CMR
INSTITUTE OF
TECHNOLOGY

Internal Test -II May 2025 QP & ANSWER KEY

Sub:	Biology for Computer Engineers			**Code:**	BBOC407
Date: 23/ 05 / 25	Duration: 90 mins	Max Marks: 50	**Sem:** 4TH	**Branch:**	CSDS

Note: Answer any five questions with neat diagram:

Q.No.	Question	OBE		
		Marks	CO	RBT
1	**Explain the function of lungs as a purification system** 1. Gas Exchange (Removal of Carbon Dioxide) • Main Function: Remove carbon dioxide (CO_2) from the blood. • Why it matters: CO_2 is a waste product of cellular metabolism. If it builds up in the body, it becomes toxic. • How it happens: o Deoxygenated blood rich in CO_2 reaches the lungs via the pulmonary arteries. o CO_2 diffuses from the blood into the alveoli (air sacs) and is then exhaled. 2. Oxygenation of Blood • Main Function: Absorb oxygen (O_2) from inhaled air. • Why it matters: Oxygen is essential for energy production in body cells. • How it happens: o Oxygen from inhaled air diffuses into the blood in the alveoli. o Oxygen-rich blood returns to the heart to be pumped throughout the body. 3. Filtering Small Blood Clots & Air Bubbles • Function: Trap small emboli (blood clots, air bubbles) that could be dangerous if they reached the brain or heart. • Why it matters: Prevents blockages in critical organs. • How it happens: The lung's capillary network acts as a biological filter. 4. Defense Against Inhaled Toxins & Microbes • Function: Filter dust, pathogens, and pollutants from inhaled air. • How it happens: o Cilia and mucus in the respiratory tract trap and move particles out.	[10]	CO3	L1

	○ Alveolar macrophages destroy microbes that reach the deep lungs. 5. Chemical Processing & Detoxification • Function: Modify or break down certain substances in the blood, including: ○ Hormones (eg., inactivating bradykinin) ○ Drugs and toxins (to a limited extent) • The lungs contribute to metabolic homeostasis. Function — Purpose CO_2 removal — Eliminate metabolic waste O_2 absorption — Supply oxygen to blood Filtering emboli — Prevent dangerous blockages Airborne pathogen defense — Prevent respiratory infections Chemical processing — Assist in detoxification			
2	**Define ECG. Briefly explain the design of a stent in the coronary artery** ECG (Electrocardiogram) is a medical test that records the electrical activity of the heart over a period of time using electrodes placed on the skin. • Detects abnormal heart rhythms (arrhythmias) • Identifies heart attacks (myocardial infarctions) • Monitors heart health over time Design of a Stent in the Coronary Artery: A stent is a tiny mesh-like tube made of metal or polymer that is inserted into a narrowed or blocked coronary artery to keep it open and restore normal blood flow to the heart muscle. *Structure of a Coronary Stent:* • Material: Usually made of stainless steel, cobalt-chromium alloy, or biodegradable polymer. • Shape: Cylindrical, mesh or lattice-like structure that can expand. • Types: 1. Bare-metal stents (BMS) – simple metal mesh. 2. Drug-eluting stents (DES) – coated with drugs to prevent artery re-narrowing. 3. Bioabsorbable stents – dissolve over time after healing.	[10]	CO3	L2

	How It Works (Design Functionality): 1. Compressed on a balloon catheter and inserted into the artery. 2. When positioned correctly, the balloon is inflated, expanding the stent. 3. The stent presses against the artery walls, holding them open. 4. The balloon is removed, and the stent remains permanently in place. *Importance:* • Used in angioplasty to treat coronary artery disease (CAD). • Helps reduce the risk of heart attacks by maintaining blood supply to the heart.			
3	**Explain the 3D printing of skin and bone in detail** 3D printing of skin and bone is a revolutionary application of bioprinting technology, combining biology, engineering, and medicine to create customized living tissues 3D skin printing involves layer-by-layer deposition of bio-inks containing cells, growth factors, and biomaterials to create skin tissue that can replicate epidermis, dermis, and sometimes hypodermis. Process Steps: 1. Cell Collection o Skin cells (like keratinocytes, fibroblasts) are harvested from the patient or a donor. 2. Bio-ink Preparation o Cells are mixed with hydrogels like collagen, gelatin, or alginate to form a printable bio-ink. 3. 3D Printing o A specialized bioprinter deposits the bio-ink layer-by-layer to form: ▪ Epidermis (outer layer) ▪ Dermis (middle connective tissue layer) ▪ Optionally: Vascular structures 4. Maturation in Bioreactor o The printed skin is kept in a bioreactor that mimics body conditions (e.g., temperature, nutrients) to promote tissue development. 5. Transplantation o Once matured, the printed skin is grafted onto the wound or burn site. Applications of 3D Printed Skin:	[10]	CO4	L1

- Burn and wound healing
- Drug and cosmetic testing (avoids animal testing)
- Skin disease modeling
- Personalized skin grafts

3D Printing of Bone:3D bone printing creates scaffolds or full bone structures using materials that mimic natural bone's strength and porosity. These structures are often seeded with stem cells to regenerate functional bone.

Process Steps:

1. Imaging and Modeling
    - CT or MRI scans of the patient's bone defect are used to create a custom 3D model.
2. Material Selection
    - Bio-inks or powders like:
        - Hydroxyapatite
        - Calcium phosphate
        - Tricalcium phosphate (TCP)
        - Biodegradable polymers (e.g., PLA, PCL)
3. 3D Printing of Scaffold
    - The bioprinter builds the structure layer-by-layer, allowing for:
        - Porosity for vascularization
        - Load-bearing strength
4. Cell Seeding
    - Mesenchymal stem cells (MSCs) or osteoblasts are added to promote bone growth.
5. Implantation and Integration
    - The printed bone is implanted, and over time, it integrates with the patient's natural bone through osteointegration.

Applications of 3D Printed Bone:

- Repair of bone defects from trauma, cancer, or congenital diseases
- Facial and jawbone reconstruction
- Dental implants
- Orthopedic implants
- Bone graft substitutes

Key Advantages

Feature	Skin Printing	Bone Printing
Customization	Matches wound area	Matches defect shape
Biocompatibility	Patient-derived cells	Natural bone-like materials
Speed	Fast wound coverage	Quick scaffold production
Regeneration	Promotes healing	Promotes new bone growth

4	**Explain the AI process for disease diagnosis and its various applications in the medical field** AI Function Medical Use Image analysis -Tumor detection in X-rays, MRIs Prediction models -Heart disease, diabetes risk Pattern recognition -Diagnosing rare diseases Virtual assistants -Basic symptom checking Robotics -Precision surgery Genomic analysis -Personalized cancer therapy	[10]	CO5	L2
5	**Explain briefly a. Bio Remediation b. Bio-Mining** a. Bio-Remediation Definition: Bio-remediation is the process of using microorganisms (like bacteria and fungi) to remove or neutralize pollutants from a contaminated site (soil, water, or air). *Key Points:* • Microbes break down harmful substances into less toxic or harmless products. • Used for oil spills, heavy metal contamination, pesticide removal, etc. • Types: o In-situ: Treatment at the site of contamination. o Ex-situ: Contaminated material is removed and treated elsewhere. *Example: Using* Pseudomonas *bacteria to clean oil spills in oceans.* b. Bio-Mining Definition: Bio-mining is the use of microorganisms to extract metals from ores and mining waste, especially low-grade ores. *Key Points:* • Bacteria like *Thiobacillus ferrooxidans* and *Acidithiobacillus* oxidize metal sulfides to release metals like copper, gold, or uranium. • Environment-friendly alternative to traditional mining.	[10]	CO4	L1

	• Slower but less polluting. *Example: Extracting copper from copper sulfide ores using* Thiobacillus ferrooxidans. Summary : Concept / Bio-Remediation / Bio-Mining Purpose / Clean pollution / Extract metals Organisms used / Bacteria, fungi / Bacteria (e.g., *Thiobacillus*) Application / Oil spills, pesticide cleanup / Mining low-grade ores Eco-impact / Reduces environmental damage / Minimizes chemical use in mining			
6	**Discuss the eye as a camera system** The human eye can be compared to a camera system because both are designed to capture, focus, and process light to form clear images. Here's a detailed comparison and explanation of how the eye functions as a natural camera: The Eye as a Camera System Eye Component / Camera Equivalent / Function Cornea & Aqueous Humor / Camera lens cover / Focus incoming light Lens / Adjustable camera lens / Fine-tunes focus (accommodation) Iris / Aperture (shutter) / Controls light entry by adjusting pupil size Pupil / Aperture hole / Allows light into the eye Retina / Camera sensor/film / Captures image as electrical signals Optic Nerve / Data cable / Sends image signals to the brain Sclera / Camera body/casing / Provides structure and protection Vitreous Humor / Internal optics / Maintains shape and light transmission Detailed Functional Comparison *1. Light Entry and Control* • Eye: Light enters through the cornea and then the pupil (controlled by the iris).	[10]	CO3	L1

- Camera: Light enters through the lens and aperture, which adjusts to light levels.

2. Focusing Light

- Eye Lens: Changes shape to focus objects at different distances (accommodation) using ciliary muscles.
- Camera Lens: Adjusts its focal length using a mechanical or digital zoom/focus system.

3. Image Capture

- Retina: Light-sensitive layer that contains rods (for dim light) and cones (for color vision). It converts light into nerve signals.
- Camera Sensor/Film: Captures light and stores the image electronically or chemically.

4. Signal Transmission

- Optic Nerve: Transfers electrical signals to the visual cortex in the brain for image processing.
- Camera Cable or Memory: Transfers data to a screen, computer, or memory card.

Features Shared by Both

Feature	Human Eye	Camera
Autofocus	Lens curvature adjustment	Motor-controlled lens
Aperture Control	Iris adjusts pupil size	Adjustable f-stop
Light Sensitivity	Rods and cones	ISO sensitivity
Image Processing	Brain interprets signals	Software/processor in camera

Differences

- The eye adapts continuously and automatically to changes in lighting and focus.
- The camera requires manual or digital adjustment unless it's fully automated.
- The eye processes depth and motion in real-time, while a camera captures static frames (unless it's a video camera).

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