

MARIA COLLEGE OF ENGINEERING & TECHNOLOGY, ATTOOR

**TWO MARK
QUESTIONS & ANSWERS**

EI 65 - BIOMEDICAL INSTRUMENTATION

UNIT-I

1. What is meant by cell?

The basic living unit of the body is cell. The function of organs and other structure of the body are understood by cell organization.

2. State the applications of medical instrumentation system?

To design experiments & clinical studies.

To summarize, explore, analyze & present data

To draw inferences from data by estimation or hypothesis testing

To evaluate diagnostic procedure

To assist clinical decision making.

3. What is meant by measurement?

Measurement is an act or the result of comparison between the quantity and a predefined standard.

4. Mention the basic requirements of measurement.

The standard used for comparison purpose must be accurately defined and should be commonly accepted. The apparatus used and the method adopted must be provable.

5. What are the applications of piezo electric sensors?

in cardiology

In phonocardiology

in blood pressure measurement

in measuring physiological accelerations

6. Define transducers.

Transducers are defined as a device which when actuated, transforms energy from one form to another. Generally, any physical parameters are converted into electrical form.

7. Name the parameters that dictate the transducer capability

Linearity

Repeatability

Resolution and

Reliability

8. Define sensitivity

Sensitivity is defines as the electrical output per unit change in the physical parameter. High sensitivity is generally desirable for a transducer.

9. Classify electrical transducers?

Active transducer : A transducer that gives its output without the use of an excitation voltage or modulation of a carrier signal is called an active transducer.

Passive transducer : A transducer that gives its output using an excitation voltage or modulation of a carrier signal is called a passive transducer.

Generally the active transducer converts a non- electrical energy into electrical energy and converts an electrical into non electrical energy.

10. Name the 2 parts of a transducer

Sensing element
Transduction element

11. What is electrode potential (or) half cell potential?

The interface of metallic ion solution with their associated metal results in an electrode potential.

12. What are the characteristics of resting potential?

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

13. Define the process of sodium pump.

It is an active process, called a sodium pump in which the sodium ions are quickly transported to the outside of the cell & the cell again becomes polarized and assumes its resting potential.

14. 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.

15. Define heart, lung?

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

16. 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.

15. Give the applications of measurement systems.

The instruments and measurement systems are used for
Monitoring of processes and operations.
Control of process and operations.
Experimental engineering analysis.

16. List the functional elements of the measurement systems.

Primary sensing element.
Variable conversion element and
Data processing element.

17. What is radiation thermometry?

The basis of radiation thermometry is that there is a known relationship between the surface temperature of an object and its radiant power. This principle makes it possible to measure the temperature of a body without physical contact to it.

18. What is signal conditioning?

The performing of non-linear processes like modulation, detection, sampling, filtering, chopping and clipping etc. on the signal to bring it to desired form is called signal conditioning.

19. What is meant by Resting Potential?

Equilibrium is reached with a potential difference across the membrane such that negative on inside and positive on outside. This membrane potential caused by the different concentration of ions is called Resting Potential.

20. What is meant by Action Potential?

Cell has a slightly positive potential on the inside due to imbalance of potassium ions. This positive potential of the cell membrane during excitation is called Action Potential and is about 20 mV.

UNIT II

1. What is Electrode Potential?

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

2. 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.

3. Give the different types of electrodes?

Microelectrodes, Depth and needle electrodes and Surface electrodes.

4. Give the different types of Surface electrodes?

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

5. What are the characteristics of a DC amplifier?

It may need balanced differential inputs giving a high Common Mode Rejection Ratio (CMRR). It should have extremely good thermal and long term stability.

6. Enumerate the merits and demerits of a dc amplifier?

It is easy to calibrate at low frequencies. It is able to recover from an overload condition unlike it is AC counterpart.

7. Define neuron, nerve fibers.

The basic Units of the nervous system is the neuron. A bundle of individual nerve fibers is called a nerve .A neuron is a single cell with a cell body, called soma, one or more inputs fibers called dendrites and a long transmitting fiber called axon. Both axons and dendrites are called nerve fibers.

8. What are parts of central nervous system?

It consists of 10¹⁰ neurons. The brain consists of cerebrum, cerebellum and brainstem. Cerebrum consists of two hemispheres and there is divided into frontal lobe, occipital lobe and temporal lobe. Cerebellum consists of two hemispheres. They regulated the coordination of muscular movements.

9. Name the parts that contain peripheral nervous system.

The nerve fibers outside the central nervous system called peripheral nerves. It consists of motor and sensory nerves.

10. Define slew rate

Slew rate is defined as the maximum output voltage change per unit time.

11. What is Electrocardiography?

It deals with the study of the electrical activity of the heart muscles. The potential originated in the individual fibers of heart muscle are added to produce the ECG waveform.

12. What are the different types of ECG lead configuration?

Bipolar limb leads
Augmented unipolar limb leads
Chest leads
Frank lead system

13. Define 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 plane.

14. Draw the standard ECG waveform?

15. 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

16. List the brainwaves and their frequency

Alpha 8 t-13 Hz
Beta 13 - 30 Hz
Theta 4-8 Hz
Delta 0.5-4 Hz

17. List the requirements of an instrumentation amplifier

Low drift
High i/p impedance, High linearity
High CMRR
High noise rejection capability.

18. Give the resistive sensor types?

potentiometer
strain gauge
bridge circuits

19. Define gauge factor

It is the ratio of per change in resistance to per unit change in length.

20. What are advantages of LVDT?

Wide range of linearity
Change of phase by 180 deg when the core passes through the center position
full scale displacement is 0.1 – 250 mm
sensitivity is 0.5 – 2 mv

UNIT III

1. What are the limitations of capacitive sensor?

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

2. What is the principle of piezo electric sensors?

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

3. What are the applications of piezo electric sensors?

in cardiology
In phonocardiology
in blood pressure measurement
in measuring physiological accelerations

4. What are the different thermal sensors?

Thermocouples
Thermistors
Radiation sensors
Fiber optic detectors

5. What are the different radiation sources?

Tungsten lamp
Fluorescent lamp
LED s
LASERS

6. What are the different radiation sensors?

thermal sensors
Quantum sensors
Photo emissive sensors
Photo conductive cells
Photo junctions sensors
Photo voltaic sensors

7. What is a filter?

A filter is often a frequency selective circuit that passes a specified band of frequencies and blocks or attenuated signal of frequencies outside this band.

8. List the different types of filters.

Analog or digital filters
Passive or active filters
Audio (AF) or radio (RF) filters.

9. Specify the advantages of an active filter

Gain and frequency adjustment flexibility
No loading problem
Low cost

10. Mention the factors considered while selecting a transducer.

Operating range
Sensitivity
Frequency response & resonant frequency
Environmental compatibility
Minimum sensitivity
Accuracy
Usage and ruggedness
Electrical parameters

11. What is meant by POT?

POT is a resistive potentiometer used for the purpose of voltage division. It consists for a resistive element provided with a sliding contact called as wiper.

12. Explain the working principle of a strain gauge.

Strain gauge works on the principal that the resistance of a conductor or a semiconductor changes when strained. This property can be used for measurement of displacement, force and pressure.

13. Name the different types of strain gauges.

Un-bonded metal strain gauge
Bonded metal wire strain gauge
Bonded metal foil strain gauge
Vacuum deposited thin metal film strain gauge
Sputter deposited thin metal strain gauge
Bonded semiconductor strain gauge
Diffused metal strain gauge.

14. Write notes on LVDT?

It is the linear variable differential transformer which is used to translate the linear motion into electrical signals. It consists of a single primary winding and secondary winding.

15. List the advantages of LVDT?

- High range of displacement measurement
- Friction & electrical isolation
- Immunity from external effects
- High I/p and high sensitivity
- Ruggedness
- Low hysteresis & low power consumption.

16. Define operational amplifier?

It is the high gain dc differential amplifier
It is normally used in circuits that have characteristics determined by external negative feedback networks.

17. What are the different applications of op-amp?

- integrator
- Differentiator
- summing amplifier
- Differential amplifier
- Rectifier
- log amplifier

18. What is heart block?

If the normal heart conduction system is disturbed, then the beat rate will be slower than the normal rate. This state is known as heart block.

19. Classify the different types of heart block?

- First degree AV block
- Second degree AV block
- Third degree AV block
- Adams – Stokes attack
- Bundle block
- Atrial fibrillation
- Ventricular fibrillations

20. Name the parts of heart conduction system?

- Sino arterial node
- Atria ventricular node
- Bundle of His
- Purkinje fibers

21. What is the color coding of the differential leads?

- White – RA
- Black – LA
- Green - RL
- Red - LL
- Brown – chest

UNIT IV

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

- Indirect or noninvasive method
- 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 deflates 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. When the cuff is inflated pressure that only occludes the brachial artery, turbulence is generated in the blood it spurts through the tiny arterial opening during each systole. The sounds generated by the 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?

- Auscultator method
- Placatory method

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

$$\text{MAP} = \frac{1}{3} (\text{systolic} - \text{diastolic}) + \text{diastolic pressure}$$

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

Peritoneus insertion
Catheterization
Implantation of a transducer in a vessel or in the heart
Other methods such as clamping transducer on the intact artery have also been used.

7. What are the different types of blood flow meters?

- Electro magnetic blood flow meter based on the principle of magnetic induction.
- ultrasonic blood flow meters
- determination by radiographic method (NMR based)
- lasers based ultrasonic blood flow meter
- Thermal convection

8. 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. The blood flow is the highest

pulmonary artery and the aorta. Where the blood vessel leave the heart .The flow at this point is called cardiac output.

9. What is photo plethysmography?

The light energy is through a capillary blood .As arterial pulsation fill the capillary blood; the changes in volume of the blood vessels modify the absorption, reflection and scattering of the light. It indicates the timing of the events such as the heart rate.

10. What is phonocardiogram?

The graphic record of the heart sound is called phonocardiogram. The heart sounds are acoustic phenomena resulting from the vibrations of the cardiac structures.

11. Classify the heart sounds based on their mechanism of origin?

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

12. Give the principle of transduction of heart sounds?

The sounds and murmurs which originate from the heart can be picked up from the chest using stethoscope or by transduction of heart sounds in to electrical signal.

13. Give the bandwidth requirement for measuring the blood pressure

- The bandwidth requirements are a function of the investigation.
- No distortion in the amplitude or phase characteristics
- Measurement of the derivative of the pressure signal increase the bandwidth requirement

14. What are the different types of heart sounds?

- first heart sounds
- second heart sounds
- third heart sounds
- fourth heart sounds

15. Explain in brief about murmurs?

- They have a noisy character and last for a long time
- It occurs due to the turbulent flow of blood in the heart and large vessels.
- HF murmurs have small amplitude

16. What are various parts of phonocardiography?

- Condenser microphone
- Phono amplifier
- Filter
- Monitor scope
- ECG electrode
- ECG amplifier
- FM tape recorder

17. Define strain gauge?

It is an electrical device which is used to measure stress or pressure in terms of strain using the principle of change of resistivity due to mechanical stress.

18. What is biometrics?

Biometrics is the science and technology of measuring and analyzing biological data. In information technology, biometrics refers to technologies that measure and analyze human body characteristics, such as DNA, fingerprints, eye retinas and irises, voice patterns, facial patterns and hand measurements, for authentication purposes.

19. What is patient monitoring?

Patient monitoring is vital to care in operating and emergency rooms, intensive care and critical care units. Additionally, it has proven invaluable for respiratory therapy, recovery rooms, out-patient care, transport, radiology, gastroenterology departments, ambulatory, home, and sleep screening applications. It can reduce the risk of infection and other complications, as well as assist in providing for patient comfort.

20. What are the types of biometrics?

There are two types of biometric

1) Behavioral Biometrics

Keystroke or Typing Recognition

Speaker Identification or Recognition

2) Physical Biometrics

Fingerprint Identification or Recognition

Hand or Finger Geometry Recognition

Facial Recognition

UNIT V

1. What are the advantages of LASER?

No contact surgery

Highly Sterile

Short period

Easy access in confined area

2. Give the characteristics of X-ray radiation

When the fast moving electrons enter 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 those incident electrons appears in the form of continuous X-rays or white X-rays.

3. What is pacemaker?

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

4. List the basic components of X-ray machine?

power supply management

collimator

Diaphragm

film

Lead shield

5. Define contrast?

It is a measure of darkness of a desired image compare to its surroundings. The contrast between two tissues is given by

$$C = 10 \log I_1/I_2 \text{ DB}$$

6. Different methods of stimulation?

External stimulation, Internal stimulation

7. What are the types of pacemaker?

ventricular synchronous (fixed rate pulse) pacemaker

ventricular asynchronous (stand by pacemaker)

Ventricular inhibited (demand)pacemaker

Atrial synchronous pacemaker

Atrial sequential ventricular inhibited pacemaker

8. Explain the application of ventricular synchronous or standby pacemaker?

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

9. What are the applications of ventricular inhibited pacemaker?

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 of a preset period of time; the pacer will supply a stimulus.

When the evolution sensor 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.

10. What is the application of atrial synchronous pacemaker?

This type of pacing is used for young patient with a mostly stable block
It is used in stress testing and coronary artery diseases, in the evaluation of severity of mitral valve and in this evolution of various conduction mechanisms.

It has been used to terminate the atrial flutter and paroxymal atrial tachycardia

It can act as a temporary pacemaker for the atrial fibrillation.

11. 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 and ventricle and adopt its method of stimulation to

the patient's need. If atrial function fails, this pacemaker will stimulate the atrium and then senses the subsequent ventricular beat.

12. What is Defibrillator?

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

13. Explain ventricular fibrillation and how can it be eliminated?

Ventricular fibrillation is a serious cardiac emergency 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 the body chemistry.

14. What are the different types of defibrillator?

Internal defibrillator

External defibrillator

- AC defibrillator
- DC defibrillator
- Synchronous DC defibrillator
- Sure pulse defibrillator
- Double square pulse defibrillator
- Biphasic DC defibrillator

15. What is the function of heart lung machine?

Heart lung machine replaces the functions of heart and lung thereby providing the rest of the body with a continuous supply of oxygenated blood while the heart is stopped.

16. 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 atrial fibrillation.

17. What is meant by hemodialysis?

Hemodialysis is the apparatus itself may be called an extracorporeal hemodialyzer. Hemo simply means blood. Dialysis is of Greek origin, meaning "to pass through"; the present use implying a filtering (or passing through) process. Extracorporeal means "outside the body"; hence an extracorporeal hemodialyzer filters the blood outside the body.

18. What is the function of hemodialysis?

Hemodialysis has long ago gone from an experimental procedure and last ditch stand against end-stage renal disease to a well established and effective therapy for the rehabilitation of the patient with chronic kidney disease. Although the artificial kidney approximates only some of the human kidney's many functions, the body nevertheless adjusts remarkably well to the state maintained by the machine. There are now many patients who continue to thrive and function as productive citizens after many years of hemodialysis and people from all walks of life.

19. Difference between peritoneal dialysis and hemodialysis?

The Peritoneal dialyses have

1. the catheter is placed directly into human body
2. PD dialysis is continuous-usually multiple cycles daily
3. PD dialysis is done at your home, by the patient
4. PD dialysis is done by gravity

The Hemo dialyses have

1. A shunt is placed in the vein and artery
2. HD is done 3-5 times a week in usually 3 hour settings
3. HD is done at a hospital or a clinic
4. HD is done by a machine or artificial kidney that circulates and cleans the blood.

20. What is lithotripsy?

Lithroscopy also referred to as lithotripsy or EWSL (Extracorporeal Shock Wave Lithotripsy) as is a technique using ultrasonic sound waves to blast the hard crystals of kidney stones into smaller particles which can then be flushed from the body. The ultrasound is applied outside the body and surgery is not required.