My apologies! It seems there was a technical error, and the PDF file was not created correctly.

I'll provide the complete answers again for you here, formatted for clarity. You can copy and paste this text into a document for saving or printing.

Answer to Question 4

(a) Generalized Measurement System

A **Generalized Measurement System** is a model that breaks down any measurement process into functional stages. It helps in understanding and designing measurement instruments.

A neat diagram of the system is as follows:

Measurand→PrimarySensingElement→VariableConversionElement→VariableManipulationElement→DataTransmissionElement→DataProcessingElement→DataPresentationElement→Observer

Explanation of Stages:

1. **Primary Sensing Element (Sensor/Transducer):** This is the first element that comes in contact with the quantity being measured (the **measurand**). It senses the input and provides a corresponding output. For example, the mercury bulb of a thermometer senses temperature.

2. **Variable Conversion Element:** It converts the output of the sensing element into a more suitable form, often an electrical signal (like voltage or current). In a pressure gauge, a Bourdon tube converts pressure into a displacement.

3.

Variable Manipulation Element: It manipulates the signal from the previous stage, for example, by amplifying a weak signal. An electronic amplifier is a common example.

4.

Data Transmission Element: It transmits the signal from one location to another, which is important in remote measurement. Examples include cables or optical fibers.

5.

Data Processing Element: It processes the transmitted data to make it more useful. This can involve filtering noise, performing calculations, or converting it into digital form. A microprocessor typically performs this function.

6.

Data Presentation Element: This final stage presents the measured value in a human-readable format, such as a digital display, an analog dial, or a chart recorder.

(b) Direct vs. Indirect Measurement

Basis of Comparison	Direct Measurement	Indirect Measurement
Method	The value is obtained directly by comparing the unknown quantity with a standard.	The value is obtained by measuring other related quantities and using a mathematical relationship to calculate the desired value.
Calculation	No calculation is needed.	Calculations are required.
Example	Measuring length with a measuring tape; measuring mass with a weighing balance.	Measuring the area of a room by measuring its length and width ($A=l\times w$); measuring density by measuring mass and volume ($\rho=m/V$).
Accuracy	Accuracy depends on the instrument and observer's skill.	Can be highly accurate, especially when direct measurement is impractical.

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Advantage of Indirect Measurement: Indirect measurement is advantageous because it allows us to measure quantities that are **impossible or highly impractical to measure directly**. For instance, we can't use a tape measure to find the distance to the Moon or put a thermometer in the Sun's core. These are measured indirectly.

(c) Drift in Measuring Instruments

Drift is an undesirable and gradual change in the output of an instrument over time, which is not caused by any change in the input (measurand). It leads to inaccurate readings.

Types of Drift:

1. **Zero Drift:** The entire calibration of the instrument shifts by the same amount. The output reading is offset by a constant value.

2. **Span Drift (Sensitivity Drift):** The sensitivity of the instrument changes over time. The error increases as the measured value increases.

3. **Zonal Drift:** Drift occurs only over a specific portion (or zone) of the instrument's measurement range.

How to Avoid Drift:

- Use high-quality, stable components.

- Maintain the instrument at a constant temperature or use temperature compensation.
- Perform regular calibration to check and adjust for drift.

Answer to Question 5

(a) True Value

The **True Value** is the theoretical, actual value of a physical quantity. In practice, it's impossible to determine the absolute true value because every measurement has some level of error. It is the value that would be obtained from a perfect, error-free measurement.

(Note: The second part of the question provides data for a thermometer but does not ask a specific question. The relationship between the parameters is shown below.)

For the given Hg-glass thermometer, the sensitivity (S) is related to the initial volume of mercury (V_0), its coefficient of expansion (γ_{Hg}), and the capillary area (A) by the formula:

$S=\Delta T\Delta L=AV_0\gamma_{Hg}$

(b) Noise in Measurement Systems

Noise is any random, unwanted signal that gets superimposed on the desired signal being measured, degrading its accuracy.

Measurement of Noise: A common measure is the **Signal-to-Noise Ratio (SNR)**, which compares the power of the desired signal to the power of the noise.

SNR=PnoisePsignal

A higher SNR indicates a cleaner measurement.

Kinds of Noise:

1. **Thermal Noise (Johnson-Nyquist Noise):** Caused by the random thermal motion of electrons in conductors.
2. **Shot Noise:** Occurs in semiconductor devices due to the discrete nature of electrons crossing a potential barrier.
3. **Flicker Noise (1/f Noise):** A low-frequency noise whose power is inversely proportional to frequency.
4. **Interference Noise:** External noise from sources like power lines (50 Hz hum) or radio signals (RFI).

(c) Shaft Basis vs. Hole Basis System

These are two systems for defining standard limits and fits for mating parts.

Basis for Comparison	Hole Basis System	Shaft Basis System
Constant Element	The size of the **hole** is kept constant. Its lower deviation is zero (H-hole).	The size of the **shaft** is kept constant. Its upper deviation is zero (h-shaft).
Variable Element	The size of the **shaft** is varied to achieve the desired fit.	The size of the **hole** is varied to achieve the desired fit.
Preference	**This is the preferred and more common system.**	Used only for specific applications.
Reason	It's easier and cheaper to machine a shaft to a specific dimension than to create a custom-sized hole.	Used when multiple parts are fitted onto a single, long shaft of uniform diameter.

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Sketches: In the **Hole Basis System**, the hole's tolerance zone is fixed on the zero line. In the **Shaft Basis System**, the shaft's tolerance zone is fixed on the zero line.

Answer to Question 6

(a) Shaft and Bush Dimensioning

We are given:

- **System:** Hole Basis System
- **Basic Size:** 50 mm
- **Tolerance of Hole (TH):** 0.050 mm
- **Tolerance of Shaft (TS):** 0.050 mm
- **Maximum Clearance (Cmax):** 0.075 mm

Step 1: Determine the dimensions of the bush (Hole). In a Hole Basis System, the **lower limit of the hole is the basic size**.

- Lower Limit of Hole = **50.000 mm**
- Upper Limit of Hole = 50.000 + 0.050 = **50.050 mm** So, the dimension for the bush is **50.000−0.000+0.050 mm**.

Step 2: Determine the dimensions of the shaft. Maximum clearance occurs when the hole is largest and the shaft is smallest.

- Cmax = (Upper Limit of Hole) - (Lower Limit of Shaft)
- 0.075 = 50.050 - (Lower Limit of Shaft)
- Lower Limit of Shaft = 50.050−0.075 = **49.975 mm** Now, we find the upper limit of the shaft.

- Upper Limit of Shaft = Lower Limit of Shaft + Tolerance of Shaft = 49.975+0.050 = **50.025 mm**

Summary of Dimensions:

- **Bush (Hole):** from **50.000 mm** to **50.050 mm**
- **Shaft:** from **49.975 mm** to **50.025 mm**

(b) Taylor's Principle of Gauge Design

Taylor's Principle provides two rules for designing **GO** and **NO-GO** limit gauges.

Statement 1: The 'GO' Gauge The **'GO' gauge must check the Maximum Material Condition (MMC)** and should be designed to check **as many dimensions as possible simultaneously** (size and form).

- **Explanation:** The MMC is where the part has the most material (largest shaft or smallest hole). The GO gauge simulates the mating part. If it fits, the part will assemble correctly.
- **Example:** A 'GO' plug gauge for a hole is a full cylinder that checks the minimum diameter, straightness, and roundness all at once.

Statement 2: The 'NO-GO' Gauge The **'NO-GO' gauge must check the Least Material Condition (LMC)** and should be designed to **check only one dimension at a time**.

- **Explanation:** The LMC is where the part has the least material (smallest shaft or largest hole). The 'NO-GO' gauge ensures no single dimension is outside its limit. It uses localized contact (like pins) to check dimensions independently.

- **Example:** A 'NO-GO' plug gauge for a hole might have pin-like ends. It should *not* enter the hole. If it does, the hole is oversized.