# K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**


# QUESTION BANK

Subject Code/Subject: **EC8073 / MEDICAL ELECTRONICS**

## UNIT-I

## ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING

***The origin of Bio-potentials; biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, lead systems and recording methods, typical waveforms and signal characteristics.***

### Part – A (2 Marks)

**1. Explain the Cell Structure.**

The basic living unit of the body is a cell. Each organ in our body is an aggregate 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 cytoplasm. The nucleus is separated from the cytoplasm is separated from the surrounding fluids by a cell membrane. The different substances that make up the cell one collectively called protoplasm, which is mainly composed of water, electrolytes, proteins, carbohydrates and lipids.

**2. What are the applications of piezo electric sensors?**

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

**3. Define Resting Potential.**

Resting potential is defined as the electrical potential of an excitable cell relative to its surroundings when not stimulated or involved in passage of an impulse. It ranges from -60mV to -100mV.

**4. Define Action Potential.**

Action potential is defined as the change in electrical potential associated with the passage of an impulse along the membrane of a cell.

**5. 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 again negative with respect to outside. This "discharging" and "recharging" of the cell known as depolarisation and repolarisation respectively.

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

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

**7. Name the physiological systems of the body.**

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

**8. 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 restrict potential. This process is called repolarisation.

**9. Name the different types of electrodes.**

1. Micro Electrode
    a) Metallic
    b) Non –Metallic
2. Depth and needle Electrode
3. Surface Electrode

**10. 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.

**11. What are the different modes of operation of differential amplifier?**

a) Single ended mode
b) Differential mode
c) Common mode

**12. 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.

**13. What is differential mode?**

The two input signals are equal but have opposite polarity at every instant of time.

$Vo=R_f/R_i(V_2-V_1)$

In this case, the input signals are called differential mode signals.

**14. 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.

$V_1=V_2=Vcm$ $V_O=0.$

**15. 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.

**16. 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.

**17. 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.

**18. 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.

**19. What are the types of chopper amplifier?**

a) Mechanical chopper amplifier.
b) Non mechanical chopper amplifier.

**20. What is Electrocardiography?**

It deals with the study of the electrical activity of the heart muscles. The potentials Originated in the individual fibres of heart muscle are added to produce the ECG waveform.

**21. What are the various parts of generalized instrumentation system?**

**1.** Measured
**2.** Primary sensing element
**3.** Variable conversion element
**4.** Signal processing unit
**5.** Output display
**6.** Control & feedback element

**22. 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.

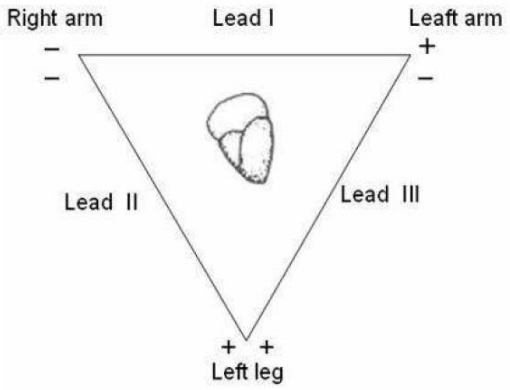
iii) According to the measurement techniques, cardio vascular, pulmonary, nervous & endocrine systems.

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

**23. What are the different types of ECG lead configurations?**

- ✶ Bipolar limb leads
- ✶ Augmented Unipolar limb leads
- ✶ Chest leads Systems.

**24. 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.

**25. What are the important parts of ECG recorder?**

- Patient cable and defibrillator protection circuit.
- Lead selector switch
- Calibrator
- Bio- amplifier
- Auxiliary amplifier
- Isolated power supply
- Output unit
- Power switch

**26. 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.

**27. 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.

**28. What is Electrooculography?**

It deals with the recording of the corneal- retinal potentials associated with eye movements.

**29. 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 Electroretinography.

**30. 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.

**31. Define latency.**

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

**32. What are the different sounds made by the heart?**

Valve closure sounds, Ventricular filling sounds, Valve opening sounds, Extra cardiac sounds.

**33. Name the parts of the heart conduction system.**

Sino atrial node, Atrio ventricular node, Bundle of His , Purkinje fibres.

**34. What is the colour coding of the different leads?**

White –RA, Black- LA, Green- RL, Red- LL, Brown- Chest

**35. 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.

**36. What is Electrode Potential?**

The voltage developed at an electrode-electrolyte interface is known as Electrode Potential.

**37. What is the purpose of electrode paste?**

The electrode paste decreases the impedance of the contact the artifacts resulting from the movement of the electrode or patient.

**38. Give the different types of Surface electrodes?**

- Metal Plate electrodes
- Suction cup electrodes
- Adhesive tape electrodes
- Multi point electrodes
- Floating electrodes.

**39. What is PH electrode?**

The chemical balance of human body is identified by measurement of Ph content of blood and other body fluids. PH is defined as logarithm of reciprocal of hydrogen ion concentration.

**40. Define polarized and non polarized electrode**.

Electrodes in which no net transfer of charge occurs across the metal electrolyte interface is called as perfectly polarized electrodes.

An electrode in which un hindered exchange of charge occurs across the metal electrode interface is called perfectly non polaraisable electrodes.

**41. What is plethysmograph?**

The instrument used for measuring blood volume is called plethysmograph.

**42**. **Write Goldman's equation?**

Vr=-kt/q{Pk(k+)i +(Pna+)I +Pcl(cl-)o/ Pk(k+)o+ Pna(Na+)o+Pcl(cl-)i

**43**. Define All or nothing law.

All or nothing law states that regardless of the method of excitation of cells or by the intensity of the stimulus, the action potential is same for any given cell.

**44. What is absolute refractory period?**

It is the time duration in which cell cannot respond to any new stimulus. Generally it is about 1ms in nerve cell.

**45. What is Relative refractory Period?**

It is one during which another action potential can be triggered but a higher stimulus is required to reinitiate the action potential and the subsequent contraction of muscles . Generally the relative refractory period is several milliseconds.

**46. Define Conduction Velocity**.

The rate at which an action potential moves down a fibre or propagated from cell to cell is termed as propagation rate.

**47. What are the characteristics of resting potential?**

- The value of potential is maintained as constant.
- It depends on temperature.
- Permeability varies

## UNIT - II

## BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT

***PH, PO2, PCO2, colorimeter , Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood cell counters.***

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### Part – A (2 Marks)

**1. What are the types of measurements of blood pressure?**

1. Indirect or non-invasive method.
2. Direct or invasive method.

**2. 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.

**3. 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.

**4. What are the methods involved in direct blood pressure measurement?**

1. Auscultatory method
2. Palpatory method

**Auscultatory method** locates the systolic and diastolic pressure valves by listening to the Korotkoff. Diastolic 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.

**5. 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**

**6. What are the methods involved in direct blood pressure measurement?**

1. Percutaneous insertion
2. Catheterization (Vessel Cut down)
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.

**7. 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.

**8. 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.

**9) What are the different types of blood flow meters?**

1) Magnetic blood flow meter –Based on the principle of Magnetic induction.

2) Ultrasonic blood flow meter-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 gas flow.

4) Determination by Radiographic method-By the injection of a contrast medium into a blood vessel, the circulation pattern can be made visible. Record of the X-ray image, obstruction can be detected and the blood flow in the blood vessels can be estimated. This technique is known as ‘angiography’.

**10) What is cardiac output?**

The blood flow 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 milli meter per min or litres per min. Blood flow are highest in the pulmonary artery and the aorta, where the blood vessels leave the heart. The flow at these points is called 'cardiac output'.

**11) 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.

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

**12) 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 $CO_2$.

**13) 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.

**14) 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 there cording spirometer. The different types of spirometer are

- Standard spirometer
- Waterless spirometer
- Wedge spirometer
- Electronic spirometer
- Broncho spirometer

**15) 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.

**16) 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.

**17) 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.

**18) 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.

**19) 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.

**20) 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.

**21. Mention various types of chemical electrodes**.

Hydrogen electrode, ph electrode, po2 electrode, pco2 electrode.

**22. Define circulation and respiration?**

We can define from the engineering point of view, the circulation is a high resistance circuit with a large pressure gradient between the arteries and veins. The exchange of any gases in any biological process is termed as respiration

**23. What is mean by transducer?**

It is a device which detects or senses the bio signal and converts it in to an electrical signal for bio signal processing

**24.What are the different methods to measure the blood pressure?**

1. Indirect method using sphygmomanometer.
2. Direct method.

**25.What is the use of blood flowmeter in bio medical instrumentation?**

Blood flow meters are used to monitor the blood flow in various blood vessels and it also helps to measure cardiac output.

**26. Give some applications of electromagnetic blood flow meters.**

Blood flow measurements during cardiac surgery, blood flow measurements during shunt operations, blood flow measurements during carotid artery, blood flow measurements in rural arteries, blood flow measurements during organ transplantation.

**27**. **What are the two methods for counting the blood?**

1. Conductivity method, 2. Laser based cell counting method.

**28. What happens when there is a fall in cardiac output?**

A fall in cardiac output may result in low blood pressure, reduces tissues oxygenation, acidosis, poor renal function and shock.

**29. What are the different types of dilution methods?**

Indicator dilution method, Dye dilution method, Thermal dilution method.

**30. How Cardiac output is measured in thermal dilution method?**

A thermal indicator of known volume introduced into either the right or left atrium will produce a resultant temperature change in the pulmonary artery or in the aorta respectively, the integral of which is inversely proportional to the cardiac output.

Cardiac output=a constant X(blood temp-injectate temp)/area under dilution curve.

**31. What is the use of blood flow meter in bio medical instrumentation?**

Blood flow meters are used to monitor the blood flow in various blood vessels and it also helps to measure cardiac output.

**32. What are the two different principles used in ultrasonic blood flow measurement?**

- Transit Time method: In this method, a piezo electric crystal emits a brief pulse of ultrasound which propagates diagonally across the blood vessel.
- Doppler effect based method: In this method, as per Doppler effect, there is a change in frequency of reflected ultrasonic wave, due to motion of blood , when it crosses blood.

**33. Define transit time principle of ultrasonic blood flow meter.**

- In Transit time method a piezo electric crystal emits a brief pulse of ultrasound which propagates diagonally across the blood vessel.
- The pulse reaches a receiving crystal situated on the opposite side wall of the blood vessel.
- Electronic circuitry attached externally interprets transit time to velocity.

**34. What is Sphygmomanometer?**

- Sphygmomanometer is a device used by the physician to measure blood pressure.
- It is used for indirect BP measurement and it consists of inflatable rubber bladder called the cuff, a rubber squeeze ball pump and value assembly and a manometer.

**35. What is korotkoff sound?**

In the BP measurement, when the systolic pressure exceeds the cuff pressure, then the doctor can hear some crashing, snapping sound through the stethoscope. This is known as korotkoff sound.

**36. What is cardiac output?**

Cardiac output is the amount of blood delivered by heart to the aorota per minute.

**37. What are the various methods to measure cardiac output?**

Ficks method, Indicator dilution method, Measurement of impedance change.

**38. Differentiate systolic and diastolic pressure.**

- The maximum pressure reached during cardiac output is called systolic pressure.
- The maximum pressure occurring at the end of ventricular relaxation is termed as diastolic pressure.

**39. What are the two types to measure pulse rate?**

Transmittance method, Reflectance method.

**40. What is a colorimeter?**

Colorimeter is otherwise called flame photometer, which is used for measuring transmittance and absorbance in the given solutions.

**41. What is the use of infrared thermometer?**

It is a device to measure skin surface temperature. It is used to locate breast cancer. It is also used to identify the spots in which blood circulation is poor.

## UNIT – III

## ASSIST DEVICES

**Cardiac pacemakers, DC Defibrillator, Dialyzer, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.**

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### Part – A (2 Marks)

**1. Define circulatory system**

It is a type of transport system. It helps in supplying the oxygen and digested food to different parts of our body and removing CO2 from the blood. The heart is the center of the circulatory system.

**2. Define heart, lung?**

Heart is a pumping organ which eats regularly and continuously for years. It beats seventy times a minute at rest. Contraction is systole and relaxation is diastole.

**3. Define circulation and respiration?**

We can define from the engineering point of view; the circulation is a high Resistance circuit with a large pressure.

**4. Different methods of stimulation**

External stimulation, internal stimulation

**5. What is a Defibrillator?**

A defibrillator is an electronic device that creates a sustained myocardial depolarization of a patient s heart in order to stop ventricular fibrillation or artial fibrillation.

**6. What are the measurements in single channel telemetry system?**

Active measurements
Passive measurements

**7. 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.

**8.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.

**9.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.

**10.Explain the application of ventricular asynchronous or stand by pacemaker?**

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

**11.What is 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.

**12.What is the application of Atrial synchronous pacemaker?**

iii. This type of pacing is used for young patients with a mostly stable block.

iv. It is used in stress testing & coronary artery diseases, in the evaluation of severity of mitral stenosis & in the evaluation of various conduction mechanisms.

v. It has been used to terminate Atrial flutter & paroxysmal Atrial tachycardia.

vi. It can act as a temporary pacemaker for the Atrial fibrillation.

**13.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 adopts 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.

**14.What is a defibrillator?**

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

**15.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.

**16.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

**17.What are the components of pacemaker?**

The pacemaker consists of

1. Pulse Generator
2. Electrodes
3. Battery

**18.List the specifications of pacemaker?**

1. Weight – 33 to 98 grams
2. Reliability – 3.5 to 18 years
3. End of Life Indicator - 2 to 10 % drop in pulse rate.
4. Pulse amplitude – 2.5 to 10 V
5. Pulse Width – 0.1 to 2.3 ms
6. Battery capacity – 0.44 to 3.2 Amps/Hour

**19.Differentiate Internal and External Pacemaker.**

| S.No | Internal Pacemaker | External Pacemaker |
|---|---|---|
| 1 | Surgically implanted near the chest or abdomen | Placed outside the body in the form of wrist watch or in the pocket. |
| 2 | MyoCardiac Electrodes are applied to the heart | Endocardiac Electrodes are applied to the heart |
| | Battery can be replaced only by minor surgery with the help of doctor | Battery can be replaced without the help of doctor and minor surgery |
| 3 | During placement swelling and pain are due to maximum foreign body reaction | No swelling or pain as it is externally placed. |
| 4 | There is 100% safety for the circuit from external disturbances. | This is not as safe as Internal Pacemaker. |
| 5 | Used for permanent heart regularity | Used for temporary heart regularity |

**20.What is the problem of AC Defibrillation?**

Since ventricular fibrillation is more dangerous than atrial fibrillation, successive methods are adopted to correct it.

When atrial fibrillation is corrected by electrical shock then serious ventricular fibrillation occurs.

**21. What are the batteries used for implantable pacemaker?[N/D 2012]**

The batteries used for implantable pacemakers are (i) Mercury cell (ii) Lithium cells (iii) Nuclear cell

**22. What types of electrodes are used in a defibrillator? [A/M 2005]**

The electrodes used in a defibrillator are

(i)Internal electrodes - Spoon shaped
(ii)External electrodes -Paddle shaped

23.**Calculate the energy stored in 16μF capacitor of a DC defibrillator that is charged to a potential of 5000 Vdc.**

**Given Data:** C = 16μF V= 5000

$E = (1/2)\ CV^2$

$= (1/2)\ 16* 10^{-6}* 25 *10^{6}$

=**200 Joules**

**24. What are the three types of exchangers used in HEMODIALYSIS system? [M/J 2005]**

The three types of exchangers used in HEMODIALYSIS systems are

- Parallel Flow dialyzer
- Coil Hemodialyser
- Hollow Fiber Hemodialyser
-

**25.What is meant by fibrillation?[M/J 2009][A/M 2010]**

The condition at which the necessary synchronizing action of the hrart is lost is known as fibrillation. During fibrillation the normal rhythmic contractions of either atria or the ventricles are replaced by rapid irregular twitching of the muscular wall.

26. **What is the need for ventilator?**

It is used to provide artificial respiration. Artificial respiration should be applied to the patient, whenever respiration is suspended due to reasons like gas poisoning, electric shock etc.

**27.What is meant by defibrillation?**

Ventricular fibrillation can be converted into a more efficient rhythm by applying a high energy shock to the heart. This sudden surge across the heart causes all muscle fibers to contract simultaneously. The fibres may then respond to normal physiological pace making pulses. The instrument administering the shock is known as defibrillator. This process is known as defibrillation.

**28. For what purpose external stimulation and internal stimulation are employed?**

External stimulation is employed to restart the normal rhythm of the heart in the case of cardiac standstill. Internal stimulation is employed in cases requiring long term pacing because of permanent damage that prevents normal self triggering of the heart.

**29. What is a dialyzer?**

**Artificial kidney** is often a synonym for hemodialysis, but may also, more generally, refer to renal replacement therapies (with exclusion of kidney transplantation) that are in use and/or in development. This article deals with bioengineered kidneys/bio artificial kidneys that are grown from renal cell lines/renal tissue.

**30.What is an oxygenator?**

The oxygenator is designed to transfer oxygen to infused blood and remove carbon dioxide from the venous blood.

**31.What is an external pacemakers?**

Pulse generator is located outside the body and electrodes are introduced into the right ventricles via a catheter. It is used on patients with temporary heart irregularities and on patients during and after a cardiac surgery for temporary management of certain heart arrhythmias.

**32. What is an internal pacemaker?**

Pulse generator is placed inside the body in a surgically formed pocket and electrodes are introduced into the right ventricle or onto the surface of the myocardium. It is used on

patients with permanent heart arrhythmias such as permanent heart block.

33. **What is Competitive or fixed rate or asynchronous pacemakers?**

It discharges artificial pacing impulses at a "fixed rate" "asynchronously" with the natural pacing impulses thereby "competing" with any natural cardiac activity.

34. **What is Non-competitive pacemaker?**

It discharges artificial pacing impulses synchronously with the natural pacing impulses thereby not competing with any natural cardiac activity. Types: (i) Ventricular programmed and (ii) Atrial programmed.

**35. What is R-wave inhibited (demand) type pacemaker?**

R-waves discharge artificial pacing impulses at a fixed rate either in case of absence of natural R-waves or in case of fall of intrinsic heart rate below a preset value.

**36. What is R-wave triggered (standby) type pacemaker?**

It senses natural R-waves and discharges artificial pacing impulses either every time when it senses a natural R-wave or at a fixed rate in case of fall of intrinsic heart rate below a preset value.

**37. What are the important parameters of MRI?**

Spin density

Spin lattice (Longitudinal) relaxation time T1

Spin spin /Transverse relaxation time T2

**38. What is the frequency range of ultrasound employ in biomedical field?**

In biomedical applications of ultrasound employ frequencies in the range of 1 to 15 MHz.

## UNIT-IV

## UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY

***Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, biotelemetry***

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**Part – A (2 Marks)**

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

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

3. **What are the types of multiple channel telemetry systems?**
   - ✶ Frequency system multiplex
   - ✶ Time division multiplex

4. **What are the advantages of diathermy?**
   - The treatment can be controlled easily.
   - Use of appropriate electrodes permits the heat to be localised only in the region to be treated.

5. **What are the different types of diathermy?**
   The various types are
   Short wave diathermy.
   Microwave diathermy.
   Ultrasonic diathermy.

Surgical diathermy.

**6. What are two methods of short wave diathermy?**

Two methods are Capacitive method and Inductive method.

**7. Define Let-go current.**

Let-go current is the minimum current to produce muscular contraction.

For men ◊ about 16 mA.
For women ◊ about 10.5 mA.

**8. Define Macro shock.**

A physiological response to a current applied to the surface of the body that produces unwanted stimulation like tissue injury or muscle contraction is called as macro shock.

**9. Define Micro shock.**

A physiological response to a current applied to the surface of the heart that results in unnecessary stimulation like muscle contractions or tissue injury is called as micro shock.

**10. What are the different types of current?**

Threshold current, pain current, let-go current, paralysis current, fibrillation and defibrillation current.

**11. Define leakage current.**

Leakage current is an extraneous current flowing along a path other than those intended. It is due to –

I. Ungrounded equipment.
II. Broken ground wire.
III. Unequal ground potentials.

**12. What are the devices used to protect against electrical hazards?**

- ✶ Ground fault interrupter.
- ✶ Isolation transformer.

**13. Define Resuscitation unit.**

It plays a major role in intensive care unit (ICU). In modern hospitals, the resuscitation units are in the form of a mobile trolley.

Various equipments mounted on the trolley are:

- o Dual trace oscilloscope.
- o Heart rate meter.
- o Graphic recorder.
- o Dc defibrillator.
- o Pacemaker.

**14. What is Radio pill?**

Radio pill is used for telemetering continuous information about one or various variables from lumen of the gut. It contains transducer sensitive to pH, temperature and pressure.

**15. Explain the principle of Microwave Diathermy.**

In this method, the tissues are heated by the absorption of microwave energy. The frequency used is about 2415MHz with the corresponding wavelength of 12.25 cm.

**16. What are the precautions and disadvantages?**

a. Excessive dosage causes skin burns and the skin should be dry as the waves are rapidly absorbed by water.
b. Patients with in planted pacemaker should not undergo this treatment.

c. There are possibilities of overheating.
d. Care should be taken while the treatment is made near the eyes.

**17. What is ultrasonic diathermy?**

Ultrasonic diathermy is used for curing the diseases of peripheral nervous system, skeletal muscle system and skin ulcers. The heating effect is produced in the tissues when the absorption of ultrasonic energy. The absorption effect is similar to that of a micro massage.

**18. What are the problems in implant telemetry?**

1) The size and weight limitations are much more serious and reliability requirement is more critical.
2) Size, weight, surface condition and shape of the implant system will be affected by the body reaction.

**19. What are the advantages of biotelemetry?**

1) It is used to record the bio signals over long periods and while the patient is engaged in his normal activities.
2) Patient is not disturbed during recording.
3) For future reference or to study the treatment effect the biotelemetry is very helpful.
4) For recording on animals, particularly for research the biotelemetry is widely used.

**20. What is the significance of Ground Fault Interrupter (GFI)?**

It protects against the shock that occurs if a person touches the hot lead with one hand and ground with the other. It consists of a magnetic coil on which hot lead and neutral lead be bound with same number of turns but in opposite directions.

**21. What is the modulation techniques used for biotelemetry? Mention the reason for adopting that modulation scheme.[N/D 2004]**

The two different modulation techniques used for biotelemetry are i)Double Modulation ii)Pulse Width Modulation.

The purpose behind this **double modulation,** it gives better interference free performance in transmission, and this enables the reception of low frequency biological signals. The sub modulators can be a FM (frequency modulation) system, or a PWM (pulse width modulation) system or a final modulator is practically always an FM system.

**22. Specify the frequencies used for biotelemetry.[N/D 2012]**

Wireless telemetry system uses modulating systems for transmitting biomedical signals. Two modulators are used here. A lower frequency sub-carrier is employed in addition to very- high frequency (VHF). This transmits the signal from the transmitter.

**23. What is the principle of telestimulation? [A/M 2008]**

Telestimulation is the measurement of biological signals over long distance.

**24. What are the different types of current that are used for medical applications?**

The different types of current are Threshold current, pain current, let-go current, paralysis current, fibrillation and defibrillation current.

**25. What is meant by diathermy? [A/M 2010]**

Diathermy is the treatment process by which, cutting coagulation of tissues are obtained.

**26. What is the need for earthing of medical instruments?**

Grounding is needed in medical equipments to avoid the macro and micro shocks. The leakage current is also reduced by proper grounding.

**27. What is counter shock?**

The phenomenon of application of an electrical shock to resynchronize the heart is known as counter shock.

**28. What are the hazards in electrosurgical unit?**

- Electrocution
- Burns
- Explosion hazards

**29. What are the safety aspects in electrosurgical unit?**

- To avoid burns, a perfect contact of the dispersive electrode to the patients should be ensured. The dispersive electrode should be properly cleaned off any strains. A pad electrode can be used to cover bony areas. Common ground can be used to avoid ground loop.
- To avoid electrocution, involuntary contact of the patient with the active electrode should be avoided and proper ground should be provided.
- To avoid explosion hazards, involuntary contact of the active electrode with cleaning agents or tubes carrying the anesthetic agents should be avoided.

**30. What are the physiological parameters adaptable to biotelemetry**

Physiological parameters are classified into two based on adaptability to biotelemetry:

- Direct biopotentials such as ECG, EEG & EMG and
- Those that require transducer such as temperature & pressure.

## UNIT-V

# RECENT TRENDS IN MEDICAL INSTRUMENTATION

***Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.***

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**Part – A (2 Marks)**

1. **What is Telemedicine?**

   Telemedicine is the remote delivery of health care service, such as health assessments or consultations, over the telecommunication infrastructure. It allows health care provides to evaluate, diagnose and treat patients without the need for an in-person visit.

2. **What are the types of Telemedicine?**
   - Real time
   - Store and forward
   - Hybrid
3. **Name some telemedicine.**

   Telecardiology
   Tele pathology
   Teledermatology
4. **What are the essential parameters for telemedicine?**
   - Data and reports
   - Primary patient data
   - Audio
   - Patient History
   - Still images
   - Clinincal information
5. **What is insulin pump?**

   It is a small device that gives your body the regular insulin it needs throughout the day and night.

6. **What are the types of Insulin pump?**
   Tethered pump-It is attached to your body by another small tube that connects to your cannula.
   Patch Pump-It is attached directly to your body where you've chosen to place your cannula.
7. **Mention the two insulin feed formats.**
   Bolus dose
   Basal dose
8. **What are parts of Traditional insulin pumps?**
   Pumps, Tubing, Infusion set
9. **What are the three main parts in patch pump?**
   Insulin reservoir
   Pumping mechanism
   Cannula
10. **What is radio pill?**
    Radio Pill is a small capsule shaped electronic pill that can be comfortably swallowed by any normal patient. It is mainly used for diagonosis of internal part mainly gastrointestinal system.
11. **What are the components present in radiopill?**
    Radio pill consists of lens, antenna, transmitters, camera or sensors and battery.
12. **What are types of radio pill?**
    -Pressure- sensitive pills -Temperature sensitive pills
    -pH sensitive pills
13. **Mention the disadvantages in pressure sensitive pill?**
    A good seal between metal and Perspex was difficult to obtain.
    Necessary to replace the diaphragm assembly quickly because damage can occur during recovery from the body.
14. **What is Temperature sensitive radio pill?**
    It has been used for body core temperature monitoring.
15. **Define Brain machine interface.**
    It is a device that translates neuronal information into commands capable of controlling external software or hardware such as a computer or Robotic aim.
16. **What are the blocks consists of BMI?**
    -Signal acquisition -Signal preprocessing
    -Feature extraction -Classification
    -Application interface
17. **Mention the application of BMI.**
    -EEa- based BCI system -ECoa- based BCI systems
    -Intracortical based BCI system.
18. **Write the purpose of endomicroscopy.**
    Conventional wide field microscopy is unsuiatable for imaging thick tissue because the images are corrupted by a blured, out of focus background signal. Endomicroscope achieve optical sectioning using the confocal principles.
19. **Classify the endo microscopes.**
    -Single fibre endomicroscope -Fibre bundle Endomicroscope
    -Distal scanning endomicroscope - Non cofocal endomicroscope
20. **What is Lab on chip?**
    It is a miniaturized device that integrates onto a single chip one or several analyses, which are usually done in a laboratory, analyses such as DNA sequencing or biochemical detection.