Explain the Cell Structure

The basic living unit of the body is a cell. Each organ in our body is an aggerate of many different cells held together by intercellular supporting structures. Each type of cell is meant for performing one particular function. Each cell consists of a centrally located nucleus, also called cell core, surrounded by cytoplasam. The nucleus is separated from the cytoplasam is separated from the surrounding fluids by a cell membarane. The different substances that make up the cell one collectively called protoplasam which is mainly composed of water, electrolytes, proteins, carbohydrates and lipids.

What are the applications of piezo electric sensors?

1) In cardiology
2) In phono cardiography
3) In blood pressure measurement
4) In measuring physiological accelerations

What are the different thermal sensors?

1) Thermo couples
2) Thermistors
3) Radiation sensors
4) Fibre optic detectors

Give the different types of inductive sensors.

1) Self inductance type
2) Mutual inductance type
3) Differential transformer type (LVDT)

What are the advantages of LVDT?

1) Wide range of linearity
2) Change of phase by 180 Deg When the core passes through the center position
3) Full-scale displacement is 0.1- 250mm.
4) Sensitivity is 0.5- 2 mV.

What are the limitations of capacitive sensor?

1) Inadequate for measuring most physiological variables because of their low frequency components.

What is the principle of piezo electric sensors?

The piezo electric materials generate an electric potential when mechanically strained. Conversely, an electric potential can cause physical deformation of the materials

Define Resting Potential

Certain type of cells within the body such as nerve and muscle cell are encased in a semi permeable membrane that permits same substances to pass through the membrane, while others are kept out, surrounding the cells of the body are the body fluids which are conductive solutions of charge ions. The principal ions are sodium(na+), Pottasiuum(e+) and

chloride(cl-) the membrane of the excitable cells readily permits entry of potassium and chloride ions but blocks the entry of sodium ions .since the various ions seek balance between inside the cell and outside. Equilibrium is reached with the potential difference across the membrane –ive on the inside and +ive on the outside of the cell. This membrane potential is called the resting of the cell.

Define Action Potential

When a section of cell membrane is excited by a flow of ionic current or same form of externally applied voltage the membrane changes its permeability and begins to allow to some of the sodium ions to enter. This movement of sodium ions into the cell results in an ionic current flow that further reduces the barrier of membrane to sodium ion rush into the cell to try to reach to balance with the ions outside. At the same time potassium ions which were higher in the concentration inside the cell during the resting stage try to leave the cell, but are unable to move as rapidly as sodium ions. As a result the cell has a slightly positive potential on the due to imbalance of potassium ions. This +ive potential is called action potential and this approximately +20mv .A cell in the action potential stage is said to be depolarized. The process of changing from resting stage to action potential stage is called depolarization.

Explain Bioelectric Potential

Bioelectric potential are generated at a cellular level. that is each cell is a minute voltage generator .because positive and negative ions tend to concentrate unequally inside and outside the cell wall, a potential difference is established and the cell becomes a tiny biological battery. In the normal resting state of the cell it interior is negative with respect to the outside when the cells “fires” however, the outside of the cell becomes momentarily negative with respect to the interior .A short time later, the cell regains the normal state in which the inside Is again negative with respect to outside. This “discharging” and “recharging” of the cell known as depolarization and repolarisation respectively.

Name the factors that are considered in the design of biomedical instrument system.

1.Range
2.Sensitivity
3.Linearity
4.Frequency Rsponse
5.Accuracy
6.Stability
7.Isolation
8.Simplicity
9.Signal to noise ratio.

Name the physcological systems of the body.

1. Bio chemical System 2. Cardio vascular System
3. Regualted System 4. Nervous System

State the principal of the sodium pump

Once the rush of sodium ions through the cell membrane has stopped that is a new stage of equilibrium is reached, the ionic currents that lowered the barrier to sodium ions are no longer present and the membrane comes back into its original selectively permeable condition, where in the passage of sodium ions from the outside to inside of the cell is again blocked. This take a long time for the resting potential to develop again .But by the active process called sodium pump, the sodium ions are quickly transported outside of the cell and the cell again becomes polarized and assumes its resting potential. This process is called repolarisation.

Name the different types of electrodes:

1.Micro Electrode
A) Mettalic
B) Non –Metallic
2.Depth and needle Electrode
3.Surface Electrode

What are the requirements of physiological signal amplifier or biomedical pre amplifier?

a) The voltage gain should be more than 100 db.
b) It should have low frequency response.
c) There is no drift in the amplifier.
d) The output impedance of the amplifier should be very small.

What are the different modes of operation of differential amplifier?

a) Single ended mode b) differential mode
c) common mode

What is single ended mode?

When either v1 or v2 is equal to zero, the operation of the differential amplifier is known as single ended mode of operation.

What is differential mode?

The two input signals are equal but have opposite polarity at every instant of time. Vo=Rf/Ri(V2-V1). In this case, the input signals are called differential mode signals.

What is common mode signal?

The input voltages appearing at the input terminals 1 and 2 are identical both in amplitude and phase at every instant of time and the circuit is said to be in common mode. V1=V2=Vcm; Vo=0.

What is CMRR in a differential amplifier?

It is the ratio of the amplification of the differential voltage ti the amplification of the common mode voltage. CMRR=Ad/Ac. ;CMRR in db=20 log10 CMRR.

What is noise figure?
It is defined as the ratio of the signal to noise ratio at the input to the signal to noise ratio at the output.

What are the advantages of the pre amplifier or instrumentation amplifier?
a)high stability
b)higher fidelity
c)high CMRR
d)high input impedance with the required gain.

What is chopper amplifier?
The chopper amplifier is used convert the dc or low frequency signal into a high frequency signal. Then this modulated high frequency signal is amplified by conventional ac amplifier. Then this is demodulated and filtered to get low frequency or dc signal.

What are the types of chopper amplifier?
a) mechanical chopper amplifier.
b) non mechanical chopper amplifier.

Neuron:
Neurons (also known as neurons, nerve cells and nerve fibers) are electrically excitable cells in the nervous system that function to process and transmit information. Neurons are typically composed of a soma, or cell body, a dendritic tree and an axon. The majority of vertebrate neurons receive input on the cell body and dendritic tree, and transmit output via the axon. Neurons communicate via chemical and electrical synapses, in a process known as synaptic transmission

What is Electrocardiography?
It deals with the study of the electrical activity of the heart muscles. The potentials originated in the individual fibers of heart muscle are added to produce the ECG waveform.

What are the various parts of generalized instrumentation system?
1. Measurand
2.Primary sensing element
3.Variable conversion element
4.Signal processing unit
5.Output display
6.Control & feedback element

Give the classifications of biomedical instruments.
i) According to the quantity that is sensed, pressure, flow or temperature sensing devices.
ii) According to the principle of transduction used, resistive, inductive, capacitive, ultrasonic or electrochemical devices.
iii) According to the measurement techniques, cardio vascular, pulmonary, nervous & endocrine systems.

iv) According to the clinical medical specialities, pediatrics, obstetrics, cardiology or radiology.

What are the different types of ECG lead configurations?
Bipolar limb leads
Augmented unipolar limb leads
Chest leads
Frank lead system

Define the Einthoven Triangle
The closed path RA to LA to LL and back to RA is called Einthoven triangle. According to Einthoven, in a frontal plane of the body, the cardiac electric field vector is a two dimensional one.

What are the important parts of ECG recorder?
Patient cable and defibrillator protection circuit.
Lead selector switch
Calibrator
Bio- amplifier
Auxilliary amplifier
Isolated power supply
Output unit
Power switch

What is Electroencephalography?
It deals with the recording and study of electrical activity of the brain. By means of electrodes attached to the skull of a patient, brain waves can be picked up and recorded.

What is Electromyography?
It is the science of interpreting and recording the electrical activity of the muscles action potentials. Meanwhile, the recording of the peripheral nerve's action potential is called electroneurography.

What is Electrooculography?
It deals with the recording of the corneal- retinal potentials associated with eye movements.

What is Electroretinography?
It deals with the recording and interpreting of the electrical activity of the eye. If the illumination of the retina is changed, the potential changes slightly in a complex manner. The recording of these changes is called Electroretinograph.

List the brain waves and their frequency.
Alpha- 8 to 13Hz, Beta-13 to 30 Hz , Theta- 4 to 8 Hz, Delta- 0.5 to 4 Hz.

Define latency.
It is defined as the elapsed time between the simulating impulse and the muscle's action potential.

What are the different sounds made by the heart?
Valve closure sounds, Ventricular filling sounds, Valve opening sounds, Extracardiac sounds

Name the parts of the heart conduction system.
Sino atrial node, Atrio ventricular node, Bundle of His , Purkinje fibres.

What is the colour coding of the different leads?
White –RA, Black- LA, Green- RL , Red- LL, Brown- Chest

Mention any four specifications of the ordinary ECG recorder.
Maximum sensitivity – 20 mm/mV, Input impedance –5 mega ohms, Output impedance - <100 ohms, CMRR- 10000:1.

What are the types of measurements of blood pressure?
1. Indirect or noninvasive method.
2. Direct or invasive method.

How is the blood pressure measured in the indirect method?
The indirect method of measuring blood pressure involves the use of a sphygmomanometer and a stethoscope. The sphygmomanometer consists of an inflatable pressure cuff and a mercury or aneroid manometer to measure the pressure in the cuff. The cuff is normally manually inflated, with a rubber bulb and deflated slowly through a needle valve.

Explain the principle of sphygmomanometer.
The sphygmomanometer works on the principle that when the cuff is placed on the upper arm and inflated, the arterial blood can flow past the cuff only when the arterial pressure exceeds the pressure in the cuff. Furthermore, when the cuff is inflated to a pressure that only occludes the brachial artery, turbulence is generated in the blood as it spurts through the tiny arterial opening during each systole. The sounds generated by this turbulence, Korotkoff sounds, can be heard through the stethoscope placed over the artery downstream from the cuff.

What are the methods involved in direct blood pressure measurement?
1. Auscultatory method
2. Palpatory method
Auscultatory method locate the systolic and diastolic pressure valves by listening to the Korotkoff. Diastoslic pressure can be easily measured. Palpatory method is a alternative method that the physician identifies the flow of blood in the artery by feeling the pulse of the patient downstream from the cuff instead of listening for the korotkoff sounds. In this method, systolic pressure can be easily measured.

What is meant by mean arterial pressure(MAP)?

Mean Arterial pressure is the weighted average of the systolic and diastolic pressure MAP falls about one- third of the way between the diastolic low and systolic peak. Formula for calculating MAP is, MAP = 1/3 (systolic –diastolic) + diastolic

What are the methods involved in direct blood pressure measurement?

1. Percutaneous insertion
2. Catheterization(Vessel Cutdown)
3. Implantation of a transducer in a vessel or in the heart.
4. Other methods such as clamping a transducer on the intact artery have also been used. But they are not common.

Explain the two ways involved in measurement of blood pressure with a catheter?

Measurement of blood pressure with a catheter can be achieved in two ways.

1. The first is to introduce a sterile saline solution into catheter so the fluid pressure is transmitted to a transducer outside the body a complete fluid pressure system is set up with provisions for checking against atmospheric pressure and for establishing a reference point. The frequency response of this system is a combination of the frequency response of the transducer and the fluid column in the catheter.
2. In the second method, pressure measurements are obtained at the source. Here, the transducer is introduced into the catheter and pushed to the point at which the pressure is to be measured, or the transducer is mounted at the tip of the catheter. This device is called a catheter-tip blood pressure transducer.

Discuss the technique involved in direct measurement?

1)A catheterization method involving the sensing of the blood pressure through a liquid column. In this method the transducer is external to the body and the blood pressure is transmitted through a saline solution column in a catheter to this transducer.

2) A catheterization method involving the placement of the transducer through the catheter at the actual size of measurement

In the bloodstream or by mounting the transducer on the tip of the catheter.

3) Percutaneous methods in which the blood pressure is sensed in the vessel just under the skin by the use of a needle or catheter.

4) Implantation techniques in which the transducer is more permanently placed in the blood vessels or the heart by surgical methods.

What are the different types of bloodflow meters?

1)Magnetic bloodflowmeter –Based on the principle of Magnetic induction.

2)Ultrasonic bloodflowmeter-Based on the principle if Doppler.

3)Thermal convection-The rate of cooling is proportional to the rate of the flow of the medium.This principle is also used to measure the gasflow.

4)Determination by Radiographic method-By the injection of a contrast medium into a

bloodvessel,the circulation pattern can be made visible.Record of the X-ray image,obstruction can be detected and the bloodflow in the bloodvessels can be estimated.This technique is known as ‘angiography’.

What is cardiac output?

The bloodflow at any point in the circulatory system is the volume of blood that passes that point during a unit of time.It is measured normally in millimeter per min or litres per min.Blood flow is highest in the pulmonary artery and the aorta,where the blood vessels leave the heart.The flow at these points is called ‘cardiac output’.

What is meant by pH?

pH can be defined as the logarithm of the reciprocal of the H+ ion concentration.It is a measure of the acid-base balance of a fluid.

$pH = - \log_{10} [H^+] = \log_{10}(1/[H^+])$

What is the pH value for blood?

The pH value of normal arterial blood ranges between 7.38 and 7.42.The pH of venous blood is 7.35,because of the extra CO_2.

Define GSR.

GSR is used for measuring variations in perspiration. In response to an external stimulus, such as touching a sharp point, the resistance of the skin shows a characteristic decrease and this is known as Galvanic Skin Response. The GSR is believed to be caused by the activity of the sweat glands.

Give the name of the instrument used for respiratory volume measurements and what are its types?

The most widely used instrument for respiratory volume measurements in the recording spirometer.The different types of spirometer are

· Standard spirometer
· Waterless spirometer
· Wedge spirometer
· Electronic spirometer
· Broncho spirometer

Give the name of the instrument used for measuring airflow and explain its principle.

Pneumotachometer can be used for measuring airflow. This device utilizes the principle that air flowing through an orifice produces a pressure difference across the orifice that is a function of the velocity of the air.

Define MVV.

Maximal voluntary ventilation is a measure of the maximum amount of air that can be breathed in and blown out over a sustained interval, such as 15 or 20seconds.

What is FVC?

Forced Vital Capacity (FVC) is the total amount of air that can forcibly be expired as quickly as possible after taking the deepest possible breath.

What is FRC?
The functional residual capacity (FRC) is the volume of gas remaining in the lungs at the end expiratory level. It the sum of the residual volume and the expiratory reserve volume.

Differentiate between tidal volume and residual volume.
The tidal volume (TV) or normal depth of breathing, is the volume of gas inspired or expired during each normal, quiet, respiration cycle. The residual volume (RV), is the volume of gas remaining in the lungs at the end of a maximal expiration.

Define total lung capacity.
Total Lung Capacity is the amount of gas contained in the lungs at the end of a maximal inspiration .It is also the sum of residual volume and vital capacity.

Which are the elements of bio-telemetry system?
The essential elements are biological signal, transducer, conditioner, transmission link.

What are the types of radio telemetry systems?
Single channel telemetry system
Radio telemetry with a sub-carrier
Multiple channel telemetry system

What are the types of multiple channel telemetry systems?
Frequency system multiplex
Time division multiplex

What are the measurements in single channel telemetry system?
Active measurements
Passive measurements

What are the types of transducer used in ultrasonography?
Linear
Sector
Convex array

What are the types of display modes used in ultrasonography?
A-mode
B-mode
M-mode

What are the recording devices used in ultrasonography?
Strip chart recorder
Video printer
Video recording
Polaroid camera

What are the artifacts in ultrasonography?
Related to instrument problems

Improper operator technique
Due to interaction of sound.

Give the characteristics of X- Ray radiation .
When the fast moving electrons enters into the orbit of the anode material atom, its velocity is continuously decreased due to the scattering of the orbiting electrons. Thus the loss of energy of that incident electron appears in the form of continuous X-Rays or white X-Rays which are called Bremsstrahlung Radiation.

Define Efficiency.
Effiency is defined as the ratio of X-Ray beam energy to the electron beam energy which is normally 1.4*10-9ZVA. Where Z is the atomic number of anode material ,VA anode voltage normally in diagnosing radiology ,tungsten is used as the anode material which has high melting point of about 33700C its atomic number Z=74
The minimum wavelength emitted by the X-Ray is given by lmin
= hc/eva
= 12408/VA Ao

What is meant by soft and hard X-Ray?
The anode voltage increases the l min decreases and hence X-Rays are called as hard X-Ray .These are mainly used for therapeautic purpose .If the anode voltage VA decreases then lmin increases and these are called soft X-Ray .

List the basic components of X-Ray Machine
1.Power supply arrangement
2.Collimator
3.Diaphragm
4.Flim
5.Lead shield

Define contrast.
It is a measure of darkness of a desired image compare to its surroundings. The contrast between two tissues is given by
C 12=10log I1/I2 Db

State the use of Bucky Diaphragm.
It is introduced between the patient and the film to improve the sharpness of the image .It consists of thin lead veins separated by spaces of a low attenuation material. The lead veins are usually angled so that the primary radiation which carries the information can pass between them while these scattered radiation from the object are observed

Why aluminum filter is used in X-Ray tube.
The emitted rays of unwanted frequencies increase the patient those and the decrease the image contrast. Aluminum filters observes the lowest X-Ray frequency and hence the intensity of low X-Ray frequencies incident on the patient is ready in use Hence the negative effects produce by low frequency X-Rays are reduced.

Explain the function of collimator

Between the patient and the X-Ray tube the collimator is placed .I t is an aperture diaphragm which restricts the beam falling on the patient. the necessary shaping of the X-Ray beam is done by it

State the classification of Artifact

It can be classified into 4 types
1.Noise Artifact
2.Motion Artifact
3.Artifact due to high differential absorption in the adjacent tissue
4.Technical errors and computer Artifacts.

Define NMR

In the presence of large magnetic field the spinning of nucleus in the atom and its axis of rotation willprecess about the magnetic field. Each spin state has different energy. At equilibrium, the lower state has more nuclei than the higher state. Using RF radiation with an energy exactly equal to the energy difference between two nuclear energy states. One state can achieve population inversion by raising the nuclei from the lower energy states to the higher energy state .The excited nuclear spins will slowly return to its equilibrium. Emitting the RF called Nuclear Magnetic Resonance

What is a pacemaker?

Pacemaker is an electrical pulse generator that starts or maintains the normal heart rhythm (i.e) application of electrical pulses to the heart is pacing action.

Explain the classification of pacemaker?

Pacemaker is broadly classified into internal & external pacemaker.
Total AV block requires internal pacemaker. It has a mini energy of 10µJ-100µJ (5V,10mA,2ms).At a level of 400µJ, it causes Ventricular Fibrillation. Cardiac Standstill is obtained by external pacemaker.

What are the types of pacemaker?

i. Ventricular synchronous(fixed rate pulse)
ii. Ventricular asynchronous(stand by pacemaker)
iii. Ventricular inhibited(demand pacemaker)
iv. Atrial synchronous pacemaker.
v. Atrial sequential ventricular inhibited pacemaker.

Explain the application of ventricular asynchronous or stand by pacemaker?

Ventricular asynchronous orstand by pacemaker is basically a simple astable multivibrator that produces a stimulus at a fixed rate irrespective of the heart rhythm.

What are the application of ventricular inhibited pacemaker?

i. The R wave inhibited pacemaker allows the heart to pace at its normal rhythm

when it is able to. If the R wave is missing for a preset period of time, the pacer will supply a stimulus.
ii. When the sensor (shielded inside the pacemaker) is slightly stressed or bent by the patient's body activity, the pacemaker can automatically increase or decrease its rate.Thus it can match with the greater physical effort.

What is the application of atrial synchronous pacemaker?
i. This type of pacing is used for young patients with a mostly stable block.
ii. It is used in stress testing & coronary artery diseases, in the evaluation of severity of mitral stenosis & in the evaluation of various conduction mechanisms.
iii. It has been used to terminate atrial flutter & paroxymal atrial tachycardia.
iv. It can act as a temporary pacemaker for the atrial fibrillation.

What is an atrial sequential ventricular inhibited pacemaker and mention its advantage?
Atrial sequential ventricular inhibited pacemaker has the capability of stimulating both the atria & ventricles and adopt its method of stimulation to the patient's need .If atrial function fails, this pacemaker will stimulate the atrium & then sense the subsequent ventricular beat.

What is a defibrillator?
A defibrillator is an electronic device that creates a sustained myocardial polarisation of a patient's heart inorder to stop ventricular fibrillation or atrial fibrillation.

Explain ventricular fibrillation and how can it be eliminated?
Ventricular fibrillation is a serious cardiac energy resulting from asynchronous contraction of the heart muscle.This uncoordinated movement of ventricle walls of the heart may result from coronary occlusion, electric shock or abnormalities of body chemistry.

What are the different types of defibrillators?
i. Internal Defibrillator
ii. External Defibrillator
a. AC. Defibrillator
b. DC. Defibrillator
c. Synchronous DC. Defibrillator
d. Square Pulse Defibrillator
e. Double Square Pulse Defibrillator
f. Biphasic DC Defibrillator

What are the different types of oxygenator?
Bubble oxygenator
Film oxygenator

Membrane oxygenator
Liquid-Liquid oxygenator

Define Heart-Lung Machine?
Heart Lung machine replaces the functions of heart and lungs thereby providing the rest of the body with a continuous supply of oxygenated blood while the heart is stopped.

What are the requirements of ideal oxygenator?
Lower priming volume
Minimum trauma to blood
Simple, safe and reliable operation
Ensured sterilization
No microembolus formation and
Short preparation time

What is the principle of Liquid-Liquid oxygenator?
The oxygen dissolved fluorides organic fluid and blood are flowing in the opposite directions and oxygenation of the blood takes place.

What is the principle of membrane oxygenator?
Effective oxygenation is obtained when oxygen and blood are running in opposite directions through a thin porous membrane.

What is the principle of film oxygenator?
Here the film of blood is spread on a rotating disc or metal screen and an oxygen mixture flows over this thin layer of blood.

What is the principle of bubble oxygenator?
By bubbling the oxygen through a large column of blood and the making the flow of blood through a slanting path, the carbon di oxide is removed form the blood

Define oxygenator.
In oxygenator mixture of oxygen and 2 to 5 percentage of carbon dioxide is usually employed to avoid respiratory alkalosis. Every oxygenator should oxygenate upto 5 liters per minute of blood.

What are the types of blood pumps?
1.Pulsatile pumps
2.Non pulsatile pumps

Define heat exchanger
Heat exchanger is used to regulate the blood temperature and compensate for the heat exchange in or out of the oxygenato