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BBOC407

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
Biology for Engineors (CSE)

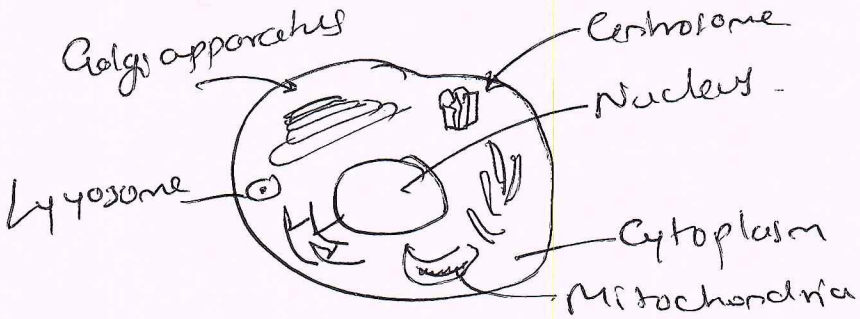
Max. Marks: 100

Notal: 1. Answer any FIVE full guestions, choosing ONE full question from each modale.
2. M : Marks , L: Bloom's lavel , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define Cell. Explain function and structure of cell.	7	L2	CO1
	b.	List the various hurmones and write the functions of them.	7	L2	CO1
	c.	Demonstrate the properties and function of lipids.	6	L3	CO1
		OR			
Q.2	a.	What are stem cells? Discuss the function of stem cells.	7	L2	CO1
	b.	List the vitamins and write the functions of them.	7	L2	CO1
	c.	Demonstrate the properties and function of mucile sekls.	6	L3	CO4
		Module – 2			
Q.3	a.	Define Biomolecute. List the classification of biomolecules with each one example in short in engineering application.	7	L2	CO2
	b.	Explain the applications of enzymes in biesensnts and bio bleaading.	7	L2	CO2
	c.	What is DNA finger printing? Explain the process involved in DNA finger printing.	6	L3	CO5
		OR			
Q.4	a.	Explain the properties of cellulose as an effective water filter.	7	L2	CO2
	b.	List the properties of PHA and explain the engineering applications of PHA.	7	L2	CO2
	c.	Demonstrate whyy as a protein.	6	L3	CO3
		Module – 3			
Q.5	a.	Define ECG. Explain in detain.	7	L2	CO3
	b.	How kidney will be used as a filteration system, explain with one type of dialysis example.	7	L2	CO3
	c.	Illustrate Brain as a CPU system.	6	L3	CO3

		OR			
Q.6	a.	Briefly discuss the various bio engineering solutions for muscular dystrophy.	7	L2	CO3
	b.	Explain roboris nrne for Prosthetic devise.	7	L2	CO3
	c.	Illustrate eye as a camera system.	6	L3	CO4
		Module – 4			
Q.7	a.	Compare the process of photo synthesis to the functioning of photo synthesis to the functioning of photoeplatic cells.	7	L2	CO4
	b.	Super hydrophobic and self cleaning surfaces. Explain in detail.	7	L2	CO4
	c.	Write a note on Lolos last effect.	6	L3	CO4
		OR			
Q.8	a.	Compare HBOC's and ETC.	7	L2	CO4
	b.	How shark skin and swim suits are using biological concepts.	7	L2	CO4
	c.	Write a note on GPS technology.	6	L3	CO4
		Module – 5			
Q.9	a.	Explain in detail flew AI will be used in all disease diagnosis.	7	L2	CO5
	b.	Demonstrate bioremediation and biomining.	7	L3	CO5
	c.	Explain muscular system as a scaffold.	6	L3	CO5
		OR			
Q.10	a.	Explain in detail electrical nose in food science.	7	L2	CO5
	b.	Demonstrate bioprinting technique list all of them.	7	L3	CO5
	c.	Explain DNA origami and lies computing.	6	L3	CO5

Q1: a. Define Cell. Explain function & Structure ... (10)



A cell is a smallest structural & functional unit of life. All living organism made up of cell. with one or more numbers. All vital activities happens inside cell

Structure of Cell

1. Cell wall → Rigid outer layer of cellulose
   - Provides shape, support & protection
2. Plasma membrane
   - Thin flexible boundry surrounding cell
   - Controls movement of substances in & out
3. Cytoplasm.
   - Jelly like substance inside cell membrane
4. Nucleus.
   - Control Center of cell
   - Contains genetic material DNA
   - Regulate growth, metabolism & reproduction
5. Mitochondria → Power house of cell
6. Ribosomes → Protein Synthesis
7. Endoplasmic Reticulum → Transport materials
8. Golgi apparatus → Packaging & Secretion
9. Vacuole → Storage
10. Chloroplast → Control photosynthesis in plants

Functions

1) Carries metabolic activities
2) Produce Energy through respiration
3) Synthesis Protein & Enzymes
4) Store genetic information
5) Helps growth & repair of organism

Q1b. List various hormones & write their functions 7 marks

1. Growth Hormone
   * Stimulate growth of bones & body tissue
   * Regulates physical development
2. Thyroxine
   * Controls metabolism of fat & proteins
   * Regulates body temperature & energy production
3. Insulin
   * Lowers blood glucose level
   * Converts glucose into glycogen
4. Glucagon
   * Increase blood glucose level
   * Converts glycogen into glucose
5. Andrenaline
   * Prepare body for emergency
   * Increase heart rate, blood pressure & energy supply
6. Ovary
   * Develope female secondary sexual characters
   * Regulate menstrual cycle.
7. Testis
   * Develop male sexual character
   * Helps sperm formation

Q1c. Properties & functions of lipids 6 mark

Properties of lipids

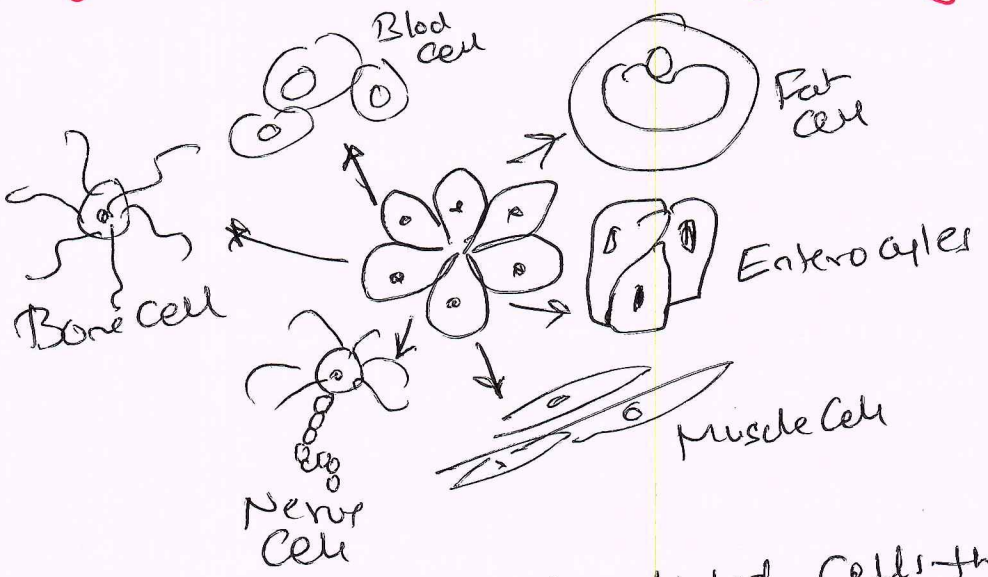
1) Lipids are insoluble & donot dissolve in water
2) They only dissolve organic solvents ether, alcohol etc
3) Lipids feel oily to touch & changes phase at room temp.

Functions of lipids

1) Act as long energy reserve for the body
2) Form essential component ie. cell membrane
3) Helps thermal insulation & control body temperature

~~22a. Who~~

Q2a. What are stem cells, discuss function of stem cell. 7



Stem cells are undifferentiated cells that have ability to self renew & differentiate into specialized cell such as muscle cell, blood cell, nerve cell etc.

Functions of Stem Cell

1. Cell differentiation.
   * Can develop different types of specialized cell
   * Essential for forming tissue

OR

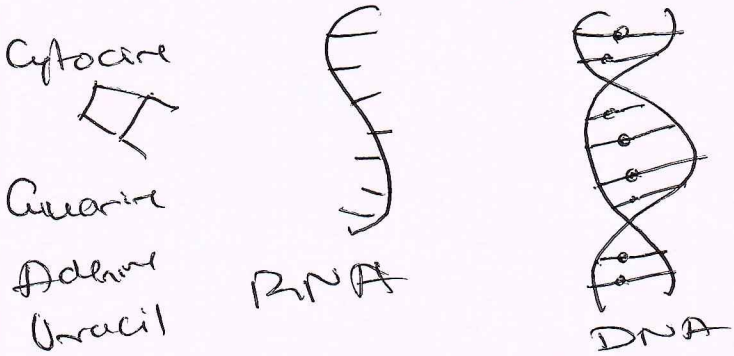
2. Growth & Development
   * Embryonic Development
   * Formation of various body system
3. Tissue Repair & Regeneration
   * Replace damaged or dead tissue
   * healing wound & repairing tissue
4. Maintain Body tissue
   * Replenis Body tissue like skin & blood
5. Medical Application
   * Used in bone marrow transplant
   * Used in regenative medicine

Q2b. List the vitamins & write their functions 7marks

1. Vitamin A.
   → Essential for vission at night
   → Maintain healty skin & ephithelial tissue

2. Vitamin B Complex
   → Helps Energy metabolism
   → Support nervous system function & red blood cell formation.
3. Vitamin C.
   → Required for Collagen formation
   → Enhances wound healing
4. Vitamin D.
   → Helps absorb calcium & phosphorous
   → Maintain healthy bone & teeth
5. Vitamin E
   → Act as Antioxidant
   → Protects Cell membrane from damage
6. Vitamin K.
   → Essential for blood clotting
   → Helps in wound healing
7. Vitamin B12
   → Necessary for blood cell formation
   → Maintain normal nerve function

Q2c. Demonstrate properties & function of nucleic acid (6 marks)



Properties

1) Polymeric in nature –
   long chain polymers made up of repeating units called nucleotides
2) Acidic character –
   Acidic in nature due to presence of phosphorous
3) Water Soluble
   will dissolve in water but dont dissolve in organic compound

Functions

→ They store genetic information
→ They synthesis protein
→ Regulates cell growth
→ Reproduction through gene expansion.

Q3a. Define biomolecules, list classification of biomolecules (5)
Example in short engg. application — 7 marks

A biomolecule is organic molecule produced by living organism that is essential for life processes such as structure, energy, growth & reproduction.

Classification & Examples

1) Carbohydrates → Glucose & Starch
   * Biofuel production
   * Bioplastic & food production

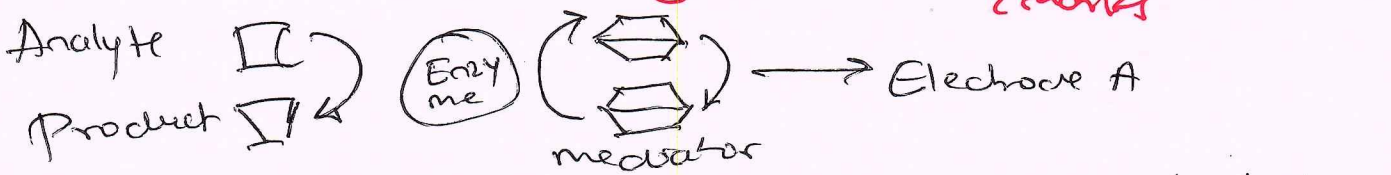
2) Proteins → Enzymes, Collagen.
   * Textile, Detergents & pharmaceutical.

3) Lipids → Fats & Phospholipids
   * Biodiesel production,
   * Drug delivery system

4) Nucleic Acids → DNA, RNA
   * Vaccines.
   * Store genetic information

5) Vitamins → Vitamin C, Vitamin D etc
   * Pharmaceutical Applications
   * Food fortification Industry

Q3b. Explain the application of Enzymes in biosensors & biobatching
7 marks



Biosensors is an analytical device that combine biological component with physochemical detector, to detect specific substance.

Role of Enzymes in Biosensor
* Enzymes acts as bioreggognition element
* Reacts with target elements to produce measurable signal

Example.
1) Glucose Biosensor → measure blood glucose level

2. Urea Biosensor → Detect urea concentration
3. Cholesterol Biosensor → Measure cholesterol level
4. Environmental monitoring → Detect toxins & pollutants

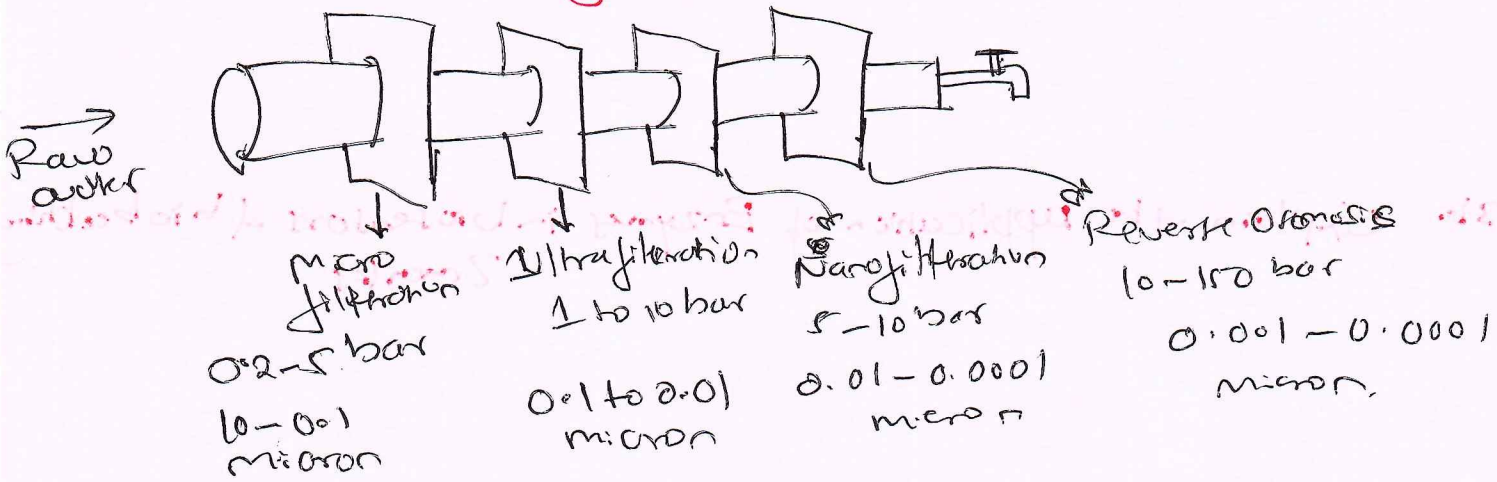
Q3c. What is DNA Finger Printing? Explain the process in DNA Finger Printing 6 marks

DNA finger printing is a laboratory experiment to identify an individual based on unique pattern present in their DNA Except for identical twin, has unique DNA Finger Print

Process → DNA Extracted from Biological Sample such as blood, hair, saliva or tissue

→ Extracted DNA cut into fragments using specific restriction enzymes
→ They separated and passed through a garose gel under an electric field
→ Seperated DNA Bands are visualised & compared for genetic similarities

Q4a. Explain Properties of cellulose as an effective water filter 7 marks



Properties of cellulose

→ Network like fibre having micro & nano size pores
→ Allows water pass-through & suspend particles
→ Contains Hydroxyl to attract bind water molecules
→ Enhance water permiability & flow rate
→ Maintain structural integrity under continuous flow
→ Can chemically modified
→ Can remove heavy metals, bacteria & pathogens
→ Does not cause secondary pollutants

4b. List various properties of PHA & its Engineering Applications (7)

7 marks

Properties of PHA

1) Complete degrade into CO_2 & water under natural condition
2) Non toxic, suitable for medical application
3) Can be processed using conventional plastic processing methods
4) Exhibits good strength & flexibility compared to petrochemical plastics.

Engineering Application

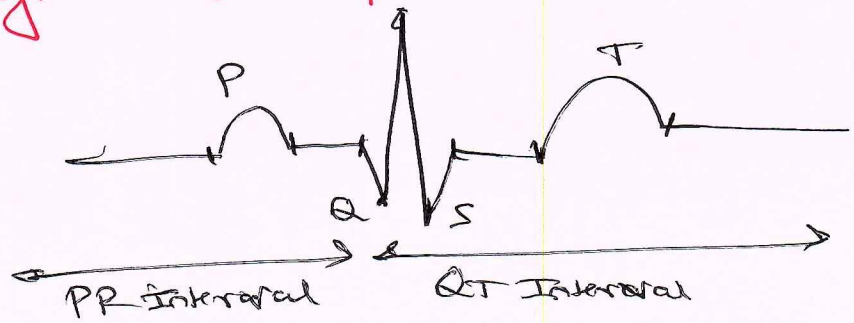
1) Used in tissue scaffold, drug delivery system
2) Manufacturing of biodegradable films, containers etc
3) Controlled release of fertilizers in agriculture field.

4c. Demonstrate WHEY Protein 6 marks

(8) Whey is a high quality, globular protein, obtained as a byproduct during the production of cheese from milk. It remains in the liquid portion after milk curdles and casein is removed

→ Whey is an animal protein
→ It is composed of amino acids
→ Rich is essential amino acids like BCAAs
→ It is a globular protein
→ Easily soluble in water & rapidly digestable
→ Contains β-lactoglobulin, α-lactalbumin.
→ Helps in muscle growth & rebuild
→ Helps in Enzyme & Hormone Synthesis

5a. Define ECG & Explain in details 7 marks



ECG
Electrocardiogram.

An electrocardiogram (ECG) is a graphical recording of the electrical activity of heart obtained from electrodes placed on the surface of the body. It is used to access the heart function & detect cardiac abnormalities

Principle of ECG.

* Heart muscle generate electrical signal during each heartbeat
* Impulse spread through heart & body fluids
* ECG Detects these electrical signals & convert them into a waveform.

Components

P. wave — Represents atrial depolarisation
Indicates Contraction of atria.

QRS Complex — Represents ventricular depolarisation
Controls contraction of ventricles
larger deflection in ECG

T-wave — Represents ventricular repolarisation

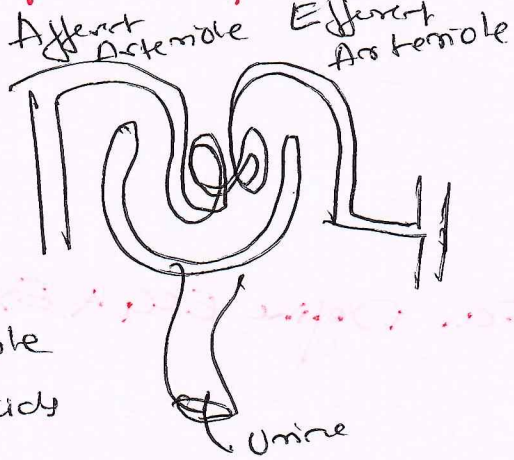
Uses

1) Detects arrhythmias, heart block
2) Helps monitoring heart rate
3) Routine cardiatric checkup & emergency diagnosis

5b

How kidney will be used as a filteration system, explain with one type of dialysis example

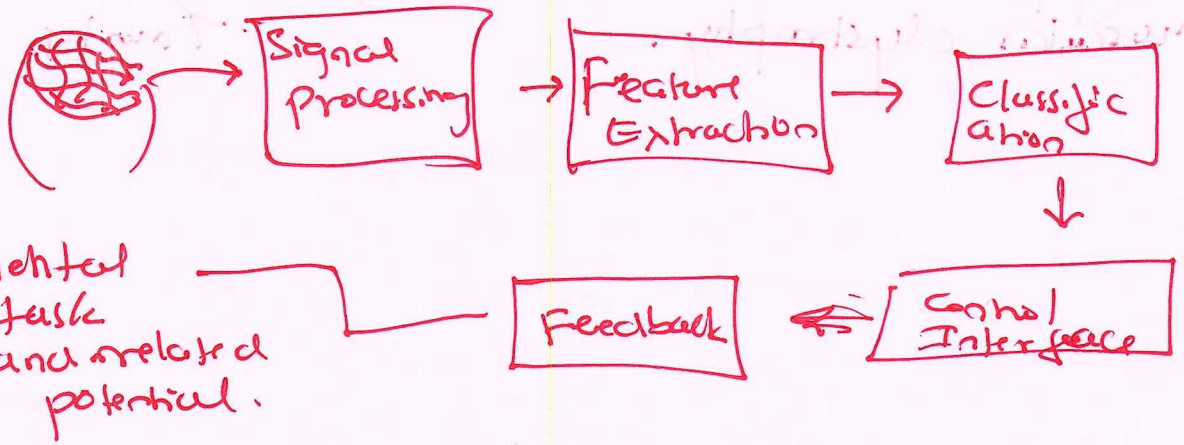
Kidney as filteration system



- Each kidney contains nephron
- Blood filteration occurs in the glomerulus where waste material, urea, excess salt & water are filtered into Bowmans capsule
- Useful substances like glucose, amino acids are reabsorbed in renal tubules
- Final urine contains waste excreted, & purified blood return for circulation
- Remove metabolic waste, Regulates blood pressure, maintain electrolytes

5c. Illustrate brain as CPU system

(9)



1. Brain as input Unit.
   * Sensory organs (eye, skin, nose, tongue) act like input devices
   * Send signals as input to brain using sensory nerves
   * Eye sends visual, ears sends sound etc
2. Brain As processing unit
   * The cerebrum analyse, intercept & proces incoming information
   * Perform thinking, reasoning, memory & decision making
   * Billions of neurons network work together like microprocesors
3. Brain as memory unit
   * Stores information in short term & long term memory
   * learning from past experience & decision
4. Brain as Control Unit
   * Controls voluntary & involuntary activities
   * Regulates heartbeat, breathing, movement etc
   * maintains coordination & Balance
5. Brain as output controller
   * Command motor nerves based on information
   * muscles & glands acts as o/p devices

6a. Briefly discuss various bio engineering solution for Muscular dystrophy. (10) 7 marks.

Muscular Dystrophy (MD) is a genetic disorder characterized by progressive muscles. weakness due to defect in muscle protein.

Major Bio engineering solutions

1) Gene Therapy.
   * Correct & Replace defective gene
   * Insert functional dystrophin using viral vectors
   * Helps slow disease progression

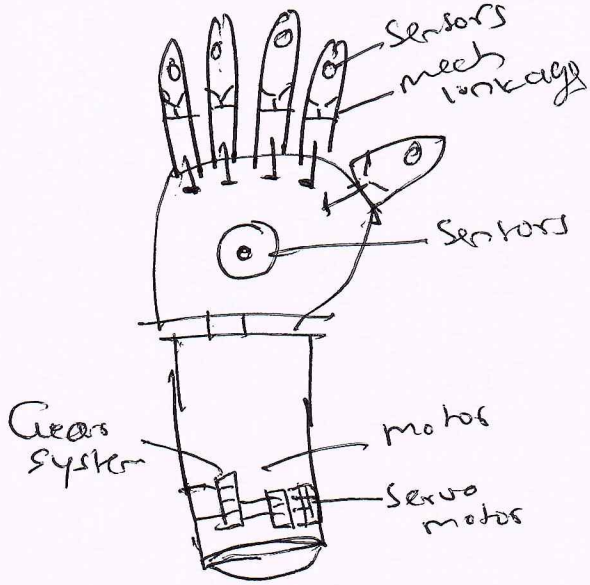
2) Stem Cell Theraphy
   * Use Stemcell to regenerates damaged muscle
   * Promote muscle repair

3) Biomedical implants
   * Orthotic devices, braces & exoskeletone support
   * Improve mobility & quality of life

4) Tissue Engineering
   * Develop artifical muscle using tissue culture
   * Aids in muscle regeneration research

6b. Explain Robotic arm for Prosthetic Devices 7 marks

Muscle Signal
↓
Myoelectric Sensors
↓
Signal Amplifiyer
↓
Microcontroller
↓
Motor Drive
↓
Actuators
↓
Robotic Arm movement



Robotic prosthetic arm is an artificial limb that replaces a missing arm & performs movements similar to a natural arm. (11)

→ Mioelectric sensors detect electrical signals from muscles
→ Signals are processed through microcontroller
→ Motors signal controls signals into mechanical movement
→ Arm performs actions like gripping, lifting and rotating.

6c Illustrate Eyes as a Camera system

Human Eye	Camera
1) Eye lens focus light on retina	1) Camera lens focus light on film
2) Iris controls size of pupils	2) Aperture controls amount of light
3) Pupils allows light to enter eye	3) Aperture opening allows light
4) Retina acts as light sensitive surface	4) Film sensors records image
5) Brain intercepts image	5) Signal cable transfer image data
6) Optic nerves transfer image data	6) Image processor process image
7) Eye adjust focus continuously	7) Camera adjust focus manually or automatically.

7a. Compare process of photosynthesis to the function of photosynthesis with photovoltaic cells.

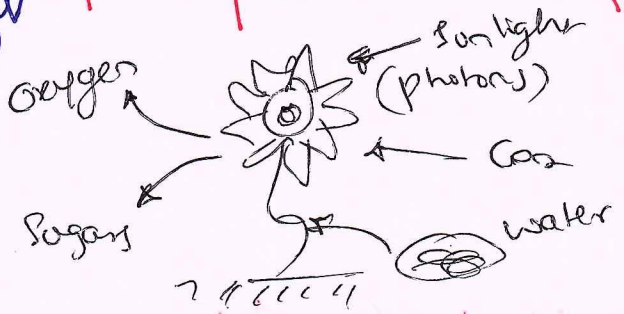
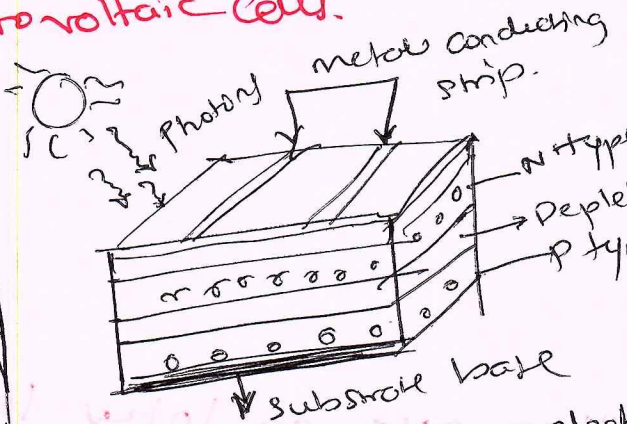


Photo synthesis

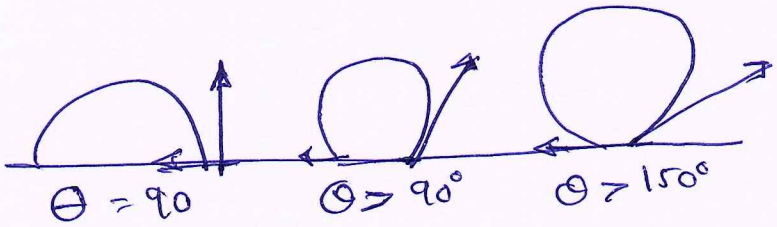
1) Convert Sunlight into chemical Energy
2) Use chlorophyll to absorb energy
3) Produce oxygen as by-product
4) Requires CO_2 + water with sunlight
5) Energy stored internally as food



1) Convert Sunlight into electrical energy
2) Uses p-n semiconductor to absorb energy
3) No chemical by-product
4) Requires only sunlight
5) Energy must be stored externally in batteries

7b. Super hydrophobic & self cleaning surfaces. Explain in detail.

Hydrophobic to Super hydrophobic 7 marks (12)



90° — 150° Hydrophobic
> 150° Superhydrophobic.

1. Super hydrophic Surfaces.

It is the one that shows extreme water repellency, with water contact angle greater than 150°. Water droplets beads of and rolls out easily.

→ High contact angle > 150°
→ Droplets nearly spherical in shape
→ Prevent water from spreading
→ Micro & Nano scale roughness achieved by surface

2. Self cleaning Surfaces.

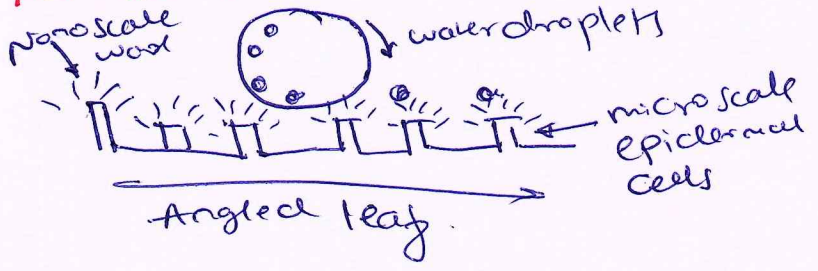
These are the surfaces that remove dust, dirt & contaminat automatically without natural washing

* Lotus effect observed as water droplets roll over a surface and carry dirt particles along with it
* Most self cleaning surfaces are superhydrophobic

#Applications

1) Glass & Building materials
2) Textile Industry
3) Biomedical devices
4) Marine & Industrial application

7c. Write a note on lotus leaf effect 6 marks



The lotus leaf effect is a natural self cleaning process that observed on a surface of lotus leaves where water droplets roll off easily and carry out dust & dirt particles

Engineering Application

→ Self cleaning glass & coting
→ Water repellent textile
→ Anti corrosion surfaces
→ Solar panel & building materials

8a. Compare HBOC's with PECs 7 marks.

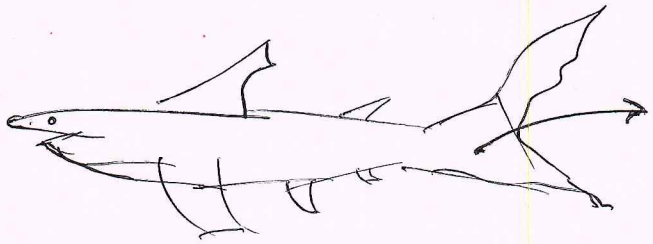
HBOC's

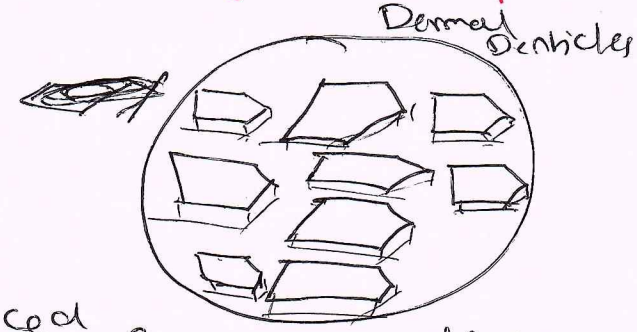
1) Hemoglobin Based oxygen Carrier
2) Carry & deliver oxygen in human body
3) Based on hemoglobin molecules
4) Used in medical & biomedical Application
5) Function inside biological system
6) Aim to support life & metabolism
7) Mimic oxygen transport in blood cells

PEC

1) Photo electrochemical Cells.
2) Convert solar energy into electrical or chemical energy
3) Based on semiconductor material
4) Used in renewable energy & engineering application
5) Functions in electrochemical system
6) Aim to support clean & sustainable Energy
7) Mimic Natural Photosynthesis,

8b. How shark skin & Swim suit use biological concepts.





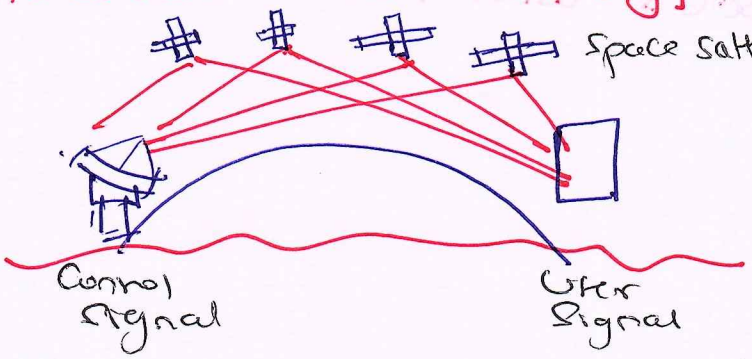
Shark skin has inspired advanced Engineering design in swimsuits through the concept of biomimicry, where biological structures are copied to solve Engineering problems

Biological Concept

- → Shark skin covered with dermal denticles
- → These denticles have ribbelt structure aligned with water flow
- → They reduce drag & turbulence
- → Prevent attachment of microorganisms

In swimsuit same concept is adopted with with ribbed surface pattern similar to shark skin. This structure reduces water resistance. Improve swimmers speed & efficiency also enhance stability & flow control of water.

8c Write a note on GPS Technology 5 marks (14)



GPS (Global Positioning System) is a satellite based navigation system used to determine exact position, velocity & time of a receiver anywhere on earth

Principles
* It works on principle of triangulations
* It receives & calculate its position by receiving signal from multiple satellite
* Distance is compound using time delay b/w signal transmission & reception

Components of GPS
1) Space Segments → Network GPS satellite orbiting earth
2) Control Segment → Ground station monitor & manage satellite
3) User Segment → GPS Receiver (Mobile, vehicle etc)

Application of GPS
* Navigation of vehicle, ships & aircrafts
* mobile phone location service
* Surveying & mapping
* Military application.

9a. Explain in detail how AI will be used in disease detection 7 marks

Artificial Intelligence is widely used in data collection & disease diagnosis to impro accuracy, speed & early detection. It supports clinical decisions

1) Data Collections
medical data collected at various sources
   1) Patient records
   2) Medical Images
   3) Lab repots (ECG, Genetic data)
   4) Wearable sensors like Smart watches

This is in the form of AI input.

2) Data Processing
1) Raw medical data cleaned & standardised
2) Missing values, noises, errors are removed
3) Images are enhanced, normalised & segmented
4) Steps ensures reliable & accurate analysis.

3). Feature Extraction.
1) Important disease related features are identified
2) Reduce data complexity & improve model efficiency

4) AI Model Train
Machine learning & deep learning
Pattern are compared with healthy & diseased condition.
Continuous learning & improvement.

9b. Demonstrate Bioremediation & Biomining

Bioremediation — It is a process of using microorganisms such as bacteria, fungi, algae to remove, degrade, detoxify pollutants from soil, water & air
* Microorganism use pollutants as source of their energy
* Toxic substances are converted into non toxic substances

Application
1) Cleaning oil spills
2) Treatment of sewage & industrial pollutants
3) Removal of pesticides, heavy metals

Advantage
1) Eco friendly & cost effective
2) Minimal environmental disturbance.

Biomining
Biomining is extraction of valuable metal from low grade ores using microorganism.

Working Principle
Bacteria oxidize metal sulfides
Metal like copper, gold and uranium released into solution
This process called bioleaching

Advantage:
Reduce use of harsh chemicals
Useful low grade ores
Environmental Safety

9c. Explain Muscular system as scaffold (16)

The muscular system can be explained as biological scaffold because it provides structural support, shape and framework for movement & tissue organisation in the body

Explanation

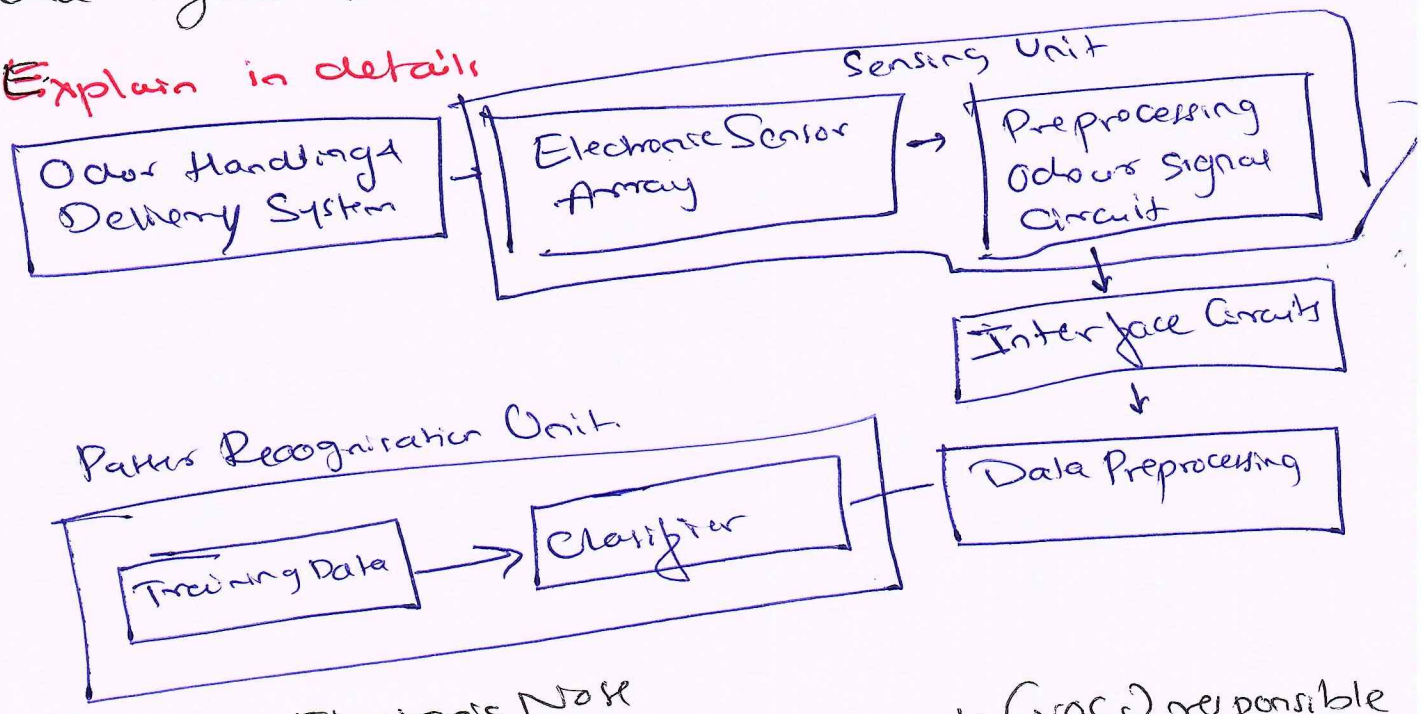
1) Structural Support
2) Attachment & Alignment
3) Force Transmission
4) Cellular Scaffold
5) Role in Regeneration

Muscle form supportive framework around bones and organs. helping maintain body posture and shape

Muscle attach to bones via tendons, holding skeletal

Muscle tissue contains extracellular matrix (ECM) that support muscle cells, supplies & nutrients and aid repair and regeneration

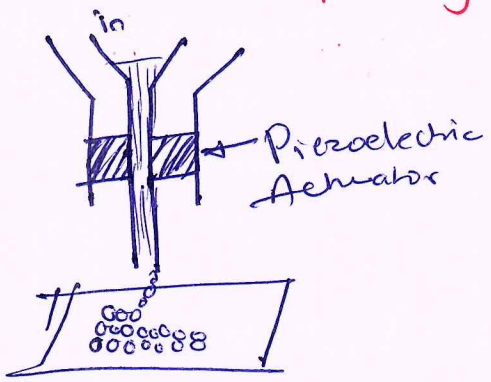
10a. Explain in details



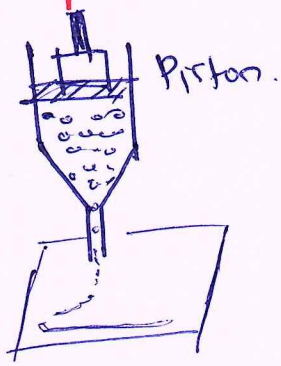
Principle of Electronic Nose

1) Food releases volatile organic compounds (VOCs) responsible for aroma
2) The E-nose uses an array of chemical sensors with partial selectivity
3) Each odor produces a unique sensor response pattern
4) Pattern recognition algorithms identify and classify the odor

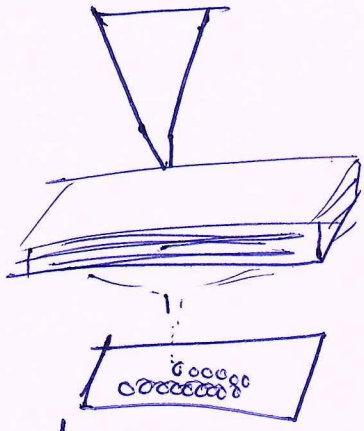
10b. Demonstrate bioprinting technique & list them all



Inkjet Printing



Extrusion Printing



Laser printing

Demonstration of working Technique

1. Bio ink preparation – living cells are mixed with biomaterial
   The mixture is called bioink
2. Digital Design –
   A 3D model of tissue/organ is created using CAD or medical imaging
3. Layer-Layer Printing –
   Bioink deposited precisely according to design
   Layer are built from 3D biological structure
4. Cross Linking | Stabilization
   Printed structure is stabilized using chemical thermal
5. Maturation
   A printed tissue cultured in bioreactor

10c Explain DNA Origami & Bio computing

1) DNA origami is a nanotechnology technique in which a long single stranded DNA molecule is folded into precise nanoscale shape using short DNA strands called staypple strands

Working Principle

1) Complementary base pairing (A-T, G-C) is used
2) Staple strands bind specific regions of a long DNA
3) This cause the DNA to fold into desired 2D or 3D model.

Application

1) Drug delivery nanoscale
2) Biosensor & nano-devices
3) Tissue Engineering

2. Biocomputing

Biocomputing is a biological molecules or systems, especially DNA, Proteins, or cells to perform computational operations similar to electronic computers.

Working Principle

* Biological reactions represents logic operation
* DNA stands. act as data and Enzymes act as processes
* DNA Logic gates (AND, OR, NOT) perform computation

Applications

* Disease diagnosis and smart drug delivery
* Solving complex computational problems
* Development of bio inspired computing system

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