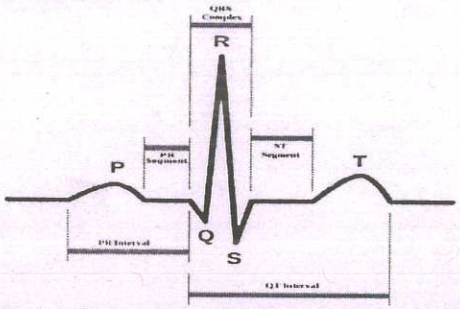
Scheme of valuation

(Scoringindicators)

Revision: 2015 **Course code and title : 5044 MEDICAL ELECTRONICS**

Qst no:	Scoring Indicator	Split up score	Sub total	Total
	PART A			
1	Surface electrode, needle electrode, micro electrode.	2	2	2
2	Centrifugal sedimentation method, Microscopic method, dark filed method, coulter blood cell counter	2	2	2
3	A defibrillator is a device that delivers electric shock to the heart muscle undergoing Ventricular or atrial fibrillation. Fibrillation is asynchronous contraction of heart muscle. Sudden cardiac arrest can be treated using defibrillator	2	2	2
4	X-Ray, CT scanner, MRI scanner, Ultra sound scanner	4X0.5	2	2
5	1. Radio frequency transmission for monitoring the health of astronauts. 2. Patient monitoring, where freedom of movement is desired 3. Patient monitoring in locations away from the Hospital. 4. Collection of medical data from a home or office for a doctor in hospital 5. To conduct study on animals in their natural habitat. 6. Use of telephone links for the transmission of or other medical data. 7. Measuring PH or pressure in the gastrointestinal tract. 8. Isolation of an electrically susceptible patient ECG equipment	Any 4X0.5	2	2
II	**PART B**			
1	 It is the reord of electrical activity of heart. Consists of P – wave, QRS complex, Twave and U wave. Waves are listed in table below.	Diagram 3 + Description 3		

Wave form	Origin	Amplitude mv	Duration
P wave	Atrial depolarisation or contraction	0.25	0.12 to 0.22 (P-R interval)
QRS complex or R wave	Repolarisation of the atria and the depolarisation of the ventricles	1.60	0.07 to 0.1
T wave	Ventricular Repolarisation (Relaxation of myocardium)	0.1 to 0.5	0.05 to 0.15 (S.T interval)
S-T interval	Ventricular contraction	-	0.2
U wave	Slow repolarisation of the intraventricular septum (Purkinje fibres)	0.4	(T-U interval)

2.

An EMG waveform

Bioelectric potentials associated with muscle activity constitute the electromyogram (EMG). These potentials may be measured at the surface of the body near muscles of interest or directly from the muscle by penetrating the skin with needle electrodes. Since most EMG measurements are intended to obtain an indication of the amount of activity of a given muscle or group of muscles, rather than of an individual muscle fibre, the pattern is usually a summation of the individual action potentials from the fibres constituting the muscle or muscles being measured. The amplitude of the measured EMG waveform is the instantaneous sum of all the action potentials generated at any given time. Because these action potentials occur in both positive and negative polarities at a given pair of electrodes, they sometimes add and sometimes cancel. Thus, the EMG waveform appears very much like a random-noise waveform, With the energy of the signal being a function of the amount of muscle activity and electrode placement.

Diagram 2 + Description 4

3 LASER (light amplification by stimulated emission or radiation) is a device that generates an intense beam of coherent monochromatic light (or other electromagnetic radiation) by stimulated emission of photons from excited atoms or molecules.

In order to produce laser radiation, the laser device must consist of three components; (i) Lasing or active medium (ii) Energy source (iii) Mechanical structure.

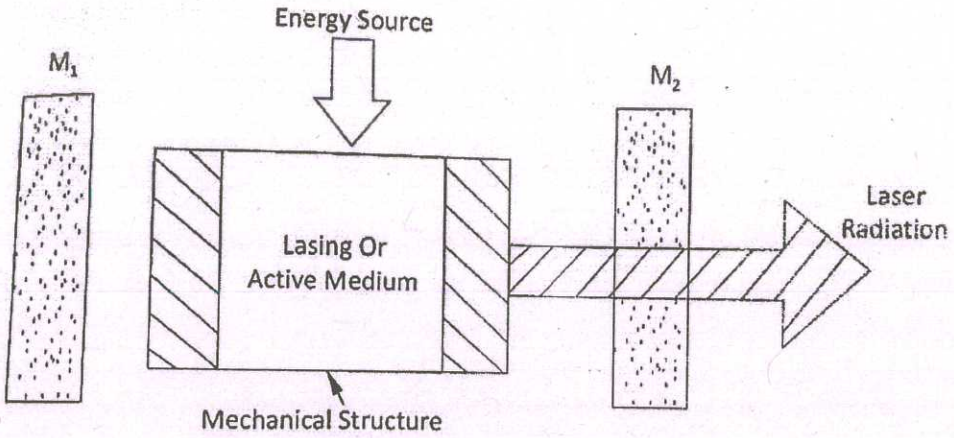


Diagram 2 + Description 4

(i) Lasing or active medium

The laser light is generated within the "lasing medium or active". It is a material which is capable to absorbing the energy produced by external excitation source like heat, current etc. the atoms in the active medium absorb energy given to them through a process called excitation. After absorbing energy, these atoms moves to higher energy state called meta-stable state. This process is called population inversion. When these excited atoms or molecules drop to lower energy levels, photons of light are generated.

Lasing medium can be gaseous, liquid, solid crystal or semiconductor. These types of lasing media can be found in various medical and surgical applications.

ii) Energy source:

An energy source is used to excite or pump the active (lasing) medium to the higher energy levels that are necessary for the production of laser radiation. This process is called pumping. Energy sources commonly used in medical applications are, a flash lamp similar to a photographic flash or an electric current similar to the electric current that lights a near or fluorescent bulb.

iii) Mechanical structure:

The mechanical structure (a resonator cavity) contents the lasing medium within a central chamber, with two parallel mirrors, at either end. The distance between them is fixed at a multiple number of the laser's wavelength. This arrangement allows for the reflection of photons of light back and forward across the chamber, resulting in the production of an intense photon resonance within the medium. The reflectance of the mirror M1 for all practical purposes is 100%. But, the second mirror M2 is partially silvered and a small percentage of the laser beam comes out of the mirror M2.

Whole blood is composed of consists of the following elements
(i) Red blood cells (ii) White blood cells (iii)Platelets. And Plasma (fluid containing dissolved and suspended substances).

4 **Plasma consists of the following elements :**
Proteins like albumins,Fibrinogen, prothrombin and Globulin. Plasma nutrients like glucose, lipids (fats) and Amino acids. Regulatory and protective substances like enzymes hormones and antibodies. Plasma electrolytes like inorganic salts and pure chemical substances. Metabolic waste substances like urea and uric acid waste from the kidneys.

(i) Red Blood Cells (RBC's) or erythrocytes - These are concave, disc-shaped cells. They contain no nucleus. They live about 120 days before being replaced by the bone marrow. Their number is 4.5 to 5.5 x 106 cells/mm3. Internally, each RBC contains four iron atoms in a structure known as the haemoglobin molecule. Oxygen from the lung alveoli enters the blood stream and chemically combines with haemoglobin to form oxyhaemoglobin.

(ii) White blood cell (WBS's) or Leukocytes :
These are amoeba like cells (10 p in diameter). They contain a nucleus. They live from 13 to 20 days. Their number is 6 to 10 X 105-3 cells/mm3. They are also present in the lymph fluid and engulf invading bacteria and foreign substances to destroy .the invaders effect. Specific antibodies are also produced to kill the invaders antigen (toxin). 3x2=6

(iii) Platelets :
These are cell fragments (3 u in diameter). They contain no nucleus. Their number is 200_to 800 X 103 cells/mm3. These form a repair substance that initiates blood coagulation and clotting. A protein, thrombin, also acts on fibrinogen (soluble protein formed in the liver) to generate insoluble fibrin.

Fibrin deposits as fine threads to form the frame work of the blood clot.

5

External pacemaker	Internal pacemaker
The pacemaker is placed outside the body. It may be in the form of wrist watch or in the pocket, from that one wire will go into the heart through the vein	The pacemaker is small and is surgically implanted beneath the skin near the chest or abdomen. Output leads are connected directly to the heart muscle.
The electrodes are called endocardiac electrodes and are applied to the heart by means of an electrode catheter with electrode's tip situated in the top of the right ventricle. These are in contact with the inner surface of the heart chamber.	The electrodes are called myocardiac electrodes and are in contact with the outer will of the myocardium (heart muscle)
It does not necessitate the open chest surgery	It requires an open chest minor surgery to place the circuit.
The battery can be easily replaced and any defect or adjustment in the circuit can be easily attended without getting any help from a medical doctor.	The battery can be replaced only by minor surgery. Further any defect or adjustment in the circuit cannot be easily attended. Doctor's help is necessary to rectify the defect in the circuit.
During placement, swelling and pain do not arise due to minimum foreign body	During placement swelling and pain arise due to foreign body reaction.
Here there is no safety for the pacemaker particularly in the case of children carrying the pacemaker	Here there is a hundred percent safety, for the circuit from the external disturbances.
Mostly these are used for temporary heart irregularities	Mostly these are used for permanent heart damages

Any 6x1=6

6

ADVANTAGES AND DISADVANTAGES OF SHORT WAVE DIATHERMY

1. The subject's body becomes. a part of the electrical circuit and the heat is produced within the body and not transferred through the skin.
2. The treatment can be controlled precisely.
3. Careful placement of the electrodes permits localization of the heat to the region that has to be treated.
4. The amount of heat can be closely adjusted by means of circuit parameters.
5. No discomfort is caused to the subject.
6. The current being alternating, it is possible to pass t currents of a much greater intensity to produce direct heating in the tissues similar.
7. The RF energy used heats the tissues and promotes healing of injured tissues and inflammations.

Disadvantages

1. frequency Tuning must be carefully carried out at the beginning of the treatment and continuously monitored during the treatment; There is a

3+3=6

possibility of the tuning getting affected due to unavoidable but involuntary movements of the patients and the resultant change of dosage of heat.
2. There is no indication of the amount of converted and absorbed heat within the body tissues.
3. The intensity of the treatment is dependent on the subjective sensation of warmth felt by the patient.
4. A severe limitation is that in SW diathermy, continuous high frequency radio waves are directed to the patients body, and if a high enough output of energy is sustained for even a brief time, they can cause burns.

7 **Effect of electricity in human body**

It is important that all Biomedical engineers and hospital staff be aware of the electrical hazards likely to occur during patient monitoring and the safety precautions necessary to prevent them.

Current intensity , 1 Sec contact	Effect
1mA	Threshold of perception.
5mA	Accepted as max harmless current intensity.
10 to 20 mA	"Let-go" current before sustained muscular contraction.
50 mA	Pain, possible fainting, exhaustion mechanical injury. Heart and respiration functions continue.
100 - 300 mA	Ventricular fibrillation will start but lungs will function
Greater than 6 A	Sustained myocardial contraction, followed by normal heart rhythm. Temporary respiratory paralysis. Burns are possible

The table below summarizes the effects of a 50 Hz electric current on an average human body through the trunk (a one-second contact).

3+3=6

Effect of radiation on body

Damage caused by nuclear and ironizing radiation depends on –dose, rate of absorption, part of body. The precautions to be taken are to Keep the isotope in thick walled container, wear Lead aprons and lead gloves, Use of special remote control robot, Use of pocket dosimeter, pocket radiation alarm etc to measure radiation

Radiation dose (rem)	Effects of ionizing radiation on human beings
0.03	Average dose from chest X-rays
5	Annual exposure limit for the persons who are handling nuclear medicines and X-rays
10	Leukemia and cancer
10 - 25	Changes in blood cells
100 - 200	Vomiting within three hours at about 125 R and hair loss within 5 to 10 days
225	Death within 60 days for 5% of those exposed
400	Death within 60 days for 50% of those exposed
500 - 600	Death within 60 days for 90% of those exposed
> 1000 (in a single exposure)	Vomiting and death within 3 hours

PART C

IIIa

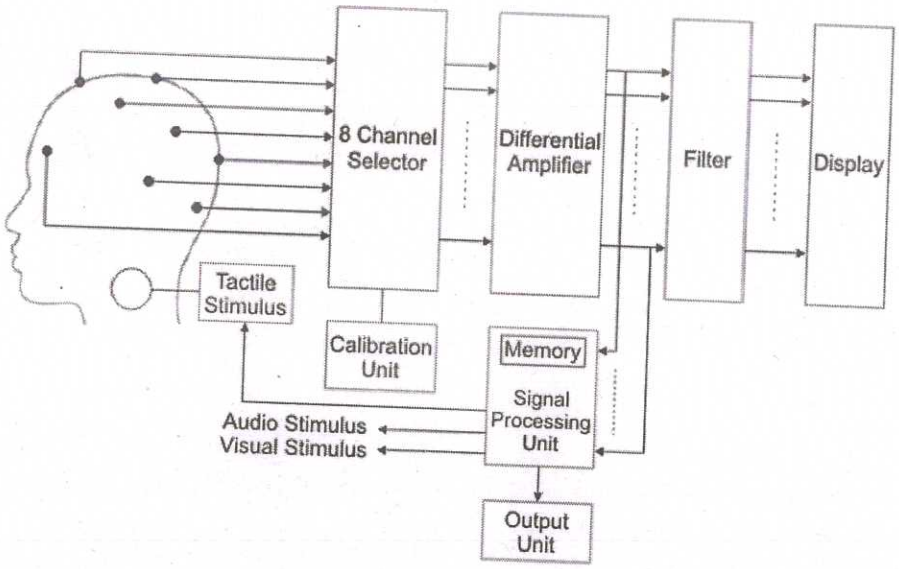


Fig 5 + Exp 4

10

15

The patient cable consists of 21 electrodes and is connected to the eight channel selector in groups of eight called a montage of electrodes. The right ear electrode acts as reference electrode for the right brain electrodes 'and the left ear electrode acts as reference electrode for the left brain electrodes. From the preamplifiers the signals are passed through 50 Hz notch filters. The effect of notch filters on signal distortion is not so much because important EEG signals have frequencies below 30 Hz. Because the source of brain waves has high internal impedance, the input impedance of the preamplifier should be very high to prevent reduction of signal amplitude. The output voltage from the amplifier may either be applied directly to the eight channel display through the filter bank or it may be stored as data on a tape recorder or in a

computer memory for further processing. The filter bank consists of appropriate filters to select different types of brain waves. There are other facilities to record evoked potentials from sensory part of the brain such that there are external stimuli like visual stimulus, audio stimulus The time delay between the stimulus and response can also be measured in the signal processing unit. In the eight channel pen-recorder there are 8 pens such that a pen for each channel. The normal paper chart speed is 30 mm/sec, There are also 60 mm/sec for higher frequency recording and 15 mm/sec to conserve paper during setup time.

IIIb

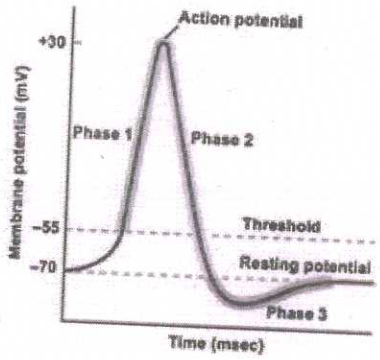


Fig 3+exp 3=6

When the cell is stimulated by some form of externally applied energy, the nature of the cell membrane wall changes abruptly, and it becomes permeable to sodium ions. The potassium ions 'which were in higher concentration inside the cell during resting state by the leave the cell, but are unable to move as rapidly as sodium ions. Because of this the cell has a slightly positive potential on the inside due to imbalance of potassium ions. This potential is known as 'Action Potential' and is about +20 mV. During this period the cell is said to be depolarized.

When the stimulus is completed, the rush of sodium ions through the cell membrane is stopped. The membrane reverts back to its original condition where in the passage of sodium ions from outside to inside of the cell are again blocked. By an active process called sodium pump, the sodium ions are quickly transported to the outside of the cell and the cell gain becomes polarized and assumes its resting potential. This process is called repolarisation.

IV a **Anatomy of human body**

Our bodies consist of a number of biological systems that carry out specific functions necessary for everyday living.

Circulatory system - to move blood, nutrients, oxygen, carbon dioxide, and hormones, around the body. It consists of the heart, blood, blood vessels,arteries and veins.

Digestive system consists of a series of connected organs that together, allow the body to break down and absorb food, and remove waste. It includes the mouth, esophagus, stomach, small intestine, large intestine, rectum, and anus. The liver and pancreas also play a role in the digestive system because they produce digestive juices.

Endocrine system consists of eight major glands that secrete hormones into the blood. These hormones, in turn, travel to different tissues and regulate

various bodily functions, such as metabolism, growth and sexual function.

Immune system is the body's defense against bacteria, viruses and other pathogens that may be harmful. It includes lymph nodes, the spleen, bone marrow, lymphocytes (including B-cells and T-cells), the thymus and leukocytes, which are white blood cells.

lymphatic system includes lymph nodes, lymph ducts and lymph vessels, and also plays a role in the body's defenses. Its main job is to make is to make and move lymph, a clear fluid that contains white blood cells, which help the body fight infection. The lymphatic system also removes excess lymph fluid from bodily tissues, and returns it to the blood.

Nervous system controls both voluntary action (like conscious movement) and involuntary actions (like breathing), and sends signals to different parts of the body. The central nervous system includes the brain and spinal cord. The peripheral nervous system consists of nerves that connect every other part of the body to the central nervous system.

Muscular system consists of about 650 muscles that aid in movement, blood flow and other bodily functions. There are three types of muscle: skeletal muscle which is connected to bone and helps with voluntary movement, smooth muscle which is found inside organs and helps to move substances through organs, and cardiac muscle which is found in the heart and helps pump blood.

Reproductive system allows humans to reproduce. The male reproductive system produce sperm. The female reproductive system produce eggs. During conception, a sperm cell fuses with an egg cell, which creates a fertilized egg that implants and grows in the uterus.

Skeletal system, which consists of 206 bones that are connected by tendons, ligaments and cartilage. The skeleton not only helps us move, but it's also involved in the production of blood cells and the storage of calcium. The teeth are also part of the skeletal system, but they aren't considered bones.

Respiratory system allows us to take in vital oxygen and expel carbon dioxide in a process we call breathing. It consists mainly of the trachea, the diaphragm and the lungs.

Urinary system helps eliminate a waste product called urea from the body, which is produced when certain foods are broken down. The whole system includes two kidneys, two ureters, the bladder, two sphincter muscles and the urethra. Urine produced by the kidneys travels down the ureters to the bladder, and exits the body through the urethra.

10X1.5 =15

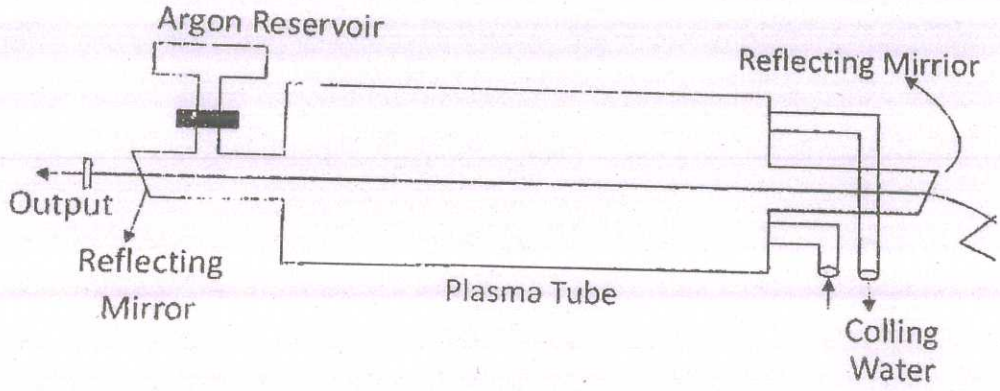
15

Va

Argon Laser

LASER (light amplification by stimulated emission or radiation) is a device that generates an intense beam of coherent monochromatic light by stimulated emission of photons from excited atoms or molecules. The laser light is generated within the "lasing medium or active medium of Argon gas. It is a material which is capable to absorbing the energy produced by external excitation. The atoms in the Argon gas absorb energy given to them through a process called excitation. After absorbing energy, these atoms moves to higher energy state called meta-stable state. This process is called population inversion. When these excited atoms or molecules drop to lower energy levels, photons of light are generated.

Fig 4+exp 5= 9



Argon laser is a gas laser, where the transitions are between the electronic energy levels of argon ion. The Argon laser tube is principally similar to Helium Neon laser. Here also excitation takes place with in a gas discharge.

The heart of the system is the plasma tube, in which argon gas is taken. A very high current discharge is made to pass though the barrel of the tube through argon gas. The discharge ionizes the argon gas. A strong electrical current is forced to flow through argon gas within the tube to produce electrical excitation. The current excites the argon atoms to a higher energy level. When they return to lower energy state, they emit LASER. As this light is reflected 'to' and 'fro' between the mirrors at each end of the tube, it stimulates additional argon atoms to emit light by forcing them to lower energy levels. Argon LASER is thus a continuous LASER which produce continuous LASER output at the end of one of the mirrors.
The disadvantages of Argon laser are - Very high current densities are required to both ionize and excite the inert gas argon. Power consumption is very large and system needs cooling arrangement. Due to high currents, there is severe cathode erosion. It limits the tube life which must be replaced occasionally.

Vb **Application of Laser in Medical Field**

(1) Opthalmology :
- (i) Photocoagulation of Retinal Bleeding
- (ii) Retinal reattachment
- (iii) Glaucoma
- (iv) Lens capsule surgery etc.

(2) Gynaecology :
- (i) Precancerous lesion coagulation
- (ii) Fallopoian tube reconstruction
- (iii) Fertility microsurgery.

(3) Gastroenterology :
- (i) Gastric bleeding hemostasis
- (ii) Hemostatis of colonic bleeding
- (iii) Hepatertomy
- (iv) Gallstone removal
- (v) Polyp excision.

(4) Dermatology:
(1) Removal of birth marks
- (ii) Cutaneous tattos excision
- (iii) Varicose vein excision.

(5) Oncology:
- (i) Photo radiation of tumours.

Any 6X1=6

(6) Orthopaedics:
- (i) Joint surgery for removing artifacts
- (ii) Arthroplastics
- (iii) Bone tumor excision

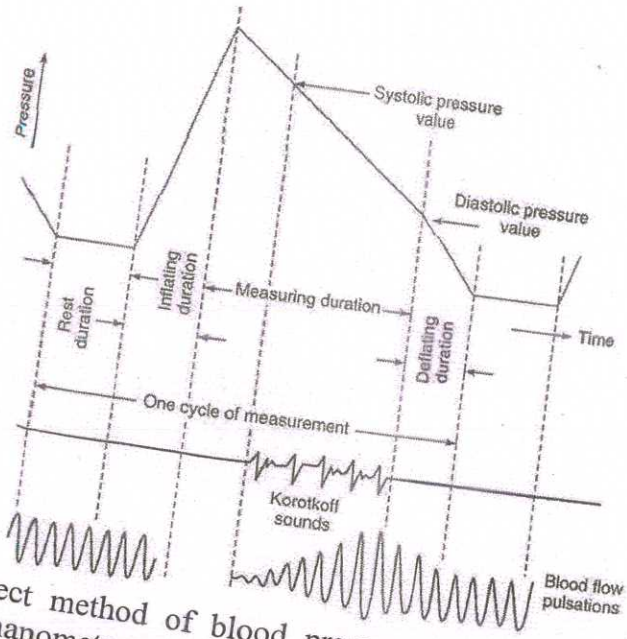
(7) Thoracic surgery
- (i) Lung cancer diagnosis and Treatment
- (ii) Heart revascularization.

(8) Neurosurgery :
- (i) Spinal and brain tumor excision
- (ii) Face and skull deformity reconstruction
- (iii) Mid line structure of frontal brain:

(9) Urology :
- (i) Kidney stone removal
- (ii) Bladder tumor removal
- (iii) Penile Carcinoma etc.

(iv) Bladder bleeding (hemorrhage).

VI a



The indirect method of blood pressure measurement will make use of a sphygmomanometer and a stethoscope. The sphygmomanometer consists of an inflatable (swellable with air) pressure cuff and a mercury manometer to measure the pressure in the cuff. The cuff consists of a rubber bladder and will have a fabric covering that can be wrapped around the upper arm. The cuff can be fixed with the help of hooks provided. The cuff is usually inflated manually with the help of a rubber bulb and deflated slowly through a valve. The stethoscope carries the sound energy to the ear of the physician via a column of air.

Fig 4+exp5 =9

10

VI b

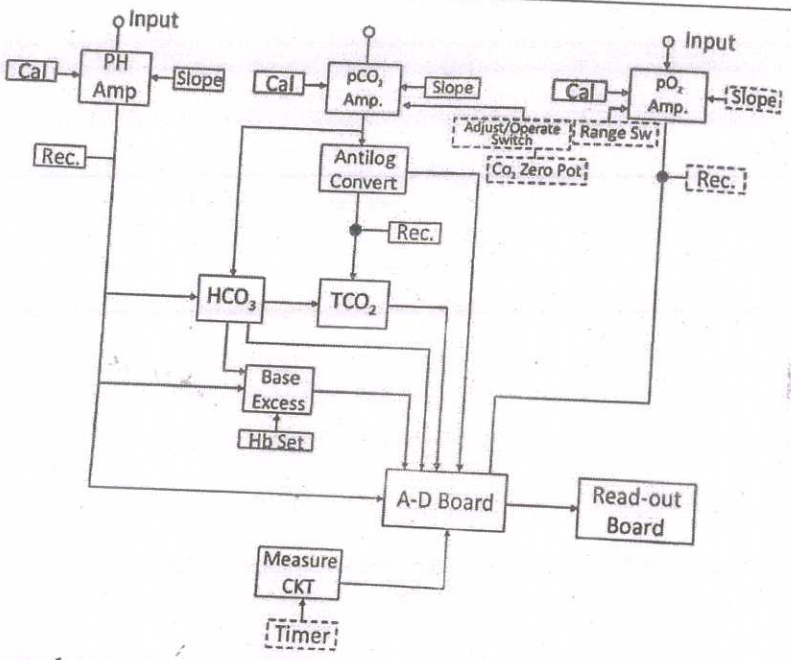
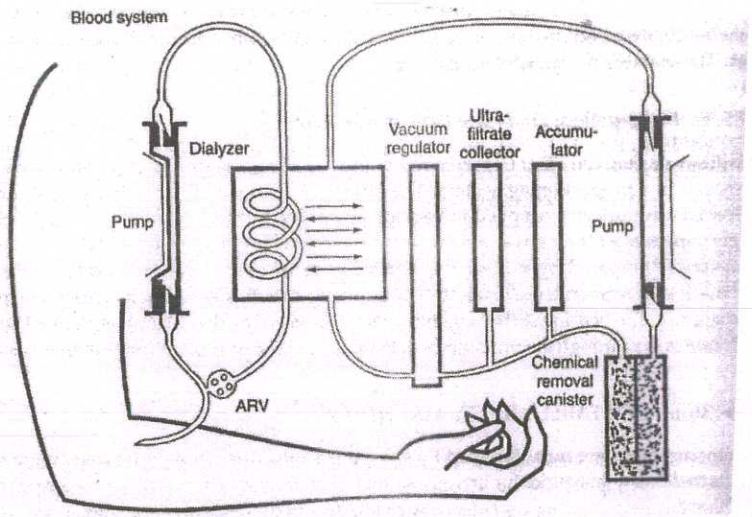


Fig 3+exp3 = 6

It is used to measure pH, PCO2, and Po2 from a sample of blood. Its built-in calculator can compute CO2, HCO3 and base excess. It has 3 sensors for pH, PCO2 and PO2. The circuit has three separate high input impendence amplifiers. Tow gasses of accurately known concentration of o2 and Co2 are required for the circuit functioning.

VIIa

working principle of a portable hemo-dialysis machine with a diagram



Dig 4 + Exp5 = 9

Hemodialysis is a process that involves the removal of toxic chemical substances from the blood by passing the blood through tubes surrounded by semi-permeable membranes. IThepatients blood is circulated through a special semi permeable coiled plastic tube made of cellophane. When Osmotic pressures are balanced, the toxins such as urea, creatinine and uric acid passes outside the tube and reaches dialysate solution.

Portable kidney machine or wearable artificial kidney (WAK) has been developed at the Lodge Moor Hospital UK. Current dialysis machine is bulky and dialysis patients find it inconvenient. Hence portablehemo-dialysis

machine are used. In the WAK system,

1. a single pump is used to pump both blood and dialysate.
2. This is accomplished by using silastic tubing ventricles with unidirectional valves. Unidirectional valve helps using single pump to pump blood in a pulsating manner to the machine.
3. The pump operates on rechargeable 12 V nickel cadmium battery.
4. The dialyzer used with the machine is a hollow fibre dialyzer. And the advantage is small size and disposable
5. The venous line bubble catcher is attached to the outside of the dialyzer to collect blood from the patient body.
6. In the figure above, the blood circuit is on the left and the dialvzing fluid circuit to the right.
7. The dialysate is drawn from the dialyzer into the canister (light weight container) which is a reservoir.
8. The accumulator expands and contracts with pulsation of pump to protect damage of membrane from sudden pressure change.
9. The blood then to an ultra filtration valve which creates a negative pressure on the dialysate solution to collect toxins from blood.

Blood flow through the machine is simple, blood comes from the patient into the blood pump ventricle, then to the inflow of the dialyzer. Purified blood out of the dialyzer reaches to the bubble-catcher and then to the patient.

The principle of operation of this machine is very simple. The dialyzing fluid is prepared in a 20 litre container. Water is collected though the inlet by the preparation circuit. The water is purified by passing through a disposable cartridge and then heated to 41°C in a temperature controlled chamber. The 41°C water passes out of the preparation circuit and into the mixture container. In that container, water is mixed with dialyzing fluid concentrate. The machine senses by weight when the container has the required quantity of mixture and then shuts down automatically."

VIIb **The functions of a Dialysis Machine**

1. Reducing the accumulation of waste products and water in the body.
2. Maintains the normal pH value of the blood.
3. Maintains/regulates constant blood pressure.
4. Maintains the creatinine and urea levels in urine.
5. Maintains/regulates blood sodium, potassium, sulphates etc in the blood
6. Removes the toxic substances from the body.

6X1=6

VIIIa **Ventilators - Pressure Cycling And Volume Cycling.**

Pressure and volume modes of mechanical ventilation are available as options in the current generation of ventilators, giving the doctors many choices when managing a mechanically ventilated patient. Ventilators can function cyclically. During inspiration, air or other gaseous mixture is pumped into the lungs. During expiration, the pressure is made to cease and air is taken from the lungs. This cycle is controlled by different ways. Accordingly we have the following types of ventilators :

1. Pressure-cycled ventilator.

The pressure-cycled ventilator, the inspiration is stopped when the gaseous mixture or air pumped into the lungs reaches a predetermined pressure. The pressure limit can be set during inspiration or expiration or both. These are simple in construction and reliable in operation. The benefit is a decreased risk of lung damage from high respiratory pressures.

4.5X2=9

2. Volume-cycled ventilator.

in the volume-cycled ventilator, a predetermined volume of gas is given to the patient for each breath. During inspiration the constant volume of air is sent to the lungs. It offers the safety of a pre-set tidal volume and minute ventilation but requires the clinician to appropriately set the inspiratory flow, flow waveform, and inspiratory time. During VCV, airway pressure increases in response to increased resistance and may increase the risk of ventilator-induced lung injury.

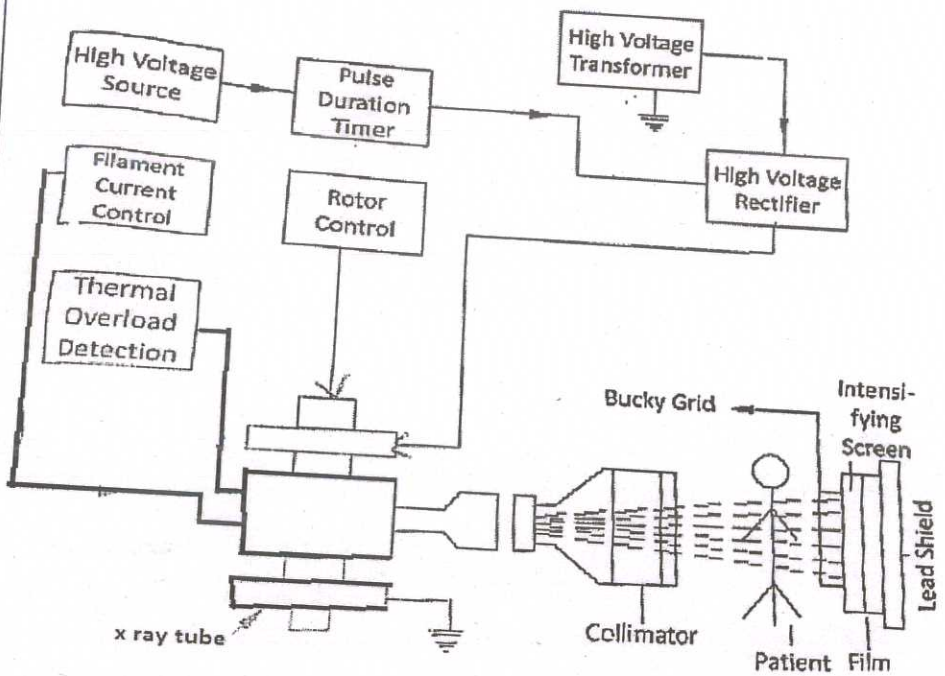
VIIIb **NEED FOR PACEMAKERS:**

1. for the treatment of cardiac rhythm disorders
2. For the treatment of Brady arrhythmias (ventricular rate of less than 60 beats per minute) a
3. For the treatment of tachy arrhythmias (having a ventricular rate of greater than 100 beats per minute)
4. in any pathological abnormalities in the SA node, AV node and His Purkinje system.
5. In the cases of heart block like AV node block and left-bundle branch block.
6. after cardiac surgery during recover period

6X1=6

IX a

Operation of an x-ray machine with a block diagram



Dig 4 + Exp 5 = 9

The basic components of a diagnostic X-ray machine are power supply arrangement, X-ray tube, aluminum filters, collimators, Bulky grid and lead shield. A high voltage source is an autotransformer which is used to get high voltages from 20 to 200 kV in the machine. There is a pulse duration timer which controls the exposure time so that the patient does not receive an excessive X ray. With the help of a High voltage rectifier, a high d.c voltage without any a.c ripples is generated. The filament current control provides the necessary current (mA) for the filament of the cathode in the X-ray tube. The filament heats the cathode and electrons are generated. These electrons are accelerated towards the anode. At the anode, these electrons strikes and X rays are emitted. The X-ray tube is the important element in the X ray machine. It can be a stationary anode or a rotating anode tube. The emitted X-rays contain a broad range of frequencies. With the help of Aluminum filters

lower X-ray frequencies can be absorbed. Between the patient and aluminum filter a collimator is placed which restricts the beam falling on the patient. A Bulky grid is placed between the patient and the film cassette to reduce scattered radiation and improve the sharpness of image. The density of the image in the film can be reduced by using image intensifiers. The cassette is loaded with a X-ray film in the dark room. The part of the body to be imaged is taken by adjusting the required parameters. (mAs, kvA etc.) The photographed image can be seen after" developing the X-ray film.

IX b

Precautions for handling x-ray machine.

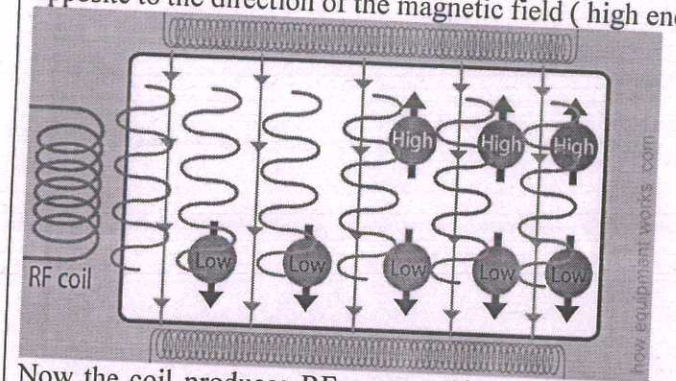
1. The place where the X-ray machine is installed must have proper grounding, and it should not affect the other equipment in the vicinity.
2. Lead shield are to be used wherever necessary to prevent radiation reaching other persons,
3. If the equipment has not been used for some amount of time, it should not be exposed immediately to take an X-ray, as it damages the X-ray tube.
4. The X-ray machine should be kept on for a few minutes to warm up the X-ray tube, and then only on X-ray is to be taken.
5. The X-ray technician should wear a lead apron (dress made of lead shields) while taking on X-ray.
6. Continuous monitoring of the dose received should be recorded for the personnel working in radiation installations.
7. The instruments such as pocket dosimeters, pecker type radiation alarm, and Film dosimeter are used to monitor the radiation dose received by individual.

Any 6X1=6

X a

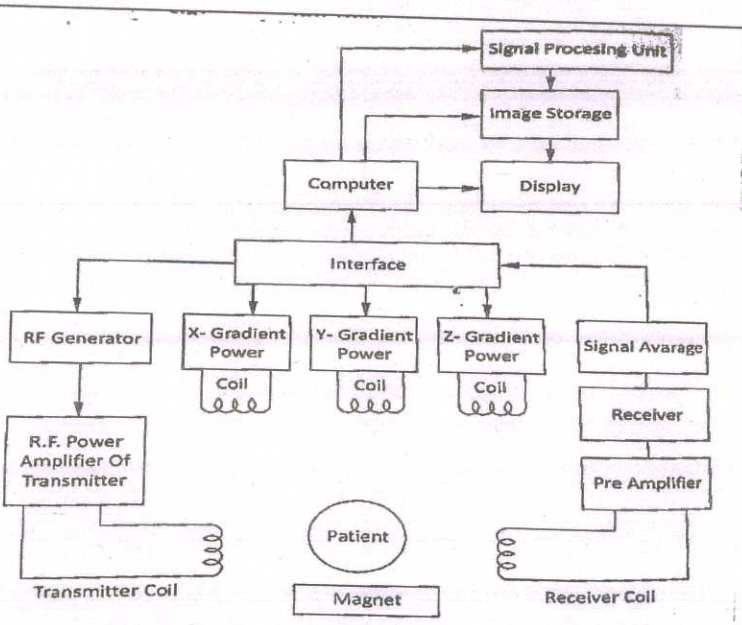
Working principle of nuclear magnetic resonance imaging system

The MRI machine is able detect hydrogen nucleus. It only sees the hydrogen nuclei contained in water molecules. Hydrogen nuclei have a quantum physics property called "spin " . Magnetic resonance imaging, as the name implies, makes use of a magnet. The strong magnetic field makes the spins of the hydrogen nuclei line up along the magnetic field (Low energy) and some hydrogen nuclei line up opposite to the direction of the magnetic field (high energy)



Now the coil produces RF energy. Those hydrogen nuclei with low energy absorb the energy sent from the RF coil and become high energy nuclei. After a short period, the RF energy is stopped. The hydrogen nuclei that recently became 'high energy' goes back to 'low energy' state and release the energy that was given to them. They release the energy in the form of waves. The MRI machine has "receiver coils that receive the energy waves sent out by the nuclei. The receiver coil converts the energy waves into an electrical current signal. In this way, the MRI machine is able to detect hydrogen nuclei in the body. The MRI machine however needs to scan the body in an organized manner. It needs to record signals from hydrogen nuclei in one area before moving onto the next. This principle is called NMR (nuclear magnetic resonance)

Fig 4 + Exp 5 =9



Magnet provides steady strong uniform magnetic field. Super conducting magnets are used- coil cooled by liquid helium to produce strong magnetic filed of 1.5 Tesla. The patient is kept in this gradient field space. X,Y and Z gradient coil produce time varying controlled spatially non uniform magnet field in different directions or portion of the body by superposition. Or simply the X,Y and Z coils makes non uniform magnetic fields on patents boy by super position principle . Since every point on the body has different magnet filed, the resonant frequency of the hydrogen nucleus is different at every point on the body. Transmitter provides RF signal pulses at different scanning frequencies to scan different points on the body. On receiving RF wave pulses of varying frequency, corresponding hydrogen nuclei excites to higher energy stage and on return to lower energy stage, the radiate. These radiations are picked up by the receiver coils. These signals are processed by computer using Fourier transform to produce 2D or 3D image

Xb **Electrical safety consideration with respect to machine operators and Patients**

Electrical safety is very important in hospitals as patients may be undergoing a diagnostic or treatment procedure where the protective effect of dry skin is reduced. Also patients may be unattended, unconscious or anaesthetised and may not respond normally to an electric current. Further, electrically conductive solutions, such as blood and saline, are often present in patient treatment areas and may drip or spill on electrical equipment. Injuries received from electric current are dependent on the magnitude of current, the pathway that it takes through the body and the time for which it flows.

To provide safety to machine operator and patient following things to be considered

1. Use only a tree-wire power cable.
2. Supply all electrical equipment within 5m of the patient from a single bank of power points that have grounded terminals tied together by 12 gauge or larger wire.
3. Do not use any other electrical outlets in the vicinity of the patient.
4. Supply the power points from a power line isolation transformer with ground fault monitors.
5. Connect the conductive surfaces of all non-electrical devices to a common ground.
6. Check the power cords for sings of damage and ground continuity from the plug to the equipment case.
7. Use monitoring equipment with isolated inputs.
8. With all the equipment turned on, measure the potential between the common ground terminals and all the conductive surfaces within 5m of the patient. No surface should be more than 5mV from the ground.
9. There should be periodic inspection of all the equipment and regular checks on ground continuity.

Any 6X1=6