Internal Question Paper

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Internal Assessment Test 2 – May – 2026

Sub:	**Biology for Engineers (CSE)**					Sub Code:	**BBOC407**	Branch:	**ISE**
Date:	29.05.2026	Duration:	90 Min	Max Marks:	50	Sem / Sec:	IV/ A,B,C (SET-2)		

QN	**Questions** Answer any 5 full questions	**Marks**	**OBE**	
			CO	**RBT**
1.	Explain spirometry? Discuss the types and functioning of the spirometry.	10	CO3	L2
2.	Use a neat labeled diagram and explain the mechanism of filtration by the nephrons.	10	CO3	L2
3.	Explain echolocation using application of echolocation in ultrasonography .	10	CO3	L2
4.	Interpret how the beak structure of the Kingfisher bird contributed to the development of high-speed bullet trains.	10	CO3	L3
5.	Explain Bioprinting Techniques.	10	CO4	L2
6.	Write a note on role of AI in disease diagnosis.	10	CO4	L2

CI **CCI** **HOD-ISE**

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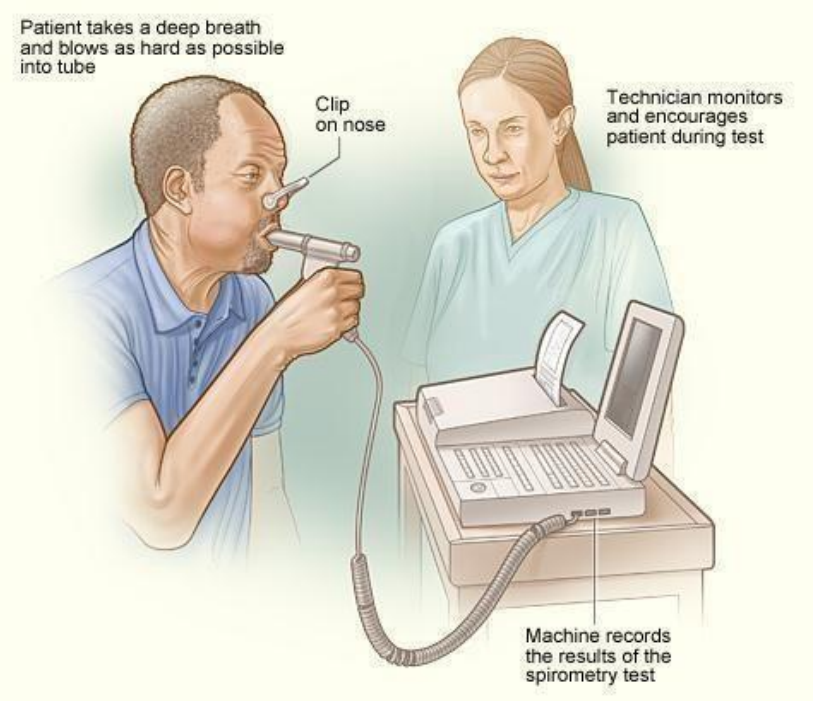
1. Explain spirometry? Discuss the types and functioning of the spirometry.

SPIROMETRY:

Spirometry (spy-ROM-uh-tree) is a common office test used to assess how well your lungs work by measuring how much air you inhale, how much you exhale, and how quickly you exhale. Spirometry is used to diagnose asthma, chronic obstructive pulmonary disease (COPD), and other conditions that affect breathing.
175 years have elapsed since John Hutchinson introduced the world to his version of an apparatus that had been in development for nearly two centuries, the spirometer.

Spirometers can be divided into two basic groups:

- Volume-measurement devices (e.g. wet and dry spirometers).
- Flow-measurement devices (e.g. pneumotachograph systems, mass flow meters).

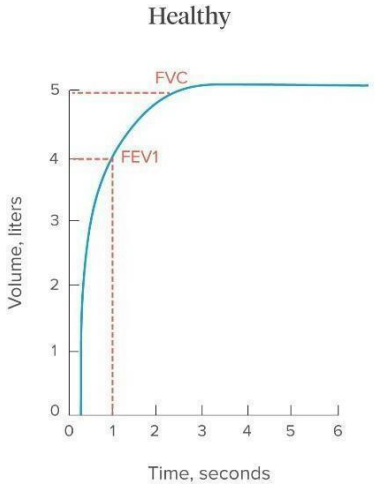


Requirements of an acceptable spirometer are:

- Spirometers must be able to accumulate volume for ≥15 s.
- The measuring volume should be ≥8 L (body temperature and pressure, saturated).
- The accuracy of reading should be at least ±3% (or ±0.05 L) with flows from 0–14 L per s.
- The total resistance to airflow at 14 L per s should be <1.5 cmH2O per L per s (<0.15 kPa per L per s).

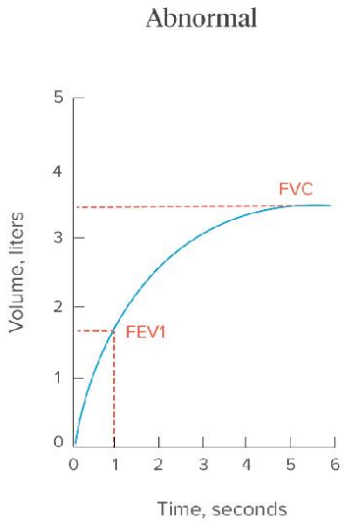
HOW TO CALCULATE THE NORMAL RATE OF RESPIRATION IN A SPIROMETER:

The FEV1/FVC Ratio (FEV1%) parameter is calculated by dividing the measured FEV1 value by the measured FVC value. The Measured column shows the absolute (numerical) ratio, and the Predicted column shows the ratio expressed as a percentage. In healthy adults of the same gender, height, and age, the normal Predicted percentage should be between 70% and 85%.



ABNORMAL LUNG PHYSIOLOGY:

Percentages lower than 70% are considered abnormal. This is an important measurement because obstructive diseases such as COPD, chronic bronchitis, and emphysema cause increased airway resistance to expiratory airflow, and may result in percentages of 45% to 60%. Restrictive diseases such as pulmonary fibrosis tend to reduce both FEV1 and FVC values, so the percentage can remain within the normal range, or even increase.



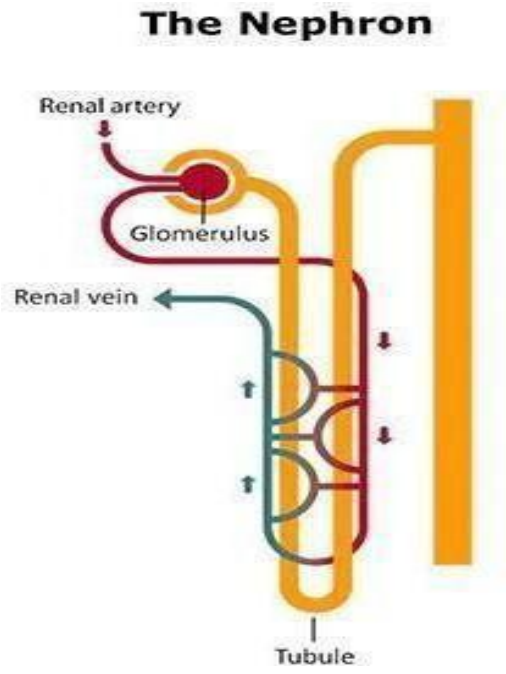
2. Use a neat labeled diagram and explain the mechanism of filtration by the nephrons.

MECHANISM OF FILTRATION:

Each kidney is made up of about a million filtering units called nephrons. Each nephron includes a filter, called the glomerulus, and a tubule. The nephrons work through a two-step process: the glomerulus filters blood, and the tubule returns needed substances to your blood and removes wastes.

Each nephron has a glomerulus to filter your blood and a tubule that returns needed substances to your blood and pulls out additional wastes. Wastes and extra water become urine.

The glomerulus filters your blood. As blood flows into each nephron, it enters a cluster of tiny blood vessels—the glomerulus. The thin walls of the glomerulus allow smaller molecules, wastes, and fluid—mostly water—to pass into the tubule. Larger molecules, such as proteins and blood cells, stay in the blood vessel. The tubule returns needed substances to your blood and removes wastes.



COURTESY: *SAMUEAL SCHRUCHB*

A blood vessel runs alongside the tubule. As the filtered fluid moves along the tubule, the blood vessel reabsorbs almost all of the water, along with minerals and nutrients your body needs. The tubule helps remove excess acid from the blood. The remaining fluid and wastes in the tubule become urine.

How does blood flow through my kidneys?

Blood flows into the kidney through the renal artery. This large blood vessel branches into smaller and smaller blood vessels until the blood reaches the nephrons. In the nephron, blood is filtered by the tiny blood vessels of the glomeruli and then flows out of the kidney through the renal vein.

Blood circulates through your kidneys many times a day. In a single day, kidneys filter about 150 quarts of blood. Most of the water and other substances that filter through your glomeruli are returned to the blood by the tubules. Only 1 to 2 quarts become urine.

When the kidney doesn't function properly, chronic kidney disease occurs when a disease or condition impairs kidney function, causing kidney damage to worsen over several months or years.

3. Explain echolocation using application of echolocation in ultrasonography .

ECHOLOCATION:

In nature's sonar system, echolocation occurs when an animal emits a sound wave that bounces off an object, returning an echo that provides information about the object's distance and size. Over a thousand species echolocate, including most bats, all-toothed whales, and small mammals. Human echolocation is the ability of humans to detect objects in their environment by sensing echoes from those objects, and by actively creating sounds: for example, by tapping their canes, lightly stomping their feet, snapping their fingers, or making clicking noises with their mouths. People trained to orient by echolocation can interpret the sound waves reflected by nearby objects, accurately identifying their location and size.

Many blind individuals passively use natural environmental echoes to sense details about their environment; however, others actively produce mouth clicks and can gauge information about their environment using the echoes from those clicks. Both passive and active echolocation help blind individuals sense their environments.

Those who can see their environments often do not readily perceive echoes from nearby objects, due to an echo suppression phenomenon brought on by the precedence effect. However, with training, sighted individuals with normal hearing can learn to avoid obstacles using only sound, showing that echolocation is a general human ability.

Mechanics:

Vision and hearing are akin in that each interprets detections of reflected waves of energy. Vision processes light waves that travel from their source, bounce off surfaces throughout the environment and enter the eyes. Similarly, the auditory system processes sound waves as they travel from their source, bounce off surfaces, and enter the ears. Both neural systems can extract a great deal of information about the environment by interpreting the complex patterns of reflected energy that their sense organs receive. In the case of sound, these waves of reflected energy are

referred to as echoes.

ULTRASONOGRAPHY:

Ultrasound:

Ultrasound refers to sound above the human audible limit of 20 kHz. Ultrasound of frequencies up to 10 MHz and beyond is used in medical diagnosis, therapy, and surgery. In investigative applications, an ultrasound source (transmitter) directs pulses into the body.
When the pulse encounters a boundary between organs or between two tissue regions of different densities, reflections of sound occur. By scanning the body with Ultrasound and detecting echoes generated by various organs, a sonogram of the internal structure(s) can be generated. The method is called diagnostic imaging by echolocation.

Diagnostic ultrasound, also called sonography or diagnostic medical sonography, is an imaging method that uses sound waves to produce images of structures within your body. The images can provide valuable information for diagnosing and directing treatment for a variety of diseases and conditions.

4. Interpret how the beak structure of the Kingfisher bird contributed to the development of high-speed bullet trains.

KINGFISHER BEAK:

The kingfishers have long, dagger-like bills. The bill is usually longer and more compressed in species that hunt fish, and shorter and broader in species.

Relationship with humans:

Kingfishers are generally shy birds, but despite this, they feature heavily in human culture, generally due to the large head supporting its powerful mouth, their bright plumage, or some species' interesting behavior.
For the Dusun people of Borneo, the Oriental dwarf kingfisher is considered a bad omen, and warriors who see one on the way to battle should return home. Another Bornean tribe considers the banded kingfisher an omen bird, albeit generally a good omen. The sacred kingfisher, along with other Pacific kingfishers, was venerated by the Polynesians, who believed it had control over the seas and waves.

THE BEAK THAT INSPIRED A BULLET TRAIN:

The Strategy:

The secret is in the shape of the kingfisher’s beak. A long and narrow cone, the kingfisher’s beak parts and enters the water without creating a compression wave below the surface or a noisy splash above. The fine point of the conical beak presents little surface area or resistance to the water upon entry, and the evenly and gradually enlarging cross-section of the beak keeps fluid flowing smoothly around it as it penetrates further into the water column. This buys the bird crucial milliseconds to reach the fish before the fish knows to flee. The length of the beak is critical here: the longer it is, the more gradually the angle of the wedge expands. A shorter, fatter, or rounder beak would increase the wedge angle, resulting in a splash, a compression wave, and

a fleeing fish.

The Potential:

Eiji Nakatsu, the chief engineer of the company operating Japan's fastest trains, wondered if the kingfisher's beak might serve as a model for how to redesign trains not to create such a thunderous noise when leaving tunnels and breaking through the barrier of tunnel air and outside-air. Sure enough, as his team tested different shapes for the front of the new train, the train became quieter and more efficient as the geometry of its nose became more like the shape of a kingfisher's beak, requiring 15% less energy while traveling even faster than before.

5. Explain Bioprinting Techniques.

Bioprinting is an advanced tissue engineering technology that uses 3D printing principles to create biological structures such as tissues and organs. It involves the layer-by-layer deposition of bioinks (a mixture of living cells, biomaterials, and growth factors) to fabricate functional biological constructs.

Major Bioprinting Techniques

- **Inkjet Bioprinting**

Principle

Inkjet bioprinting deposits tiny droplets of bioink onto a substrate using thermal or piezoelectric forces.

Working

1. Bioink is loaded into a cartridge.
2. Pressure pulses generate droplets.
3. Droplets are deposited layer by layer according to a digital design.

Advantages

- Fast and cost-effective.
- High printing speed.
- Suitable for low-viscosity bioinks.

Limitations

- Limited cell density.
- Nozzle clogging may occur.
- Restricted to low-viscosity materials.

Applications

- Skin tissue engineering.
- Drug testing models.
- Cartilage fabrication.

- **Extrusion-Based Bioprinting**

Principle

Bioink is continuously extruded through a nozzle using pneumatic, piston, or screw-driven pressure.

Working

1. Bioink is placed in a syringe.
2. Mechanical or pneumatic force pushes the bioink through the nozzle.
3. Continuous filaments are deposited layer by layer.

Advantages

- Can print highly viscous materials.
- Suitable for high cell densities.
- Most widely used bioprinting method.

Limitations

- Lower printing resolution.
- Shear stress may damage cells.

Applications

- Bone tissue engineering.
- Cartilage regeneration.
- Organ prototypes.

- **Laser-Assisted Bioprinting (LAB)**

Principle

Uses laser energy to transfer bioink droplets from a donor layer to a receiving substrate without a nozzle.

Working

1. A laser pulse strikes an energy-absorbing layer.
2. Bioink droplets are propelled toward the substrate.
3. Precise cell patterns are formed.

Advantages

- High resolution and precision.
- No nozzle clogging.
- High cell viability.

Limitations

- Expensive equipment.
- Complex operation.

Applications

- Vascular tissue fabrication.
- Cell patterning studies.
- Tissue regeneration research.

- **Stereolithography (SLA) Bioprinting**

Principle

Uses ultraviolet (UV) or visible light to solidify photosensitive bioinks layer by layer.

Working

1. A liquid photopolymer bioink is exposed to light.
2. Selected regions are cured and solidified.
3. The process is repeated to build the structure.

Advantages

- Very high resolution.
- Smooth surface finish.
- Accurate complex geometries.

Limitations

- Limited choice of bioinks.
- Potential cell damage from UV exposure.

Applications

- Tissue scaffolds.
- Microfluidic devices.
- Complex organ models.

6. Write a note on role of AI in disease diagnosis.

ARTIFICIAL INTELLIGENCE IN DISEASE DIAGNOSIS:

Artificial intelligence can assist providers in a variety of patient care and intelligent health systems. Artificial intelligence techniques ranging from machine learning to deep learning are prevalent in healthcare for disease diagnosis, drug discovery, and patient risk identification. Numerous medical data sources are required to perfectly diagnose diseases using artificial intelligence techniques, such as ultrasound, magnetic resonance imaging, mammography, genomics, computed tomography scan, etc. Furthermore, artificial intelligence primarily enhanced the infirmary experience and sped up preparing patients to continue their rehabilitation at home.

Detecting any irresistible ailment is nearly an afterward movement and forestalling its spread requires ongoing data and examination. Hence, acting rapidly with accurate data tosses a

significant effect on the lives of individuals around the globe socially and financially (Minaee et al. 2020). The best thing about applying AI in health care is to improve from gathering and processing valuable data to programming surgeon robots.
AI describes the capability of a machine to study the way a human learns, e.g., through image identification and detecting pattern in a problematic situation. AI in health care alters how information gets composed, analysed, and developed for patient care.

System planning is the fundamental abstract design of the system. It includes the framework's views, the course of action of the framework, and how the framework carries on underneath clear conditions. A solid grip of the framework design can help the client realize the limits and boundaries of the said framework. In pre-preparing, real-world information requires upkeep and pre-preparing before being taken care of by the calculation. Because of the justifiable explanation, real-world data regularly contains mistakes regarding the utilized measures yet cannot practice such blunders. Accordingly, information pre-preparing takes this crude information, cycles it, eliminates errors, and spares it an extra examination. Information experiences a progression of steps during pre-handling: Information is purged by various strategies in information cleaning.
These strategies involve gathering information, such as filling the information spaces that are left clear or decreasing information, such as the disposal of commas or other obscure characters. In information osmosis, the information is joined from a combination of sources.

The information is then amended for any blend of mistakes, and they are quickly taken care of. Information Alteration: Data in this progression is standardized, which depends upon the given calculation. Information standardization can be executed utilizing several ways. This progression is obligatory in most information mining calculations, as the information wants to be as perfect as possible. Information is then mutual and developed.