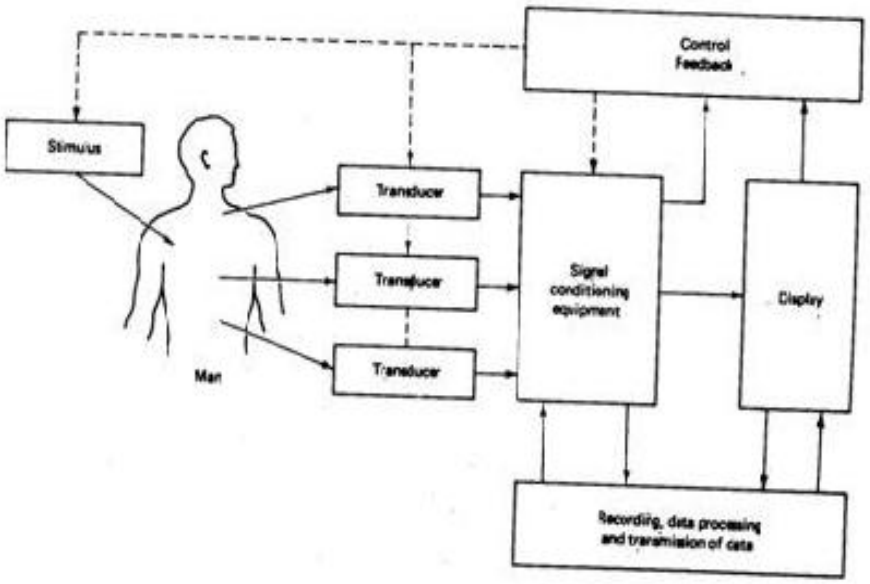
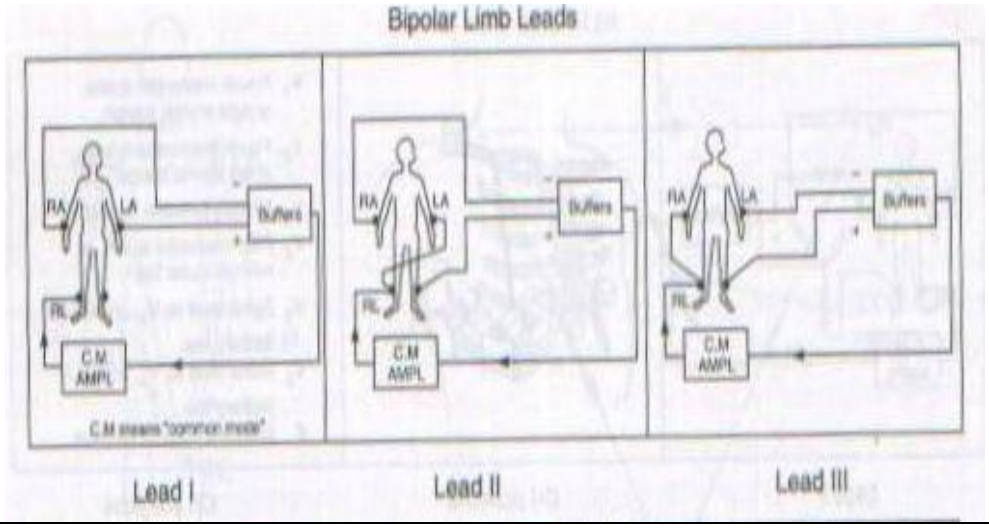
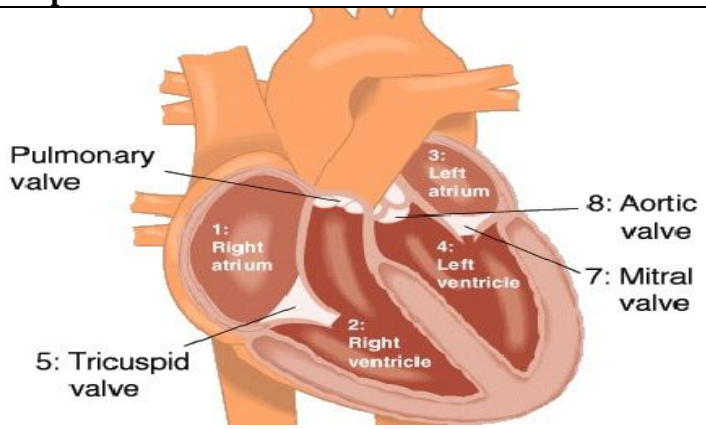
Important Instructions to examiners:

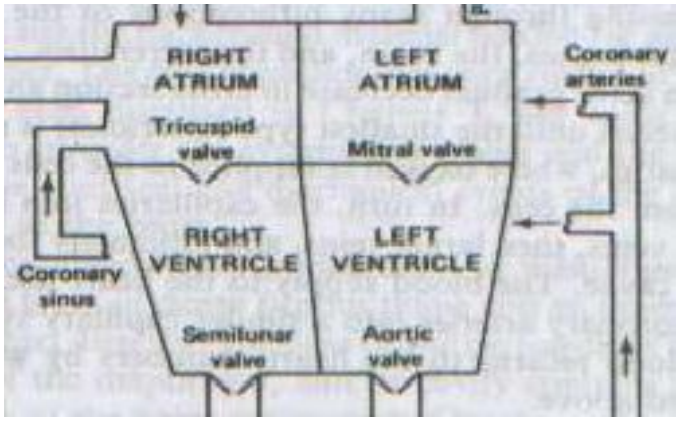
1) The answers should be examined by keywords and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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.

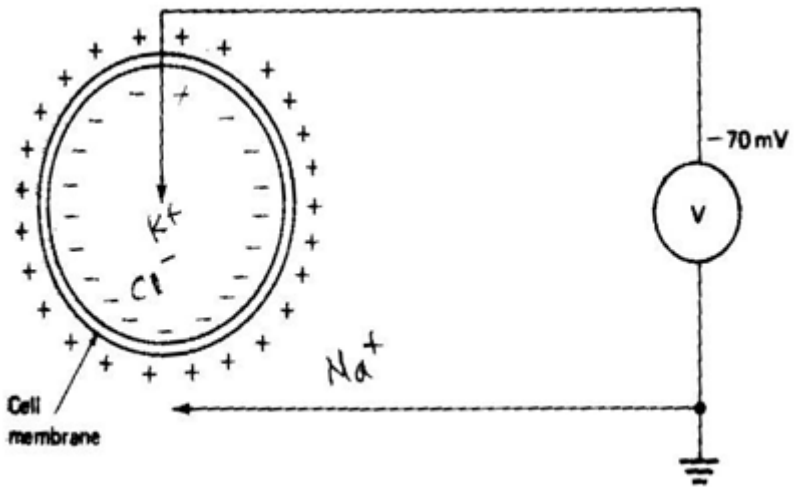
Q. No.	Question & its Answer	Remark	Total Marks
1. A	**Attempt any Three of the following**		12
i)	**Explain with block diagram Man-Instrument system**		04
Answer	**Diagram of Man-Instrument system :** 	**2 Marks** for diagram and labeling	

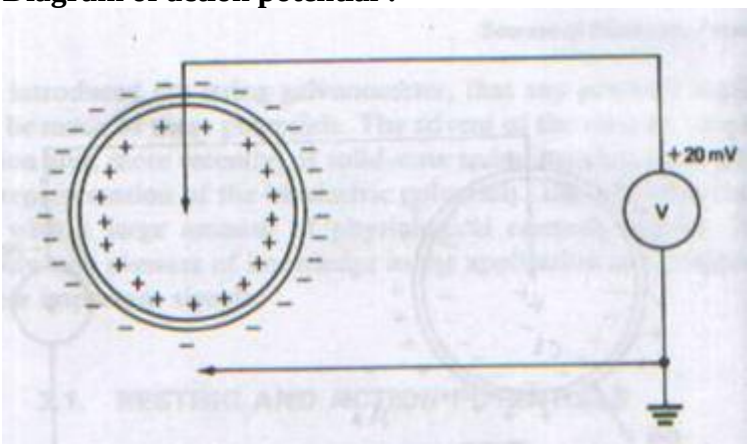
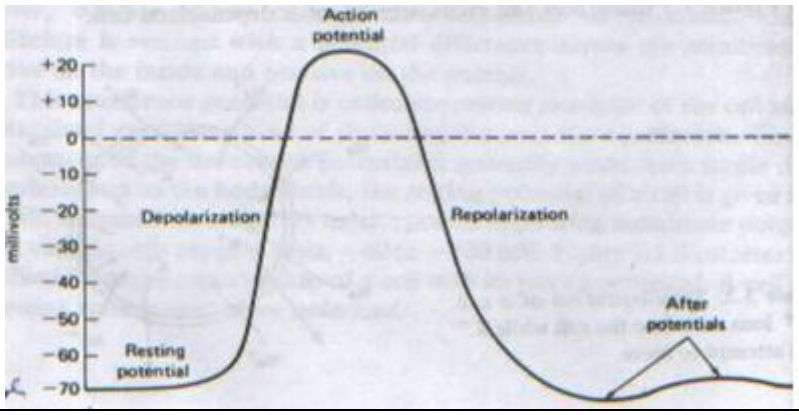
	Operation of Man – Instrument system : The basic components of the man instrument system are: 1. **Subject**: The subject is the human being on whom the measurements are to be made. 2. **Stimulus**: Stimulus generates response. The instrumentation used to generate and present this stimulus to the subject is the vital part of man-instrument system whenever responses are measure. E.g. visual (flash of light), auditory (a tone), etc. 3. **Transducer**: A transducer is device used to produce an electrical signal that is an analog of the phenomenon being measured. 4. **Signal conditioning equipment**: This part of the system amplifies, modifies, or in any other ways changes the electric output of the transducer to satisfy the functions of the system and to prepare signals suitable for operating the display or recording equipment that follows. 5. **Display equipment**: The input to the display device is the modified electric signal from the signal conditioning equipment which is converted into a form that can be perceived by one of the human's senses in a meaningful way. E.g. graphic pen recorder for recoding ECG signal. 6. **Recording, Data processing, and Transmission**: Recording instruments are required to record the desirable information that can be used to transmit or for further processing. E.g. on line digital computer, recording equipment etc. 7. **Control devices**: Where it is necessary or desirable to have automatic control of the stimulus, transducers, or any other part of the man instrument system, a control system is incorporated which uses control devices.	**2 Marks for relevant explanation**	
ii)	**Draw diagram of bipolar lead configuration in ECG recording**		**04**
Answer		**4 Marks for Neat diagram**	

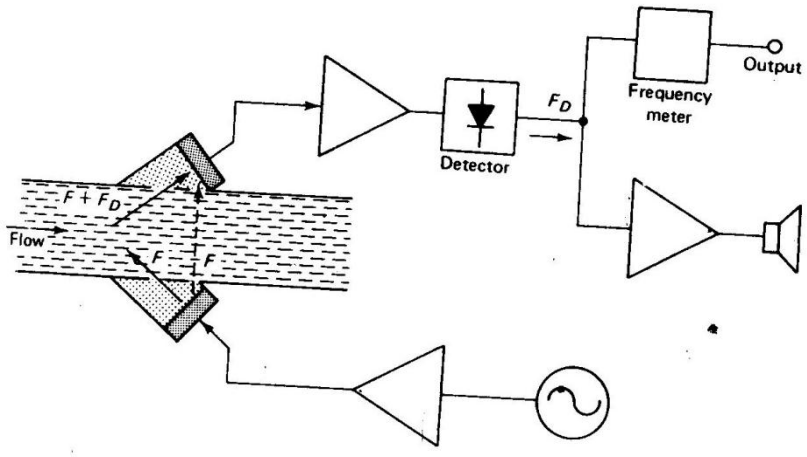
<table>
<tr><td>iii)</td><td>Explain the need of Dialysis machine</td><td></td><td>04</td></tr>
<tr><td>Answer</td><td>Need of Dialysis machine:
There is need When the original kidney of patient is
• Unable to form urine
• Unable to removal of waste products from blood plasma
• Unable for the regulation of the composition of blood plasma
• Unable to regulates volume , osmotic pressure in the blood vessels ,
• Unable to Balance Ph and electrolyte composition of the body fluids</td><td>01Mark each point or Relevant explanation</td><td></td></tr>
<tr><td>iV)</td><td>Compare Micro shock and Macro shock</td><td></td><td>04</td></tr>
<tr><td>Answer</td><td><table><tr><th>Microshock</th><th>Macroshock</th></tr><tr><td>i) When one contact is applied directly to the heart, then effect of current is referred as Microshock</td><td>i) when both the contacts are made on surface of body or skin , the effect of current is referred as Macroshock</td></tr><tr><td>ii) Electrical accidents are caused by interaction of current with tissue of body</td><td>ii) Electrical accidents are caused by interaction of current with surface or skin.</td></tr><tr><td>iii) hazard due to shock is to heart of internal part of body</td><td>iii) hazard due to this shock is to skin or surface of body</td></tr><tr><td>iv) There may be possibility damage to working of heart.</td><td>iv) There may possibility cause of burn of skin.</td></tr><tr><td>v)Dig showing connection of contact to heart</td><td>v) diagram showing both the contacts on surface of body</td></tr></table></td><td>01 mark Each (any 4 compare point)</td><td></td></tr>
<tr><td>1. b</td><td>Attempt any one of the following</td><td></td><td>06</td></tr>
<tr><td>i)</td><td>Draw neat and labeled diagram of heart structure .Explain cardiac output</td><td></td><td>06</td></tr>
<tr><td>Answer</td><td> 

OR</td><td>Neat and labeled diagram of heart has 03 marks</td><td></td></tr>
</table>

	 **Explanation of Cardiac output:** Cardiac output is the volume of blood pumped by the heart per minute (mL blood/min). Cardiac output is a function of heart rate and stroke volume. The heart rate is simply the number of heart beats per minute. The stroke volume is the volume of blood, in milliliters (ml), pumped out of the heart with each beat. Increasing either heart rate or stroke volume increases cardiac output. **Cardiac Output in ml/min = heart rate (beats/min) X stroke volume (ml/beat)** An average person has a resting heart rate of 70 beats/minute and a resting stroke volume of 70 ml/beat. The cardiac output for this person at rest is: **Cardiac Output = 70 (beats/min) X 70 (ml/beat) = 4900 ml/minute.** The total volume of blood in the circulatory system of an average person is about 5 liters (5000 ml). According to our calculations, the entire volume of blood within the circulatory system is pumped by the heart each minute (at rest). During vigorous exercise, the cardiac output can increase up to 5 fold (25 liters/minute).	**(Any other relevant diagram should be considered)** **explanations of cardiac output 03 marks**	
ii)	**Give specifications of X ray machine. List any two applications of X ray machine**		**06**
Answer	**specifications of X ray machine:** 1. X ray tube : Fixed anode, 65 – 85KVP @ 1mA continuous rating Air Cooled 2. Image Intensifier with CCD Miniature Camera12" High Resolution TV Monitor 3. Capacity of 1800 Hour (dependent on oyster and operator) 4. Maximum power consumption is 200VA 5. Standard Model is 220/240/250V AC 50 or 60HZ 6. For dehumidifying One 25W lamp in both upper and lower sections total power consumption 50W	**Each specification 01 mark (any relevant four specification for 4**	

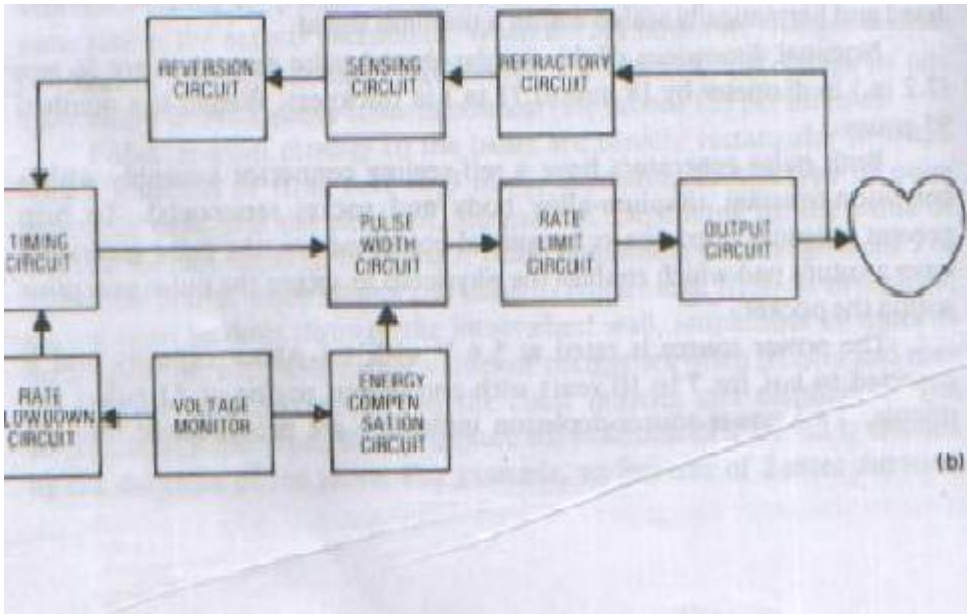
	7. All components in lower section sealed against salt water and deck hose 8. Upper section is completely sealed to salt water 9. Control box is splash proof only **Applications of X ray machine:** 1. To examine broken bones, cavities and swallowed objects, foreign parts in the body like safety pin , coins etc 2. Modified X-ray Machines used to examine softer tissue, such as the lungs, blood vessels or the intestines. 3. Used for medical diagnosis purpose 4. Used for therapy purpose 5. To visualize intestine tract 6. To visualize vascular structure of heart **7.** 3D visualization of organs located one behind another by taking X- ray images from diff locations.	**marks)** **01 mark each (any 2 application)**	
2	**Attempt any two of the following**		**16**
a)	**Explain with figure and graph. Action and resting potential.**		**08**
Answer	**Diagram of resting potential :**  **Explanation of above : (expected in brief)** Cell is surrounded by fluid which contains Na +, Cl - , K+ ions. Because of semi permeability of the cell membrane cl- , k+ is allowed to enter in the cell and Na+ is restricted. So –ve potential is developed inside the cell and positive potential outside the cell. The potential developed in side the cell measured with respect to outside is called as "Resting potential". **OR** Surrounding the cell of the body or body fluid which are ionic and provide	**1 mark for diagram of resting potential** **02 mark for explanation of resting potential**	

	conductive medium for electric potential. Principle ion involved in producing cell potential is Na +, Cl - , K+ ions. The membrane of excitable cell readily permits entry of K+ and Cl- restricts flow of Na+ ions. This result in the concentration of sodium ions more on outside of cell membrane than inside. The unequal charge distribution is result of certain chemical reaction and processes occurring within living cell and potential measured is called a resting potential. The cell in such condition is said to be a polarized cell. **Diagram of action potential :**  **Explanation of action potential :** When cell is excited by any external excitation or stimulus then property of cell membrane changes, which allows entry of Na+ ions. The large number of Na+ ions tries to enter inside the cell than the number of Cl- ions leaving the cell body. So after some time inside the cell body potential is more +ve than outside. This developed potential in the cell is called as "action potential". A decrease in resting membrane potential difference is called Depolarization. **Typical graph or waveform showing resting and action potential:**  	**02 mark for explanation of action potential** **1 mark for diagram Action potential** **02 marks for Graph or waveform**	

b)	**Explain with neat diagram the ultrasonic method for blood flow measurement.**		**08**
Answer	Diagram of Ultrasonic method for blood flow measurement. **Diagram of Ultrasonic Blood Flow Meter based on** Doppler shift **:**  **Working of ultrasonic blood flow meter :** Ultrasonic blood flow meter works on two principle 1. Transit type ultrasonic flow meter 2. Doppler shift type ultrasonic blood flow meter. In an ultrasonic blood flow meter a beam of ultrasonic energy is used to measure the velocity of flowing blood. A pulsed beam is directed through the blood vessel at a shallow angle and its transit time is measured. The transit time is proportional to the velocity of blood flow. An oscillator, operating at a frequency of several megahertz, excites a piezoelectric transducer. This transducer is coupled to the wall of an exposed blood vessel and sends an ultrasonic beam with a frequency F into the flowing blood. A small part of the transmitted energy is scattered back and is received by a second transducer arranged opposite the first one. Because of the scattering, due to moving blood cells the received frequency is either F+Fd or F – Fd depending on direction of flow. The Doppler frequency component (Fd) is proportional to velocity of blood. **Note : any equivalent diagram based on transit time with explanation carries 04 + 04 Marks**	**04 Marks for any relevant diagram** **04 marks for explanation**	
c)	**Explain the internal and external pacemaker**		**08**
Answer	A device capable of artificial pacing impulses and delivering them to the heart is known as a Pacemaker system (Pacemaker) • This pacemaker consists of a pulse generator and appropriate electrodes. • These are available in various forms external **Internal Pacemaker:**		

- Internal pacemaker may be permanently implanted in patients Whose SA Nodes have failed to function properly Or who suffer from permanent heart blocks because of heart attack.
- An internal pacemaker is defined as one which the entire system is inside the body.

Block diagram of internal pacemaker:

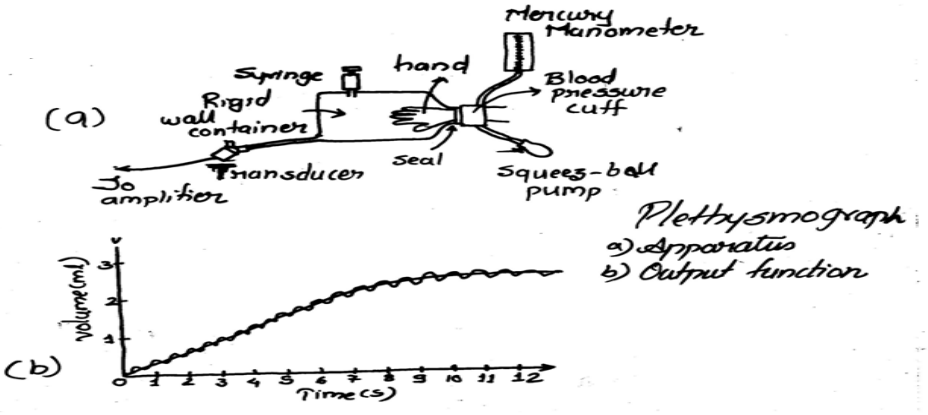


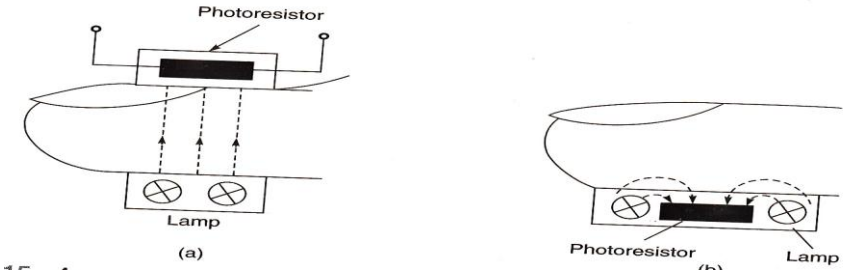
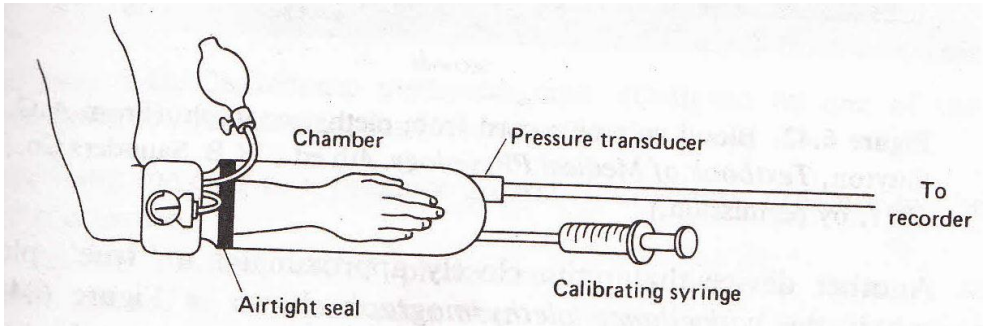
04 Marks for relevant Explanation of internal pacemaker

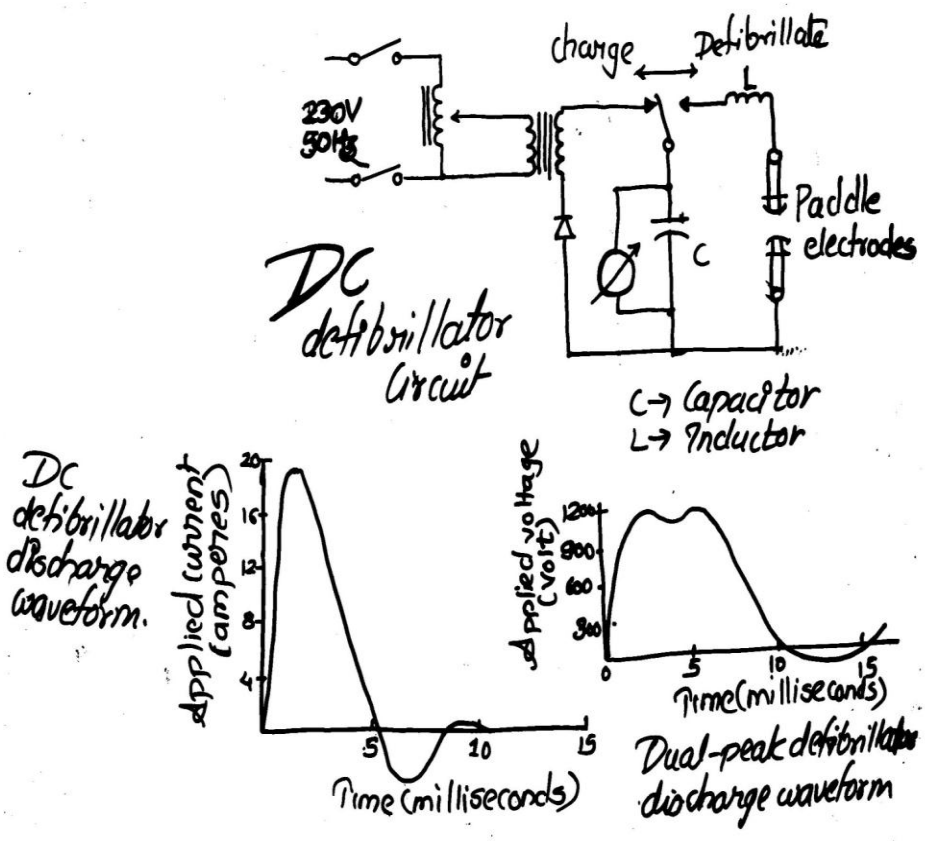
Explanation:

- This block dig of Internal pacemaker showing the timing ckts which is RC n/w.
- **The timing ckt:** which consists of an RC n/w , reference volt source, and comparator determines the basic pace rate of the pulse generator.
- Its o/p signals feeds into a second RC n/w,
- **Pulse width ckt** – which determines the stimulating pulse generator.
- **The rate limiting ckt:** disables the comparator for preset interval and thus the pacing rate to a max of 120 pulses / min for most single component failures.
- **The o/p ckt:** provides a voltage pulse to stimulate the HEART.
- **The volt monitor ckt:** senses cell depletion and signals the rate slow down ckt and energy and energy compensation ckt of this event.
- **The slow down ckt:** shuts off some of the current to the basic timing ckt to cause the rate to slow down. 8 + / - beats per minute when cell depletion has occurred.

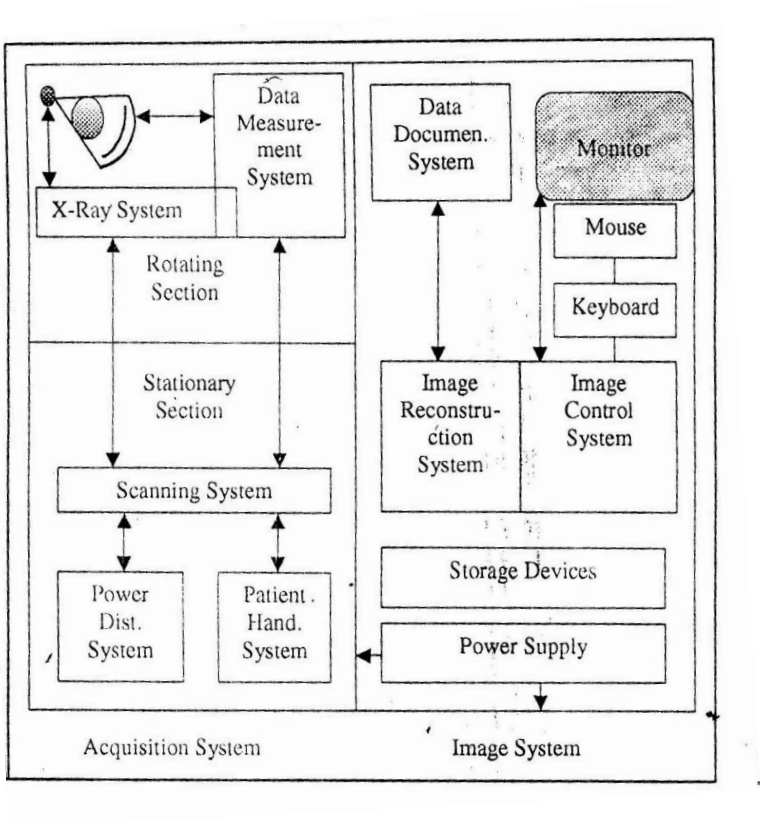
	• **The energy compensation ckt:** causes the pulse duration to increase as the battery voltage decreases to maintain nearly const. stimulation energy to HEART. • **There is f/b loop from o/p ckt to the refractory ckt,** which provides a period of time following an o/p pulse or a sensed R wave during which the amplifier will not respond to out side signals. • **The Sensing ckt**: detects a spontaneous R wave and reset the oscillator timing capacitor. • **The reversion ckt:** allows the amplifier to detect a spontaneous R wave in presence of low level continuous wave interference. **External pacemaker:** • External pacemaker usually consists of an externally worn pulse generator connected to electrode located on or within the myocardium. • External pacemakers are use on patients with temporary heart irregularities, such as those encountered in the coronary patient, including heart attacks. • This contains pulse generators located outside body, connected through wires going into right ventricle via cardiac catheter • Sometimes external pacemaker is strapped to the lower arm of patient who is confined to bed.	**04 Marks for relevant Explanation of external pacemaker**	
3	**Attempt any FOUR of the following**		**16**
a)	**Define :** **i) Tidal Volume (TV)** **ii) Residual Volume (RV)** **iii) Expiratory Reserve Volume (ERV)** **iv) Vital Capacity (VC)**		**04**
Answer	i) **Tidal Volume**- It is the normal depth of breathing. It is the volume of the gas/air inspired during each normal, quiet, respiration cycle. ii) **Residual volume** – It is the volume of gas / air remaining in the lungs at the end of a maximal expiration. iii) **Expiratory Reserve Volume** – It is the extra volume of gas / air that can expired with maximum effort beyond end expiratory level iv) **Vital capacity** – It is the maximum volume of gas that can be expelled from the lungs by forceful effort after a maximal inspiration.	**01 mark for each correct definition**	
b)	**Write different effect of electric shock hazards with their magnitude on human body.**		**04**

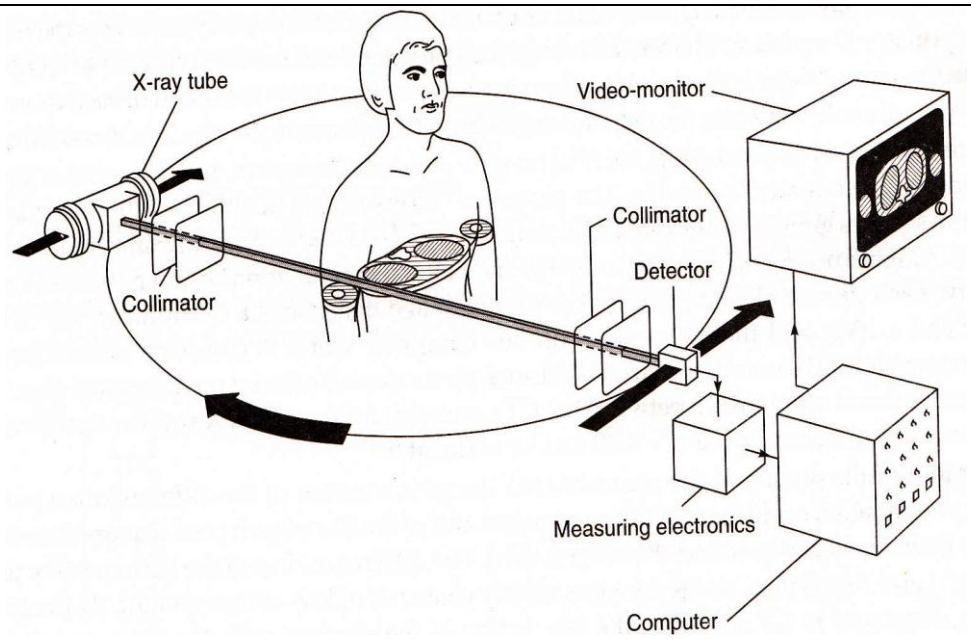
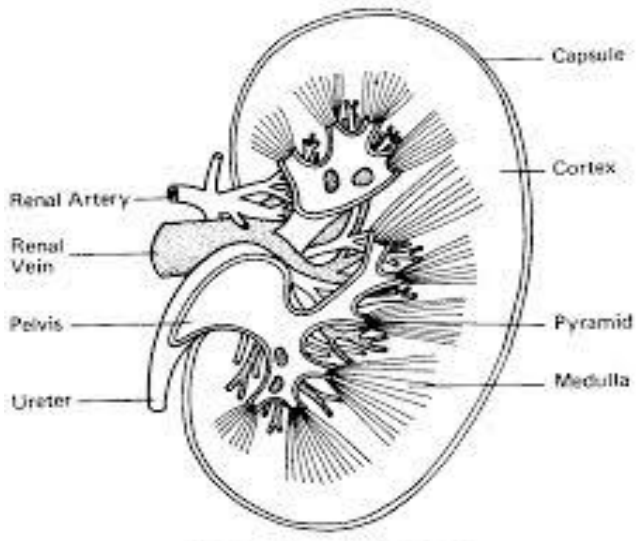
Answer		**Current Intensity** / **Effect on Human body** **Micro Shock (Considered at direct heart level)** 20μA – Safe for normal heart 20-80μA – Ventricular fibrillation threshold **Macro Shock (Considered at body level)** 1 mA – Threshold of perception **Current intensity** / **Effect on human body** 5mA – Accepted as maximum harmless current intensity 10-20mA – "LET GO" current before sustained muscular cotraction 50mA – Possible Pain, fainting, exhaustion, mechanical injury. 100-300 mA – Ventricular fibrillation will start 6A – Sustained myocardial contraction followed by normal heart rhythm. Temporary respiratory paralysis. Burns if current intensity is high.	**01 mark each (any 4 correct effect)**	
c)	**With the help of neat lebelled diagram explain plethysmograph.**			**04**
Answer	The measurement of volume changes in blood in the body is called plethysmography. In this method a rigid cup or chamber is placed over the limb or digit in which the volume changes in the blood are to be measured. The cup is tightly sealed to the limb or digit so that the volume changes are reflected as pressure changes inside the chamber.By inflating the cuff to pressure just above venous pressure, arterial blood can flow past but venous blood cannot. Hence the limb or digit increases its volume with each heart beat.  **OR**	**02 mark for relevant explanation** **2 mark for diagram 'a' only graph is optional**	

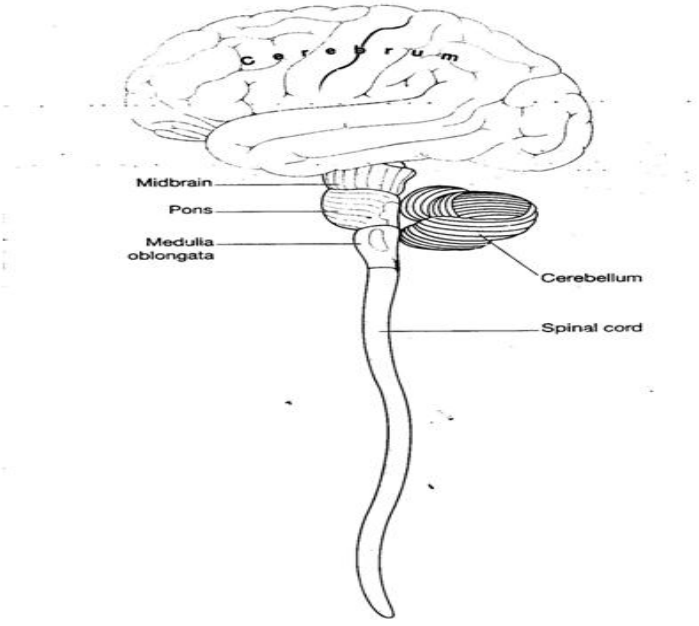
	The pulse pressure and waveform are indicator for blood pressure and flow. Instrument used to detect atrial pulse and pulse pressure waveforms are called plethysmograph. Most plethysmograph techniques respond to changes in volume of blood as a measure of blood pressure. The pulse gives measure of pulse wave velocity and can be recorded and compared with ECG signal. Pulse wave travels depending on size and rigidity of arterial valve. Larger and more rigid arterial valve the greater the velocity. Method used for detection of volume change due to blood flow are 1. Electrical impedance change 2. Stain gauge or microphone (mechanical) 3. Optical change (Change in density) **Diagram of Optical Change method**  Transmission Method Reflection Method **Note : Diagram of above anyone method with brief description carries 2 Mark** OR **Diagram the measurement of blood flow using plethysmograph :**  **Explanation :** The plethysmograph is illustrated in above figure. This is used to measure the amount of blood flowing into the limb being measured.	**2 marks for explanation** **02 marks for diagram** **02 marks for diagram** **02 marks**	

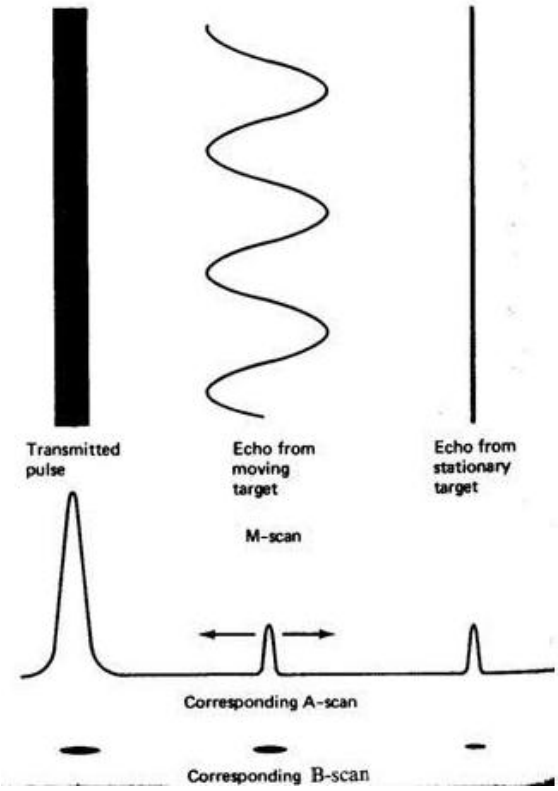
	By inflating the cuff (placed slightly upstream from the seal) to a pressure just above venous pressure, arterial blood can flow pass the cuff but venous blood cannot leave. The result is that the limb or digit increases its volume with each heart beat by the volume of blood entering during that beat. This increased in volume sensed by pressure transducer. The output of pressure transducer is given to recorder. This recorder displays the volume changes due to blood flow.	**for explanation**	
d)	**What is fibrillation? Explain D.C. defibrillator with circuit and graph.**		**04**
Answer	Fibrillation: A condition in which necessary synchronism of the muscles or chambers of heart is lost is known as fibrillation. In DC defibrillator a capacitor is charged to a high DC voltage and then rapidly discharged through the paddle electrodes across the chest of the patient. An inductor in the defibrillator is used to shape the wave in order to avoid sharp current spike. Depending on the energy setting the amount of electrical energy discharged by the capacitor may of the range 100W and 400 W per second.  	**01 mark** **1 mark for brief explanation** **01 mark for diagram** **01 mark for any one graph**	

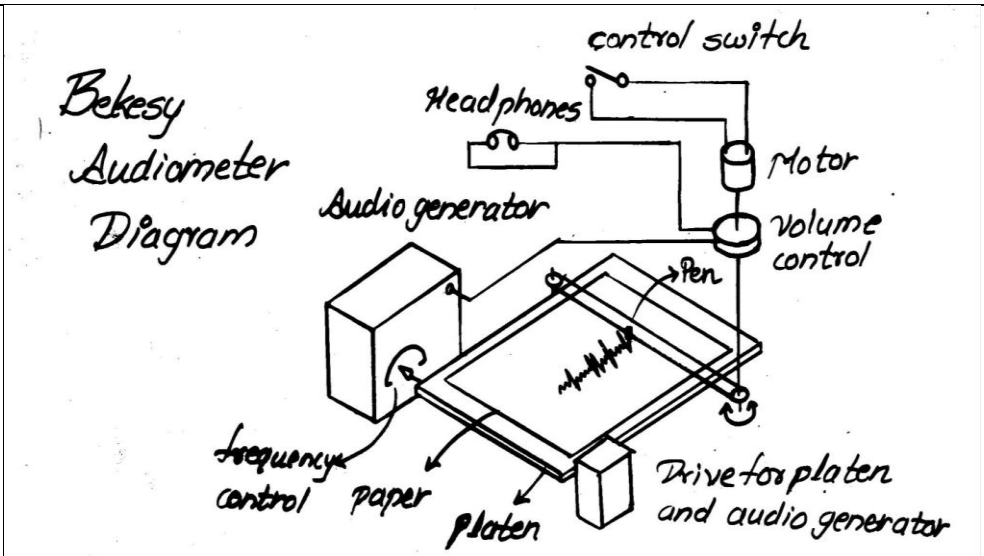
e)	**Write any two applications of** **i) X-ray machine** **ii) Ultrasonography**		**04**
Answer	X ray Machine: 1. Used in medicine to detect fractures in bones or presence of foreign body. 2. Used in diagnosis of tuberculosis, ulcers, cancer etc. 3. In industry they are used to test metal castings and moulds and also to detect cracks in them. 4. They are used to test the genuineness of the diamonds and pearls. 5. They are used to study the crystal structure. **Ultrasonography:** 1. Locating abnormal structures in body. 2. Studies of abdominal structure such as liver, pancreas and kidneys. 3. Localization of tumors. 4. Distinction between cystic masses and solid structures.	**01 mark each (any 2 application)** **01 mark each (any 2 application)**	
4.a	**Attempt any THREE of the following**		**12**
i)	**With the help of block diagram explain the working of CAT.**		**04**
Answer	The CT scanner consists of gantry, patient table, X-ray tube, detector assembly, computer and monitor. X ray tube and detector assembly mounted opposite each other in a rigid gantry rotates once around the patient. The x ray tube emits the x rays at short intervals so that during a full rotation a number of sets of absorption values are collected by detectors. Computer process this data and produces images of the measured values. The image system controls the function of CT scan such as reconstruction, display and evaluation of the CT image. The image control system is connected to monitor, keyboard, mouse and various storage devices such as disks, tape etc. The image reconstruction system receives measure data and performs the image reconstruction on it. These images are processed and displayed. The data documentation system is connected to the image reconstruction system and is used to photograph the reconstructed CT image. Acquisition system acquires the data. The data measurement system belongs to the rotating part of the gantry and contains all the elements to measure the attenuated radiation and to transfer this to image system for	**02 mark for explanation in brief.**	

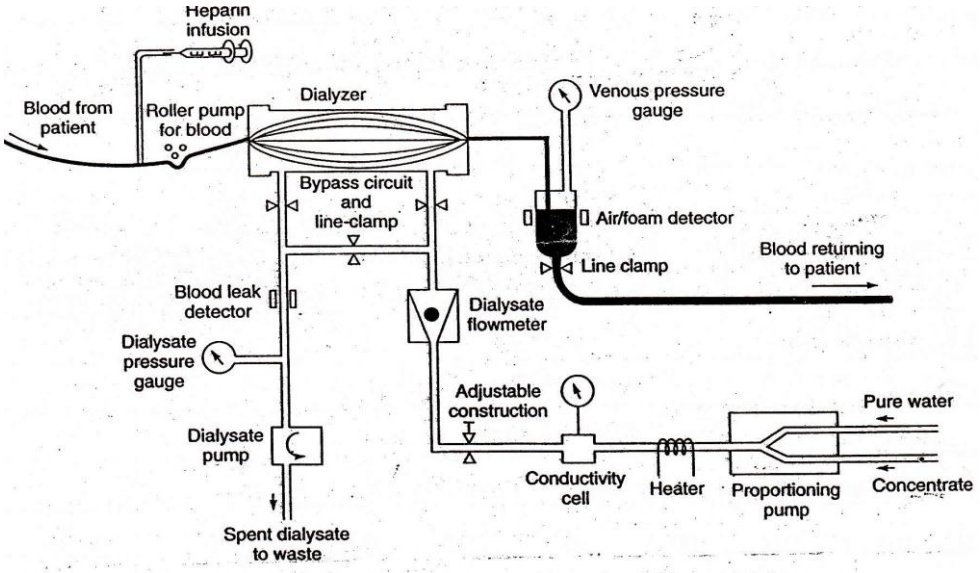
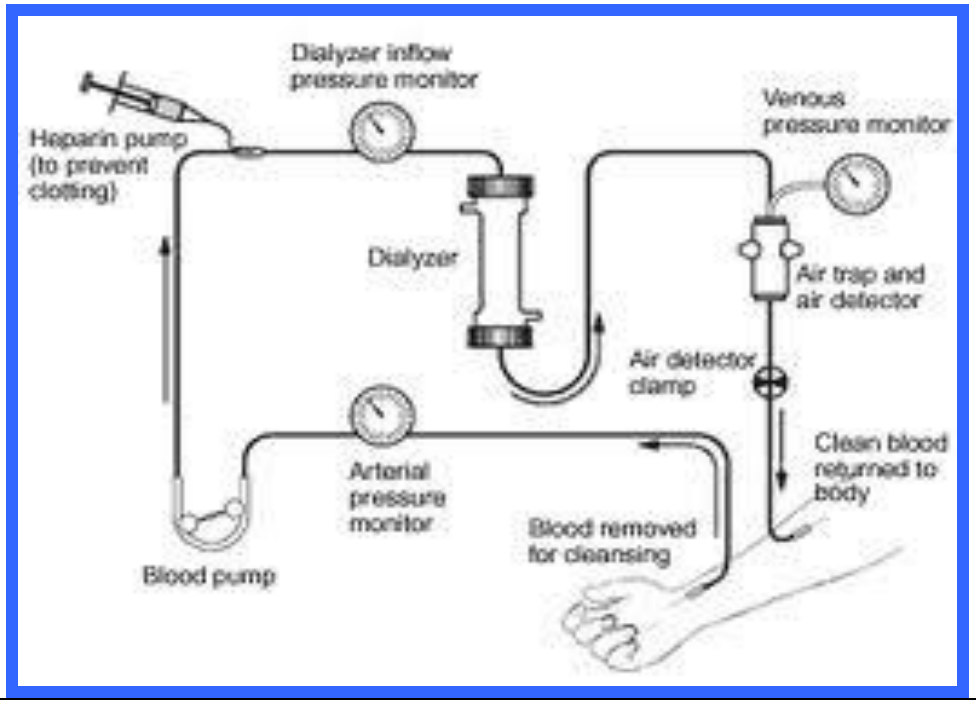
	reconstruction and display of CT image. X ray system also belongs to the rotating part of gantry. The scanning system contains the function of gantry rotation, gantry tilt, to exchange data with X ray system and data measurement. The patient handling system consists of patient table, motor for vertical and horizontal drive and system controller. The power distribution system provides power supply to all the various systems shown in figure.  **OR**	**02 mark for diagram**	

			
ii)	**Draw the structure of kidney and list its functions**		**04**
Answer	**Functions of Kidneys** 1. Removing wastes and water from the blood 2. Balancing chemicals in our body 3. Releasing hormones 4. Helping to control blood pressure 5. Helping to produce red blood cells **6.** Producing vitamin D, which keeps the bones strong and healthy 	**02 mark for any 2 function** **02 mark for structure**	
iii)	**Describe with figure Central Nervous System (CNS).**		**04**

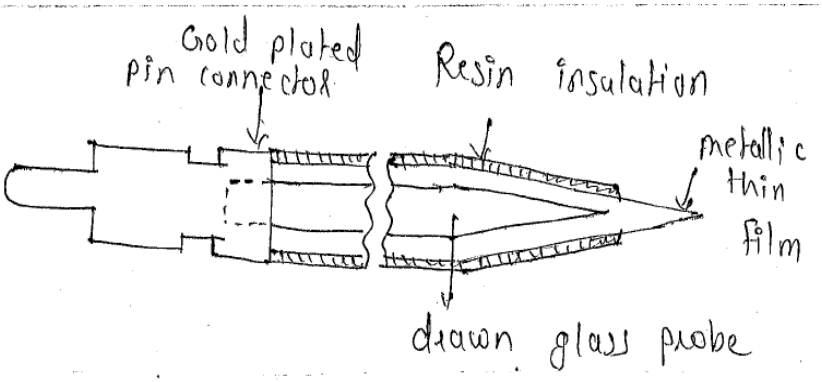
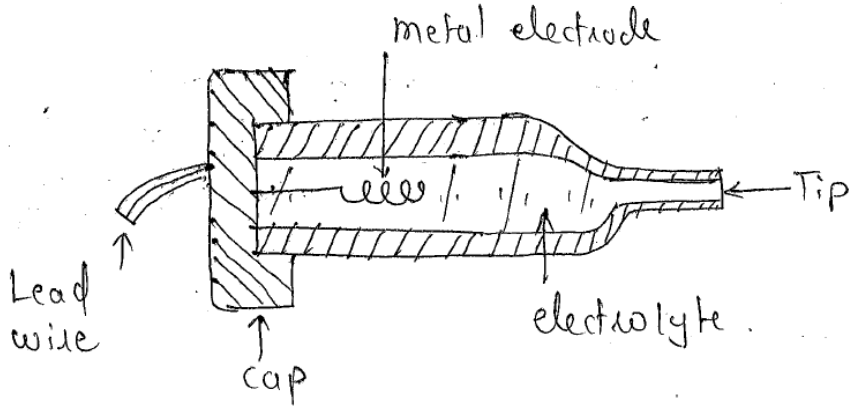
Answer	Together the brain and spinal cord form the central nervous system. The brain consists of : • Cerebrum • Midbrain • Pons • Medulla oblongata • Cerebellum Cerebrum: It is largest part of the brain and its functions are: It is associated with intelligence, reasoning, sensory perception, initiation and control of skeletal muscle. Midbrain: The midbrain is the area of brain situated between cerebrum and pons. It helps in connecting the cerebrum with lower parts of the brain and spinal cord. Pons: It consists of nerve fibres which forms a bridge between two hemispheres of cerebellum. It plays role in facial expression, relay for auditory system. Medulla Oblongata: It has following vital centers; cardiac center, respiratory center, vasomotor center, reflex center of vomiting, coughing, seezing and swallowing. Cerebellum: It is concerned with coordination of voluntary muscular movement, posture and balance and equilibrium of body. Spinal Cord: It is the link between the brain and rest of the body.  The parts of the central nervous system.	**02 mark for relevant explanation** **02 mark for diagram**	

iv)	**Describe :** **1) M-scan mode in ultrasonography.**		**04**
Answer	**M scan:** M scan is very useful in monitoring moving structure inside the body. M scan is basically a combination of A scan and B scan. In this system intensity or brightness of the beam is modulated using received echoes and displayed on horizontal axis with the help of horizontal timing information, that is horizontal sweep.  	**02 mark for explanation** **02 mark for diagram**	
4.b	**Attempt any ONE of the following**		**06**
i)	**With the help of neat diagram explain "Audiometer"**		**06**
Answer	Acuity of the hearing can be measured by audiometer. The subject first presses a control button, thus starting a reversible motor, which drives the volume control potentiometer and increases the amplitude of the stimulus signal until it is perceived by the subject. The subject then releases the button, opening the switch and the motor reverses. By alternate opening and closing the switch the subject maintains the volume at a level at which the tone can be heard.	**04 mark for relevant explanation**	

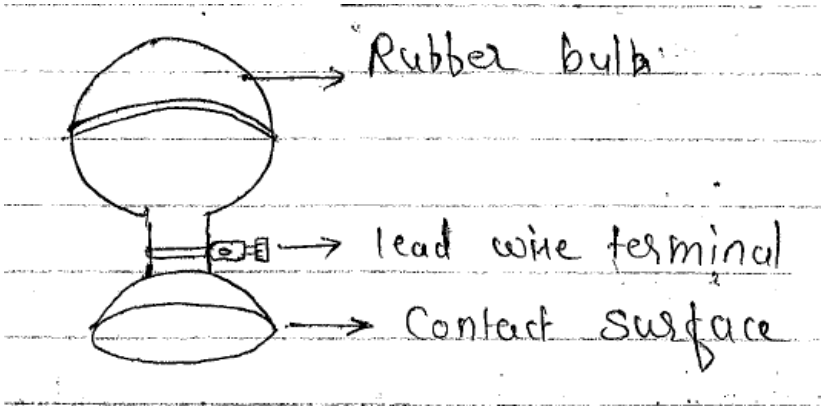
	 A pen connected to the volume control mechanism draws a line on the graph along with slowly changing the frequency of the tone.	**02 mark for diagram with labelling**	
ii)	**Explain with block diagram dialysis machine.**		**06**
Answer	In dialysis machine the blood from the patient through the roller pumps enters the dialyzer unit. The blood flow in the dialyzer unit flows from the bottom to top on one side of the semi-permeable membrane, while the dialysate which has negligible amount of urea flows from top to bottom. A blood leak detector monitors the dialysate for traces of blood in it. Heparin pump is usually in form of syringe. The dialysate is the mixture of concentrate and water and is passed through proportioning pump. The dialysate temperature is controlled at body temperature. Conductivity of the dialysate is monitored to verify the accuracy of proportioning pump. A flowmeter measures the flow of dialysate. Effluents pump help to pass the dialysate to the drain. Once through the dialyzer the blood free from urea is returned back to the body through the bubble trap which diminishes the chances of bubbles in	**03 mark for relevant explanation**	

	blood.  **OR**  	**03 mark for any diagram out of 02**	
5	**Attempt any TWO of the following**		**16**
a)	**Describe problems encountered in living system.**		**08**
Answer	**1. Inaccessibility of variables to measurement:** One of the greatest problems in attempting measurement from a living system is the difficulty in gaining access to the variable being measured.		

	For Eg. In the measurement of dynamic neuro chemical activity in the brain, it is impossible to place a suitable transducer in a position to make the measurement; an attempt is often made to perform an indirect measurement. 2. **Visibility of the data** : Measurement taken under a fixed set of conditions at one time will not necessarily be the same as similar measurements made under the same conditions at another time. The visibility from one subject to another is even greater. **3. Lacks of knowledge about Interrelationships :** Physiological measurements with large tolerances are often accepted by the physician because of a lack of knowledge. **4. Interaction among physiological systems :** Because of the large number of the feedback loops involved in the measure physiological systems, a several degree of interaction exists both within a given system and among the measure systems. **5. Effect of the transducer on the measurement :** In many situations the physical presence of the transducer changes the reading significantly. Often the presence of a transducer in one system can affect responses in other systems. The physiological effect of the measurement can also affect the results. **6. Artifacts :** A major source of artifacts in the measuring of living system is the movement of the subject, which in turn results in movement of the measuring device and thus it produces variations in the output signal. **7. Energy limitations:** Many physiological measurement techniques require that a certain amount of energy be applied to the living system in order to obtain a measurement. In dealing with living cells, care must continually be taken to avoid the possibility of energy concentrations that might damage cells or affect the measurements. **8. Subject considerations :** Extra care must be taken in the design of any measurement system to protect the patient.The measurement should not cause undue pain, trauma, unless it becomes necessary to endure these conditions in order to save the patient's life.	**02 marks each for any 4 problems**	

b)	Explain different types of electrodes with figure.		08
Answer	1. **Metal microelectrode :**  Metal microelectrodes are formed by electrolytically etching the tip of a fine tungsten or stainless steel wire to the desired size. Then the wire is coated almost to the tip with an insulating material some electrolytic processing can be performed on the tip to lower the impedance. The metal ion interface takes place when the metal tip contacts the electrolytes either inside or outside the cell. 2. **Micropipet Microelectrode** :  The micropipet type of microelectrode in a glass micropipet with the tip drawn out to the desired size. The micropipet is filled with an electrolyte compatible with the cellular fluids. This type of microelectrodes has a dual interface. One interface consists of a metal wire in contact with the electrolyte solution inside the micropipet, while other is the interface between the electrolyte inside the pipet and the fluids inside or immediately outside the cell.	**04 marks for each type (any 2)** **(02 marks for relevant diagram and 02 mark for relevant explanation)**	

3. Suction Cup Electrode :



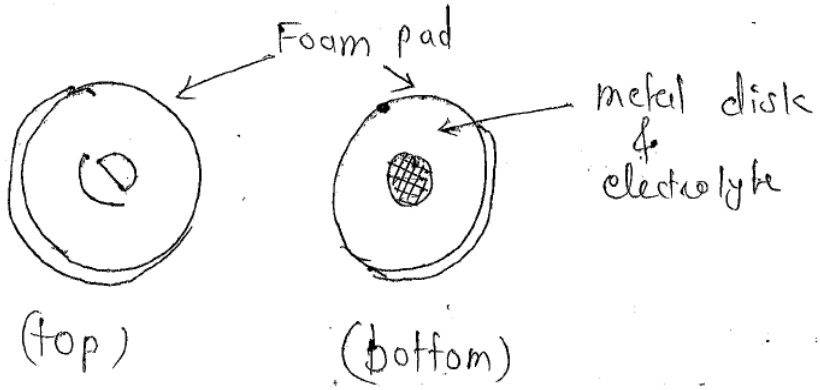
A modification of the metal plate electrodes which requires no adhesives for holding it in place is the suction electrode.

This electrode is used in ECG as the pericardial (chest) lead, since it can be placed at a particular location for recording and then quickly moved to the next location.

It consists of a hollow metallic cylinder electrode that makes contact with the skin at its base. A lead wire terminal is attached to the metal cylinder and a rubber suction bulb fits over its other base. Electrolyte paste is placed over the contacting surface of the electrode, the bulb is squeezed and the electrode is then placed on the chest wall. The bulb is released and applies suction against the skin holding the electrode assembly in place.

Although, the electrode is quite large, the actual covering area is relatively small. Thus it tends to have higher source impedance than the relatively large surface area (Eg. metal plate electrodes). So suction electrodes produce more distortion of the ECG signal when used with low input impedance amplifiers.

4. Disposable electrodes :



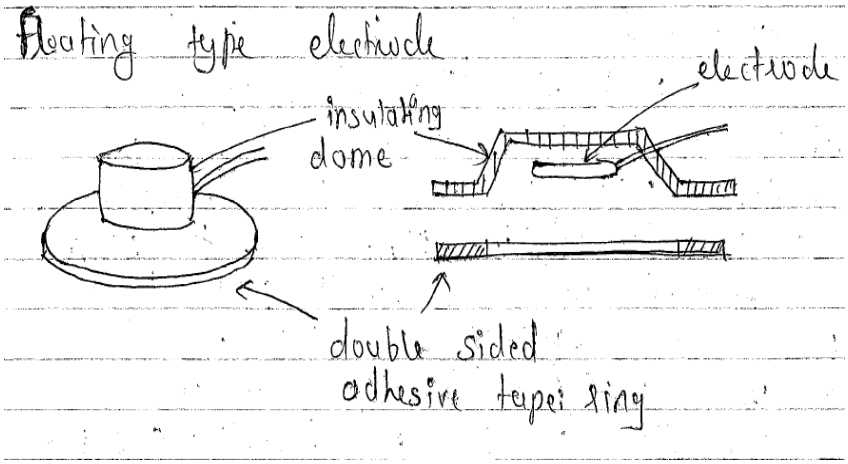
Disposable electrodes with adhesive already in place are now being used.

It consists of a disk of plastic form material with a silver plated disk on one side attached to a silver plated snap, similar to that used on clothing, in the centre of the other side.

A layer of electrolyte paste covers the disk and electrode side of the foam material is covered with an adhesive material that is compatible with the skin.

To apply the electrode, the electrode packet is opened, the release paper is removed and the electrode placed on the selected skin on the body. Once used the electrodes are to be disposed off.

5. Floating type electrode :



When the patient is moving, exercising or performing physical tasks, floating electrodes or liquid junction electrodes are used.

The actual metal disk is reused in cavity

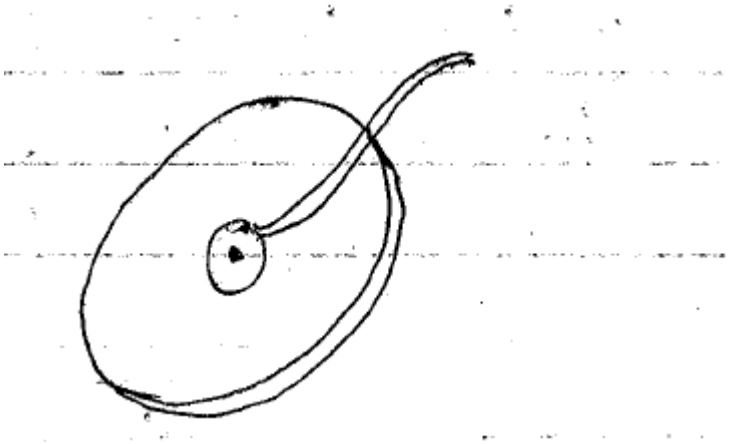
So that it does not make direct contact with the skin.

The electrical contact is established through the electrolyte paste filled in the cavity.

Electrode is made up of silver and often coated with silver chloride (Agcl)

The assembly is fixed on the skin with double sided adhesive tape ring. With this arrangement the cavity does not move w. r. to the metal disk and thus does not produce any mechanical movement.

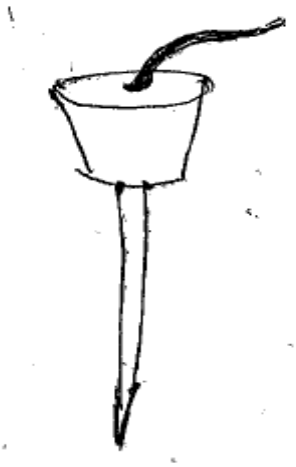
6. Metal disc electrode :



This electrode can be made of different metals (silver ,platinum, stainless steel)

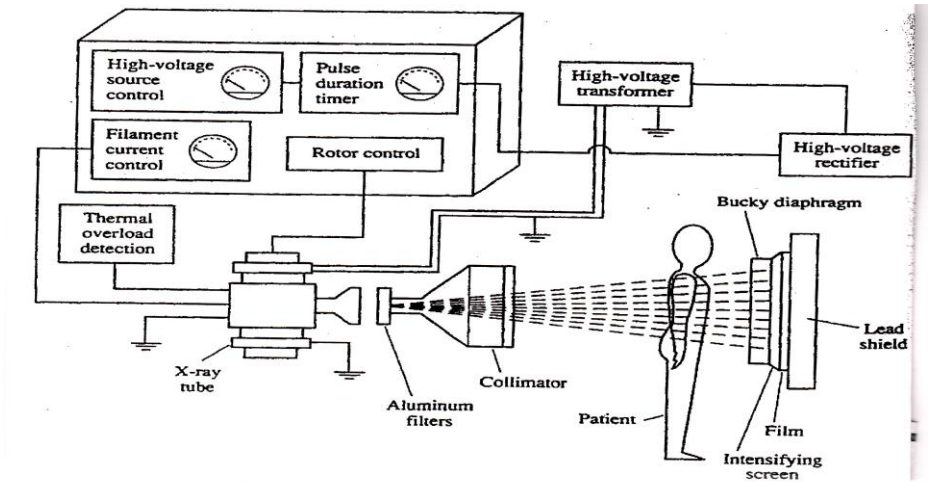
Lead wire is soldered or welded to the back surface and protected by a layer of insulating material. This electrode is mainly used as a chest electrode for recording ECG for long term recordings. It is maintained in place over the skin site, applied with electrolyte paste by a strip of surgical tape. This is also used to measure of EMG or EEG but generally smaller in diameter (about 8mm) than those used in recording ECG.

7. Needle electrode :



To reduce interface impedance and consequently, movement artifacts, small sub dermal needles are inserted into the skin.

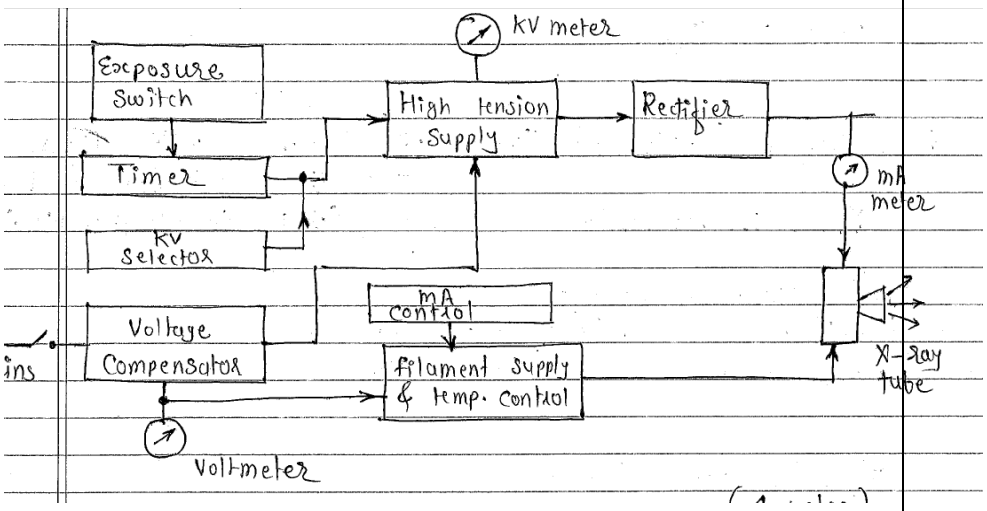
The basic needle electrode consists of a solid needle, usually made

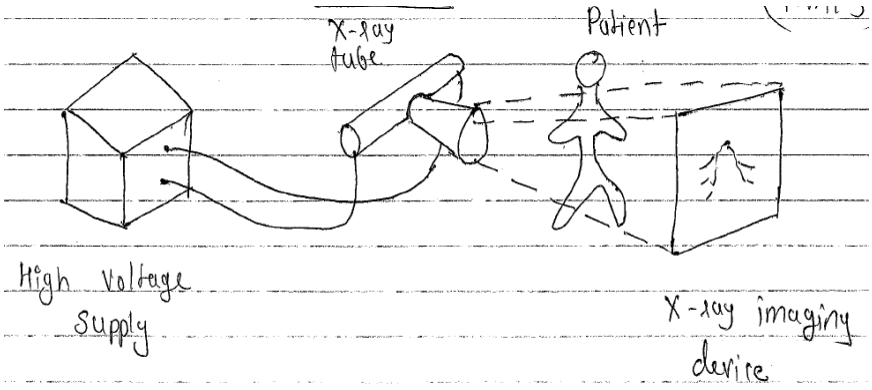
	up of stainless steel, with sharp point. The repairing part of the needle electrode is insulated with a coating such as insulating varnish, with only the tip left exposed. A lead wire is attached to the other end of the needle and the joint is encapsulated in a plastic hub to protect it. Needle electrodes that can create an interface beneath the surface of the skin seem to be less susceptible to movement artifacts then surface electrode. By making direct contact with the sub dermal tissue on intercellular fluids, these electrodes also seem to have lower impedances.		
c)	**Explain with block diagram principle and working of x-ray machine.**		**08**
Answer	Figure shows a block diagram of basic x-ray machine  Basically there are two parts of the circuit. 1. First part is for producing high voltage, which is applied to the tubes anode and cathode and comprises a high voltage setup transformer followed by rectification. The current through the tube follows the HT pathway and is measured by an mA meter. A KV switch facilitates change in voltage between exposures. The voltage is measured with the help of KV meter. The exposure switch controls the timer and thus the duration of the application of KV. To compensate for mains supply voltage (230v) variations, a voltage compensator is included in the circuit. 2. The second part of the circuit concerns the control of heating x-ray tube filament. The filament is heated with 6-12V of AC supply at a	**04 marks for any diagram and 04 marks for relevant explanation**	

current of 3-5 amperes. The filament temperature determines the tube current or mA and therefore, the filament temperature control has an attached mA section. The filament current is controlled by using, in the primary side of the filament transformer, a variable choke or a rheostat. The rheostat provides a stepwise control of mA and is most commonly used in modern machine.

A preferred method of providing high voltage DC to anode of the x-ray tube is by use a bridge rectifier using focal value of solid state rectifier.

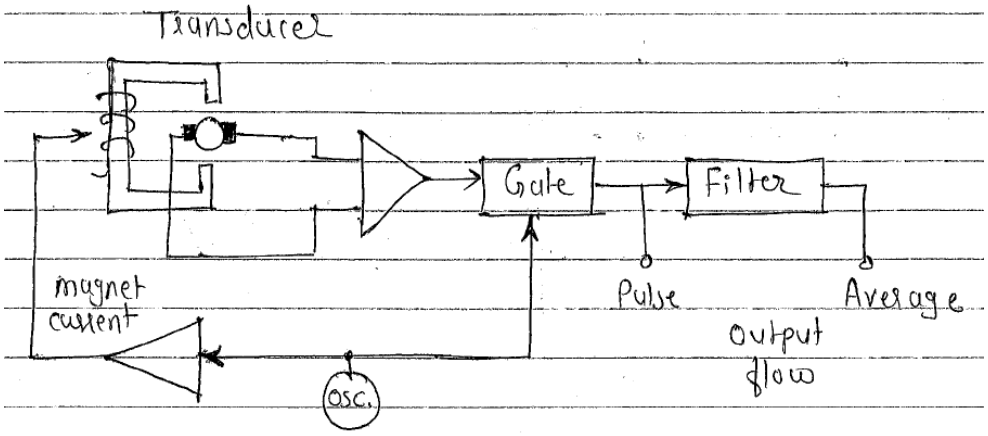
OR

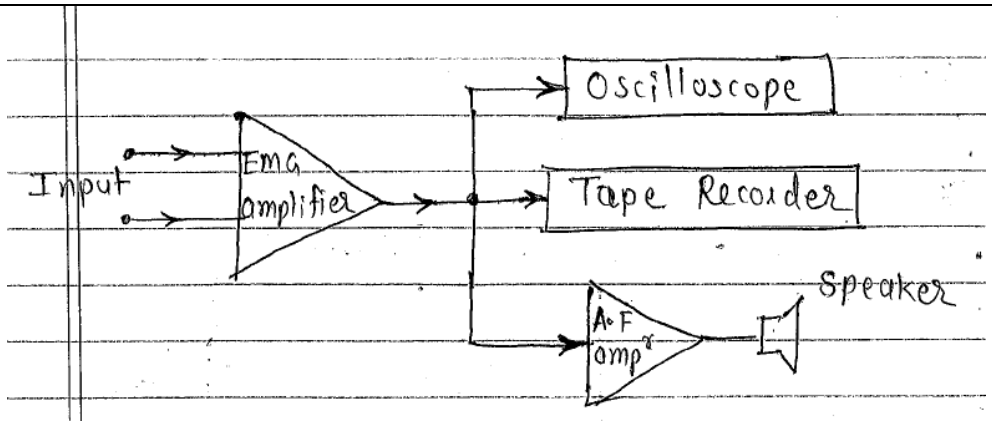




- The x-rays are diagnostic tool and is based on the fact that various components of the body have different densities for the rays.
- When x-rays from a point source penetrate a body section, the internal structure of the body absorbs varying amount of the radiation.

	• The radiation that leaves the body therefore has a spatial intensity variation that is image of the internal structure of the body. • When, as shown in the figure, this intensity distribution is visualized by a suitable device, a shadow image is generated that corresponds to the x-ray density of the organs in the body section. • Bones and foreign bodies' especially metallic ones and air filled cavities shown up well on these images because they have much higher or a much lower density than the surrounding tissues. • Most body organs however differ very little in density and do not show up on the x-ray image unless one of the special techniques is used.		
6	**Attempt any FOUR of the following**		**16**
a)	**Define following terms :** **i) EOG** **ii) ERG** **iii) EGG**		**04**
Answer	i) **EOG** : Electro-oculogram A record of the variation in the corneal-retinal potential as affected by the position and movement of the eye. ii) **ERG** : Electro retino gram A record of the complex pattern of bioelectric potentials obtained from the retina of the eye. This is usually a response to a visual stimulus. iii) **EGG** : Electrogastrogram The EMG pattern/record associated with the peristaltic movements of the gastrointestinal tract.	**01 mark for all full forms** **And** **01 mark for each definition**	
b)	**Write meaning of leakage current, state only two methods to reduce electric shock hazards.**		**04**
Answer	Leakage current : It is an inherent flow of non-functional current from the live electrical parts of an instrument to the accessible metal parts. Leakage current usually flows through the third wire connection to the ground. Methods to reduce electric shock hazards : 1. In the vicinity of the patient, appliances with three wire power cords should be used. 2. Provide isolated input circuits on monitoring equipment.	**02 marks for meaning**	

	3. Have periodic checks of ground wire continuity of all equipment. 4. Connectors for probes and leads should be standardized so that current intended for powering transducers are not given to the leads applied to pick up physiologic electric impulses. 5. Ground fault circuit interrupters should be used to disconnect the source. 6. Reducing leakage current inside the chasis of instruments by using layout. 7. The solid state electronic diagnostic equipment to be so selected that they work on low voltage. 8. A separate (double) secondary layer of insulation between the chasis and the outer case is provided to protect personnel from ground fault. 9. Double insulation reduces leakage current and also protects against both macroshock and microshock.	**01 mark each (any 2 points)**	
c)	**Explain principle, operation of electromagnetic type blood flow measurement with diagram.**		**04**
Answer	 Magnetic blood flowmeters are based on the principle of magnetic induction. When an electrical conductor is moved through a magnetic field, a voltage is induced in the conductor which is proportional to the velocity of its motion. A permanent magnet or electromagnet positioned around the blood vessel generates a magnetic field perpendicular to the direction of the blood flow. A voltage induced in the moving blood column is measured with stationary electrodes located on opposite sides of the blood vessel and perpendicular to	**02 mark for diagram** **02 mark for explanation**	

	the direction of the magnetic field. As shown in the block diagram, The oscillator, drives the magnet and provides the control signal for the gate (Frequency 60 to 400 Hz) The use of gated detector makes the polarity of the output signal reverse when the flow direction reverses. The frequency response of the system is high enough to allow the recording of the flow pulses, while the mean or average flow can be derived by use of a low pass filter.		
d)	**Explain with block diagram EMG (Recorder) machine.**		**04**
Answer	 Electromyograph is an instrument used for recording the electrical activity of the muscles to determine whether the muscle is contracting or not. EMG is usually recorded by using surface electrodes or more often by using needle electrodes which are inserted directly into the muscle. A ground electrode is necessary for providing a common reference for measurement. These electrodes pick up the potential produced by the contracting muscles fibres. EMG is usually recorded by using surface electrodes or more often by using needle electrodes which are inserted directly into the muscles. A ground electrode is necessary for providing a common reference for measurement. These electrodes pick up the potentials produced by the contracting muscle fibres. The signal can then be amplified and displayed on the screen of the cathode ray tube. It is also applied to an audio amplifier connected to a loudspeaker.	**02 marks for diagram** **02 marks for explanation**	

	The oscilloscope displays EMG waveforms. The tape recorder is included in the system to facilitate playback and study of the EMG sound waveforms at a later convenient time. A trained EMG interpreter can diagnose various muscular disorders as per the sounds produced.		
e)	**Give functions of following :** **i) Medulla oblongata.** **ii) Temporal lobe** **iii) Occipital lobe** **iv) Thalamus**		**04**
Answer	**i) Medulla oblongata :** It is the lowest section of the brainstem and contains centres for regulating work performed by the heart and it control blood distribution and respiratory centres which controls the ventilation of the lungs. **ii) Temporal lobe :** On the upper side of the temporal lobe, the acoustic pathways terminate making it as hearing centre. The temporal lobes are also of importance for the storage process in the long term memory. **iii) Occipital lobe :** Visual pathways terminate in the posterior part of the occipital lobe. The rest of the occipital lobes store visual memory, by means of which we interpret what we see. **iv) Thalamus :** The thalamus manipulates nearly all sensory information on its way to the cerebrum. It contains main relay points for the visual, auditory and somatic sensory system.	**01 mark for each correct function**	