QUESTION BANK

Name of the Department : Electronics and Communication Engineering

Subject Code & Name : EC8073 & Medical Electronics

Year & Semester : III & V

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING

PART-A

1. Mention the various lead systems used in ECG recording.

i) Bipolar limb leads or standards leads or Einthoven lead system
   a) Lead I
   b) Lead II
   c) Lead III

ii) Unipolar limb leads or Wilson lead system
   a) Augmented unipolar limb lead
      I) aVR
      II) aVL
      III) aVF

iii) Unipolar chest leads

2. What are the requirements of a biological amplifier?

Bio amplifiers must have a)High input impedance b)Isolation and protection circuit c)High voltage gain d)Constant gain throughout required bandwidth e)Low output impedance f)High CMRR.

3. What is half cell potential?

The voltage developed at an electrode-electrolyte interface is called as half cell potential or electrode potential.

4. Give the EMG signal characteristics.

The EMG signal ranges from 0.1mV to 0.5mV. The frequency components of the EMG signal vary from 20 Hz to 10 KHz and they are restricted to the frequency range of 20 Hz to 200 Hz for clinical purpose using a low pass filter.

5. What is PCG?

Phonocardiography is a technique to measure the sounds generated from opening and closure of heart valves.

6. What are the different types of electrodes used in bipolar measurement?

- Surface electrode
- Micro electrode and
- Needle electrode

7. Name the electrodes used for recording EMG and ECG.

The electrodes used for recording EMG are

- Surface electrodes like metal disk and disposable electrode
- Needle electrodes like unipolar and bipolar electrode

The electrodes used for recording ECG are

- Surface electodes like metal disk,suction cup and metal plate electrode

8. Define resting and action potential.

Resting potential: The membrane of excitable cells readily permits the entry of K^+ ions and cl^- ions,while it effectively blocks the entry of Na^+ ions. Therefore the concentration of Na^+ ions inside the cell becomes much lower than that outside the cell. Since the Na^+ ions are positive, the outside cells are more positive than the inside. Thus the charge balance is not achieved. Thus a potential difference is developed across the membrane. This membrane potential caused by the different concentration of ions is called the resting potential of the cell.

Action potential: When a cell membrane is excited by some form of externally applied energy, the membrane changes its electrical characteristics and begins to allow to some of the Na^+ ions to enter. The movement of Na^+ ions into the cell constitutes ionic current which further reduces the barrier of the membrane to Na^+ ions. The net result in Na^+ ions rush into the cell and try to balance with the ions outside. At the same time K^+ ions present inside the cell try to leave the cell. But they are unable to move as rapidly as Na^+ ions. As a result the cell has a slightly positive potential. This potential is called as action potential.

9. What is meant by 'Depolarization'?

When the impulse reaches the muscle, the polarized condition(-90mV) is altered i.e., the resting membrane potential is abolished. The interior of the muscle becomes positive and outside becomes negative. This condition is called as depolarization.

10. What is ECG?

The electrocardiograph is the instrument by which the electrical activities of the heart are recorded. The graphical registration of electrical activities of heart is called as Electrocardiogram.

11. Mention the importance of PCG signals.

- The presence of higher frequencies in the PCG indicates a possible heart disorder like Rheumatic valvular lesions, murmur of aortic steonosis and murmur of mitral steonosis.
- Different types of heart sounds are measured.
- Additional sounds are heard between normal heart sound due to vibration setup in the blood inside the heart by sudden closure of valves.

12. What are perfectly polarized and perfectly non polarized electrodes?

Electrodes in which no net transfer of charge occurs across the metal electrolyte interface is called perfectly polarized electrode. Electrodes in which unhindered exchange of charge occurs across the metal electrolyte interface is called perfectly non polarized electrode.

13. Define Conduction Velocity.

Conduction velocity is defined as the rate at which an action potential moves down a fiber or is propagated from cell to cell. It is also called as Nerve conduction rate.

14. Define latency as related to EMG.

Latency is defined as the elapsed time between the stimulating impulse and the muscle action potential. In other words it is the time delay between stimulus and response.

15. What is meant by sodium pump?

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

PART-B

1. Draw the action potential waveform and explain the following terms: Resting potential, Action potential.
2. Discuss about the different EEG signal frequency bands and also EEG recording set up.
3. Discuss about the different types of electrode used in bio potential measurement.
4. Draw the 12 lead system used in ECG.
5. What should be the characteristics of bio-potential amplifier? Explain with proper justification.
6. Write a note on PCG.
7. Describe the recording setup used in EMG?.
8. Explain the different lead systems used in the measurement of ECG waveform and also explain the working of ECG recorder.
9. Write about 10-20 system of recording EEG.

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT

PART-A

1. **What is meant by pH value of blood?**
   The pH value of blood is defined as the logarithm of the reciprocal of H^+ ion concentration in the blood.
   $pH=\log_{10}(1/[H^+])=-\log_{10}[H^+]$

2. **What do you understand by electrophoresis.**
   Electrophoresis is a method for separating and analyzing macromolecular substances such as plasma proteins. The method is based on the fact that the molecules carry electric charges and therefore migrate in an electric field.

3. **What is a colorimeter?**
   Colorimeter is used to measure the transmitted and absorbed light as it passes through a sample. The basic principle behind the colorimeter that many chemical compounds in solution appear coloured with the saturation of the colour depending on the

concentration of the compound. By analyzing the transmitted light through the sample or emitted light by thr sample, the concentration of the substance can be determined.

4. Name any four physical principles based on which blood flow meters are constructed.

- Electromagnetic blood flow meter
- Ultrasonic(Doppler shift) blood flow meter
- NMR blood flow meter
- Laser Doppler blood flow meter

5. What are the demerits of electromagnetic blood flow meter?

The magnetic flux density is not uniform along the axis, which causes circulating currents to flow in the axial direction. The magnetic flux density is not uniform in the transverse plane,this accentuates the problem of circulating current. Fluid outside the wall of the vessel has a greater conductivity than the wall. So it shunts the flow signal.

6. Mention the methods of measurement of cardiac output.

- Indicator dilution method
- Fick's method
- Dye dilution method
- Thermal dilution
- Impedance technique

7. What are cardiac output and phonocardiogram?

The amount of blood pumped out or delivered by the heart to the aorta per minute is called as cardiac output. The instrument used for recording sounds connected with the pumping action of the heart is called as phonocardiogram.

8. Define stroke volume.

It is defined as the amount of blood that is ejected during each heart beat.
Stroke volume=cardiac output/number of heart beats per minute.

9. Define tidal volume.

Tidal volume is the volume of gas inspired or expired during each normal, quiet respiration cycle.

10. Define residual volume.

Residual volume is the volume of gas remaining in the lungs at the end of a maximal expiration.

11. Name any two methods of respiration rate measurement.

- Thermistor method
- Impedance pneumography
- CO_2 method of respiration rate measurement

12. What are Korotkoff sounds?

Sounds produced by sudden pulsation of blood being forced through a partially occluded artery and heard during ausculatory blood pressure determination are called korotkoff sounds.

13. Write down the demerits of indirect method of blood pressure measurement.

- Does not provide continuous recording of pressure variations.
- Less repetition rate
- The measured depends up on the experience of the doctor and his hearing capability.

14. Mention the basic principle behind electrochemical pH determination.

To measure the pH of a solution, the solution is taken in a beaker. A pair of electrodes one glass or indicating electrode and the other reference or calomel electrode is immersed into the solution. The voltage developed across the electrodes is applied to an electronic amplifier which transmits the amplified signal to the display.

15. Write the principle behind electromagnetic blood flow meter.

When an electrical conductor is moved through a magnetic field, a voltage is induced in the conductor proportional to the velocity of its motion. The same principle applies when the moving conductor is not a wire, but rather a column of conductive fluid that flows through a tube located in the magnetic field.

16. How is the pulse rate measured?

- Electrical impedance method
- Strain gauge method
- Photoelectric method
- Microphone method
-

17. Which transducer is used for measuring temperature? Why?

Thermistor because of high sensitivity.

18. What is the principle used in pulse rate measurement?

Photo electric sensor is used to measure the pulse rate. It consists of light source and LDR. During the contraction of the heart, the blood flow to the finger tip will increase, will reduce the amount of light fall on LDR and during relaxation the amount of light will increase. This change in resistance per minute will be measured as pulse rate.

19. Give the typical values of blood pressure and pulse rate of an adult.

Blood pressure: 120 mm Hg/80 mm Hg(systolic pressure: 120 mm Hg, diastolic pressure:80 mm Hg)
Pulse rate: 72 pulses/min

PART-B

1. Explain the working principle electromagnetic blood flow meter and Ultrasonic blood flow meter. What are its advantages and disadvantages?
2. Explain the direct and indirect method of blood pressure measurement with neat diagram.
3. i) Explain the working principle of colorimeter with suitable diagram.

ii) How pH can be measured using glass electrode?
4. With a neat diagram, explain the operation of a blood cell counters.
5. Explain the principle of operation of coulter counter. What is its application?
6. Explain the following: Fick's method for the determination of cardiac output.
7. Draw the block diagram of automated electro sphygmomanometer for blood pressure measurement and explain its operation.
8. Explain the measurement of respiration rate using impedance technique.
9. Explain about Po2 and PCO2 with suitable diagrams.
10. Write short notes on temperature and pulse measurements.
11. Brief about cardiac output.

UNIT III ASSIST DEVICES

PART-A

1. **What is Pacemaker?**
   Pacemaker is an electrical pulse generator for starting or maintaining the normal heart beat.

2. **Classify pacing modes of pacemaker.**
   1. Competitive
      a) Fixed rate
   2. Non competitive
      a) Ventricular programmed
         i) R-wave inhibited(Demand)
         ii) R-wave triggered (Stand by)
      b) Atrial programmed
         i) R-wave synchronized

3. **Give two important factors that demand internal pacemakers usage.**
   These are mostly used for permanent heart damage.
   This is cent percent safety for the internal circuits.

4. **Write the classification of pacemaker based on the mode of operation.**
   - Ventricular asynchronous pacemaker(Fixed ratepacemaker)
   - Ventricular synchronous pacemaker
   - Ventricular inhibited pacemaker(Demand pacemaker)
   - Atrial synchronous pacemaker(Standby pacemaker)
   - Atrial sequential venricular inhibited pacemaker

5. **What is demand pacemaker?**
   The R wave inhibited pacemaker allows the heart to pace at its normal rhythm when it is able to. However if the R wave is missing for a preset period of time, the pacemaker will supply a stimulus. Therefore if the heart rate falls below a predetermined level, the pacemaker will turn on and provide the heart a stimulus. For this reason it is called as demand pacemaker.

6. **What is fibrillation? What are the types of fibrillation?**
The heart is able to perform its important pumping function only through precisely synchronized action of the heart muscle fibres. A condition in which this necessary synchronism is lost is known as fibrillation.

7. **What is 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.

8. **What types of electrodes are used in a defibrillator?**
Large spoon shaped electrode is used for internal defibrillation and Paddle shaped electrode is used for external defibrillation.

9. **What are the advantages of rectangular wave defibrillator?**
Efficient and quick recovery of the heart to beat in the normal manner. Atrial fibrillation is not introduced. No burning of skin.

10. **What are the batteries used for implantable pacemaker?**
Mercury, lithium and nuclear batteries.

11. **What are the three types of exchangers used in HEMODIALYSIS system?**
The three types of exchangers used in HEMODIALYSIS systems are i)Parallel Flow dialyzer (ii)Coil Hemodialyser (iii)Hollow Fiber Hemodialyser

12. **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.

13. **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.

14. **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.

15. 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.

PART-B

1. Explain the working of different types of defibrillator with neat diagram.
2. Explain the working of ventilators with neat diagram.
3. Discuss with suitable block diagram the different modes of operation of cardiac pacemakers.
4. What is dialysis? Explain the principle of operation of a dialyser machine with a neat block diagram.
5. Discuss about Magnetic resonance imaging system and Ultrasonic imaging system with neat sketch.
6. Explain in detail the principle block diagram and working of hemodialyser.

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY

PART-A

1. List the applications of Bio Telemetry.

- Monitoring ECG even under ergonomic conditions
- Monitoring the health of astronauts in space
- Patient monitoring in an ambulance and other locations away from hospital.
- Research on unanaesthesized animals

2. Specify the frequencies used for biotelemetry.

100 KHz to 1 MHz(for shorter distance)
10 MHz to 100 MHz(for longer distance)

3. Mention the advantages of a bio telemetry system.

- Major advantage of using biotelemetry is removing the cables from patient and providing a more comfortable medium to patient. Patient needs to carry a only small transmitter.
- Isolation of patient from high voltage completely. Transmitters in the patient side work with batteries without any danger of electrical shock.

4. **Mention the scheme of modulation techniques used for biotelemetry. Also mention the reason for such scheme.**
   - Double modulation: either AM/AM, AM/FM, FM/FM, FM/AM-to avoid loading effect.
   - Pulse width modulation: more than bio signal can be transmitted and recorded.

5. **What is the use of A/D converter in the transmitter of a biotelemetry system?**
   It is used to convert analog signal into digital signal.

6. **What is diathermy? List its types.**
   Diathermy is the treatment process by which cutting, coagulation, blending etc., of tissues are obtained.
   Types: i) shortwave diathermy ii) microwave diathermy iii) ultrasonic diathermy iv)surgical diathermy

7. **What is the frequency of currents used in surgical diathermy units? Why?**
   A frequency of 300-3000KHz is used in surgical diathermy. At these frequencies, large current flow into the cells causing it to vapourize and thereby causing a rupture to the tissue close to the cutting electrodes.

8. **What is the frequency of operation of ultrasound diathermy? What is the reason for this frequency selection?**
   The amount of ultrasonic energy absorbed by the tissue depends upon the frequency of ultrasonic waves. Normally the frequency range of 800 KHz to 1 MHz is the suitable frequency for ultrasonic therapy. This frequency is used because a greater depth of passage can be obtained without any pain to the patient.

9. **What is the use of ultrasonic diathermy?**
   Ultrasonic diathermy can be used to cure few diseases like Neuritis, Arthritis, Skin ulcers.

10. **Give the types and frequency of operation of diathermy units.**
    - Shortwave diathermy: 300 KHz-3000KHz
    - Microwave diathermy: 450 MHz
    - Ultrasonic diathermy: 800 KHz-1 MHz

11. **What are the two methods of shortwave diathermy?**
    The two methods of shortwave diathermy are i)Capacitive method ii) Inductive method

PART-B

1. Discuss cutting and coagulation waveform in surgical diathermy in brief.
2. Write a brief note on the functioning of microwave diathermy unit.
3. Explain the single channel and multi channel biotelemetry system with a neat block diagram.
4. What is diathermy? Explain the different types of diathermy techniques with neat diagram.

5. Define biotelemetry. Give the importance of biotelemetry and also explain the different elements involved in biotelemetry circuit.

UNIT V RECENT TENDS IN MEDICAL INSTRUMENTATION

PART-A

1. **Explain the principle of telemedicine.**
   Telemedicine is a rapidly developing application of clinical medicine where medical information is transferred via telephone, the internet or other networks for the purpose of consulting and sometimes remote medical procedures or examinations.

2. **Mention the types of lasers used in medical field.**
   - CO_2 laser-surgery, dental treatment
   - Nd-YAG- surgery, dental treatment, Photocoagulation
   - Argon ion-Ophthalmology (Photocoagulation of blood vessels in eye)
   - Ruby laser-retinal treatment, dental treatment

3. **What are the types of lasers used for therapeutic purposes?**
   The types of lasers used for therapeutic purposes are CO_2 laser, Ruby, argon ion, Nd-YAG.

4. **Mention the advantages of LASER in surgery?**
   - Highly sterile
   - Highly localized and precise
   - Non contact surgery
   - Dry-field, almost bloodless surgery
   - Short periods of surgical time

5. **What is an endoscope?**
   Endoscope is atubular optical instrument to inspect or view the body cavities which are not visible to our naked eye.

6. **List the applications of Endoscope.**
   Endoscopes are used in hospitals for examination, treatment of disease and surgery.

7. **Mention the types of endoscope.**
   Types of endoscopes are cardioscope, bronchoscope, laparoscope, otoscope, gastroscope etc.

8. **What is radio pill?**
   Radio pill is a silicon coated capsule containing a miniature radio transmitter that can be swallowed by a patient. During its passage through the digestive tract a radio pill transmits information about internal conditions. (acidity, etc.)

9. **Define Insulin pump.**
   An insulin pump is a medical device used for the administration of insulin in the

treatment of diabetes mellitus, also known as continuous subcutaneous insulin therapy. The device configuration may vary depending on design.

10. What is Endomicroscopy?

Endomicroscopy is a technique for obtaining histology-like images from inside the human body in real-time, a process known as 'optical biopsy'.

11. Define Brain Machine Interface.

A brain–computer (Machine) interface (BCI/BMI) is a direct communication pathway between an enhanced or wired brain and an external device.

12. What is Lab on a chip?

A lab-on-a-chip (LOC) is a device that integrates one or several laboratory functions on a single integrated circuit to achieve automation and high-throughput screening.

PART-B

1. Write short notes on Brain Machine Interface and Lab on a Chip.
2. With neat sketch explain about Endomicroscopy.
3. Describe about Insulin pumps.
4. Write a short note on telemedicine.
5. What is radiopill? Explain with the help of an example.