

CBCS SCHEME

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BBOC407

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.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.	What is stem cell? Explain its types and list its applications.	7	L2	CO1
	b.	Explain in detail the properties and functions of nucleic acids.	6	L2	CO1
	c.	Explain the importance of special biomolecules.	7	L2	CO1
OR					
Q.2	a.	What is a biomolecule? Explain the classifications of biomolecule.	7	L2	CO1
	b.	Explain the properties and functions of carbohydrates.	6	L2	CO1
	c.	Describe the structure and functions of a cell with a neat diagram.	7	L3	CO1
Module – 2					
Q.3	a.	What is the role of lipids? Outline the process of obtaining biodiesel from lipids.	7	L3	CO2
	b.	Differentiate between PHA and PLA as a bioplastic materials.	6	L4	CO1
	c.	Explain the role of DNA vaccine for rabies and RNA vaccine for COVID-19.	7	L2	CO1
OR					
Q.4	a.	What are the key properties, advantages and limitations of cellulose based water filters.	7	L3	CO2
	b.	How can DNA finger printing be applied to evaluate its effectiveness and reliability in forensic applications.	6	L4	CO1
	c.	Describe the use of meat analogue and plant protein as food.	7	L2	CO2
Module – 3					
Q.5	a.	Deliberate the functioning of brain as CPU system.	7	L3	CO2
	b.	Write a short note on spirometry and ventilator.	6	L2	CO2
	c.	Explain heart as pump system.	7	L3	CO2

1 of 2

OR

Q.6	a.	Explain eye as a camera system.	7	L3	CO2
	b.	Write a short note on cardiac pacemaker.	6	L2	CO2
	c.	Explain kidney as purification system.	7	L3	CO2

Module – 4

Q.7	a.	Describe the materials used and engineering applications of Velcro technology.	7	L3	CO3
	b.	Compare the process of photosynthesis to the functioning of photovoltaic cells.	6	L4	CO3
	c.	Explain the HBOCs and PFCs as human blood substitutes.	7	L3	CO3

OR

Q.8	a.	Explain the terms lotus leaf effect and bird flying.	7	L3	CO3
	b.	Compare biological echolocation and technological echolocation highlighting their applications in navigation and detection.	6	L4	CO3
	c.	Explain the terms shark skin, swim suits and bullet train using biological concepts.	7	L3	CO3

Module – 5

Q.9	a.	Compare the functioning of electrical tongue and human tongue.	7	L4	CO4
	b.	Explain muscle cells as scaffold for tissue growth.	6	L2	CO4
	c.	Explain bioremediation and biomining via microbial surface adsorption.	7	L2	CO4

OR

Q.10	a.	Illustrate the basic steps of bioprinting process and list the various types of bioprinting techniques.	7	L4	CO4
	b.	Write a short note on: i) Importance of DNA origami ii) Self healing bioconcrete.	6	L2	CO4
	c.	Discuss the applications of artificial intelligence in the diagnosis of disease.	7	L2	CO4



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Scheme & Solutions

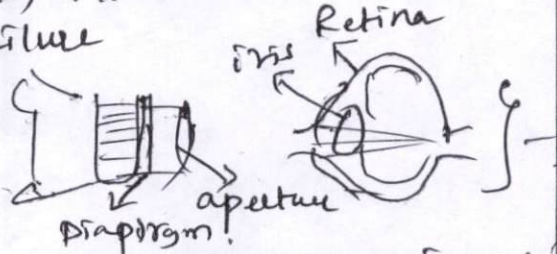

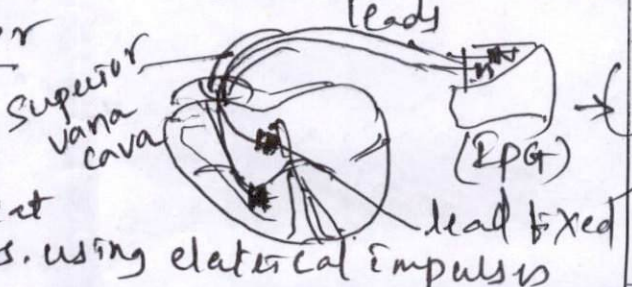
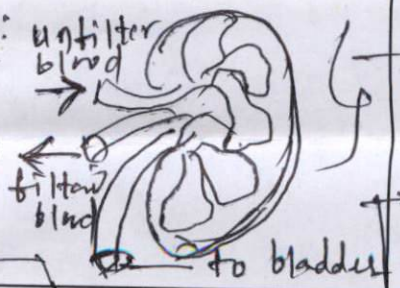
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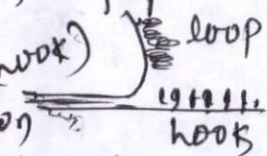
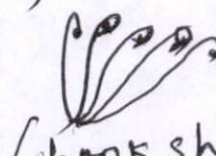
Subject Title : Biology for Engineers (CSE)

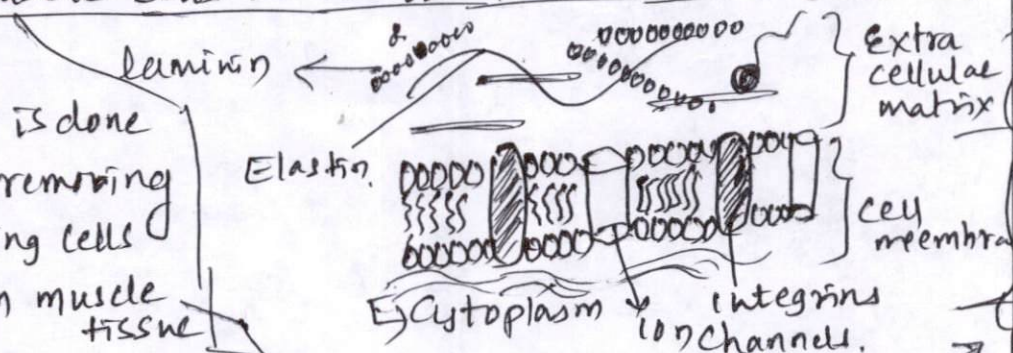
Subject Code : BBOC407

Question Number	Solution	Marks Allocated
Q.1	<p>a) Stem cells are cells with the potential to develop many cells <u>Types</u> - Adult stem cells b) Embryonic stem cells) <u>ex</u> <u>App</u> - a) tissue regeneration b) Treatment of brain disease, Cardiovascular, blood dis</p> <p>b) <u>Properties of Nucleic acid</u>: hydrolysis, solubility, Feulgen test. <u>Functional properties</u>: - carries genetic info, synthesis of protein, DNA fingerprinting, cell creation.</p> <p>c) <u>Enzymes</u>: - biological catalyst to speed up chemical reaction <u>ex</u> - Amylase, protease, lipases - <u>ex</u> <u>Vitamins</u>: - boosts immune system, support normal growth (A, K, E, B12) <u>ex</u> <u>Hormones</u>: - ^{are} chemical messengers coordinate body functions (ex - pituitary gland, thyroid gland) <u>sex</u> hormones for - metabolism, reprod.</p>	<p>2 4 (7) 1 3 (6) 3 3 2 (7) 2 2</p>
Q.2	<p>a) <u>Biomolecule</u>: - all fundamental building blocks of living organisms produced by cells <u>classification</u>: - Lipids, Nucleic acids, Carbohydrates, proteins, (Vitamins, Enzymes)</p> <p>b) <u>Properties of Carbohydrates</u>: - Solubility, Hydrolysis, oxidation, viscosity, crystalline. <u>Functions</u> 4 : Energy storage, sparing protein</p> <p>c) <u>Cell structure</u> <u>explain</u> → cell membrane, Nucleus, Cilia, Cytoplasm, mitochondria, golgi apparatus, Endoplasmic reticulum, ribosomes, lysosomes, Centrosome, vacuole</p>	<p>4 (7) 3 3 (6) 3 3 (7) 4</p>

Question Number	Solution	Marks Allocated
Q.3	<p>a) <u>Role of lipids</u>:- Energy storage, hormone synthesis - helps to insulate the body regulating temp</p> <p><u>Process of biodiesel</u>:- ex: a) Raw material preparation b) Transesterification c) separation d) washing & drying e) purification.</p> <p>b) <u>PHA</u> <u>PLA</u></p> <ul style="list-style-type: none"> - made from microbes - flexible in nature - one-time use - have upper temp limit - used in food containers - made from starch, corn - brittle in nature - Reusable - Can withstand above boiling temp - used in sports goods. <p>c) <u>DNA for Rabies</u>: to stimulate an immune resp. - once against virus, by producing viral proteins</p> <p><u>RNA for Covid19</u>: works by introducing pathogens RNA into body, faster production time than DNA vaccines.</p>	<p>3</p> <p>4</p> <p>6</p> <p>4</p> <p>3</p> <p>7</p>
Q.4	<p><u>Cellulose based water filters</u></p> <p>a) <u>properties</u>:- Biodegradability, cost effective, high porosity, good mechanical strength.</p> <p><u>Advantages</u>:- Safe & clean, sustainability, versatility, cheap</p> <p><u>Limitations</u>:- Limited lifespan, difficult to sterilize, easily clog</p> <p>b) <u>DNA fingerprinting evaluation</u>:- create DNA profile, extraction of DNA through blood, hair, semen, etc. <u>DNA amplification</u>, <u>DNA analysis</u>, <u>DNA comparison</u> (using PCR)</p> <p>c) <u>Meat analogous plant proteins as food</u></p> <p>→ <u>Meat analogue</u> - mimics meat in its functionality bearing similar appearance, texture (ex- soybean chunks)</p> <p>→ <u>Plant proteins</u>: consists of lentils, nuts, grains also whey proteins extracted from milks.</p>	<p>3</p> <p>2</p> <p>2</p> <p>3</p> <p>3</p> <p>3</p> <p>3</p> <p>4</p> <p>7</p>

Question Number	Solution	Marks Allocated
Q.5 a)	<p><u>Brain</u> → Neurons, synapses - increases connecting synaptic links - 12 watts of power consumption - low processing</p> <p><u>CPU</u> - Res, diodes, transistors - by adding memory chips - Gigawatts of power consumption - high processing</p>	7
b)	<p><u>Spirometry</u>: - measures functions of lungs to diagnose chronic obstructive pulmonary disease (COPD)</p> <p>b) <u>Ventilators</u>: all the devices that assist or control breathing in individuals to treat acute respiratory failure</p>	3 3 6
Q.6 a)	<p><u>Eye as Camera</u>:</p> <p>- Both eye & camera transforms into image. - Eye have visual perception, - camera stores image - eye have ability to perceive color, depth, - cam adjusts angles.</p> 	3 7
Q.5 b)	<p><u>Heart as pump system</u>.</p> <p>- Heart pumping is controlled by electrical & chemical signals. - Electrical pulse controls pumping of blood in and out.</p> 	2 7 5
Q.6 b)	<p><u>Cardiac Pacemaker</u></p> <p>- Small device surgically implanted to regulate the heart beat, to treat rhythmic disorders, using electrical impulses</p> 	3 6 3
c)	<p><u>Kidney as Purification system</u>:</p> <p>- plays imp role in regulating blood pressure & also purification by excreting the waste through bladder.</p> 	3 7 4

Question Number	Solution	Marks Allocated
Q. 7	<p>a) plant burrs, such as burdock, inspired the invention of Velcro, a popular hook-and-loop fastening system (hook)  (loop) </p> <p>Materials: strips of Nylon (hook) and polyester-(loop) (hook shape)</p> <p>Applications: shoes, bags, medical devices (Burdock plant)</p>	2 3 2
b)	<p>Photosynthesis & photovoltaics uses conversion of light into usable forms of energy (chlorophyll) (silicon)</p> <p>→ Photosynthesis: light energy → Chemical energy</p> <p>→ photovoltaics: light energy → electrical energy</p>	6
c)	<p>HBOs: made by isolating haemoglobin, responsible for carrying oxygen in RBCs (MP40x)</p> <p>Advantages: increased oxygen, longer shelf life</p> <p>PFCs: perfluorocarbons based on synthetic chemicals</p> <p>advantages: stability & long shelf life, oxygen solubility</p>	4 7 3
Q. 8	<p>a) Lotus leaf effect: Inspired by its super hydrophobic effect, ability to repel water and resist wetting. Self-polymer-based materials developed. (dig)</p>	3 7
b)	<p>Bird flying: Bio mimicking to design aircraft similar to its wings, and aerodynamic (airfoil) (dig)</p>	4
8 b)	<p>Biological echolocation: Bats & dolphins use sound waves to determine the location of objects</p> <p>→ Technological echolocation: uses sound waves or ultrasonic frequencies (e.g. - SONAR, X-Ray etc.) (Both EM waves & sound waves)</p>	3 3
8 c)	<p>Sharks skin as swim suits: Inspired by shark's skin, using denticles, similar frictionless swim suits are developed to reduce drag in water.</p> <p>→ Kingfisher beak as Bullet train: Inspired by aerodynamic design of beak, to reduce the air resistance, pressure wave reduction?</p>	4 7 3

Question Number	Solution	Marks Allocated
Q.9	<p><u>Human tongue</u></p> <ul style="list-style-type: none"> - Taste buds detect taste - Tastes are sensitive - relatively slow process - perception is subjective - No maintenance <p><u>Electrical tongue</u></p> <ul style="list-style-type: none"> - Electronic sensors detect taste. - Very high sensitivity - Analyze multiple tastes - It is objective - requires. <p>b) <u>Muscle cells as scaffold for tissue growth</u></p>  <p>- It is done by removing living cells from muscle tissue</p> <p>c) <u>Bioremediation</u> :- to remove pollutants from environment - takes long time.</p> <p>→ <u>Biomining</u> :- to extract metals or minerals from ores, focus on desired metals, quicker results in controlled conditions</p>	<p>(7)</p> <p>(6)</p> <p>(7)</p> <p>(7)</p>
Q.10	<p>a) <u>Bioprinting process</u> :- to mimic structure & function of human tissues & organs.</p> <p>→ <u>Types</u> :- a) Ink-jet based (diag) b) Extrusion based (diag) c) Laser based</p> <p>b) a) <u>Importance of DNA Origami</u> :- It is a technique to fold DNA molecules in different shapes to study molecular structures</p> <p>b) <u>Self healing bioconcrete</u> :- It uses micro-organisms along with calcium lactate to repair the concrete, which increases durability.</p> <p>c) <u>Applications of artificial intelligence in disease diagnosis</u> :- using AI algorithms</p> <p>App/ a) a) Image analysis b) Data analysis c) Diagnosis (d) Clinical decision support e) Create personalized medicines.</p>	<p>(7)</p> <p>(4)</p> <p>(6)</p> <p>(3)</p> <p>(7)</p>