousness dysfunction, coma etc.	**04**
5.		**Attempt any <u>FOUR</u>**	**16**
	a	**Draw the circuit of digital temperature indicator and describe its operation.** **Ans:**  **Fig: Digital temperature indicator** 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	**02** **02**

		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.	
	b	**Draw and explain block diagram of respiration rate meter.** **Ans:**  **Fig: Block diagram of respiration rate meter** 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, whereas 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 thermistor .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 Multiviabrator 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.	**02** **02**

	c	**Draw the block diagram and explain principle of operation of GSR meter.** **Ans:**  **Fig: GSR meter** Galvanic skin response (GSR) is a method of measuring the electrical resistance of the skin. It is also known by many other names such as electro dermal response psycho galvanic reflex (PGR) of skin conductance response (SCR) All these terms relate to one of more activities inside the sweat glands like a change in resistance and generation of potential. A decrease in the subjects resistance indicate arousal, whereas increase in resistance is indicated Relaxation. GSR measurement is normally performed by measuring a resistance change This is done by detecting the change in impedance between two electrodes on the subject. Silver - silver chloride electrodes can be used to measure GSR. To make measurement technique sensitive primary to resistance change and also to avoid use of DC currents, very low frequency AC technique are used in GSR measurement. A typical arrangement of electrode placement of GSR measurement is shown in fig GSR is due to the activity of the sweat glands .The BSR output is connect to RC network with a time constant of 3 to 5 seconds which enables the measurement of GSR as change of the skin resistance. In some cases, instead of the change of skin resistance the change of the skin used. The range of potential changes is between 50mv and 70mv.	**02** **02**
	d	**How four sounds are produced during one complete cardiac cycle?** **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	**04**

		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	**List any four technical specifications of respiration rate mater.** **Ans:** **Technical specifications of respiration rate mater:** 1. Power: 230V AC, 50Hz, or Battery. 2. Measuring range: 0to 50 Breaths. 3. Transducer: Nose (Thermistor) or chest (strain gage). 4. Display: 7 segment LED or LCD. 5. Respiration indication: Audio beep and LED.	**04**
	f	**Explain recording technique of EMG machine.** **Ans:** **Recording technique of EMG machine:** 1. **Surface EMG:** Surface EMG assesses muscle function by recording muscle activity from the surface above the muscle on the skin. Surface electrodes are able to provide only a limited assessment of the muscle activity. Surface EMG can be recorded by a pair of electrodes or by a more complex array of multiple electrodes. More than one electrode is needed because EMG recordings display the potential difference (voltage difference) between two separate electrodes. 2. **Intramuscular EMG:** Intramuscular EMG can be performed using a variety of different types of recording electrodes. The simplest approach is a Monopolar needle electrode. This can be a fine wire inserted into a muscle with a surface electrode as a reference, or two fine wires inserted into muscle referenced to each other. Most commonly fine wire recordings are for research or kinesiology studies. Diagnostic Monopolar EMG electrodes are typically insulated and stiff enough to penetrate skin, with only the tip exposed using a surface electrode for reference.	**02** **02**
6.		**Attempt any <u>FOUR</u>**	**16**
	a	**Draw and explain right leg drive circuit of ECG machine.** **Ans:**  **Fig: Right leg drive circuit of ECG machine**	**02**

		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**.**	**02**
	b	**Draw the block diagram of puretone audiometer.** **Ans:**  **Fig: Puretone audiometer**	**04**
	c	**Explain systemic and skin temperature.** **Ans:** **Systemic temperature:** It is temperature of internal regions of body. Body maintains systemic temperature as controlled balance between the heat generated by the active tissues and the heat lost by the body to the ambient. This temperature is constant throughout the body. Systemic temperature is accomplished by temperature sensing devices placed in mouth under armpits or in rectum (37 C healthy people).The under arm temperature is one degree lower, whereas the rectal temperature is one degree higher than mouth reading. **Skin temperature:** It is function of surface circulation, environmental temperature & air circulating around the area (range 30 - 35degree C).Thus is a balance between heat received and heat spent. Skin temperature can vary several degrees from one point to another point. The factors that affect the skin temperature are ambient temperature, covering of fat at capillaries of skin and blood circulation pattern at that point. Skin temp. Measurement can be used to find defects in blood circulation system. Measurements can be made by small flat thermistor probes. Infrared thermometer can be used to measure the skin temperature.	**02** **02**
	d	**State any four front panel controls of EMG machine and state their function.** **Ans:** 1. **AC:** Light will be on when the power cord is plugged into AC power. This also indicates that the battery, if installed, is charging. 2. **100 mv calibration knob:** Calibration of EMG machine. 3. **Sensitivity (gain control):** The sensitivity control determines the amplitude of potentials which are usually measured in microvolts per centimeter. The range of sensitivity is from 5 to 10000µV (10 mV). 4. **Filter:** Turns the baseline Wander and Noise filters on or off.	**04**

		5. **Speed knob:** 1, 10, 15, 30, 60 mm/sec. 6. **Low battery:** This light indicates that the EMG must be plugged into recharge the battery. 7. **On/ Standby:** Switches the EMG between On and Standby. Standby means the, EMG is off but it is still keeping the battery charged as long as the EMG is plugged into AC power. 8. **Speakers (Volume control knob):** Speakers are used for audio output.	
	e	**Explain air conduction and bone conduction in hearing mechanism.** **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 losses 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**