7. Explain digestion Physiology of digestion n detail

Ans. Digestion is the breakdown of large insoluble food molecules into small water-soluble food molecules so that they can be absorbed into the watery blood plasma. In certain organisms, these smaller substances are absorbed through the small intestine into the blood stream. Digestion is a form of catabolism that is often divided into two processes based on how food is broken down: mechanical and chemical digestion. The term mechanical digestion refers to the physical breakdown of large pieces of food into smaller pieces which can subsequently be accessed by digestive enzymes. Mechanical digestion takes place in mouth through mastication and in small intestine through segmentation contractions. In chemical digestion, enzymes break down food into the small molecules the body can use.

8. Explain regulation of food intake and digestive secretions in detail.

Ans. Despite substantial fluctuations in daily food intake, animals maintain a remarkably stable body weight, because overall caloric ingestion and expenditure are exquisitely matched over long periods of time, through the process of energy homeostasis. The brain receives hormonal, neural, and metabolic signals pertaining to body-energy status and, in response to these inputs, coordinates adaptive alterations of energy intake and expenditure. To regulate food consumption, the brain must modulate appetite, and the core of appetite regulation lies in the gut-brain axis. This Review summarizes current knowledge regarding the neuroendocrine regulation of food intake by the gastrointestinal system, focusing on gastric distention, intestinal and pancreatic satiation peptides, and the orexigenic gastric hormone ghrelin.

9. Explain Coordination - Structure of Brain and Neurons in detail.

Ans. Coordination is the harmonious functioning of interrelated organs and parts and is applied especially to the process of the motor apparatus of the brain, which provides for the co-working of particular groups of muscles for the performance of definite adaptive useful responses.

The brain has three main parts: the cerebrum, cerebellum and brainstem.
Cerebrum: is the largest part of the brain and is composed of right and left

hemispheres. ... Brainstem: acts as a relay center connecting the cerebrum and cerebellum to the spinal cord

A neuron has three main parts: dendrites, an axon, and a cell body or soma (see image below), which can be represented as the branches, roots and trunk of a tree, respectively. A dendrite (tree branch) is where a neuron receives input from other cells

10. Explain Physiology of nerve impulse conduction, excitability of membranes, electrical and chemical transmission between cells.

Ans. A nerve impulse is the electric signals that pass along the dendrites to generate a nerve impulse or an action potential. ... Conduction of nerve impulse occurs due to the presence of active and electronic potentials along the conductors. Transmission of signals internally between the cells is achieved through a synapse

Cell excitability is the change in membrane potential that is necessary for cellular responses in various tissues. Cell excitability is a property that is induced during early embriogenesis. Excitability of a cell has also been defined as the ease with which a response may be triggered

Neurons communicate with one another at junctions called synapses. At a synapse, one neuron sends a message to a target neuron—another cell. Most synapses are chemical; these synapses communicate using chemical messengers. Other synapses are electrical; in these synapses, ions flow directly between cells.

11. Explain cardiovascular System - Physiology of blood – compositions & structure, coagulation;

Ans. The blood circulatory system (cardiovascular system) delivers nutrients and oxygen to all cells in the body. It consists of the heart and the blood vessels running through the entire body. The arteries carry blood away from the heart; the veins carry it back to the heart.

blood, fluid that transports oxygen and nutrients to the cells and carries away carbon dioxide and other waste products. Technically, blood is a transport liquid pumped by the heart (or an equivalent structure) to all parts of the body, after which it is returned to the heart to repeat the process.

Coagulation, also known as clotting, is the process by which blood changes from a liquid to a gel, forming a blood clot. It potentially results in hemostasis, the cessation of blood loss from a damaged vessel, followed by repair. The mechanism of coagulation involves activation, adhesion and aggregation of platelets, as well as deposition and maturation of fibrin.

12. Explain about Heart beat, initiation, conduction and regulation

Ans. A heartbeat is a two-part pumping action that takes about a second. As blood collects in the upper chambers (the right and left atria), the heart's natural pacemaker (the SA node) sends out an electrical signal that causes the atria to contract.

Initiation is the beginning of transcription. It occurs when the enzyme RNA polymerase binds to a region of a gene called the promoter. This signals the DNA to unwind so the enzyme can ''read'' the bases in one of the DNA strands. The enzyme is now ready to make a strand of mRNA with a complementary sequence of bases.

The heart conduction system is the network of nodes, cells and signals that controls your heartbeat. Each time your heart beats, electrical signals travel through your heart. These signals cause different parts of your heart to expand and contract.

Regulatory System means the body of legal requirements for Good Manufacturing Practices, inspections, and enforcements that ensure public health protection and legal authority to assure adherence to these requirements.

13. Explain Physiology of Circulation.

Ans. The circulatory system is the continuous system of tubes through which the blood is pumped around the body. It supplies the tissues with their nutritional requirements and removes waste products. The pulmonary circulatory system circulates deoxygenated blood from the heart to the lungs via the pulmonary artery and returns it to the heart via the pulmonary vein. The systemic circulatory system circulates oxygenated blood from the heart around the body into the tissues before returning deoxygenated blood to the heart.

14. Explain Respiration & Physiology of respiration.

Ans. In physiology, respiration is the movement of oxygen from the outside environment to the cells within tissues, and the removal of carbon dioxide in the opposite direction.

The physiological definition of respiration differs from the biochemical definition, which refers to a metabolic process by which an organism obtains energy (in the form of ATP and NADPH) by oxidizing nutrients and releasing waste products. Although physiologic respiration is necessary to sustain cellular respiration and thus life in animals, the processes are distinct: cellular respiration takes place in individual cells of the organism, while physiologic respiration concerns the diffusion and transport of metabolites between the organism and the external environment.

15. Explain exchange and transport of gases and its regulation.

Ans. Gas exchange is the process that occurs between oxygen and carbon dioxide. Oxygen is passed from the lungs to the bloodstream and carbon dioxide is eliminated from the bloodstream to the lungs. Exchange of Gas takes place in lungs between the alveoli and capillaries which are tiny blood vessels, placed at the walls of alveoli. The rate of diffusion depends on the thickness of the biological membrane which forms the boundary between the external environment and organisms. Let's learn more about how this gas exchange and transport take place.

16. Explain Physiology of Excretion, Fluid and electrolytes balance,

Ans. The physiological process by which an organism disposes of its nitrogenous by-products is called excretion. ... Besides carbon dioxide, compounds of nitrogen arise from metabolism and are eliminated, chiefly by the kidney, in the urine (excretion). Food not digested is eliminated through the anus (defecation

Fluid moves throughout cellular environments in the body by passively crossing semipermeable membranes. Osmolarity is defined as the number of particles per liter of fluid. Physiologic blood plasma osmolarity is approximately 286 mOsmoles/L. Less than this is hypoosmotic, and greater is hyperosmotic.

Electrolytes play a vital role in maintaining homeostasis within the body. They help regulate myocardial and neurological function, fluid balance, oxygen delivery, acid-base balance, and other biological processes. ... Kidneys work to keep the electrolyte concentrations in blood constant despite changes in your body.

17. Explain Acid Base balance & roles of kidney in body water regulation

Ans.Acid-base balance: Acid-base balance refers to the mechanisms the body uses to keep its fluids close to neutral pH (that is, neither basic nor acidic) so that the body can function normally.

One way the the kidneys can directly control the volume of bodily fluids is by the amount of water excreted in the urine. Either the kidneys can conserve water by producing urine that is concentrated relative to plasma, or they can rid the body of excess water by producing urine that is dilute relative to plasma.

18. Explain the Resting potential, action potentials, synaptic potentials in detail.

Ans. resting potential, the imbalance of electrical charge that exists between the interior of electrically excitable neurons (nerve cells) and their surroundings. ... If the inside of the cell becomes less negative (i.e., the potential decreases below the resting potential), the process is called depolarization.

An action potential is a rapid rise and subsequent fall in voltage or membrane potential across a cellular membrane with a characteristic pattern. ... Examples of cells that signal via action potentials are neurons and muscle cells. Stimulus starts the rapid change in voltage or action potential.

Synaptic potential refers to the potential difference across the postsynaptic membrane that results from the action of neurotransmitters at a neuronal synapse. In other words, it is the "incoming" signal that a neuron receives. There are two forms of synaptic potential: excitatory and inhibitory.

19. Explain the Exhitatory Post Synaptic Potentials (EPSP).

Ans. An excitatory postsynaptic potentials (EPSP) is a temporary depolarization of postsynaptic membrane caused by the flow of positively charged ions into the postsynaptic cell as a result of opening of ligand-sensitive channels. An EPSP is received when an excitatory presynaptic cell, connected to the dendrite, fires an action potential. The EPSP signal is propagated down the dendrite and is summed with other inputs at the axon hilllock. The EPSP increases the neurons membrane potential. When the membrane potential reaches threshold the cell will produce an action potential and send the information down the axon to communicate with postsynaptic cells. The strength of the EPSP depends on the distance from the soma. The signal degrades across the dendrite such that the more proximal connections have more of an influence.

20. Explain the Inhibitory Post synaptic Potentials (IPSP).

Ans. An inhibitory postsynaptic potentials (IPSP) is a temporary hyperpolarization of postsynaptic membrane caused by the flow of negatively charged ions into the postsynaptic cell. An IPSP is received when an inhibitory presynaptic cell, connected to the dendrite, fires an action potential. The IPSP signal is propagated down the dendrite and is summed with other inputs at the axon hilllock. The IPSP decreases the neurons membrane potential and makes more unlikely for an action potential to occur. A postsynaptic cell typically has less inhibitory connections but the connections are closer to the soma. The proximity of the inhibitory connections produces a stronger signal such that fewer IPSPs are needed to cancel out the effect of EPSPs.

21. Explain the interaction of signals and Bioelectric signals ECG generation and propagation.

Ans. Bioelectrical signals are very low amplitude and low frequency electrical signals that can be measured from biological beings, for example, humans. Bioelectrical signals are generated from the complex self-regulatory system and can be measured through changes in electrical potential across a cell or an organ. The bioelectrical signals of our interest are in particular, the electrocardiogram (ECG) and the electroencephalogram (EEG). An ECG measures the electrical manifestation of the ionic potential of the heart while an EEG measures the electrical activity evoked along the scalp of the brain. The ECG and the EEG are recorded using standard equipments in the noninvasive fashion. The researchers of multiple disciplines have shown their greater interest in analyzing the ECG and the EEG to understand the high level features an individual is producing. However, the interdisciplinary analysis of bioelectrical signals not only helps in assessing the individuals state of health but also it suggests that the bioelectrical signals can be used as the candidate of biometrics for identity verification.

22. Explain EMG, EEG its generation and propagation in detail.

Ans.Electromyography (EMG) is a technique for evaluating and recording the electrical activity produced by skeletal muscles.[1] EMG is performed using an instrument called an electromyograph to produce a record called an electromyogram. An electromyograph detects the electric potential generated by muscle cells[2] when these cells are electrically or neurologically activated. The signals can be analyzed to detect abnormalities, activation level, or recruitment order, or to analyze the biomechanics of human or animal movement. Needle EMG is an electrodiagnostic medicine technique commonly used by neurologists. Surface EMG is a non-medical procedure used to assess muscle activation by several professionals, including physiotherapists, kinesiologists and biomedical engineers. In Computer Science, EMG is also used as middleware in gesture recognition towards allowing the input of physical action to a computer as a form of human-computer interaction.[3]

Electroencephalography (EEG) is a method to record an electrogram of the electrical activity on the scalp that has been shown to represent the macroscopic activity of the surface layer of the brain underneath. It is typically non-invasive, with the electrodes placed along the scalp. Electrocorticography, involving invasive electrodes, is sometimes called intracranial EEG.

23. Illustrate Recording Electrodes & Electrocardiograph.

Ans. Electrocardiography is the process of producing an electrocardiogram (ECG or EKG[a]), a recording of the heart's electrical activity. It is an electrogram of the heart which is a graph of voltage versus time of the electrical activity of the heart using electrodes placed on the skin. These electrodes detect the small electrical changes that are a consequence of cardiac muscle depolarization followed by repolarization during each cardiac cycle (heartbeat). Changes in the normal ECG pattern occur in numerous cardiac abnormalities, including cardiac rhythm disturbances (such as atrial fibrillation[6] and ventricular tachycardia), inadequate coronary artery blood flow (such as myocardial ischemia[8] and myocardial infarction), and electrolyte disturbances (such as hypokalemia and hyperkalemia).

Recording electrodes provide the direct brain interface for an emerging class of neuroprosthetic systems. This chapter focuses on implantable microelectrode arrays for recording neuronal action potentials and local field potentials

24. Illustrate Electroencephalograph,Electromyograph Patient Monitoring Systems

Ans. Electroencephalography is a method to record an electrogram of the electrical activity on the scalp that has been shown to represent the macroscopic activity of the surface layer of the brain underneath. It is typically non-invasive, with the electrodes placed along the scalp. Wikipedia

Electromyography is a technique for evaluating and recording the electrical activity produced by skeletal muscles. EMG is performed using an instrument called an electromyograph to produce a record called an electromyogram. Wikipedia

Electrocardiography (ECG) and electromyography (EMG) are used to monitor brain, heart and muscle activities. respectively. The patient monitoring system updates the physician about the patients health status.

25. Illustrate Electromyograph Patient Monitoring Systems

Ans. Electromyography (EMG) is a technique for evaluating and recording the electrical activity produced by skeletal muscles.[1] EMG is performed using an instrument called an electromyograph to produce a record called an electromyogram. An electromyograph detects the electric potential generated by muscle cells[2] when these cells are electrically or neurologically activated. The signals can be analyzed to detect abnormalities, activation level, or recruitment order, or to analyze the biomechanics of human or animal movement. Needle EMG is an electrodiagnostic medicine technique commonly used by neurologists. Surface EMG is a non-medical procedure used to assess muscle activation by several professionals, including physiotherapists, kinesiologists and biomedical engineers. In Computer Science, EMG is also used as middleware in gesture recognition towards allowing the input of physical action to a computer as a form of human-computer interaction

26. Illustrate Foetal Monitoring Instruments & Oximeters

Ans. Continuous fetal monitoring was achieved with a fetal scalp pulse oximetry sensor in 86 labours. The average recorded fetal oxygen saturation in early labour (cervical dilatation less than 5 cm) was 68% (SD 13%). At the end of labour (cervical dilatation greater than or equal to 9 cm) the recorded mean oxygen saturation was 58% (SD 17%). The largest range of readings during a single labour was 81%-11% but this drop was associated with cord compression. The average SD during 1 h of normal labour was 10%. A second group of 40 fetuses was monitored during induction of labour before and after elective amniotomy. Oxygen saturation did not appear to change after amniotomy (mean change -0.4%, SD 1.2%) and there was no difference between mean antenatal or early intrapartum readings. We excluded the amniochorionic membranes as a possible source of data corruption by measuring their in vitro absorption spectra and confirming that they do not preferentially absorb light of either 660 or 940 nm wavelength. Non-invasive pulse oximetry can be used to monitor the fetus before and during labour.

27. Explain Blood Flowmeters, Pulmonary Function Analysers.

Ans. Blood flow-meters are the devices that monitor the blood flow in various blood vessels and measure the cardiac output. In the blood vessels, the blood flow rate is maximum along the axis of the vessel and decreases with the square of the distance from the axis, reaching zero at the wall of the vessel.25-Nov-2017

Pulmonary function analyzers measure the performance of a patient's respiratory system, especially for outpatient or presurgical screening. These systems measure the ventilation, diffusion, and distribution of gases in the lungs.

28. Explain Blood Gas Analysers, Blood Cell Counters.

Ans. BGAs are devices that integrate a or a series of direct ion-selective or indirect ion-selective, amperometric, conductive, or fluorescence biosensors for the detection of ions, blood gasses, pH, electrolyte, other metabolites (calcium, magnesium, glucose, lactate), partial pressure of carbon dioxide, and partial pressure of oxygen from whole blood samples in the blood. A dry reagent pad system, a filter pad that is impregnated with the required reagents, is employed for particular reactions to occur. Potential, current, or fluorescent signals due to the reactions are detected and evaluated by the BGA system.

- The blood cell counter count the number of RBC or WBC per unit of volume of blood using either of two method:

– Electrical method called aperture impedance change

– Optical method called flow cytometry

Aperture impedance change

- When blood is diluted in the proper type of solution, the electrical resistivity of blood cells (ρ_c) is higher then thhe resistivity of the surrounding fluid (ρ_f)

- By contriving a situation in which these resistivities can be differentiated from each other, we can count cells

Blood cell sensing

- The sensor consist of a two-chamber vessel in which the dilute incoming blood is on one side of barrier, and the waste blood to be discarded is on the other

- A hole with a small diameter (50µm) is placed in the partition between the tow halves of the cell

- Ohmmeter measure the change on the resistance when the blood cell p ass the aperture

29. Explain about audiometers and Hearing Aids.

Ans. It involves using an audiometer, which is a machine that plays sounds via headphones. Your audiologist or an assistant will play a variety of sounds, such as tones and speech, at different intervals into one ear at a time, to determine your range of hearing. The audiologist will give you instructions for each sound.

A hearing aid is a small electronic device that you wear in or behind your ear. It makes some sounds louder so that a person with hearing loss can listen, communicate, and participate more fully in daily activities. ... The amplifier increases the power of the signals and then sends them to the ear through a speaker

30. Explain X-ray Computed Tomography in detail.

Ans. The term “computed tomography”, or CT, refers to a computerized x-ray imaging procedure in which a narrow beam of x-rays is aimed at a patient and quickly rotated around the body, producing signals that are processed by the machine’s computer to generate cross-sectional images—or “slices”—of the body.

These slices are called tomographic images and contain more detailed information than conventional x-rays. Once a number of successive slices are collected by the machine's computer, they can be digitally "stacked" together to form a three-dimensional image of the patient that allows for easier identification and location of basic structures as well as possible tumors or abnormalities.

31.Explain Nuclear Medical Imaging Systems in detail

Ans. Nuclear medicine imaging is a method of producing images by detecting radiation from different parts of the body after a radioactive tracer is given to the patient. The images are digitally generated on a computer and transferred to a nuclear medicine physician, who interprets the images to make a diagnosis.

Radioactive tracers used in nuclear medicine are, in most cases, injected into a vein. For some studies, they may be given by mouth. These tracers aren't dyes or medicines, and they have no side effects. The amount of radiation a patient receives in a typical nuclear medicine scan tends to be very low.

Nuclear imaging is used primarily to diagnose or treat illnesses. Conditions diagnosed by nuclear medicine imaging include:

Blood disorders.

Thyroid disease, including hypothyroidism.

Heart disease.

Gallbladder disease.

Lung problems.

Bone problems, including infections or breaks.

Kidney disease, including infections, scars or blockages.

Cancer.

Nuclear medicine imaging can also be used to treat conditions or to evaluate how treatment is working. One example of this is radioimmunotherapy, which combines radiation and immunotherapy to deliver radiation precisely to a targeted area.

32. Explain Magnetic Resonance Imaging System

Ans. Magnetic resonance imaging (MRI), also known as nuclear magnetic resonance imaging, is a scanning technique for creating detailed images of the human body.

The scan uses a strong magnetic field and radio waves to generate images of parts of the body that can't be seen as well with X-rays, CT scans or ultrasound. For example, it can help doctors to see inside joints, cartilage, ligaments, muscles and tendons, which makes it helpful for detecting various sports injuries.

MRI is also used to examine internal body structures and diagnose a variety of disorders, such as strokes, tumors, aneurysms, spinal cord injuries, multiple sclerosis and eye or inner ear problems, according to the Mayo Clinic. It is also widely used in research to measure brain structure and function, among other things

33. Explain Ultrasonic Imaging Systems in detail.

Ans. An ultrasound imaging system is a medical diagnostic tool that uses high frequency sound waves to capture live images from the inside of the body. The instrument has become increasingly important in medicine and has taken its place along with X-rays for imaging internal body structures. Ultrasonic imaging is based on the use of sound waves produced at frequencies beyond those detectable in human hearing, that is greater than 20 kHz. Ultrasonic transducer is a very important component of an ultrasound imaging system. The different types of ultrasound transducers based on multi-array configuration are linear sequential array, curvilinear array, linear phased array and phased array. Ultrasound scanners are used for obtaining images of almost the entire range of internal organs in the abdomen.

34. Explain Tissue engineering as therapeutics & electromagnetic therapy.

Ans. Tissue engineering is a biomedical engineering discipline that uses a combination of cells, engineering, materials methods, and suitable biochemical and physicochemical factors to restore, maintain, improve, or replace different types of biological tissues. Tissue engineering often involves the use of cells placed on tissue scaffolds in the formation of new viable tissue for a medical purpose but is not limited to applications involving cells and tissue scaffolds. While it was once categorized as a sub-field of biomaterials, having grown in scope and importance it can be considered as a field in its own

Electromagnetic therapy or Electromagnetic field therapy refers to therapy involving the use of magnets or electromagnets.[citation

Magnetic field therapy uses magnets to maintain health and treat illness. The human body and the earth naturally produce electric and magnetic fields. Electromagnetic fields also can be technologically produced, such as radio and television waves. Some people use magnet therapy for treating pain, such as foot, back, or joint pain. Research studies have been done on magnets, but there are not consistent results showing that magnets help with pain relief.

35. Explain bio ceramics, microrobots and nanobots.

Ans. Bioceramics are not new to mankind and can be classified on the basis of their origin, composition, crystallinity, and type of tissue response associated with them. Because of the positive interactions of bioceramics with human tissues, bioceramics can be utilized in numerous biomedical applications. Various fields of medicine, surgery, dentistry, and tissue engineering are making good use of bioceramics to introduce more potent treatment options to augment the traditional medical and dental practices. This chapter begins with an introduction to bioceramics and then covers all possible classifications of bioceramics followed by a detailed account of the possible biomedical applications of bioceramics.

Soft microrobots represent end-effectors of electromagnetic- and permanent magnet-based manipulation systems. These microrobots can navigate controllably under the action of a controlled magnetic field. We are interested in precise control of the microrobots. Therefore, the actuating field should be designed to simultaneously propel and steer the microrobots along a prescribed trajectory. The magnetization of the microrobot and the relation between the control inputs and the field of the manipulation system are important factors in the design of a control system. This chapter will begin with an introductory modeling of the magnetic torque on soft-magnetic material and actuation systems. We will then show an open-loop control framework for a variety of soft microrobots to move them along a prescribed trajectory

Nanobots are robots that carry out a very specific function and are ~50–100 nm wide. They can be used very effectively for drug delivery. Normally, drugs work through the entire body before they reach the disease-affected area. Using nanotechnology, the drug can be targeted to a precise location which would make the drug much more effective and reduce the chances of possible side effects. Figure 21.1 shows a device that uses nanobots to monitor the sugar level in the blood [4]. Special sensor nanobots can be inserted into the blood under the skin where microchips, coated with human molecules and designed to emit an electrical impulse signal, monitor the sugar level in the blood.

36. Explain about Biomaterials & Radiotherapy in detail.

Ans. Biomaterials have made an enormous impact on the treatment of injury and disease and are used throughout the body. The field remains a rich area for research and invention because no material alone is suitable for all biomaterial applications, and new applications are continually being developed as medicine advances. Because of the complexity of cell and tissue reactions to biomaterials, it has proven advantageous to look to nature for guidance on biomaterials design, selection, synthesis, and fabrication. This approach is known as biomimetics. Within the discipline of biomaterials, biomimetics involves imitating aspects of natural materials or living tissues such as their chemistry, microstructure, or fabrication method.

Radiation therapy is a type of cancer treatment that uses beams of intense energy to kill cancer cells. Radiation therapy most often uses X-rays, but protons or other types of energy also can be used.

The term "radiation therapy" most often refers to external beam radiation therapy. During this type of radiation, the high-energy beams come from a machine outside of your body that aims the beams at a precise point on your body. During a different type of radiation treatment called brachytherapy (brak-e-THER-uh-pee), radiation is placed inside your body.

Radiation therapy damages cells by destroying the genetic material that controls how cells grow and divide. While both healthy and cancerous cells are damaged by radiation therapy, the goal of radiation therapy is to destroy as few normal, healthy cells as possible. Normal cells can often repair much of the damage caused by radiation.

37. Explain Ultrasound Enhanced Nano medicine & targeted drug delivery in detail.

Ans. While ultrasound is most widely known for its use in diagnostic imaging, the energy carried by ultrasound waves can be utilized to influence cell function and drug delivery. Consequently, our ability to use ultrasound energy at a given intensity unlocks the opportunity to use the ultrasound for therapeutic applications. Indeed, in the last decade ultrasound-based therapies have emerged with promising treatment modalities for several medical conditions. More recently, ultrasound in combination with nanomedicines, i.e., nanoparticles, has been shown to have substantial potential to enhance the efficacy of many treatments including cancer, Alzheimer disease or osteoarthritis. The concept of ultrasound combined with drug delivery is still in its infancy and more research is needed to unfold the mechanisms and interactions of ultrasound with different nanoparticles types and with various cell types. Here we present the state-of-art in ultrasound and ultrasound-assisted drug delivery with a particular focus on cancer treatments. Notably, this review discusses the application of high intensity focus ultrasound for non-invasive tumor ablation and immunomodulatory effects of ultrasound, as well as the efficacy of nanoparticle-enhanced ultrasound therapies for different medical conditions. Furthermore, this review presents safety considerations related to ultrasound technology and gives recommendations in the context of system design and operation.

38. Explain Automated Drug Delivery Systems.

Ans. We have developed a novel automated drug delivery system for simultaneous control of systemic arterial pressure (AP), cardiac output (CO), and left atrial pressure (P(LA)) in acute heart failure. The circulatory equilibrium framework we established previously discloses that AP, CO, and P(LA) are determined by equilibrium of the mechanical properties of the circulation, i.e. pumping ability of the left heart, stressed blood volume and systemic arterial resistance. Our system directly controls the three mechanical properties with cardiovascular drugs including inotropes and vasodilators, thereby controlling AP, CO, and P(LA). Furthermore, by precisely controlling bradycardia and LV inotropy, our system enables to improve cardiac energetic efficiency while preserving AP, CO, and P(LA) within acceptable ranges. In conclusion, by directly controlling the mechanical properties of the heart and vessel, our automated system realizes comprehensive management of hemodynamics in acute heart failure.

39. Explain about Artificial skin, limb, advancement in prosthetics.

Ans. Skin, the largest organ of the human body, is organized into an elaborate layered structure consisting mainly of the outermost epidermis and the underlying dermis. A subcutaneous adipose-storing hypodermis layer and various appendages such as hair follicles, sweat glands, sebaceous glands, nerves, lymphatics and blood vessels are also present in the skin. These multiple components of the skin ensure survival by providing critical functions in protection, thermoregulation, excretion, absorption, metabolic functions, sensation, evaporation management and aesthetics. The study of how these biological functions are performed is critical in our understanding of basic skin biology, such as regulation of pigmentation and wound repair. Impairment of any of these functions may lead to pathogenic alterations, including skin cancers. Therefore, the development of genetically controlled and well-characterized skin models can have important implications, not only for scientists and physicians, but also for manufacturers, consumers, governing regulatory boards and animal welfare organizations. Since cells making up human skin tissue grow within an organized three dimensional (3D) matrix continually surrounded by neighboring cells, standard monolayer (2D) cell cultures do not recapitulate the physiological architecture of the skin. Several types of human skin recombinants, also called artificial skin, that provide this critical 3-D structure, have now been reconstructed in vitro. This review contemplates the use of these organotypic skin models in different applications, including substitutes to animal testing.

Artificial skin is a term used to describe a group of products used to treat burns and other wounds. Skin is the largest organ in our body. You can think of it as a fortress. Its chief purpose is to provide protection to the structures inside our bodies as well as to keep our body temperature regulate.

40. Explain advancement in prosthetics, Biocompatibility of artificial organs.

Ans.