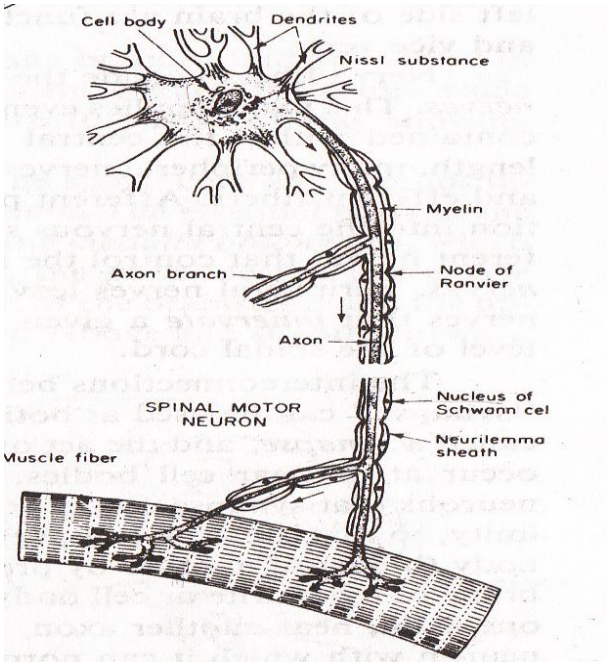
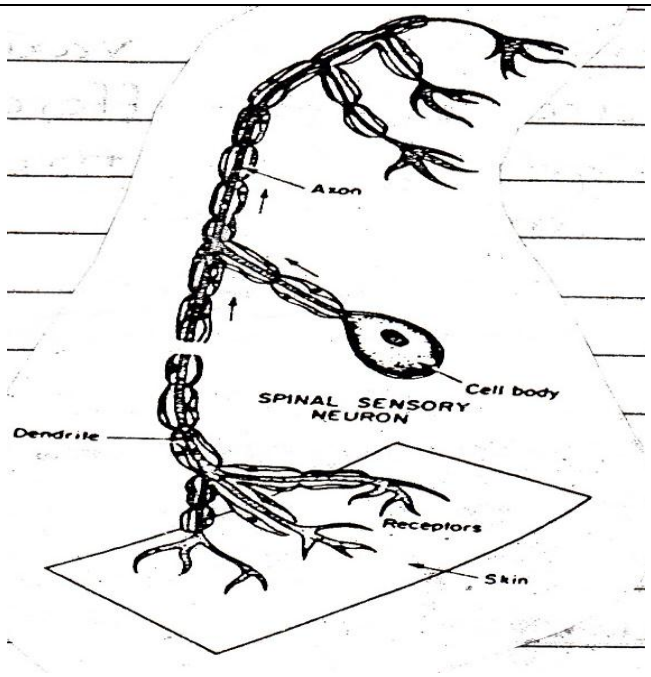
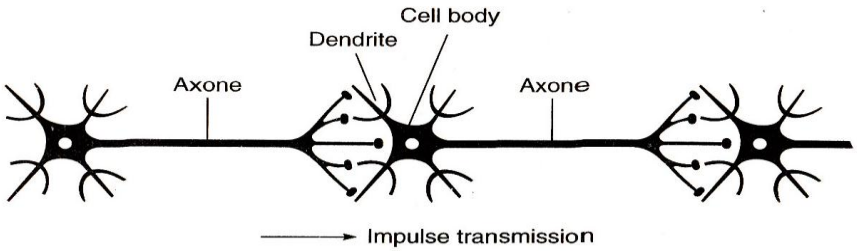
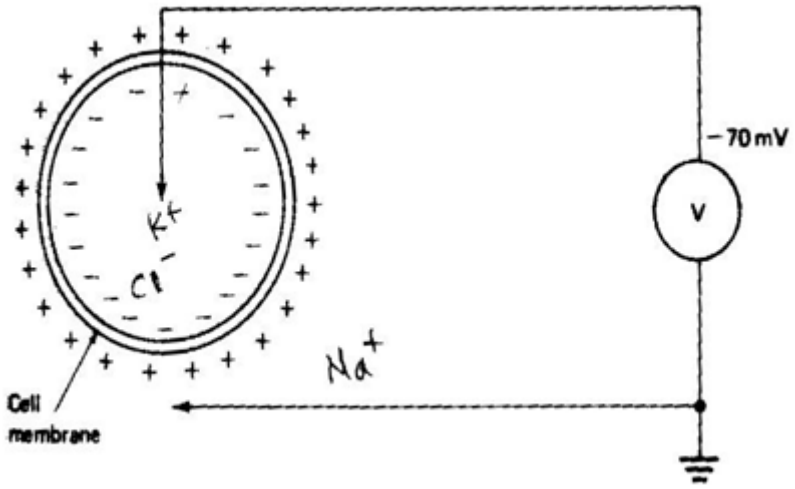
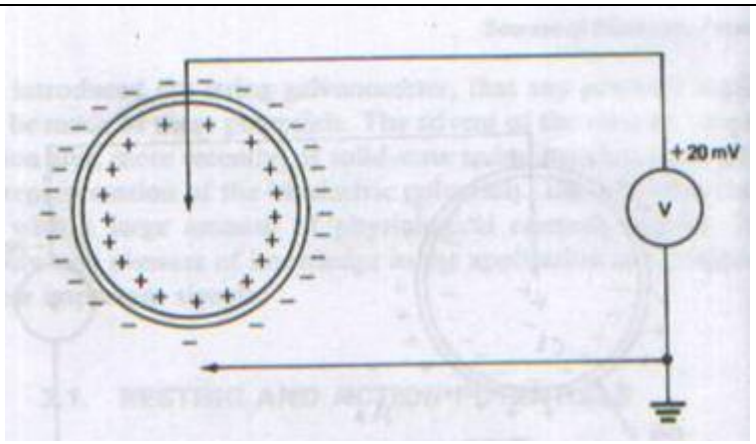
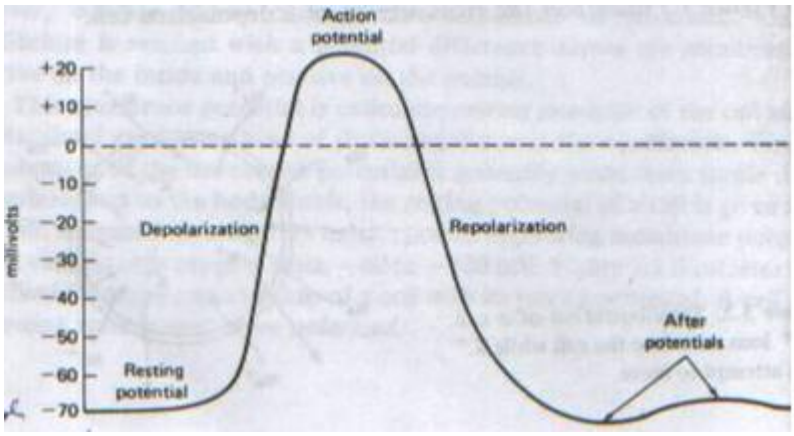
Important Instructions to examiners:

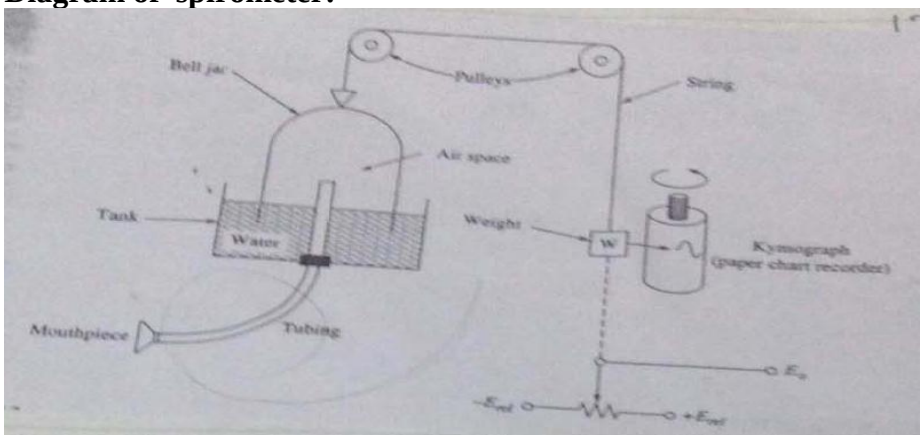
1) The answers should be examined by keywords and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling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

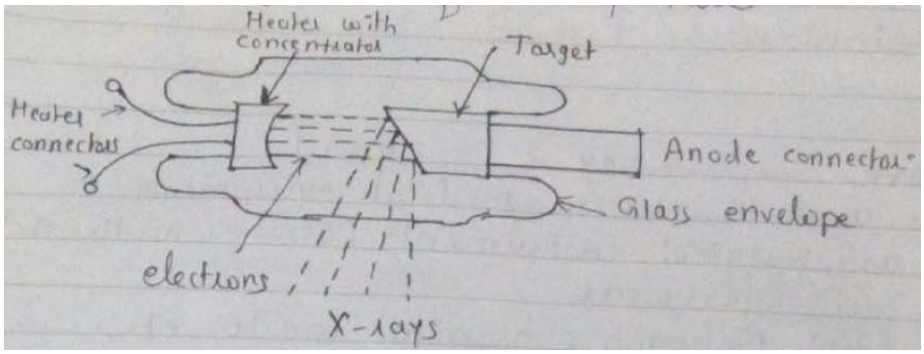
Q. No.	Question & its Answer	Remark	Total Marks
Q1	**Attempt any five of the following**		20
a)	**Draw structure of neuron. Explain its functioning**		04
Ans.	**Diagram of structure of Neuron**:  **Or**	**Any one typeof diagram 02 marks**	

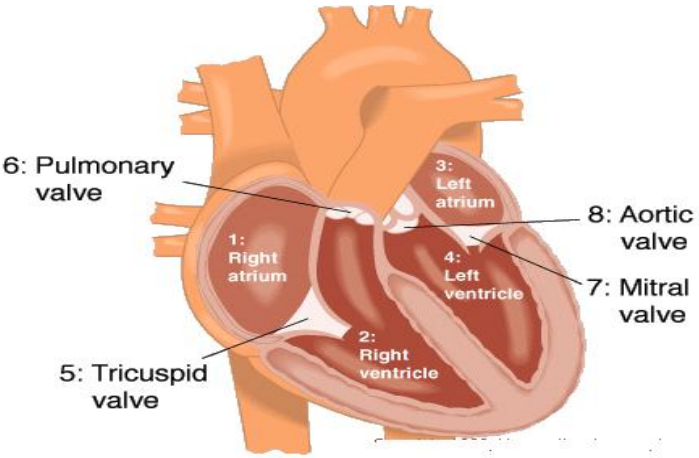
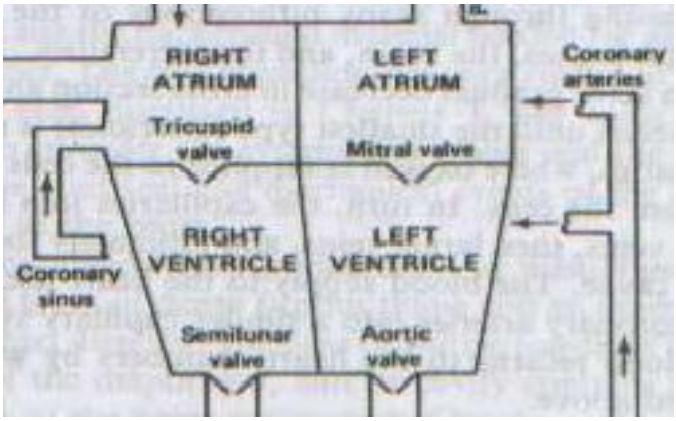
	 **Or**  **Explanation:** The Neuron is the basic unit of the Nervous system. A Neuron is a single cell with a cell body. Axon hillock is the point at which action potentials are usually generated. Nodes of ranvier help speed the transmission of information along the nerves Afferent nerves carry sensory information from the various parts of the body to the brain and efferent nerves carry signals from the brain to operate various muscles.	**02 marks for relevant explanation**	
b)	**Describe action and resting potential of cell with neat diagram and Waveform**.		**04**
Ans	**Resting potential:** Surrounding the cell of the body or body fluids. These fluids of conductive solutions containing charged atoms known as ions. The principle ions are sodium (Na+), potassium (K+) and chloride(Cl -).		

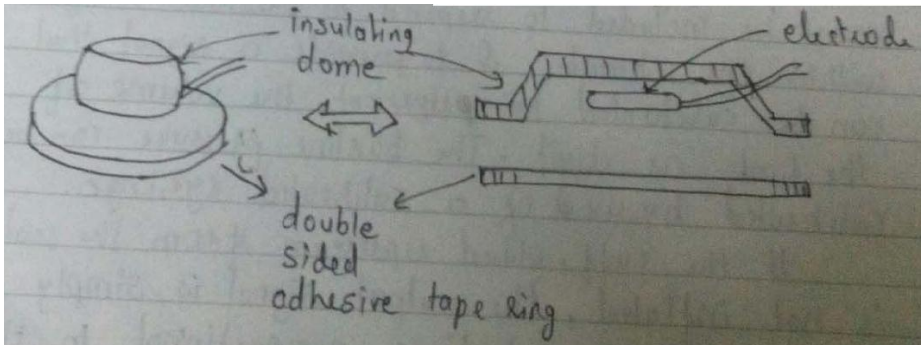
	The membrane of excitable cell readily permit entry of K+ and Cl- restricts flow of NaCl. The inability of sodium to penetrate the membrane results in two conditions. First, the concentration of sodium ion inside the cell much lower than in the intercellular fluid outside. Since the sodium ions are positive, these would tend to make the outside of the cell more positive than the inside. Second, in an attempt to balance the electric charge, additional potassium ions, which are also positive, enters the cell, causing a higher concentration of K+ ions on the inside than on the outside. These charge balance can not be achieved, however because of the concentration imbalance of K ions. Equilibrium is reached with the potential difference across the membrane, negative on the inside and positive on the outside. This membrane potential is called the resting potential of the cell and is maintained until some kind of disturbance upset the equilibrium. **Diagram of resting potential:**  **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. **Diagram of action potential :**	**1 ½ mark for resting potential Brief explanation with diag.** **1 ½ mark for action potential Brief explanation with diag.**	

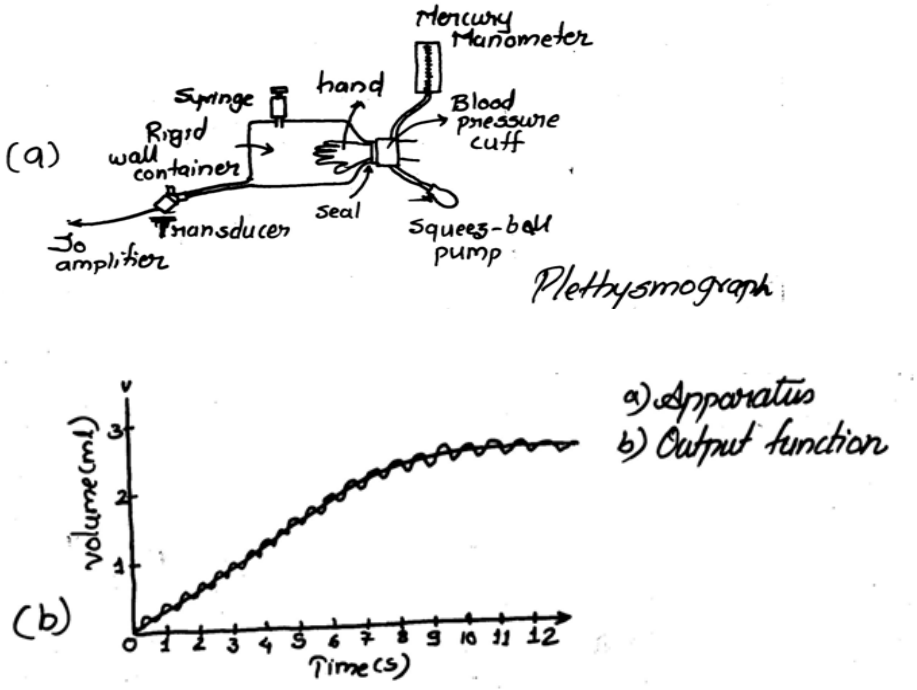
	 **Typical waveform** 	**01 mark for waveform**	
c)	**How lung volumes and capacities can be determine with the help of spirometer.**		**04**
Ans	Figure shows the diagram for Spirometer. Spirometer is a device which is used to determine all lung volumes and capacities. The standard Spirometer consists of a movable bell inverted over a chamber of water. Inside the bell is the gas that is to be breathed. The bell is counterbalanced by a weight to maintain the gas inside the atmospheric pressure so that its height above the water is proportional to the amount of gas in the bell. A breathing tube connects the mouth of the patient to the Spirometer. Thus as the patient breathe gas from the tube there are changes in internal volume of Spirometer which causes proportional displacement	**02 mark for brief explanation**	

	of bell downwards. Similarly, as the patient breaths back into the tube, the bell moves up proportional to the change in internal volume. The motion is recorded on a rotating drum i.e. kymogram through a pen that is attached to a counter balancing mechanism. 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 changes on the piece of graph paper by attaching a pen to the counter weight or a tension string. Some spirometer also offers an electrical output that is the electrical analog of the respiration waveform. Most frequently the electrical output is generated by connecting the pen and weight assembly to a linear potential if precise and negative potentials are connected to the end of the potentiometer, then the electrical signal will present the same data as the pen when no one is breathing in to the mouthpiece, E0 will be zero, but when the patient is breathing in to the tube, E0 will take the value proportional to the volume and a polarity that indicates in inspiration or expiration. Thus all lung volumes and capacities can be determined by measuring the amount of gas inspired or expired under a given set of condition or during a specified time interval can obtained by the use of spirometer. **Diagram of spirometer:** 	**02 mark for Diagram**	
d)	**State any two functions and four specifications of dialysis machine.**		**04**
Ans	**Functions:** 1. It mixes the dialysate 2. Maintains the dialysate 3. Pumps the blood and controls administration of anti coagulants. 4. Maintains the blood for presence of air and drip chamber pressure. 5. Monitors the ultra-filtration rates. **Specification:**	**Any 2 functions for 2 marks**	

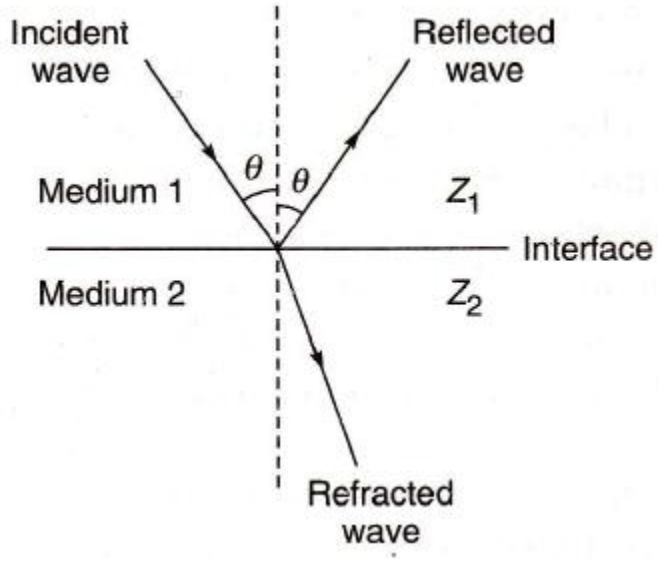
	1. Input power plug- 120V input 2. Time delay fuse on ckt breaker 3. 120L dialysate holding tank 4. Temperature 25^0C to 50^0C (37^0C is body temp) 5. Over temperature shutoff and alarm 6. Positive and negative pressure monitor micro switch.	**Any 4 speci for 2 marks**	
e)	**Explain principle of x-rays with a neat diagram of x-ray tube.**		**04**
Ans.	**Diagram of x-ray tube:**  **Principle:** X-rays are generated when fast moving electrons are suddenly decelerated by impinging on the target. An x-ray tube is basically a high vacuum diode with a heated cathode located opposite to target anode. This diode is operated in a saturated mode with a fairly low cathode temperature so that the current through the tube does not depend on the applied anode voltage. The intensity of x-rays depends on the current through the tube. This current can be varied by varying the heater current, which in turn controls the cathode temperature. The wavelength of x-rays depends on the target material and the velocity of electrons hitting the target. It can be varied by varying the target voltage of the tube. X-ray equipment for diagnostic purposes uses target voltage in the range of 30 to 100 KV. While the current in the range of several hundred milliamperes.	**02 mark for diagram** **02 mark for Principle**	
f)	**List any two applications each for** **i. Autoclave** **ii. deionizer**		**04**
Ans	**i. Autoclave** It is used to sterilize medical equipment such as 1. Surgical instruments (scissors, needles etc) 2. Glass ware 3. Pathogenic hospital waste etc 4. Used in food industry 5. Used in dentistry **ii. Deionizer**	**Any 2 Applicati on for 2 marks each**	

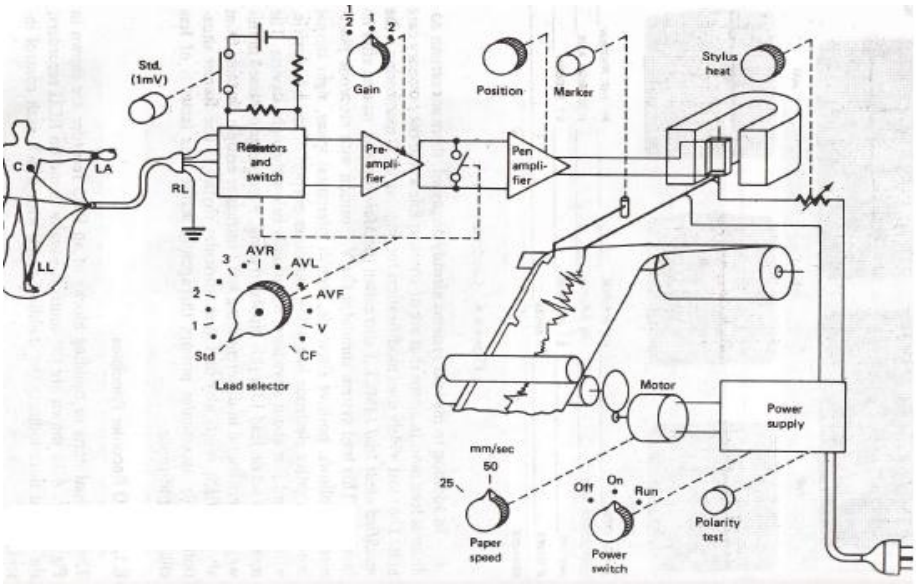
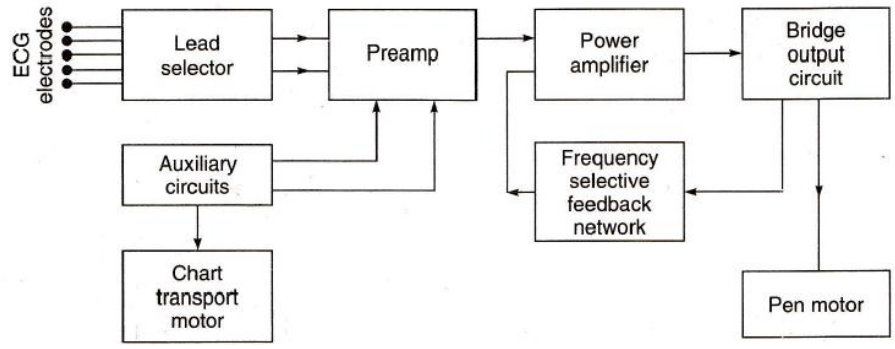
	1. Medical 2. Laboratory 3. Pharmaceutical 4. Cosmetics 5. Electronic manufacturing 6. Food processing		
g)	**Draw a neat labelled internal structure of human heart.**		**04**
Ans	**Structure of human heart** :  **OR**  	**2 marks diagram and 2 marks for labeling**	
Q2	**Attempt any four of the following**		**16**
a)	**List various types of heart sound. How they are generated?**		**04**
Ans	The principle cause of heart sound seems to be vibrations set up in the blood inside the heart by the sudden closure of the heart valves. • **First heart sound**: it is also called as “lub” sound is caused due to the closure of the atrioventricular valves, which permits flow of blood from the atria in to the ventricles but prevent flow in reverse direction. • **Second heart sound**: it is also called “dub” sound is caused	**4 marks for any 4 type**	

	due to the closing of semi lunar valves. • **Third heart sound**: occurs from 0.1 to 0.2 seconds after the second heart sound is due to rush of blood from the atria into the ventricles, which causes turbulence and some vibration of ventricle walls • **Atrial heart sound**: It is not audible but may be visible on a graphic recording, occurs when the atria actually do contract, squeezing the remainder of the blood into the ventricles. • **Murmurs**: In abnormal heart additional sound called murmurs, are heard with a normal heart sound. They are generally caused either by improper opening of valves when the valves do not closed completely and allow some backward flow of blood. In either case the sound is due to high velocity blood flow through the small opening.		
b)	**Explain a floating type skin surface electrode with a neat diagram.**		**04**
Ans	When a patient is moving, exercising or performing physical tasks, floating electrodes are used. The principle of this electrode is to partially eliminate movement artifacts by avoiding any direct any direct contact of the metal with the skin. The only conductive path between metal and skin is the electrolyte paste or jelly, which forms an electrolyte bridge. Even with the electrode surface held at the right angle with skin surface, performance is not impaired as long as the electrolyte bridge maintains contact with both the skin and metal. Floating electrodes are generally attached to the skin by means of two sided adhesive rings, which adhere to both plastic surface of the electrode and the skin. Electrode is made up of silver and often coated with silver chloride (AgCl). **Diagram of floating electrode:**  	**02 marks for relevant explanation** **02 marks for diagram**	
c)	**With a neat labeled schematic, Explain working of**		**04**

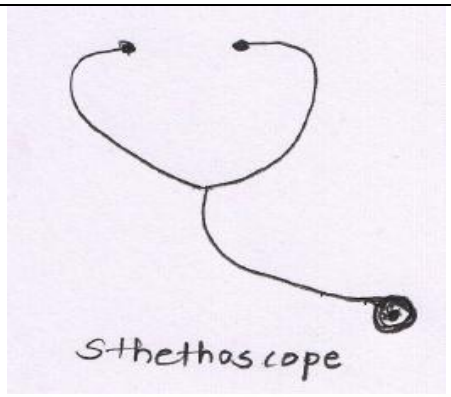
	plethysmograph.		
Ans	**Diagram of plethysmograph:**  **Plethysmograph**: instruments measuring volume changes or providing outputs that can be related to them are called Plethysmograph. This instrument consists of a rigid cup or chamber placed over the limb or digit in which the volume changes are to be measured, as shown in above figure. The cup is tightly sealed to the chamber whose volume is to be measured so that any changes of volume in the limb or digit reflect as pressure changes inside the chamber either fluid or air can be used to fill the chamber. Some form of displacement or pressure transducer must be included to respond to pressure change within the chamber and to provide a signal that can be calibrated to represent the volume of the limb or digit. The baseline pressure can be calibrated by use of a calibrated syringe. If the cuff, places upstream from the seal, is not inflated, the output signal is simply a sequence of pulsations proportional to the individual volume changes with each heart beat. It can also be used to measure the total amount of blood flowing in the limb or digit being measured. By infloating the cuff to a pressure just above venous pressure, arterial blood can flow past the cuff, but venous blood can not leave. The result is that the limb or digit increase with volume with each heart beat by the volume of the blood entering during that beat. The slope of the line along peaks of these pulsations	**02 marks for diagram** **02 marks for brief explanation**	

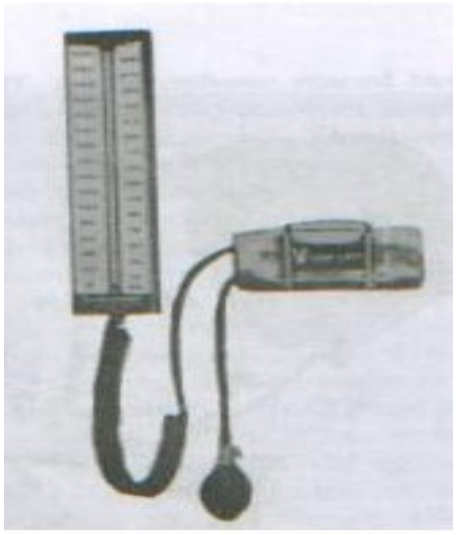
	represents the overall rate at which blood enters the limb or digit.		
d)	**What is fibrillation? List types of defibrillators**		**04**
Ans	**Fibrillation:** the heart is able to perform its important pumping function only through precisely synchronized action of the heart muscle fibers. The rapid spread of action potentials over the surface of the atria causes these two chambers of the heart to contract together and pump blood through the two atrioventricular valves into the ventricles. After a critical time delay the powerful ventricular muscles are synchronously activated to pump blood through the pulmonary and systemic circulatory system. A condition in which this necessary synchronization is lost is known as fibrillation **Types of defibrillators:** 1. AC defibrillators 2. DC defibrillators	**03 marks for explanation** **01 marks for types**	
e)	**Explain the principle of ultrasonography with suitable diagram.**		**04**
Ans	**Principle of Ultrasonography :**Ultrasound is an imaging modality lies in its non massive character and ability to distinguish interfaces between soft tissues. It is diagnostic tool used in medicine. Ultrasound is not only noninvasive, externally applied but also apparently safe at acoustical intensities in diagnostic equipment. It gives images of almost entire range of internal organ in abdominal. Ultrasonic waves or sound waves are associated with frequencies above the audible range and generally extend upward from 20 KHz. Transmission of ultrasonic wave motion can takes place in different mode like longitudinal and transverse. Ultrasonic waves are transmitted mechanical vibration and passes only through a medium as a wave motion. The velocity of propagation of wave motion is determined by density of medium travelling through and stiffness of medium. Reflection and refraction of ultrasound occurs at an interface between two media having different acoustic impedance. Ultrasonic equipment serves a variety of functions in medicine. The principle of imaging or making pictures of internal organs is that of ultrasonic wave reflection. Ultrasonic waves reflect from the boundary of two medium, just as waves reflect from an object in water. Because the amount of reflection differs in different tissues, it is possible to distinguish between materials and make images of them using ultrasonic.	**03 marks for principle**	

	Diagram of principle of Ultrasonography:  	**01 marks for diagram**	
f)	**Explain any four effects of leakage current on human body.**		**04**
Ans	**List of effect of current on human body with increasing current intensity** i) Threshold of perception : it is at approximately 500 microAmp or 1 mA. ii) Accepted safe level: it is up to 5 mA. It is not considered harmful. iii) Maximum let go current: It is in excess of 10mA or 20mA. It can tentize the arm muscle. iv) Danger of ventricular Fibrillation : It is above 75 mA v) Contraction of heart (Sustained myocardial contraction): it is at excess of 1A or 2A current. vi) Severe burns and physical injury: It is at excess above 10A current. vii) Danger of respiratory paralysis: It is current excess at 100mA onwards. **viii)** Sustained Myocardial contraction: entire heart muscle contract at current in the range of 1- 6 Amp.	**04 marks for any 4 effect**	
Q3	**Attempt any four of the following**		**16**
a)	**Explain mechanism of breathing**		**04**
Ans.	Breathing is process of supplying oxygen to and carbon dioxide from tissues. During Breathing there is creation of negative and positive		

	pressure that moves air in and out of the lungs. These gases are carried in the blood, oxygen from the lungs to the tissues & carbon dioxide from the tissues to lungs. The external air is inhale thru nasal cavities, pharynx, trachea, bronchi & bronchioles. Then it passes to lungs. The air is filled in to small air bags called alveolus. There is nesting of blood vessels and air sacs exchanges the oxygen from air sacs into blood vessel and carbon dioxide from blood vessel to air sacs. The carbon dioxide is exhaled out, and oxygen is carried to different parts of body through lungs.	**04 marks for relevant explanation**	
b)	**Draw a block diagram of electro-cardiograph. Explain it in brief**		**04**
Ans	**Block diagram of ECG Recorder:**  **OR**  **Explanation:** • This system is used to plot a ECG waveform. • The leads are used for connecting electrode o/p to recorder	**02 marks for relevant block diag./diagram**	

	system. • Lead selector switch: This is used to select type of lead connection like Lead I, II , III or AVL , AVF or AVR and chest lead type connection. The wires from the electrodes are connected to the lead selector switch, which also incorporates the resistors necessary for lead configuration. • A push button (Calibrator push Button): It produces standardization voltage of 1mV to calibrate ECG recorder. The signals from lead switch goes to preamplifier. • Preamplifier: it is differential amplifier with high gain & CMRR . It is ac coupled to avoid problems with small dc voltages. These small voltages originate from polarization of the electrodes. This preamplifier is also provided with gain setting facility, so that gain of amplifier can be adjusted. • Pen drive Amplifier: The o/p of preamplifier is given to dc amplifier. This dc amplifier is called as Pen drive amplifier. This provides power to drive the pen motor that records the actual ECG waveform. • Position control: This ckt controls the pen amplifier gain so that pen is at center of recording paper. • Stylus (pen) control ckt: As modern recorder uses heat sensitive paper so temperature of ink in stylus (pen) is controlled by this ckt. This gives optimum recording on paper. • Marker Stylus ckt: This repositions marker stylus at marginal side. This marker stylus marks coded indication of lead being connected by lead selector switch. • Recording paper driving system: The paper is moved at regular speed by motor connected to rollers. Recording paper is rolled on these rollers. Speed of paper is 25mm / sec faster speed is of 5o mm / sec is provided to allow better resolution of QRS complex at more heart rate. **Or** **Note: Any relevant block diagram with explanation may be considered (02 Marks for Dig & 02 Marks for explanation)**	**02 marks for brief explanation**	
c)	**How blood pressure is measured with the help of sphygmomanometer?**		**04**
Ans	**Diagram of sphygmomanometer:**		



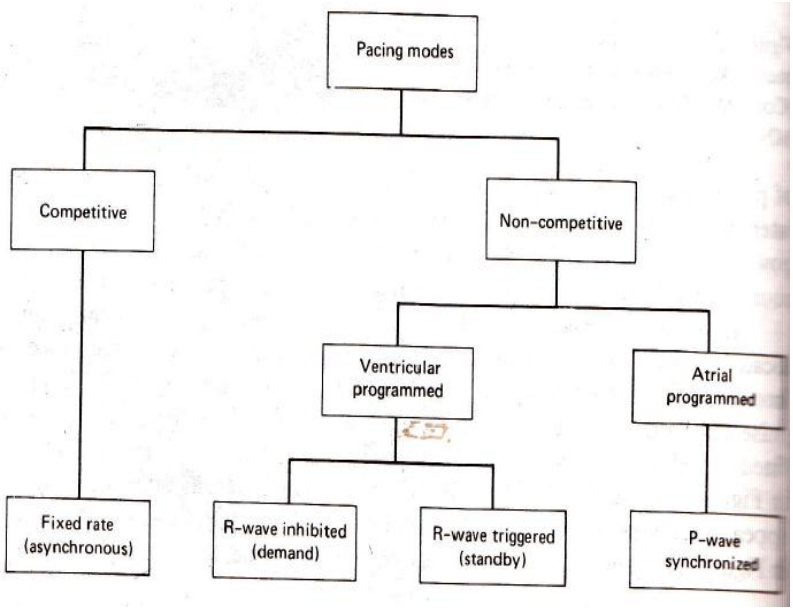


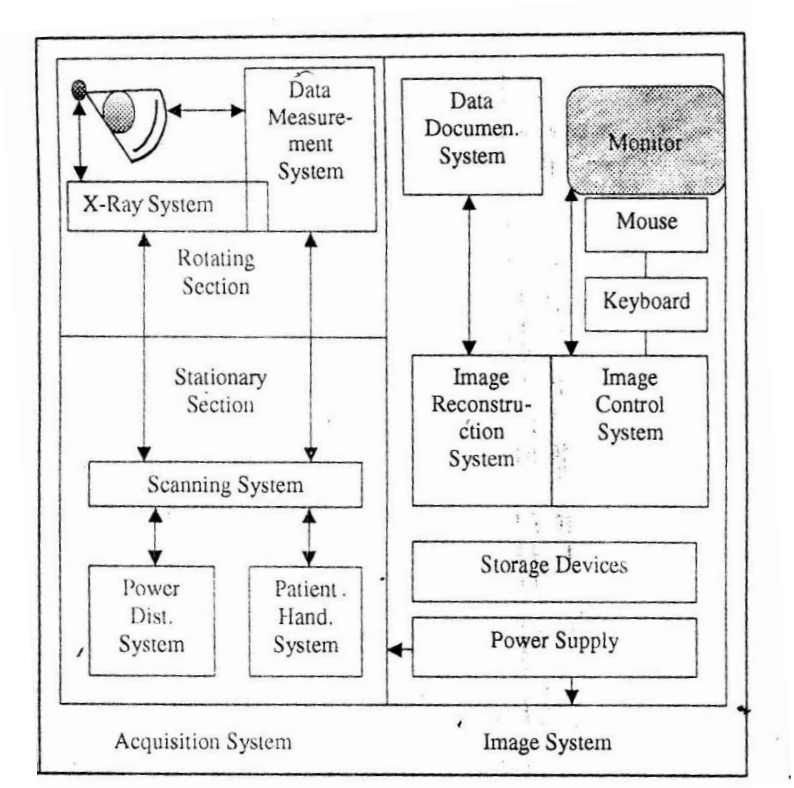
01 marks for diagram

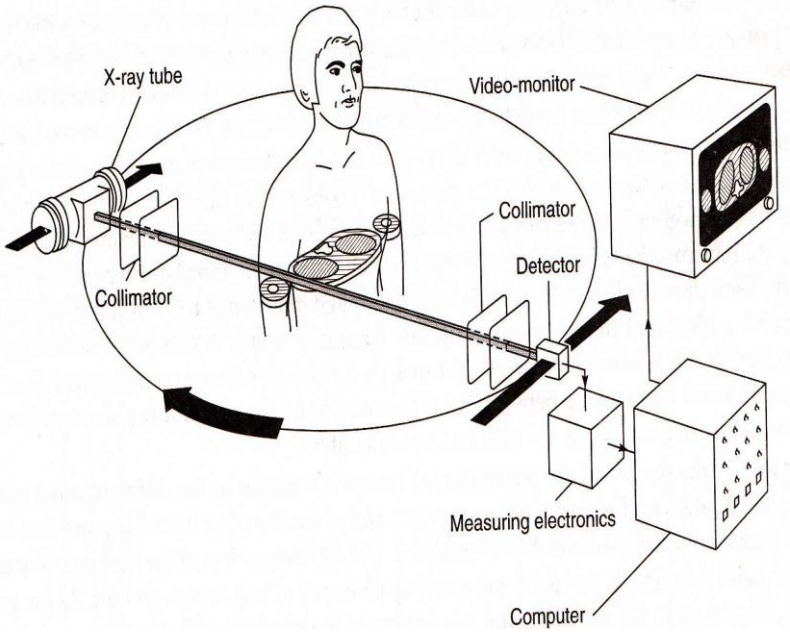
Working of Sphygmomanometer:

- The Sphygmomanometer works on the principle of that when the cuff is placed on the upper arm and inflated (filled with air pressure), arterial blood can pass after the cuff only when the arterial pressure exceeds the pressure in the cuff.
- So first pressure in cuff is increased by inflating cuff with the help of rubber bladder pumping manually as well above systolic pressure.
- At this point no sound is heard through stethoscope, which is placed over the brachial artery.
- The pressure in the artery gradually reduced by opening needle vale slowly.
- As soon as cuff pressure falls below systolic pressure, small

03 marks for explanation

	amount of blood Spurt passes after cuff and KOROTKOFF sounds begin to be heard thru stethoscope. • The pressure of the cuff that is indicated on MANOMETER when the first Korotkoff sound is heard is recorded as the systolic blood pressure. • As pressure in the cuff continues to drop, the KOROTKOFF sound continue until the cuff pressure no longer sufficient to occlude the vessel during any part of the cycle. Below this pressure the KOROTKOFF sound disappears, marking the value of the diastolic pressure.		
d)	**List various pacing modes available in pacemaker. Explain any one in detail**		**04**
Ans	**Diagram:**  **Explanation:** • PACING MODES • Fixed rate or asynchronous devices that produces pulses at a fixed rate (set by doctor) and are independent of any natural cardiac activity. • Theses asynchronous pacing also called as " competitive pacing" because the fixed rate impulses may occur along with natural pacing and there may be competition in between them in controlling the heartbeat. • This is avoided by use of ventricular or atrial –programmed	**02 marks for Diagram** **02 marks for any one pacing mode explanation .**	

	pulse generators. • Fixed rate pacers are sometimes installed in elderly patients whose SA nodes cannot provide proper stimuli. • Shorter of battery life and competition in controlling pacing , in fixed rate (asynchronous pacing) , the ventricular programmed is developed. • When intrinsic rate falls below the preset of standstill 70 bpm , the unit will automatically provide an output to a pace the heart.		
e)	**Explain the principal of operation of CT scan.**		**04**
Ans	**Diagram of CT Scan:**  **OR**	**02 marks for Diagram**	



Explanation of CT Scan:

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.

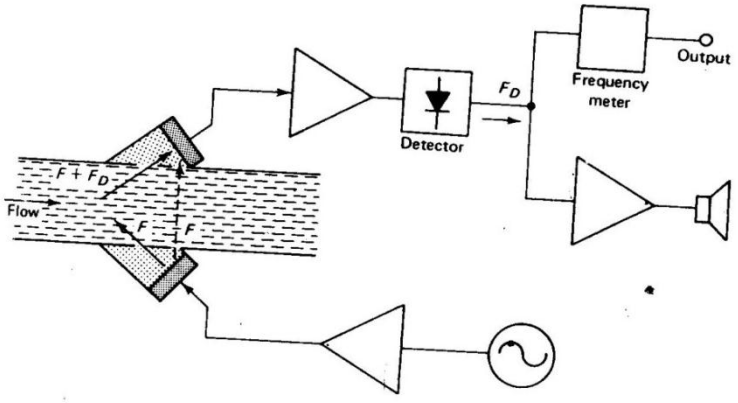
The image reconstruction system receives measure data and performs the image reconstruction on it. These images are processed and displayed. The data documentation system is connected to the image reconstruction system and is used to photograph the reconstructed CT image.

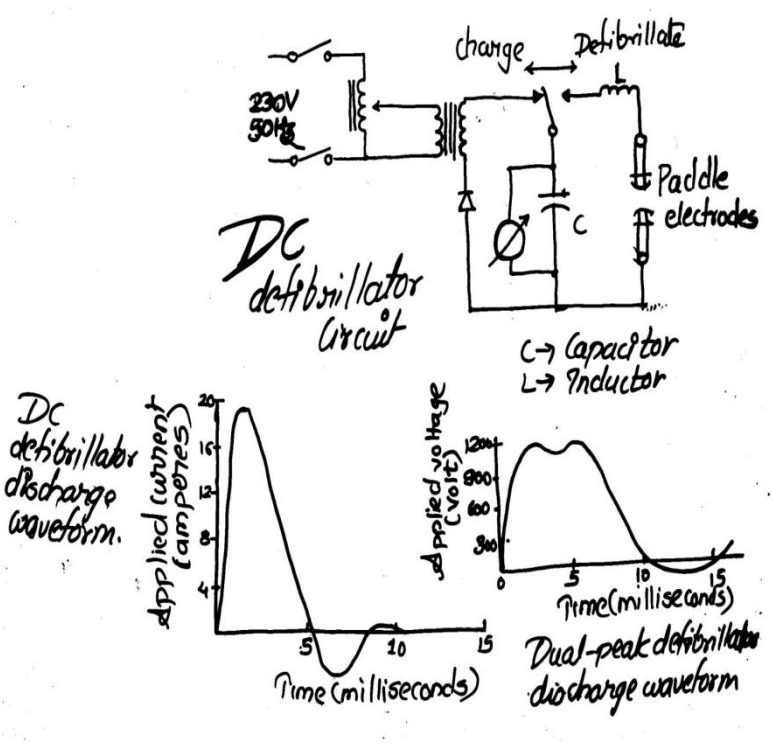
Acquisition system acquires the data. The data measurement system belongs to the rotating part of the gantry and contains all the elements to measure the attenuated radiation and to transfer this to image system for reconstruction and display of CT image. X ray system also belongs to the rotating part of gantry. The scanning system contains the function of gantry rotation, gantry tilt, to exchange data with X ray system and data measurement.

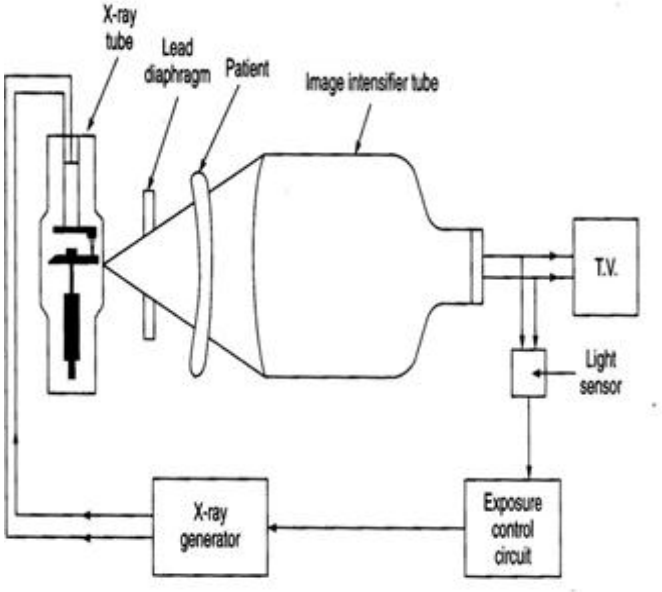
02 marks for explanation

	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.		
f)	**Explain any four precautions to minimize electric shock hazards.**		**04**
Ans	**Precautions to minimize 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. 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 for each precaution.** **(any four)**	
Q4	**Attempt any four of the following**		**16**
a)	**List any four function of kidney**		**04**
Ans	Main function of kidney is to form urine out of blood plasma. It consists of two processes i) To form urine out of blood plasma. ii) removal of waste product and iii) Regulation of composition of blood plasma. iv) To maintain osmotic pressure **v)** PH & electrolyte composition of extra cellular blood fluids	**01 mark for each function (any 4 functions)**	
b)	**Describe working details of EEG (electro encephalogram)**		**04**
Ans	**<u>The Electroencephalogram</u> <u>(EEG):</u>** • The recorded representation of bio electric potentials generated by the neuron activity of the brain is called the		

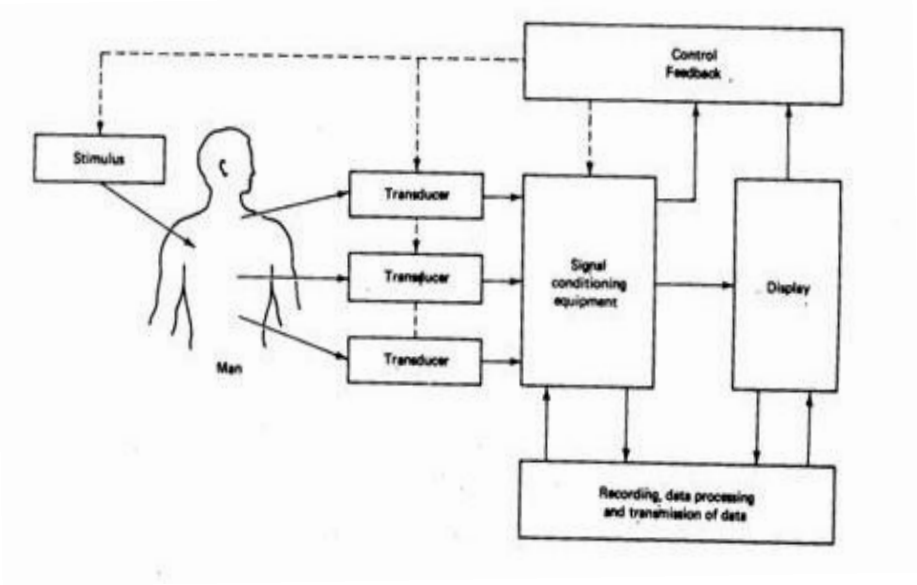
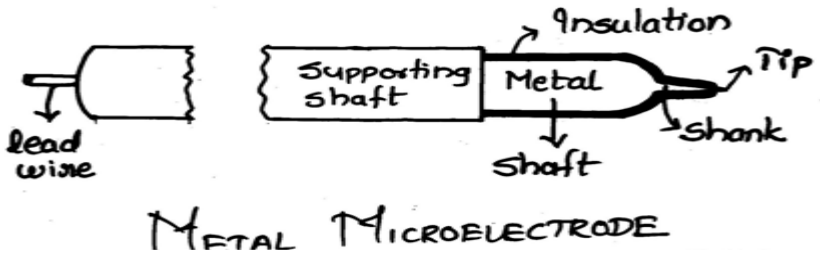
	electroencephalogram, ECG. • The ECG has very complex pattern, which is much more difficult to recognize than the ECG. • The wave form varies greatly with the location of the measuring electrode on the surface of the scalp. • EEG potentials, measured at the surface of the scalp, • This actually represents the combined effect of potentials from fairly wide region of brain. • Experiments have shown that the frequency of EEG seems to be affected by the mental activity of a person The various frequency ranges of the EEG have roughly been given Greek letter. • Below 3 ½ Hz ……. Delta • From 3 ½ Hz to 8 Hz …… theta • From about 8 Hz to About 13 HZ …….. Alpha • Above 13 Hz ….. Beta • Most human seem to develop EEG patterns in alpha range when they are relaxed with their eyes closed. • This condition seems to represent a form of synchronization, almost like a natural freq. of the brain. • As soon as person becomes alert or begins thinking, the alpha rhymes disappear and is replaced with a desynchronized pattern generally in the beta range.	**04 marks for relevant explanation**	
c)	How ultrasonic method is used for measurement of blood flow ?		**04**
Ans	**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 marks.**	**02 Marks for any relevant diagram** **02 marks for relevant explanation**	
d)	**Draw D.C. defibrillator circuit. Explain its working.**		**04**

Ans	In DC  **Explanation:** In 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.	**02 mark for diagram** **02 mark for brief explanation**	
e)	**Describe working of image intensifier with neat schematic.**		**04**
Ans	**Image intensifier** • This is mostly used as instead of fluoroscopic screen as image is faint , viewed only in dark room • In Image Intensifier faint image of fluoroscopic screen can be made brighter with the help of electronic image intensifier • X ray image intensifier is used for visual observation & reading of picture with movie camera or video recorder • Intensifier tube contain fluorescence screen act as photo cathode • The electron image thus obtained is projected on a	**02 marks for explanation**	

	photopshospor screen at the end of tube by means of electronic system • There is increase in brightness due to acceleration of electron in the lens system • But o/p image is smaller than primary fluorescent image • X ray image can be observed in normally illuminated room • This tube is heavy so require special type of suspension • Image can be seen from right side mirror • Or can be seen by video placed at suitable placed monitor • Moving camera can be used to record the image while examining the patient  **OR** **Note: Any relevant diagram with explanation may be considered**	**02 marks for diagram**	
f)	**List any two functions of i) cerebellum ii) Medula oblongata.**		**04**
Ans	**i)** **Cerebrum:** It does functions associated with 1)intelligence, 2)reasoning, 3)sensory perception, initiation 4) Control of skeletal muscle. ii) **Medulla Oblongata:** It is associated with functions like has 1) It control blood distribution 2) Respiratory centers which controls the ventilation of the lungs.	**02 mark for 02 functions each**	

	3) reflex center of vomiting, 4) coughing, seezing 5) Swallowing.		
Q5	**Attempt any four of the following:**		**16**
a)	**Draw a block diagram of man instrument system. Explain each block in brief.**		**04**
Ans	The basic components of the man instrument system are: **Subject**: The subject is the human being on whom the measurements are made. **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. **Transducer**: A transducer is device used to produce an electrical signal that is an analog of the phenomenon being measured. **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. **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 o the human's senses in a meaningful way. E.g. graphic pen recorder for recoding ECG signal. **Recording, Data processing, and Transmission**: Recording instruments are required to record the desirable information that can be used to transmit or for possible later use. E.g. on line digital computer, recording equipment etc. **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. **Diagram of man instrument system:**	**02 marks for brief explanation**	

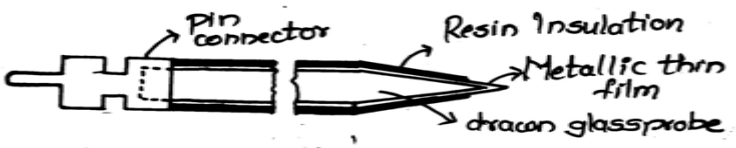
		**02 marks for diagram**	
b)	**Illustrate constructional details of micro electrode**		**04**
Ans	Microelectrodes can be formed from solid metal needles, from metal contained within or on the surface of a glass needle or from a glass micropipette having lumen filled with an electrolytic solution. **<u>Metal Microelectrode</u>** The metal microelectrode is essentially a fine needle of a strong metal that is insulated with an appropriate insulator up to its tip. Suitable strong metals for these microelectrodes are stainless steel, platinum - iridium alloy and tungsten. The compound tungsten carbide is also used. The etched metal needle is then supported in a larger metallic shaft that can be insulated. This shaft serves as a sturdy mechanical support for the microelectrode and as a means of connecting it to its lead wire. The microelectrode and the supporting shaft are usually insulated by a film of some polymeric material or varnish. Only the extreme tip of the electrode remains uninsulated. **Diagram:**  METAL MICROELECTRODE	**02 marks for explanation** **(Any one of the following types)** **02 marks for diagram**	

OR

Supported Metal Microelectrode

A glass tube is drawn to a micropipette structure with its lumen filled with an appropriate metal. In this type of structure, the glass not only provides the mechanical support but also serves as the insulation. The active tip is the only metallic area exposed in cross section. Metals such as silver solder alloy and platinum and silver are used. In some cases metals with low melting points such as indium are used.
New supported metal electrodes may also have a glass rod drawn to micropipet on which a thin film of metal is deposited uniformly. A polymeric insulation is then coated over this leaving just the tip with the metal film exposed.

Diagram:



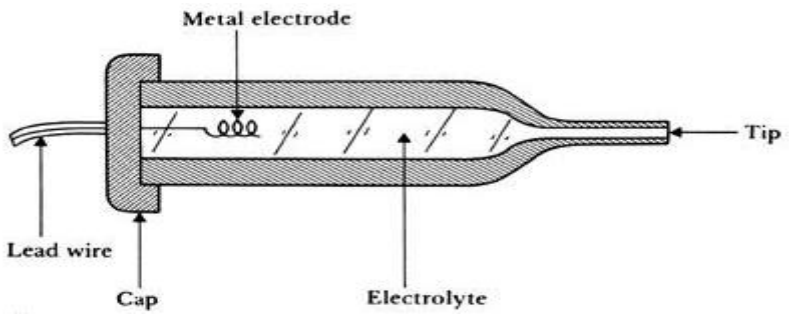
COMMERCIAL MICROELECTRODE WITH METAL FILM ON GLASS

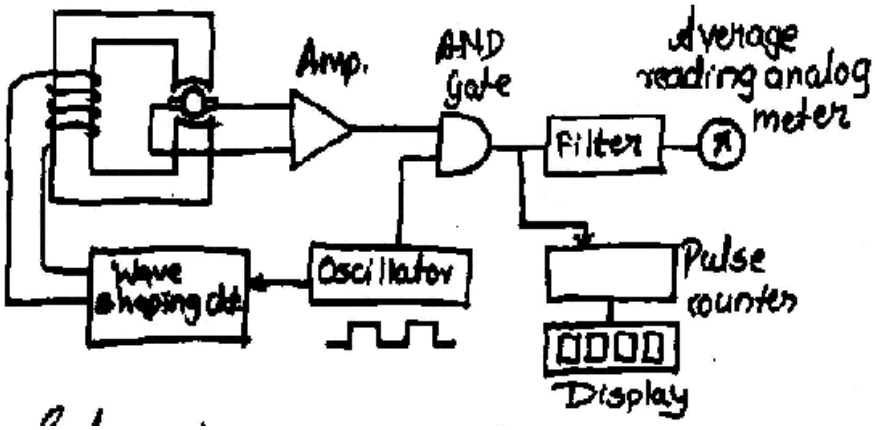
OR

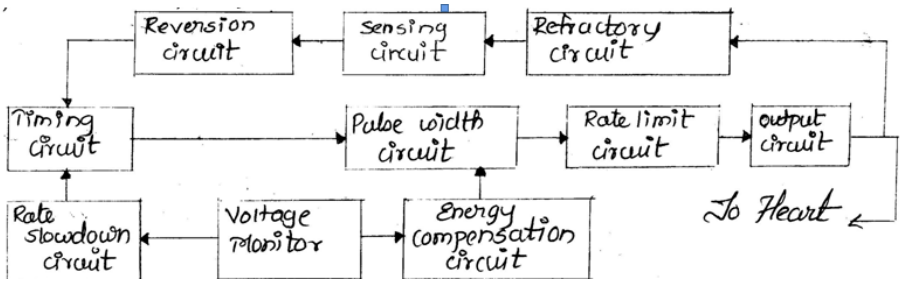
Micropipet Electrodes

Glass micropipette microelectrodes are fabricated from glass capillaries. The pipet structure has a tip diameter of order of 1µm. This pipet is fabricated into the electrode form. It is filled with an electrolyte solution that is frequently KCL. A cap containing a metal electrode is then sealed to the pipet. The metal electrode contacts the electrolyte within the pipet. The electrode is frequently a silver wire prepared with an electrolytic AgCl surface. Platinum, stainless steel wires are also occasionally used.

Diagram:



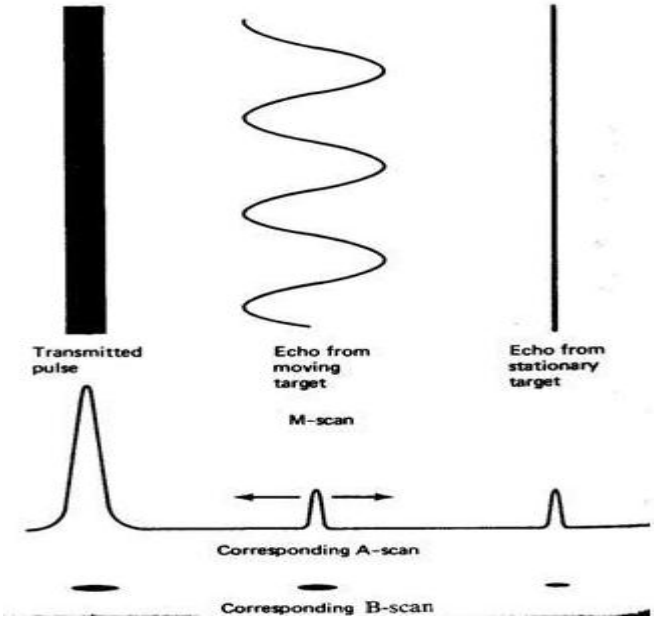
c)	**Explain electromagnetic technique of blood flow measurement.**		**04**
Ans	**Diagram of electromagnetic technique of blood flow measurement:**  **Explanation:** An electromagnetic blood flow meter works on the principle of magnetic induction. When an electrical conductor is moved through a magnetic field an voltage is induced in the conductor proportional to the velocity of its motion. This same principle applies when the moving conductor is a column of conductive fluid through a tube located in a magnetic field. A permanent magnet or electromagnet is positioned around the blood vessel generates a magnetic field perpendicular to the direction of the blood flow. The voltage induced in the moving bloods column is measured with stationary electrodes located on the opposite side of the blood vessel and perpendicular to the direction of the magnetic field. The slip on or c type probe is applied by squeezing an exposed blood vessel together and slipping it to the slot of the probe. The block diagram shows an oscillator which drives the magnet and provides a control signal for the gate. It operates at a frequency between 60 to 400 Hz. The use of gated detector makes the polarity of the output signal reverse when the flow direction is reverse. The frequency of this type of the system is usually high enough to allow the recording of the flow pulses. The output from emf generated is provided to the gate by amplifying it. The output of the gate is provided to the filter and the filter gives output that can be displayed on the meter.	**02 marks for diagram** **02 marks for relevant Explanation**	
d)	**Draw a block diagram of internal pacemaker. Explain each block in brief.**		**04**

Ans	**Diagram of internal pacemaker:**  **Explanation:** In the given block diagram the timing circuit consists of an RC network, reference voltage source and a comparator that determines the basic pacing rate of the pulse generator. Its output signal is given to second RC network, the pulse width circuit which determines the stimulation pulse duration. A third RC network and the rate limiting circuit disable the comparator for a preset interval and thus limit the pacing rate to a maximum of 120 pulses per minute. The output circuit provides a voltage pulse to stimulate the heart. The voltage monitoring circuit senses cell depletion and then signals the rate slow down circuit and the energy compensation circuit of this event. The rate slow down circuit shuts off some of the current to the basic timing network to cause the rate slow down to 8± 3 beats per minutes. When cell depletion has occurred the energy compensation circuit causes the pulse duration to increase as the battery voltage decreases to maintain nearly constant stimulation to the heart. There is a feedback loop from output circuitry to the refractory circuit which provides a period of time following an output pulse on sensed R wave during which the amplifier will not respond to the outside signals. The sensing circuit detects a spontaneous R wave and resets the oscillation timing capacitor. The reversion circuit allows the amplifier to detect a spontaneous R wave. In the absence of R wave this circuit allows the oscillator to pace at its present rate ± beat per minute.	**02 marks for diagram** **02 marks for Explanation**	
e)	**List and explain various modes available in ultrasonography.**		**04**
Ans	**Various modes : There are different scanning modes of** ultrasonograpy: A scan (Amplitude Scan) B scan (Brightness scan) M scan (Motion scan)		

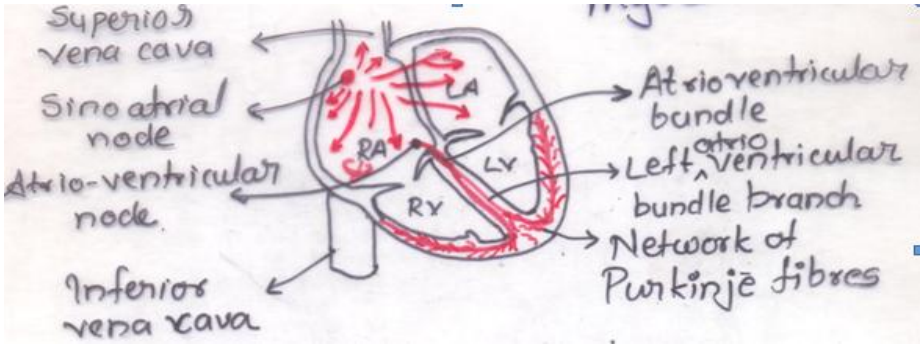
- **A scan:** This mode is the simplest among other methods. The transmitted signals and echo signals are applied to the Y plates of CRT so that they are displayed as vertical deflections on the CRT screen. The vertical sweep is calibrated in units of distance and provides vertical deflections in various ranges depending upon the distance of the interface. Echoencephalogram is typical example of A scan display.
- **B scan:** If A scan echoes are rotated electronically 90° towards the viewer, the echoes can be viewed along the horizontal axis as bright and dim dots. The distance between the bright and dim dots represents the depth of tissues and the brightness of the dots represents the strength of the echoes. These dots can be used to obtain a pictorial display of internal organs if position of the probe is continuously moved and the corresponding echoes are obtained.
- **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.

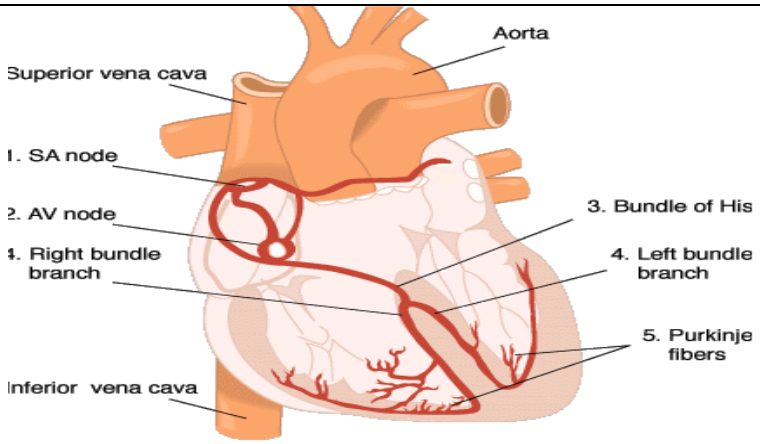
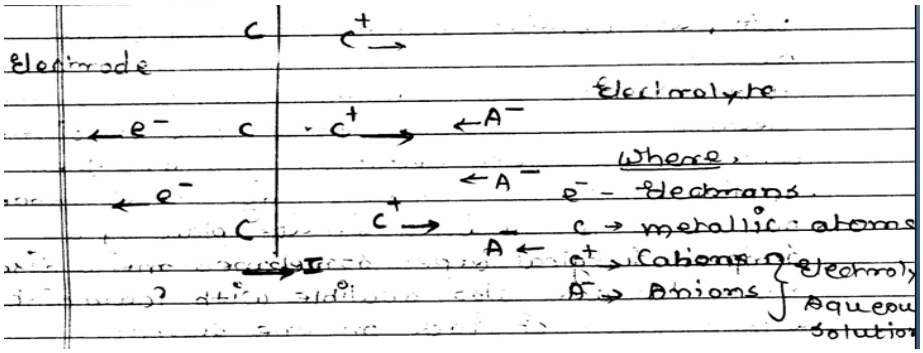
02 marks for explanation (Only listing the names of modes 01 mark)

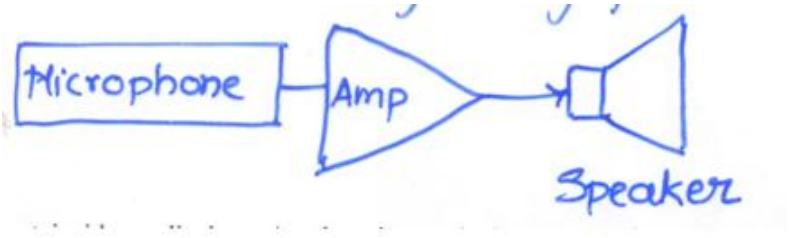
Diagram:

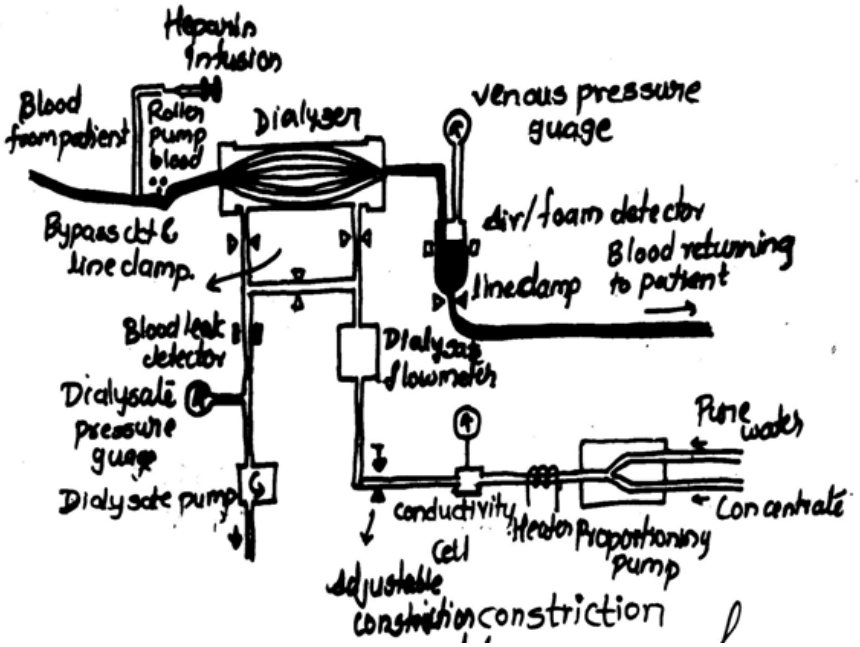


02 marks for diagram

f)	**List any four applications of CAT.**		**04**
Ans	a. It is ideally suited for studying structures in the chest and abdomen. b. It can be used in the diagnosis of infectious conditions, heart disease, lung disease, diseases involving the bones and muscle. c. It can be used to diagnose disorders related to the central nervous system, more specifically the brain. **d.** It can also be used to confirm the presence of lesions such as cysts, solid tumors in different areas of the body.	**Any four applications 4Mark**	
Q 6	**Attempt any four of the following:**		**16**
a)	**Explain electrical conduction system of human heart**		**04**
Ans	**Explanation:** Excitation of the heart does not proceed directly from the central nervous system. It is initiated into the sinuatrial node or pacemaker, a special group of excitable cells. The electrical events that occur within the heart are reflected in ECG. The sinuatrial node creates an impulse of electrical excitation that spreads across the right and left atrium. The right atrium receives the excitation earlier because of its nearness to sinuatrial node. This excitation causes the atria's to contract and a short time later stimulates the AV node. The activated AV node after a brief period initiates an impulse into the ventricles through a bundle of His and into the bundle branches that connect to purkunje fibers in the myocardium. Contraction result in the myocardium supplies the force to pump the blood into circulatory system. The heart rate is controlled by the frequency at which the sinuatrial node generates the pulses. **Diagram:**  **OR**	**02 marks for explanation** **02 marks for any Diagram**	

			
b)	**Describe the charge distribution phenomenon at electrode-electrolyte interface.**		**04**
Ans	**Explanation:** Electrodes are the devices that convert ionic potentials into electric potentials. The interface of metallic ions in the solution with their associated metals result in an electric potential which is called as electrode potential. This potential is a result of difference in diffusion rates of ions into and out of the metal. Equilibrium is produced by the formation of layer of charge at the interface. This charge is a double layer with the layer nearest to the metal being of one polarity and the layer next to the solution being of opposite polarity. All types of bio-potential electrodes have metal electrolyte interface. This is developed across the interface and is proportional to the exchange of ions between the metals and electrolytes of the body. **Diagram:** 	**03 marks for explanation** **01 marks for Diagram**	
c)	**What is phonocardiograph? Explain its working.**		**04**
Ans	**Explanation:**The instrument used for graphically recording heart sound is called phonocardiograph. A graphic record of heart sounds is called phonocardiogram. The basic transducer for the phonocardiogram is a microphone having necessary frequency response ranging from 5 Hz to above 1000Hz. An	**03 marks for explanation**	

	amplifier with similar response characteristics is required which may offer a selective low pass filter to allow the high frequency cut off to be adjusted for noise. The readout of a phonocardiograph is either a high frequency chart recorder or an oscilloscope. Although the normal heart sounds fall within the frequency range of pen recorders, the high frequency murmurs that are often important in diagnosis require the grater response of phonographic device. Microphones for phonocardiogram's are designed to be placed on the chest over the heart. Spectral display of heart sounds provides a useful diagnostic tool that requires a high speed digital computer with analog to digital conversion capability. **Diagram of phonocardiograph:** 	**01 marks for Diagram**	
d)	**Draw a schematic diagram of a dialysis machine. Expalin its operation in brief.**		**04**
Ans	**Explanation:** 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 is temperature controlled at body temperature. Conductivity of the dialysate is monitored to verify the accuracy of proportioning. 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 blood. **Diagram of dialysis machine:**	**02 marks for brief explanation**	

	 **Note: any relevant diag with explaination may consider**	**02 marks for Diagram**	
e)	**Enlist any four applications of X ray machine.**		**04**
Ans	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.	**Any four application 4Mark**	
f)	**With respect to lung volumes and capacities define following:** **i. Tidal Volume** **ii. Inspiratory Reserve Volume** **iii. Residual volume** **iv. Vital capacity**		**04**
Ans	**Tidal Volume-** It is the normal depth of breathing. It is the volume of the gas/air inspired during each normal, quiet, respiration cycle. **Inspiratory Reserve Volume –** It is the maximum amount of airt that can be inspired after reaching the end expiratory level. **Residual volume –** It is the volume of gas / air remaining in the lungs at the end of a maximal expiration. **Vital capacity –** It is the maximum volume of gas that can be expelled from the lungs by forceful effort after a maximal inspiration.	**Each definition 1Mark**	