BBOC407

USN

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

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , 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 hormones 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 nuclic acids.	6	L3	CO1
		Module – 2			
Q.3	a.	Define Biomolecule. List the classification of biomolecules with each one example in short in engineering application.	7	L2	CO2
	b.	Explain the applications of enzymes in biosensors and bio bleaching.	7	L2	CO2
	c.	What is DNA finger printing? Explain the process involved in DNA finger printing.	6	L3	CO2
		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 whey as a protein.	6	L3	CO2
		Module – 3			
Q.5	a.	Define ECG. Explain in detail.	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

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			M	L	C
		OR			
Q.6	a.	Briefly discuss the various bio engineering solutions for muscular dystrophy.	7	L2	CO3
	b.	Explain robotic arms for Prosthetic device.	7	L2	CO3
	c.	Illustrate eye as a camera system.	6	L3	CO3
		Module – 4			
Q.7	a.	Compare the process of photo synthesis to the functioning of photo synthesis to the functioning of photovoltaic cells.	7	L2	CO4
	b.	Super hydrophobic and self cleaning surfaces. Explain in detail.	7	L2	CO4
	c.	Write a note on Lotus leaf effect.	6	L3	CO4
		OR			
Q.8	a.	Compare HBOC's and PEC.	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 flow 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	L2	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 Bio computing.	6	L2	CO5

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Sub:	**BIOLOGY FOR COMPUTER ENGINEERS**	Sub Code:	**BBOC407**	Branch:AIML & CSE(AIML)

Answer any FIVE FULL Questions Choosing one full Question from each module

1. Cells are the fundamental units of life, and they play crucial roles in the functioning of living organisms. Here's how cells contribute to the functioning of organisms(5)

   Structural Support: Cells form the structural framework of all living organisms. They provide shape, support, and organization to tissues, organs, and organ systems.

   Metabolism: Cells carry out various metabolic processes necessary for life, such as respiration, photosynthesis (in plant cells), digestion, and synthesis of biomolecules like proteins, carbohydrates, and lipids.

   Reproduction: Cells are responsible for the reproduction of organisms through processes like mitosis (in eukaryotes) and binary fission (in prokaryotes).

   Communication: Cells communicate with each other through chemical signals, allowing them to coordinate activities and respond to changes in their environment.

   Homeostasis: Cells maintain internal balance (homeostasis) by regulating factors like temperature, pH, and concentration of ions and molecules.

   Defense: Some cells, like white blood cells in animals and certain cells in plants, play roles in defending the organism against pathogens and other harmful agents.

Progesterone :- Critical role in menstrual cycle

Auxins :- Auxins regulate plant growth and development including cell elongation, apical dominance and root formation.

Cytokinins :- It regulates cell division.

Listing of Lipids properties

1) Hydrophobicity   3) Amphipathicity
2) Structural Diversity 4) Energy storage
5) Insulation 6) Lubrication.

Function of Lipids.

1) Energy storage, 2) Structural role, 3) Insulation
4) Hormone Regulation, 5) Cell Signalling
6) Absorption of nutrients. [Explaining each]

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2. Stem cells are unique cells.
They have the ability to develop into various specialized cell types (cells in heart, kidney, eyes are all different)…
They play very crucial role in growth, mainly tissue repair.

Applications

Regenerative Medicine : Stem cells are used to regenerate damaged tissues & organs.
-Tissue Repair
- Orthopedic Treatments : Joint and bone regeneration
Treatment of Diseases
Blood Disorders : treating Anaemia, leukemia by replacing blood cells.
Neurological Disorders : In Parkinson and Alzheimer diseases.
Drug Development and Testing : For testing new drugs before using on animals.
Understanding Disease Mechanisms : In labs and controlled manner, diseases and their spread and control, can be studied using stem cells.
Cell-Based Therapies : To address various medical conditions and treating a particular malignant cell to stop spreading of disease.
Personalized Medicine : Tailoring treatments based on personalized traits and genetics and characteristics.

Stem cell :-> Are undifferentiated cells with the remarkable ability to differentiate into specialized cell types. [Defn]

Characteristics.
1) Self Renewal 2) Differentiation

Application of Stem cells.
1) Tissue Engineering, 2) Biomaterial 3) Integration
Bioprinting 4) Drug screening, and Development
5) Gene therapy 6) Disease modelling [Explaining all these]

properties and function of Vitamins.

Vitamin A → Essential for vision immune function

Vitamin B₁ → Energy metabolism nerve function

Vitamin B₂ → Energy production, metabolism of fats, carbohydrates

Vitamin B₃ → DNA repair & cell signalling

Vitamin B₅ → fatty acid synthesis

Vitamin C → Antioxidant supports immune function wound healing

Vitamin D → Calcium absorption bone health

Vitamin E → An antioxidant that protects cell membrane from oxidative damage

properties and function of nucleic Acids

properties: polarity. Double Helix Structure Base pairing, hydrogen bonding, acidic nature

Function :→ Genetic information Storage, protein Synthesis, Gene expression Regulation, Energy transfer, catalysis. Immune response, Chemical Signalling

3.

Biomolecule :→ Are Chemical compounds found in Living organisms that are essential for the Survival of living cells and all life processes.

Classification of Biomolecules.

→ Carbohydrates
monosacchaside Disaccharide polysaccharides

→ Lipids.

→ Enzymes

→ proteins

→ nucleic Acids → DNA RNA.

CARBOHYDRATES

These are class of organic compounds.

They play crucial role in biology and are important energy source.

They are composed of carbon (C), hydrogen (H), and oxygen (O) atoms and are classified based on their molecular structure and function.

General formula is $C_n(H_2O)_n$

Simple Carbohydrates obey this formula where as complex carbohydrates do not obey this formula.

Nucleic acids are biopolymers, macromolecules, essential to all known forms of life.

The 2 main classes of nucleic acids are:

Deoxyribonucleic acid (DNA) and Ribonucleic acid (RNA).

If the sugar is ribose, the polymer is RNA. if the sugar is the ribose derivative deoxyribose, the polymer is DNA.

Enzymes in Bio-sensors & bio bleaching

Enzymes are commonly used in biosensors

Glucose oxidase (Gox)

working of different Biosensors

Biosensors are analytical devices that combine a biological recognition

Biosensors have several advantages over traditional analytical methods rapid response time high sensitivity

Enzymes (Gox) (Lox) Cholinesterase (ChE) (ALP) Alkaline phosphatase, urease, [Explaining each]

Lignolytic Enzymes in Bio Bleaching.

It removes color and brighten fibes paper or textiles. It uses hydrogen peroxide and Chlorine [Explaining Advantages]

DNA Finger printing Process involved in finger printing

Is a technique used in forensic science to identify an individual based on their unique DNA profile.

working, 1)Sample collection, 2)DNA Amplification 3)DNA analysis 4)DNA comparison.

4.	**a. Cellulose** a complex carbohydrate, or polysaccharide, consisting of 3,000 or more glucose units. It is extremely abundant, easily renewable, and biodegradable. It's insoluble in water: Due to inter- and intramolecular hydrogen bonding between hydroxyl groups of the neighboring cellulose chains. Also, it is difficult to dissolve with common organic solvents. The best application of cellulose is, Cellulose-based water filters. b. Bioplastics are one type of plastic which can be generated from natural resources such as starches and vegetable oils. Bioplastics are basically classified as bio based and/or biodegradable. Not all bio-based plastics are biodegradable and similarly not all biodegradable plastics are bio based. Bio plastics are said to be biodegradable if they are broken down with the effect of right environmental conditions and microbes. The bioplastics are considered compostable, if, within 180 days, a complete microbial assimilation of the fragmented food source takes place in a compost environment. Based upon this, we have PHA and PLA. c. WHEY protein is a mixture of proteins isolated from whey (liquid by-product of cheese production) Whey is left over, when, milk is coagulated during the process of cheese production. It contains everything, that is soluble from milk, after the pH is dropped to 4.6, during coagulation. It is a 5% solution of lactose in water. It contains water soluble proteins of milk as well as some lipid content.

properties of cellulose as a water filter
1) High porosity, 2) Biodegradability 3) cost effective
4) Renewable resource 5) good mechanical Strength.
6) Chemical resistance, 7) large surface area.
Explaining all above
- Importance safe & cleanwater, sustainability
Affordability, versatility Alternatie to synthetic
filters

properties of PHA
1) Biodegradability 2) Biocompatibility.
3) mechanical properties 4) processing.
Engg application
1) packaging of medical devices, 2) Textiles.
3) Agriculture mulch films, 4) consumer goods.
5) Automotive parts 6) Electronic devices.
7) Aerospace. 8) Sporting goods. 9) Construction [Explaining]

whey as a protein
sports nutrition, weight management Heathpromotion
meal replacement, whey protein available in
variety of forms including powders bars and
drinks Smoothies explanation
• B2 & B12 calcium potassium.
→ High in branched - chain amino acids.
→ commonly found in Smoothies & shakes.
→ dietary supplement
→ Amino acids that needs to build the repair
tissue.
It is the protein derived from the liquid
that separates from milk during the
cheese making process.

5.	The human heart is a four-chambered muscular organ, shaped and sized roughly like a man's closed fist with two-thirds of the mass to the left of midline.

Electrocardiography (ECG) is a quick and easily accessible method for diagnosis and screening of **cardiovascular diseases** including **heart failure (HF)**. Artificial intelligence (AI) can be used for semi-automated ECG analysis. The aim of this evaluation was to provide an overview of AI use in HF detection from ECG signals and to perform a meta-analysis of available studies.

Evaluation of symptoms suggestive of HF currently demands physicians to valuate various parameters including imaging and laboratory data and the electrocardiogram

(ECG). Besides a standard examination that includes an ECG, imaging information, such as echocardiography or magnetic resonance imaging, is seen as gold standard in diagnosis of HF. Nevertheless, an adequate use of such imaging data is associated with relevant technical infrastructure and medical expertise. The ECG is a well-established, quick, and easily accessible method for diagnosis and screening of various cardiovascular diseases. It provides specific features that indicate presence of HF or prognosis in HF patients especially to rule out HF in case of a normal ECG. However, use of an ECG as primary diagnostic instrument often only yields insufficient diagnostic specificity. Further, general practitioner–based ECG reporting has varying results, introducing further diagnostic uncertainty.

P wave (atria)
QRS complex (ventricle:
T wave (rest)

Define ECG Explanation.

ECG measure the electrical signals produced by the heart as it beats and generates a trace waveform that reflects the electric activity of the heart.

→ The pumping action is controlled
→ This checks the heart condition & monitors hearts function

Arrhythmias, Heart disease.
ECG is useful tool for diagonising and monitoring heart related issues [Explanation]

Kidney as filteration System

It removes waste & excess fluid from the blood stream & maintains a delicate balance of electrolytes harmons & other substances that are critically for the body normal functioning

nephron Explanation

Explanation of Hemodilaysis
OR peritoneal dialysis

Brain of Human as a CPU.

■ Computing cell
□ memory cell

CPU   memory

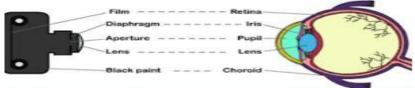|	
	In brain cortex In CPU ALU Brain memory In cpu memory Storage primary & secondary hippocampus Comparision of both CPU & brain interms of computation, memory growth, Backup System memory power memory density size & weigh Energy consumption Information Storage
6.	• Muscular dystrophy is a group of diseases that cause progressive weakness and loss of muscle mass • Awareness is increasing that : • Osteoporosis is a major complication of Duchenne muscular dystrophy (DMD) and • Its treatment, requires monitoring for early diagnosis and intervention to prevent clinically important sequelae. Bioengineering solutions to muscular Dystrophy muscular Dystrophy is group of genetic disorders that result in progressive weakness and degeneration of skeletal muscles 1) DMD 3) FSHD Diseases. 2) Beckker Solutions Gene therapy stem cell therapy Exoskellton technology Tissue Engg [Explaining each] Robotic arms for prosthetic These Device use motors actuators and sensors. These are controlled by muscle signals. → Some prosthetic arms also incorporate machine learning algorithm → myoelectric controls of robotic arms Eye as a Camera System. comparing Eye parts to the camera Drawing both eye & camera Explanation The cornea, The iris, The pupil, the retina, the optic nerve. • The human eye is a wonderful instrument, relying on refraction and lenses to form

images.

- There are many similarities between the human eye and a camera, including:

- A diaphragm to control the amount of light that gets through to the lens. This is the shutter in a camera, and

- The pupil, at the center of the iris, in the human eye, is a lens to focus the light and create an image.

- The image is real and inverted. A method of sensing the image.

- In a camera, film is used to record the image; in the eye, the image is focused on the retina, and a system of rods and cones is the front end of an image-processing system that converts the image to electrical impulses and sends the information along the optic nerve to the brain.
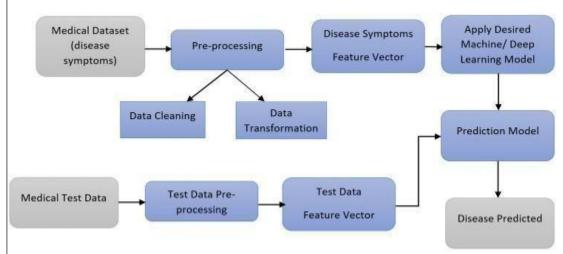

Film	Retina
Diaphragm	Iris
Aperture	Pupil
Lens	Lens
Black paint	Choroid

7.

- The lotus leaf is well-known for having a highly water-repellent or superhydrophobic surface.

- Thus the name lotus effect.

- Water repellency mechanism is used in the development of self-cleaning materials.

- It has been studied in both natural and artificial systems.

- The self-cleaning function of superhydrophobic surfaces means removal of contaminating particles.

- It can be done by impacting or rolling water droplets.

- A unique self-cleaning mechanism:

- Here, the contaminated superhydrophobic surface is exposed to condensing water vapor

- The contaminants are removed by self-propelled jumping motion of the resulting liquid condensate

- The liquid condensate partially or fully covers the contaminating particles.

- The jumping motion of the surface is due to energy released by coalescence of condensed water around contaminants.

8.	- HBS Concerns that fueled development of blood substitutes are :

- Shortages in blood supplies and Safety of donated blood

- The 2 major types of blood substitutes are:

1. Volume expanders: Include solutions (saline) that are used to replace lost plasma volume, and

2. Oxygen therapeutics: These are agents that replace oxygen normally carried by hemoglobin in RBC

- Of these 2 types development of oxygen therapeutics has been the most challenging.

Human Blood Substitutes
Hemoglobin Based oxygen carrier [explanation]
Advantage & limitation of HBCs
PFCs perflourocarbon
Advantage & Disadvantage

Shark Skin & Friction reducing swim suits
Turbulence in water, Reducing Drag
materials used polyurethane, Lycra /spandex
high tech fabric
Speedo FastSkin. Arena powerskin carbon ultra, TYR vermo [Explanation].

GPS technology
Satellites, Recivers, control segment
user segment [Explanation]
positioning navigation, flight planning
Approach & Landing, Airtraffic management
Collision avoidance , Flight data recording
explanation |

9.

- AI can assist providers in a variety of patient care and intelligent health systems.

- AI techniques are prevalent for disease diagnosis, drug discovery, and patient risk identification.

- Detecting and forestalling spread of ailments require ongoing data and examination.

- AI in health care aid in gathering and processing valuable data to programming surgeon robots.

- AI describes the capability of a machine to study the way a human learns.

- AI in healthcare alters how information gets composed, analysed, and developed for patient care.

Biomining & Bioremediation explaination
- Biomining is the process of using microorganisms (microbes) to extract metals of economic interest
- Biomining techniques may also be used to clean up sites that have been polluted with metals.
- Valuable metals are commonly found in solid minerals.
- Microbes can oxidize metals, allowing them to dissolve in water.
- This is the basic process behind most biomining.
- Another, biomining technique uses microbes to break down the surrounding minerals.
- This makes it easier to recover the metal of interest directly from the remaining rock.
- Bioremediation is a biotechnical process.
- It is a type of waste management technique which involves use of organisms to remove or utilize the pollutants from a polluted area.
- Bioremediation is of 3 types :

1)Biostimulation

2)Bioaugmentation

3)Intrinsic Bioremediation

Muscular system as a scafold explaination

Awareness is increasing that bone morbidity due to osteoporosis is a major complication of Duchenne muscular dystrophy (DMD) and its treatment and that

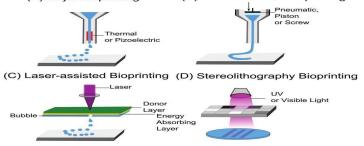|	
	it requires monitoring for early diagnosis and intervention to prevent clinically important sequelae.
	The traditional method of fabricating 3D muscle constructs involves casting myogenic cells within a cylindrically shaped collagen-I gel that is anchored at the ends to porous felts. Rapid-prototyping techniques for hydrogel molding can be used to vary local myofiber alignment and to design complex muscle structures, and advanced biomaterials can deliver angiogenic, myogenic, and pro-survival factors to cells in a spatiotemporally controlled fashion. In addition to using biomaterial scaffolds, scaffold-free muscle tissue constructs have been generated using magnetic fields that allow the controlled assembly of magnetically labeled cells, as well as thermo-responsive polymers that allow controlled cell detachment from culture surfaces.
	Although hydrogels have been the dominant muscle-engineering scaffold in vitro, in vivo studiesof muscle repair have mainly utilized acellular natural scaffolds, porous matrices made ofdegradable polymeric materials, or scaffold-free myoblast sheets.
10.	❖ E-noses have a series of sensors that correspond to components of an odor and analyzes its chemical makeup to identify it. ❖ They are much more sensitive than human noses as they have a greater number of receptor sensors with higher sensitivity. ❖ Our human nose is elegant, sensitive, and self-repairing, but the E-nose sensors do not fatigue or get the "flu". ❖ Further, the E-nose can be sent to detect toxic and otherwise hazardous situations that humans may wish to avoid. The E-Nose devices are used in these Industries: ● Agricultural ● Petrochemical ● Chemical ● Food and beverage ● Packaging materials ● Plastics ● Pet food ● Pulp and paper ● Medical research ● Military **Bio printing** is defined as the printing of structures consisting of living cells, bio materials and active bio molecules. Controllable microstructures with a high degree of reproducibility and scalability. A solution for the organ shortages and Significant potential of drug delivery & cancer studies Hydrogels are attractive materials for bio printing.

They are enormous three dimensional network of polymer chains holding a mass of water

(A) Inkjet Bioprinting
(B) Microextrusion Bioprinting
(C) Laser-assisted Bioprinting
(D) Stereolithography Bioprinting

DNA origami is the nanoscale folding of DNA to create arbitrary two- and three-dimensional shapes at the nanoscale. The specificity of the interactions between complementary base pairs makes DNA a useful construction material, through design of its base sequences. DNA is a well- understood material that is suitable for creating scaffolds that hold other molecules in place or to create structures all on its own.

BIOCOMPUTING:

A computer that uses components of biological origin (such as molecules of DNA) instead of electrical components.

Main component used is DNA. The main application is in disease prediction and disease diagnosis.