USN										

Internal Assessment Test 1 – March 2025

Sub:	**Biology for Engineers**				Sub Code:	**BBOK407**	Branch:	**ECE**
Date:	**24/03/2025**	Duration:	90 Minutes	Max Marks: 50	Sem/Sec:	**4/A, B, C, D**		**OBE**

	Answer Any 5 Questions	MARKS	CO	RBT
1	Explain in detail about Prokaryotic and Eukaryotic cell and its applications.	[10]	CO1	L2
2	Explain about glucose-oxidase in biosensors as an Enzyme.	[10]	CO2	L2
3	Explain in details about DNA fingerprinting process with neat sketch.	[10]	CO1	L2
4	Explain why lipids are used as cleaning agents.	[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

USN										

Internal Assessment Test 1 – March 2025

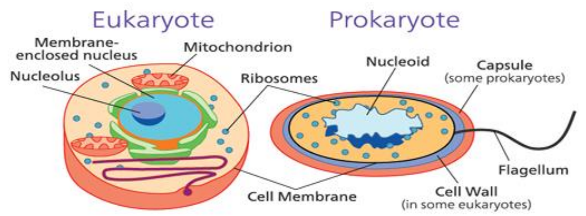
Sub:	**Biology for Engineers**				Sub Code:	**BBOK407**	Branch:	**ECE**
Date:	**24/03/2025**	Duration:	90 Minutes	Max Marks: 50	Sem/Sec:	**4/A, B, C, D**		**OBE**

	Answer Any 5 Questions	MARKS	CO	RBT
1	Explain in detail about Prokaryotic and Eukaryotic cell and its applications.	[10]	CO1	L2
2	Explain about glucose-oxidase in biosensors as an Enzyme.	[10]	CO2	L2
3	Explain in details about DNA fingerprinting process with neat sketch.	[10]	CO1	L2
4	Explain why lipids are used as cleaning agents.	[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

Answers:

1. Explain in detail about Prokaryotic and Eukaryotic cell and its applications.



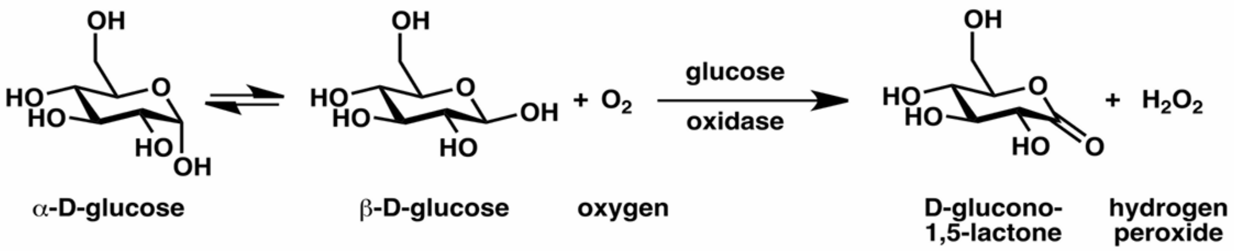
Prokaryotic Cells | Eukaryotic Cells

Aspect	Prokaryotic Cells	Eukaryotic Cells
Feature	Simple cell structure	Complex cell structure
Size	0.1 – 5 µm	10 – 100 µm
Nucleus	No true nucleus (nucleoid region present)	Membrane-bound nucleus
Genetic Material (DNA)	Single circular chromosome; no histones	Multiple linear chromosomes; associated with histones
Membrane-bound Organelles	Absent	Present (mitochondria, endoplasmic reticulum, Golgi apparatus, etc.)
Ribosomes	70S	80S
Cell Wall	Present (peptidoglycan in bacteria)	Present in plants (cellulose), fungi (chitin); absent in animal cells
Flagella Structure	Simple; made of flagellin	Complex; made of microtubules in a 9+2 arrangement
Reproduction	Asexual (binary fission)	Sexual (meiosis) and asexual (mitosis)
Cytoskeleton	Absent or poorly developed	Well-developed (microfilaments, intermediate filaments, and microtubules)
Metabolism	Simple metabolic pathways	Complex metabolic pathways
Cell Division	Binary fission	Mitosis and meiosis
Respiration	Occurs across the cell membrane	Occurs in mitochondria
Functions	Efficient for rapid reproduction and adaptation to harsh environments	Specialized for complex and multicellular life functions
Characteristics	- No compartmentalization of cytoplasm	- Compartmentalized organelles for specialized functions

2. Explain about glucose-oxidase in biosensors as an Enzyme.

Glucose oxidase

The glucose oxidase enzyme (GOx or GOD) also known as notatin is an oxidoreductase that catalyses the oxidation of glucose to hydrogen peroxide and D-glucono-δ-lactone. This enzyme is produced by certain species of fungi and insects and displays antibacterial activity when oxygen and glucose are present



Glucose oxidase is widely used for the determination of free glucose in body fluids (medical testing), in vegetal raw material, and in the food industry. It also has many applications in biotechnologies, typically enzyme assays for biochemistry including biosensors in nanotechnologies. It was first isolated by Detlev Müller in 1928 from Aspergillus Niger.

3. Explain in details about DNA fingerprinting process with neat sketch.

DNA fingerprinting

- **DNA fingerprinting**, also called **DNA typing, DNA profiling, genetic-fingerprinting, genotyping,** or **identity testing**, in genetics, is a method of isolating and identifying variable elements within the base-pair sequence of DNA (deoxyribonucleic acid).
- The technique was developed in 1984 by British geneticist Alec Jeffreys, after he noticed that certain sequences of highly variable DNA (known as minisatellites), which do not contribute to the functions of genes, are repeated within genes. Jeffreys recognized that each individual has a unique pattern of minisatellites (the only exceptions being multiple individuals from a single zygote, such as identical twins).

The following are the steps involved in DNA fingerprinting:

Isolating the DNA.
↓
Digesting the DNA with the help of restriction endonuclease enzymes.
↓
Separating the digested fragments as per the fragment size by the process of electrophoresis.
↓
Blotting the separated fragments onto synthetic membranes like nylon.
↓
Hybridising the fragments using labelled VNTR probes.
↓
Analysing the hybrid fragments using autoradiography.

The procedure for creating a DNA fingerprint

1. The procedure for creating a DNA fingerprint consists of first obtaining a sample of cells, such as skin, hair, or blood cells, which contain DNA.
2. The DNA is extracted from the cells and purified. In Jeffreys's original approach, which was based on restriction fragment length polymorphism (RFLP) technology, the DNA was then cut at specific points along the strand with proteins known as restriction enzymes.
3. The enzymes produced fragments of varying lengths that were sorted by placing them on a gel and then subjecting the gel to an electric current (electrophoresis): the shorter the fragment, the more quickly it moved toward the positive pole (anode).
4. The sorted double-stranded DNA fragments were then subjected to a blotting technique in which they were split into single strands and transferred to a nylon sheet.
5. The fragments underwent autoradiography in which they were exposed to DNA probes—pieces of synthetic DNA that were made radioactive and that bound to the minisatellites.
6. A piece of X-ray film was then exposed to the fragments, and a dark mark was produced at any point where a radioactive probe had become attached. The resultant pattern of marks could then be analyzed.

4. Explain why lipids are used as cleaning agents.

Lipids are used as cleaning agents because of their unique chemical properties, particularly their amphiphilic nature. This means that lipids have both hydrophobic (water-repelling) and hydrophilic (water-attracting) parts, making them effective at breaking down and removing oily and greasy substances. Here's a detailed explanation:

Why Lipids Are Effective Cleaning Agents:

1. **Amphiphilic Structure:**
   Lipids, especially those classified as surfactants (e.g., soaps and detergents), consist of a long hydrocarbon chain (hydrophobic tail) and a polar head group (hydrophilic head). The hydrophobic tail dissolves in oils and greases, while the hydrophilic head interacts with water.
2. **Micelle Formation:**
   When added to water, lipids organize into spherical structures called micelles. The hydrophobic tails surround and trap oily or greasy substances, while the hydrophilic heads face outward, making the entire micelle water-soluble. This process emulsifies the oils, allowing them to be rinsed away with water.
3. **Reduction of Surface Tension:**
   Lipids reduce the surface tension of water, increasing its ability to spread and penetrate greasy surfaces. This enhances the cleaning efficiency by allowing water to mix with oils and dirt.
4. **Solubilizing Greasy Substances:**

Lipids dissolve nonpolar substances, such as oils and fats, which are insoluble in water. This property makes lipids ideal for cleaning greasy residues.

Examples of Lipids Used in Cleaning Agents:
Soaps: Made from natural fats and oils (triglycerides) through a process called saponification, producing fatty acid salts that act as cleaning agents.
Detergents: Synthetic lipids designed for enhanced cleaning in hard water.
Emulsifiers: Used in cosmetics and food products to mix oil and water phases.

5. Write in detail about Protein Synthesis process.

Protein synthesis is a fundamental biological process through which cells create proteins, which are essential for virtually all cellular functions. It occurs in two main stages: Transcription and Translation. This intricate process involves the flow of genetic information from DNA to RNA and then to proteins, following the central dogma of molecular biology. Protein synthesis can be summarized in three main steps:

1. Transcription: DNA → mRNA (in the nucleus)
2. RNA Processing: mRNA maturation (in eukaryotes)
3. Translation: mRNA → Protein (in the cytoplasm or on ribosomes)

1. Transcription: DNA to mRNA

Transcription is the first stage of protein synthesis where the genetic information from DNA is transcribed into messenger RNA (mRNA). It occurs in the nucleus of eukaryotic cells and cytoplasm of prokaryotic cells.

2. RNA Processing (in Eukaryotes)

Before mRNA can be translated into proteins, it undergoes post-transcriptional modifications to become mature mRNA. This step occurs only in eukaryotes.

3. Translation: mRNA to Protein

Translation is the process where the information encoded in mRNA is used to assemble amino acids into a polypeptide chain, forming a protein. It occurs in the cytoplasm on ribosomes (either free or attached to the endoplasmic reticulum).

4. Post-Translational Modifications

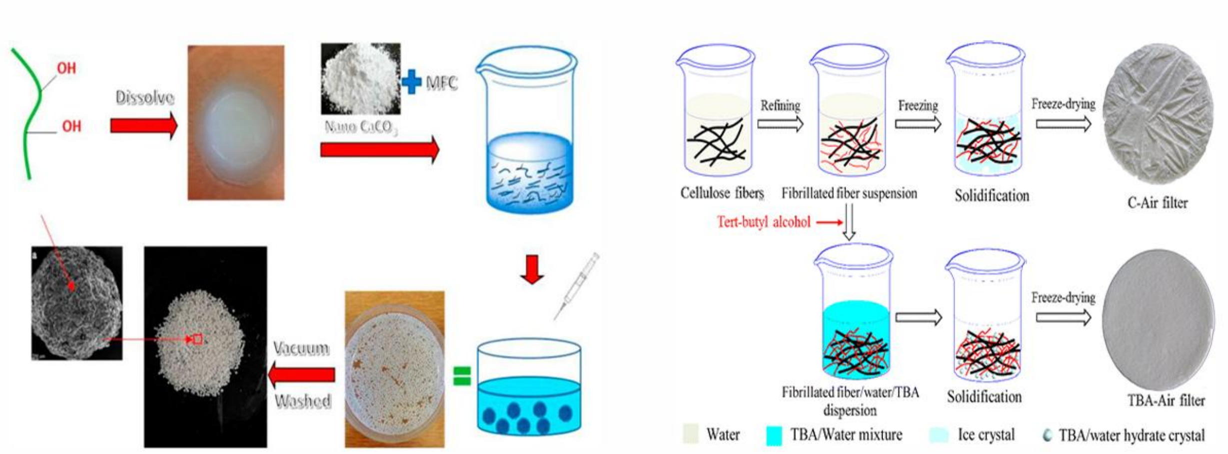
After translation, the new polypeptide undergoes further modifications, including:

- Folding: Proper folding into a functional three-dimensional shape, often assisted by chaperone proteins.
- Chemical Modifications: Addition of phosphate, methyl, acetyl, or carbohydrate groups.
- Cleavage: Removal of certain segments or signal peptides.
- Formation of Disulfide Bonds: Stabilizing protein structure.

These modifications ensure the protein's functionality, stability, and targeting to specific cellular locations.

6. Explain Cellulose based water filter with diagram.

Cellulose-based water Filters



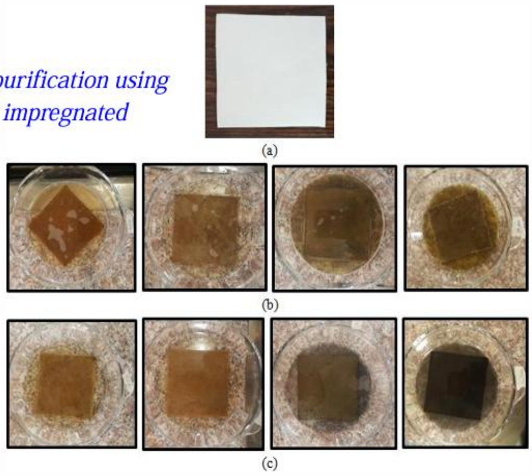
Bioproduction of Chemicals: Microbial Fuel Cells (MFCs) can be employed to synthesize valuable bio-products, including hydrogen, methane, or even specific organic compounds, through the microbial metabolism of substrates in the fuel cell.

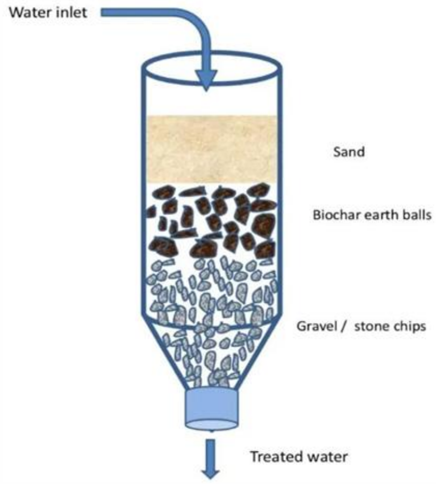
Cellulose-based water purification using paper filters modified with polyelectrolyte multilayers to remove bacteria from water through electrostatic interactions

Research Centre:

Department of Fibre and Polymer Technology, KTH Royal Institute of Technology, Teknikringen 56-58, 114 28 Stockholm, Sweden

Surface-water purification using cellulose paper impregnated





7. Write about Bioplastics and its functions.

Bioplastics are a type of plastic material derived from renewable biological sources, such as corn starch, sugarcane, vegetable oils, and cellulose. Unlike conventional plastics made from petroleum, bioplastics are designed to reduce environmental impact by being biodegradable, compostable, or recyclable. They play a significant role in addressing the global plastic pollution crisis by offering a sustainable alternative.

Types of Bioplastics

Bioplastics are classified based on their origin and biodegradability:

1. Bio-Based Plastics: Made from renewable biological sources but may not be biodegradable.
   Examples: Polyethylene (Bio-PE), Polypropylene (Bio-PP), Polyethylene Terephthalate (Bio-PET).
2. Biodegradable Plastics: Can decompose under specific conditions, regardless of their origin.
   Examples: Polylactic Acid (PLA), Polyhydroxyalkanoates (PHA), Starch Blends.
3. Compostable Plastics: A subset of biodegradable plastics that break down under composting conditions, producing carbon dioxide, water, and biomass.
   Examples: PLA, PBAT (Polybutylene Adipate Terephthalate).

Production of Bioplastics

Bioplastic production involves three primary steps:

1. Fermentation or Extraction: Raw materials like corn, sugarcane, or cellulose are fermented to produce monomers (e.g., lactic acid).
2. Polymerization: Monomers are chemically bonded to create polymers such as PLA or PHA.
3. Processing: The bioplastic polymer is processed into films, sheets, or moulded products using conventional plastic manufacturing techniques.

Functions and Applications of Bioplastics

1. Packaging Industry
   Flexible and Rigid Packaging: Used for making food containers, bottles, and packaging films.
   Compostable Packaging: Reduces environmental impact by breaking down naturally.
2. Agriculture
   Mulch Films and Plant Pots: Biodegradable materials that enhance soil health and eliminate disposal issues.
   Controlled-Release Fertilizers: Slow decomposition releases nutrients over time.
3. Medical and Healthcare
   Medical Implants and Sutures: PLA and PHA are used for bioresorbable implants and surgical sutures.
   Drug Delivery Systems: Bioplastics can encapsulate drugs for targeted release.

4. Consumer Goods
    - Disposable Cutlery and Plates: Eco-friendly alternatives to single-use plastics.
    - Toys and Household Items: Durable and sustainable plastic products.
5. Automotive Industry
    - Interior Components and Upholstery: Lightweight and biodegradable parts.
6. Textiles and Clothing
    - Biodegradable Fibers: Used in clothing, carpets, and upholstery.

Advantages of Bioplastics

1. Reduced Carbon Footprint: Lower greenhouse gas emissions compared to petroleum-based plastics.
2. Renewable Resources: Made from sustainable materials.
3. Biodegradability and Composability: Environmentally friendly disposal options.
4. Reduced Dependence on Fossil Fuels: Less reliance on petroleum.
5. Versatile Applications: Used across multiple industries.

Challenges of Bioplastics

1. High Production Costs: More expensive compared to conventional plastics.
2. Limited Decomposition Conditions: Biodegradation requires specific environments.
3. Competition with Food Crops: Use of crops for bioplastics can affect food supply.
4. Recycling Issues: Difficult to recycle due to mixed plastic streams.