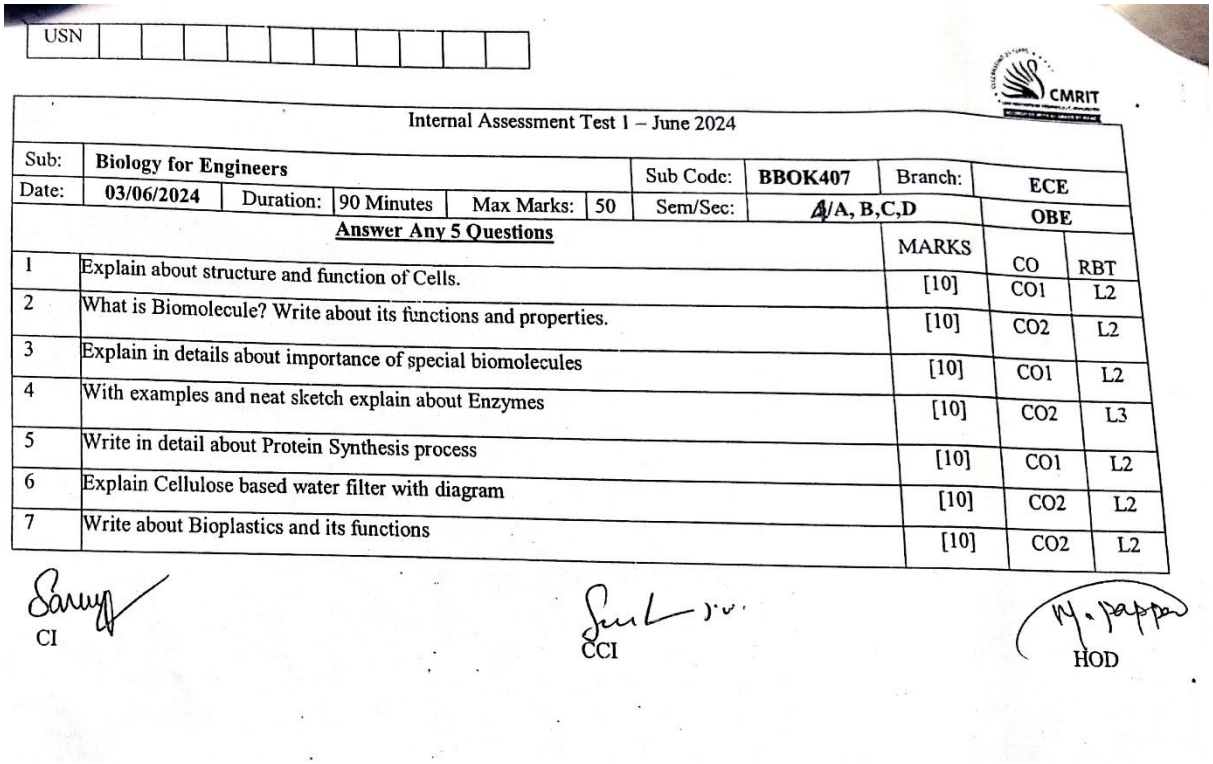

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CMRIT

Internal Assessment Test 1 – June 2024

Sub:	Biology for Engineers					Sub Code:	BBOK407	Branch:	ECE
Date:	03/06/2024	Duration:	90 Minutes	Max Marks:	50	Sem/Sec:	A/A, B,C,D		OBE

Answer Any 5 Questions

		MARKS	CO	RBT
1	Explain about structure and function of Cells.	[10]	CO1	L2
2	What is Biomolecule? Write about its functions and properties.	[10]	CO2	L2
3	Explain in details about importance of special biomolecules	[10]	CO1	L2
4	With examples and neat sketch explain about Enzymes	[10]	CO2	L3
5	Write in detail about Protein Synthesis process	[10]	CO1	L2
6	Explain Cellulose based water filter with diagram	[10]	CO2	L2
7	Write about Bioplastics and its functions	[10]	CO2	L2

CI CCI HOD

SOLUTIONS:

1.Structure and function of cells

Cells are the fundamental structural and functional unit of all living beings.

• A cell is the smallest unit of a living thing. All living thing, are called an organism. Thus, cells are the basic building blocks of all organisms. In multicellular organisms, several cells of one particular kind interconnect with each other and perform shared functions to form tissues (for example, muscle tissue, connective tissue, and nervous tissue), several tissues combine to form an organ (for example, stomach, heart, or brain), and several organs make up an organ system (such as the digestive system, circulatory system, or nervous system).

Several systems functioning together form an organism (such as an elephant, for example).

There are many types of cells, and all are grouped into one of two broad categories: prokaryotic and eukaryotic. Animal cells, plant cells, fungal cells, and protist cells(aqautic and are unicellular) are classified as eukaryotic, whereas bacteria and archaea (cells does not have nucleus) cells are classified as prokaryotic.

SIZE AND STRUCTURE OF CELL

The size and the shape of the cell range from millimetre to microns, which are generally based on the type of function that it performs. A cell generally varies in their shapes. A few cells are in spherical, rod, flat, concave, curved, rectangular, oval and etc. These cells can only be seen under microscope.

Below are the following characteristics of a cell:

Cells help in formation of the structure of an organism. A cell is a membrane-bound organelle having other cell organelles which perform different functions. Nucleus present in the between of a cell carries all the genetic information of a cell. Lysosomes help in cellular digestion. Cytoplasm is present in the interior of a cell in which all cell organelles are present.

FUNCTIONS OF A CELL

The below mentioned are some of the functions of a cell:

Structure and Support: Cells provide the structural basis of all organisms.

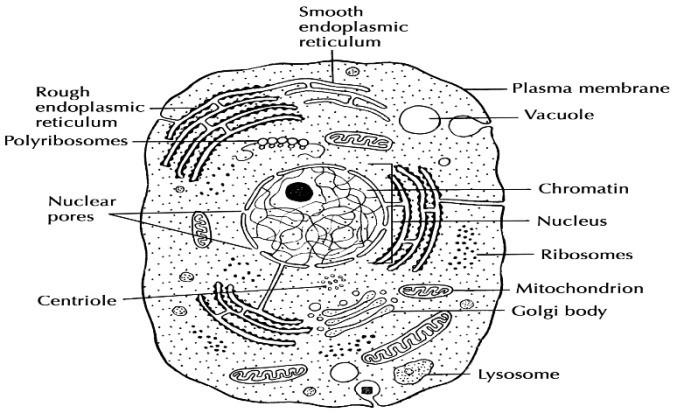
Growth: Cells are responsible for the growth of the organism.

Transport: Cells transport the nutrients that are used in the different chemical processes which take place inside them. As a result of these processes, a waste product is produced. Cells then work to get rid of this waste. In this manner, small molecules like oxygen, carbon dioxide, and ethanol pass through the cell membrane by diffusion. This method is known as passive transport. On the other hand, the larger molecules like the proteins and polysaccharides, go in and out of the cell via active transport.

Energy Production: Organisms need energy to perform different chemical reactions. In plants, the energy comes from the process of photosynthesis while in animals the energy comes via respiration.

Metabolism: The cell is responsible for the metabolism which includes all the chemical reactions that take place inside an organism to keep it alive.

Reproduction: A cell helps in reproduction through the processes of mitosis and meiosis.



2. What is Biomolecule? Write about its functions and properties?

The bio-macromolecules such as carbohydrates, proteins, lipids and nucleic acid are the important chemicals that provide cellular fuel, form the basis of enzymes, structural and cellular components and storage of genetic information.

Physical Properties of Carbohydrates

- **Stereoisomerism** – Compound shaving the same structural formula but they differ in spatial configuration. Example: D-glucose and L-glucose.
- **Optical Activity** – It is the rotation of plane-polarized light forming (+) glucose and (-) glucose.

- **Diastereoisomers** – It the configurational changes with regard to C2, C3, or C4 in glucose.
- **Annomerism** – It is the spatial configuration with respect to the first carbon atom in aldoses and the second carbon atom in ketoses.

Chemical Properties of Carbohydrates

- **Osazone formation**: Osazone are carbohydrate derivatives when sugars are reacted with an excess of phenylhydrazine (mushroom). eg. Glucosazone
- **Benedict's test:** When Benedict's reagent solution and reducing sugars are heated together, the solution changes its color to orange-red/ brick red.

Oxidation: Monosaccharides are reducing sugars if their carbonyl groups oxidize to give carboxylic acids. In Benedict's test, D-glucose is oxidized to D-gluconic acid thus, glucose is considered a reducing sugar.

Properties of Monosaccharides

- Most monosaccharides have a sweet taste (fructose is sweetest; 73% sweeter than sucrose).
- They are solids at room temperature.
- They are extremely soluble in water: – Despite their high molecular weights, the presence of large numbers of OH groups makes the monosaccharides much more water-soluble than most molecules of similar MW.

Glucose can dissolve in minute amounts of water to make a syrup (1 g / 1 ml H_2O).

Functions of Carbohydrates

Carbohydrates are widely distributed molecules in plant and animal tissues.

Some of their major functions include

- Living organisms use carbohydrates as accessible energy to fuel cellular reactions. They are the most abundant dietary source of energy for all living beings
- .Carbohydrates along with the chief energy source, in many animals- are instant sources of energy.
- Serve as energy stores, fuels, and metabolic intermediates.
- It is stored as glycogen in animals and starch in plants.

Stored carbohydrates act as an energy source instead of proteins.

- They form structural and protective components, like in the cell wall of plants and microorganisms.
- Structural elements in the cell walls of bacteria, plants (cellulose), and animals.
- Carbohydrates are intermediates in the biosynthesis of fats and proteins.
- Carbohydrates aid in the regulation of nerve tissue and is the energy source for the brain.
- Carbohydrates get associated with lipids and proteins to form surface antigens, receptor molecules, vitamins, and antibiotics.

- Formation of the structural framework of RNA and DNA (ribonucleic acid and deoxyribonucleic acid).
- They are linked to many proteins and lipids. Such linked carbohydrates are important in cell-cell communication and in interactions between cells and other elements in the cellular environment.
- In animals, they are an important constituent of connective tissues.
- Carbohydrates that are rich in fiber content help to prevent constipation. Also, they help in the modulation of the immune system.

3. Explain in detail about importance of special biomolecules?

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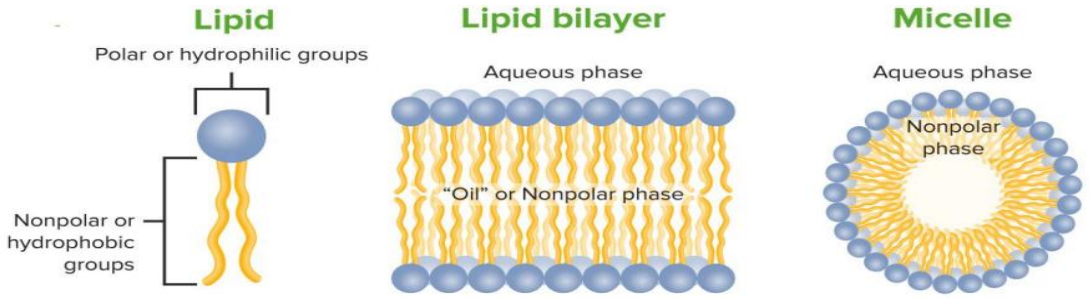

Figure: Schematic representation of lipid molecule, bilayer formation, and miscelle formation.

Role of Lipids

1. Energy storage: Lipids are a major source of stored energy in the body, and they can be broken down to release energy when it is needed.

2. Insulation: Lipids help to insulate the body, helping to regulate temperature and protect against heat loss.

3. Cell membrane structure: Lipids are a major component of cell membranes, helping to maintain their fluidity and stability.

4. Hormone synthesis: Some lipids, such as cholesterol, are precursors to hormones, and are necessary for their production

5. Transport: Lipids are soluble in fat, but not in water. This makes them ideal for carrying fat soluble vitamins and other lipophilic compounds through the bloodstream.

There are several types of lipids, including saturated and unsaturated fats, phospholipids, and steroids. It is important to have a balanced diet that includes a moderate amount of healthy lipids, such as monounsaturated and polyunsaturated fats, while limiting the intake of saturated and trans fats. This can help to maintain overall health and reduce the risk of chronic diseases such as heart disease and stroke

Functions of Lipids

- Biological lipids are a chemically diverse group of compounds.
- In the body, fats serve as an efficient source of energy and are also stored in the adipose tissues.
- These also serve as an insulating material in the subcutaneous tissues and around certain organs.
- Phospholipids and sterols are major structural elements of biological membranes.
- Similarly, fats combined with proteins (lipoproteins) are important constituents of the cell membranes and mitochondria of the cell.
- Lipids also act as the structural component of the cell and provide the hydrophobic barrier that allows the separation of the aqueous contents of the cell and subcellular structures.
- Cholesterol acts as a precursor to fat-soluble vitamins like Vitamin D and hormones.
- Lipids are also activators of enzymes like glucose-6-phosphatase, dehydrogenase, and stearyl CoA desaturase.

4. With examples and neat sketch explain about Enzymes

Enzymes

- Enzymes are proteins that act as catalysts in biological reactions.
- They speed up the rate of chemical reactions without being consumed in the process.
- Enzymes are specific to the type of reaction they catalyze, and they bind to specific substrates to facilitate the reaction.
- Enzymes play a crucial role in various metabolic pathways, digestion, and cellular respiration.

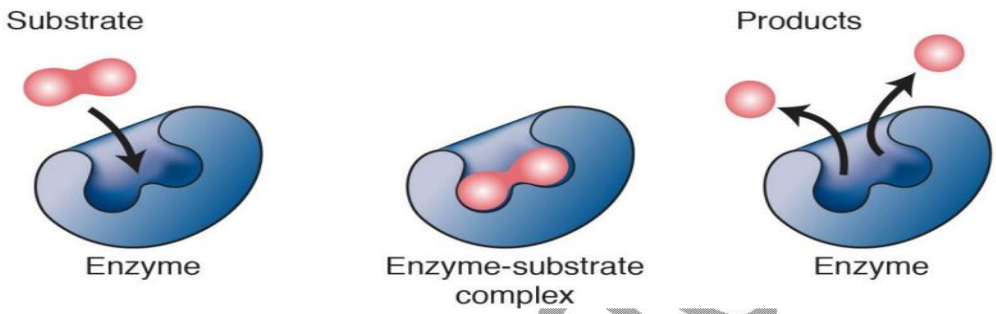

Figure: Schematic representation of working of enzyme as catalyst

Classification of Enzymes

The following are their functions:

1. Oxidoreductases: Oxidoreductase is an enzyme that catalyses the oxidation and reduction reactions in which electrons are transferred from one form of a molecule (electron donor) to the other (electron acceptor). Consider the enzyme pyruvate dehydrogenase. Cofactors for oxidoreductase enzymes are commonly NADP+ or NAD+.

$$AH_2+B \rightarrow A+BH_2$$

2. Transferases: These catalyse the transfer of a chemical group (functional group) from one compound (referred to as the donor) to another compound (referred to as the recipient) (called the acceptor). A transaminase, for example, is an enzyme that transfers an amino group from one molecule to another.

$$A–X+B \leftrightarrow B–X+A$$

3. **Hydrolases:** They are hydrolytic enzymes that catalyse the hydrolysis reaction by cleaving the bond and hydrolyzing it with water molecules, i.e. they catalyse the hydrolysis of a bond. Pepsin, for example, breaks down peptide connections in proteins.

$$A–X+H_2O \rightarrow X–OH+A–H$$

4. **Lyases:** They are enzymes that catalyse bodywork by creating a double bond or adding a group to a double bond without involving hydrolysis or oxidation. Aldolase (a glycolysis enzyme) catalyses the conversion of fructose-1, 6-bisphosphate to glyceraldehyde-3-phosphate and dihydroxyacetone phosphate, for example.

$$A–X+B–Y \rightarrow A=B+X–Y$$

5. **Isomerases:** They're an enzyme family that converts a chemical from one isomer to another. Isomerases aid intramolecular rearrangements by breaking as well as forming bonds. In glycogenolysis, for example, phosphoglucomutase catalyses the conversion of glucose-1-phosphate to glucose-6-phosphate (the phosphate group is moved from one position to another in the same substance). For energy to be released fast, glycogen is converted to glucose.

$$A_{Cis} \rightarrow A'_{Trans}$$

6. **Ligases:** Ligase is a catalytic enzyme that catalyses the ligation or connecting of two big molecules by establishing a new chemical link between them. DNA ligase, for example, catalyses the formation of a phosphodiester bond between two DNA fragments.

$$A+B \rightarrow AB$$

5. Write in detail about protein synthesis process?

Proteins are large, complex molecules made up of chains of smaller building blocks called amino acids. They play a vital role in the structure, function, and regulation of cells, tissues, and organs. Proteins are also involved in immune responses, hormone regulation, and muscle contraction. The structure of a protein determines its function, and the sequence of amino acids in a protein determines its structure. There are 20 different types of amino acids, and the specific sequence of amino acids in a protein determines its unique structure and function. Proteins are synthesized by cells from the genetic information encoded in DNA. The process of protein synthesis begins when the genetic code for a particular protein is transcribed into a molecule of messenger RNA (mRNA). The mRNA is then transported out of the nucleus and into the cytoplasm, where it is translated into a protein by ribosomes. Proteins play a critical role in many biological processes, and their dysfunction is involved in the development of many diseases, including cancer, heart disease, and neurological disorders.

Functions of Proteins

Proteins perform a wide range of functions in the body, including

1) Catalyzing chemical reactions

· Amylase: An enzyme that breaks down **starch into simple sugars** like glucose and maltose. It is found in saliva and pancreatic juice.

· Lipase: An enzyme that breaks down **fats into fatty acids and glycerol**. It is found in the pancreas and small intestine.

· Catalase: An enzyme that converts **hydrogen peroxide into water and oxygen**. It is found in most cells of the body.

Trypsin: An enzyme that breaks down **proteins into smaller peptides**. It is produced in the pancreas and released into the small intestine.

· ATP synthase: An enzyme that catalyzes the synthesis of ATP (adenosine triphosphate) from ADP (adenosine diphosphate) and phosphate. It is found in the mitochondria of cells.

2) Transporting molecules

· Hemoglobin: Hemoglobin is a **protein found in red blood cells** that transports oxygen from the lungs to the tissues in the body.

· Albumin: Albumin is a protein found in **blood plasma** that helps transport various substances such as hormones, fatty acids, and drugs throughout the body.

· Transferrin: Transferrin is a protein that transports **iron in the blood** from the site of absorption in the gut to the bone marrow, liver, and other tissues that require it.

· Apolipoproteins: Apolipoproteins are a family of proteins that transport lipids (fats) in the bloodstream. Examples include ApoA, ApoB, and ApoE.

· Ferritin: Ferritin is a protein that **stores iron in a non-toxic** form in the liver, spleen, and bone marrow.

· Glut transporters: Glut transporters are a **family of proteins** that transport glucose and other sugars across cell membranes. Examples include GLUT1 and GLUT4.

3) Providing mechanical support

· Collagen: Collagen is the main structural protein in the body and provides support to tissues such as skin, tendons, cartilage, bone, and teeth.

· Elastin: Elastin is a protein that provides elasticity and stretchability to tissues such as skin, lungs, arteries, and ligaments.

· Keratin: Keratin is a protein that forms the structural basis of hair, nails, and the outer layer of skin.

· Actin and Myosin: Actin and myosin are proteins that are involved in muscle contraction and provide the mechanical force required for movement.

· Tubulin: Tubulin is a protein that forms the structural basis of microtubules, which provide support to cells and are involved in various cellular processes such as cell division and intracellular transport.

· Laminin: Laminin is a protein that forms part of the extracellular matrix and provides structural support to cells in tissues such as skin, muscles, and organs.

4) Regulating cell behavior

· Receptor proteins: Receptor proteins are proteins that are located on the surface of cells and bind to specific signaling molecules such as hormones, growth factors, and neurotransmitters. When these molecules bind to the receptor, they trigger a cellular response, such as a change in gene expression or the activation of an intracellular signaling pathway.

· Enzymes: Enzymes are proteins that catalyze specific chemical reactions in the body. Many enzymes are involved in regulating cellular behavior, such as kinases and phosphatases that regulate protein phosphorylation and dephosphorylation, respectively.

· Cytoskeleton proteins: Cytoskeleton proteins, such as actin and tubulin, play a critical role in regulating cell shape, movement, and division.

· Transcription factors: Transcription factors are proteins that bind to DNA and regulate gene expression. They play a critical role in regulating cellular differentiation, proliferation, and apoptosis.

· Adhesion proteins: Adhesion proteins are proteins that are involved in cell-to-cell and cell-to-matrix adhesion. They play a critical role in regulating cell behavior such as cell migration, tissue development, and wound healing.

· Ion channels: Ion channels are proteins that allow ions to move across the cell membrane. They play a critical role in regulating cellular excitability and communication.

6. Explain Cellulose based water filter with diagram?

Cellulose-based water filters are filters made from cellulose, a carbohydrate polymer found in plant cell walls. They are used to remove impurities and contaminants from water and are an alternative to traditional synthetic polymer filters. The high mechanical strength and hydrophilic properties of cellulose make it an ideal material for water filtration. Cellulose filters can effectively remove particles, pathogens, and other contaminants from water, making it safer and more potable. Cellulose-based water filters are widely used in both developed and developing countries for household, industrial, and agricultural applications. They are also an environmentally friendly alternative to traditional filters, as they are biodegradable and can be produced from renewable resources.

Properties of cellulose based water filter

Cellulose-based water filters have several properties that make them an attractive choice for water filtration:

· High Porosity: Cellulose-based water filters have a high porosity structure, which allows them to efficiently remove impurities and contaminants from water.

· Biodegradability: Cellulose-based water filters are made from a biodegradable material, cellulose, which reduces their impact on the environment compared to synthetic polymer filters.

Cost-effective: Cellulose-based water filters are often more affordable than traditional synthetic polymer filters, making them accessible to a wider range of consumers and communities.

· Renewable resource: Cellulose-based water filters are made from a renewable resource, cellulose, reducing the dependency on non-renewable resources.

· Good mechanical strength: Cellulose-based water filters have good mechanical strength, allowing them to maintain their structure and perform effectively over time.

· Chemical resistance: Cellulose-based water filters are resistant to most chemicals, including acids and bases, and can be used in a wide range of water treatment applications.

· Large surface area: Cellulose-based water filters have a large surface area, which enhances their filtration capabilities and reduces the frequency of filter replacement.

Importance of cellulose based water filters

Cellulose-based water filters are important for several reasons:

· Safe and clean water: Cellulose-based water filters effectively remove impurities and contaminants from water, making it safer and more potable for various applications, including household, industrial, and agricultural use.

· Sustainability: Cellulose-based water filters are made from a renewable resource, cellulose, are biodegradable, reducing their impact on the environment and promoting sustainability in water treatment processes.

· Affordability: Cellulose-based water filters are often more affordable than traditional synthetic polymer filters, making them accessible to a wider range of consumers and communities, especially in developing countries.

· Versatility: Cellulose-based water filters can be used in various types of filtration systems and can be produced in different sizes and shapes to fit specific needs.

· Alternative to synthetic filters: Cellulose-based water filters provide an environmentally friendly alternative to traditional synthetic polymer filters, reducing the dependency on non-renewable resources and reducing waste

7. Write about Bioplastics and its functions?

STEPS:

1. A little colony of bacteria are grown in plates
2. Now, feed the bacteria with sugar solution or glycerol or fatty acids (to get more oxygen).
3. Bacteria will grow only with sufficient carbon, nitrogen and phosphorus.
4. Next process is fermentation
5. In fermentation, the supply of nitrogen and phosphorus stops, the bacteria get stressed and started generating granules of polymer inside the cells.
6. Hence pearls of polymers will produce and will be dried and mixed with acetone and the resulting cocktail will be filtered.
7. This stressing moment will happen only during the process of fermentation, and hence they produce bioplastic as a stress related response
8. Refer the link for more related info

PHA as Bioplastic

Polyhydroxyalkanoates (PHAs) are a class of biodegradable and biocompatible polyesters produced by microorganisms, such as bacteria and fungi.

They are a type of bioplastic.

They are made from renewable resources, such as sugar and cornstarch, and are considered to be an environmentally friendly alternative to traditional petroleum-based plastics

PHAs have several properties that make them ideal for use as bioplastics, including:

Biodegradability: PHAs are biodegradable and can break down into water and carbon dioxide, reducing their impact on the environment.

Biocompatibility: PHAs are biocompatible and can be used in medical devices, such as sutures and implants, without causing adverse reactions in the body.

Mechanical properties: PHAs have similar mechanical properties to traditional petroleum based plastics, making them suitable for various applications.

Processing: PHAs can be processed using conventional plastic processing techniques, such as injection molding, blow molding, and extrusion.

Engineering applications of PHA bioplastic

Packaging: PHA is used in various forms of packaging such as food containers, beverage cups, and clamshell containers.

Medical Devices: PHA is biocompatible and can be used in the manufacture of medical devices such as sutures, implants, and drug delivery systems.

Textiles: PHA is used in the production of biodegradable textiles, as well as for the production of biodegradable composites for use in construction and furniture.

Agricultural Mulch Films: PHA is used in the production of biodegradable films for agriculture to reduce soil erosion and conserve moisture.

Consumer Goods: PHA is used in the production of various consumer goods, such as toys, phone cases, and water bottles.

Automotive Parts: PHA is used for the production of biodegradable automotive parts such as air ducts and headlamp covers

PLA as Bioplastic

Polylactic Acid (PLA) is a biodegradable and bio-based plastic made from corn starch, sugarcane, or other natural resources. It is commonly used as a sustainable alternative to traditional petroleum-based plastics due to its good mechanical properties and good processability. Its various applications such as packaging, disposable tableware, and 3D printing. However, it's important to note that while PLA is biodegradable in industrial composting facilities, it may not break down in the environment as quickly as advertised and may still have negative impacts on wildlife and ecosystems if not properly disposed of. PLA bioplastics are made from polylactic acid, a transparent thermoplastic aliphatic polyester made from renewable resources.

Bio-based plastics like PLA are derived from biomasses like corn, sugarcane, seaweed, or even shrimp shells. PLA is also biodegradable, meaning it breaks down in natural environments and only leaves behind biomass, carbon dioxide, and water. It’s important to note that not all bio-based plastics are necessarily biodegradable, and vice-versa. PLA bioplastics are the only commercially available bioplastics that are both bio-based and biodegradable, and they are one of the few bioplastics suitable for 3D printers.