SNS COLLEGE OF PHARMACY AND HEALTH SCIENCES
Coimbatore -641035

COURSE NAME: BP102T-PHARMACEUTICAL ANALYSIS (Theory)

I YEAR / I SEMESTER

SUB TOPIC: UNIT I-ERRORS**:** SOURCES OF ERRORS AND TYPES OF ERRORS.

Pharmaceutical Analysis – Errors: Sources and Types

Pharmaceutical Errors

Sources of Errors

1. Instrumental Errors – Faulty calibration or malfunctioning equipment
2. Personal Errors – Carelessness, fatigue, or bias of analyst
3. Method Errors – Incorrect or unsuitable analytical method
4. Environmental Errors – Temperature, humidity, light affecting results

Types of Errors

1. Determinate (Systematic) Errors – Consistent and reproducible; can be corrected
2. Indeterminate (Random) Errors – Occur by chance; cannot be predicted
3. Gross Errors – Major mistakes such as recording wrong data or calculation errors

Design Thinking in Pharmaceutical Analysis – Errors

Empathize – Why Errors Matter
Accurate medicines
Patient safety
Trust in healthcare

Define – What Are Errors?
Mistakes in measurement or formulation
Leads to wrong results

Pharmaceutical Errors

Ideate – Sources of Errors
Human: carelessness
Instrumental: calibration issues
Environmental: humidity, temp
Method: wrong procedure

Test – Prevention
Double-check work
Calibrate instruments
Keep clean lab
Follow SOPs

Prototype – Types of Errors
Systematic – predictable
Random – unpredictable
Gross – major human blunders

ERRORS: SOURCES OF ERRORS AND TYPES OF ERRORS:-

DEFINITION:

In pharmaceutical analysis, an error is the difference between the true value and the observed (measured) value. No experiment is free from errors, but understanding and minimizing them ensures accurate and reliable results.

a) Personal Errors:

These are caused by human mistakes due to carelessness or lack of skill.

Examples:

Wrong reading of instruments (parallax error)

Improper weighing or titration

Fatigue or lack of concentration

Instrumental Errors:-

b) Instrumental Errors

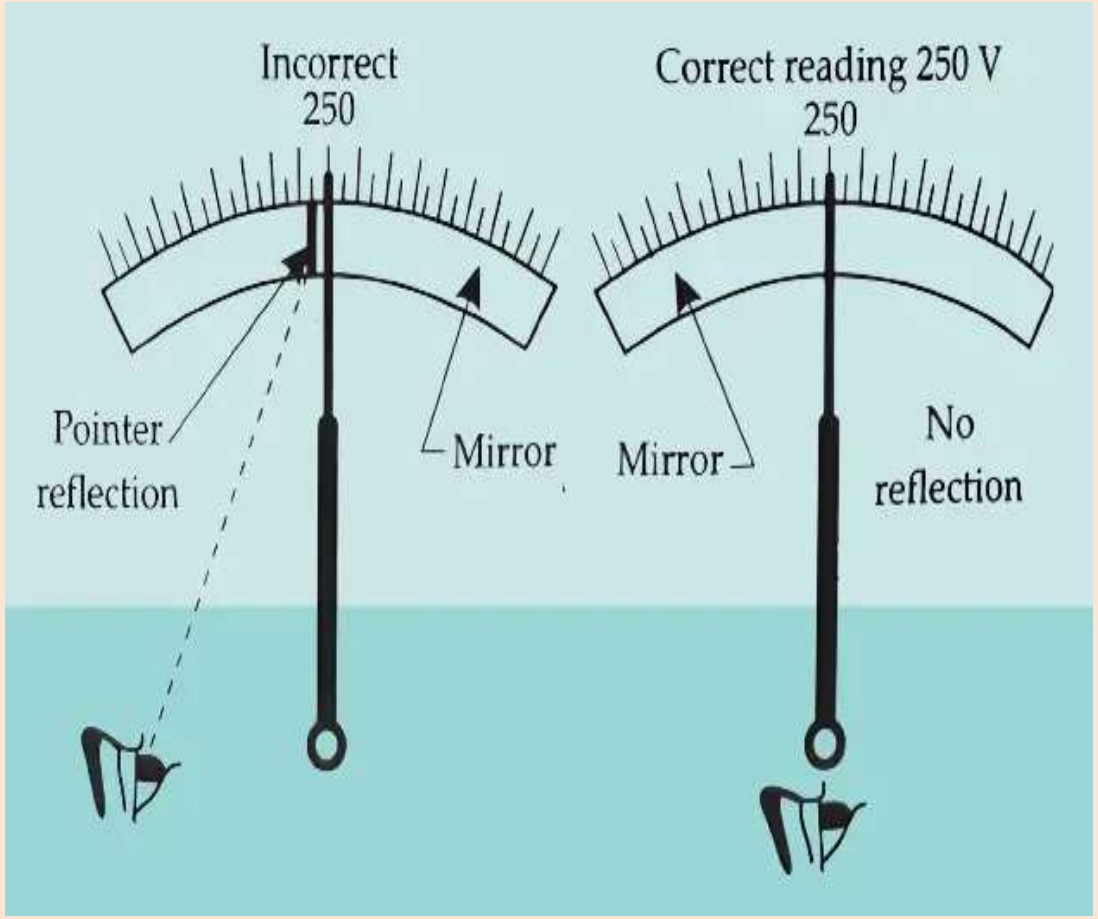
These arise from faulty or uncalibrated instruments or defective apparatus.

Examples:

Incorrect calibration of balance

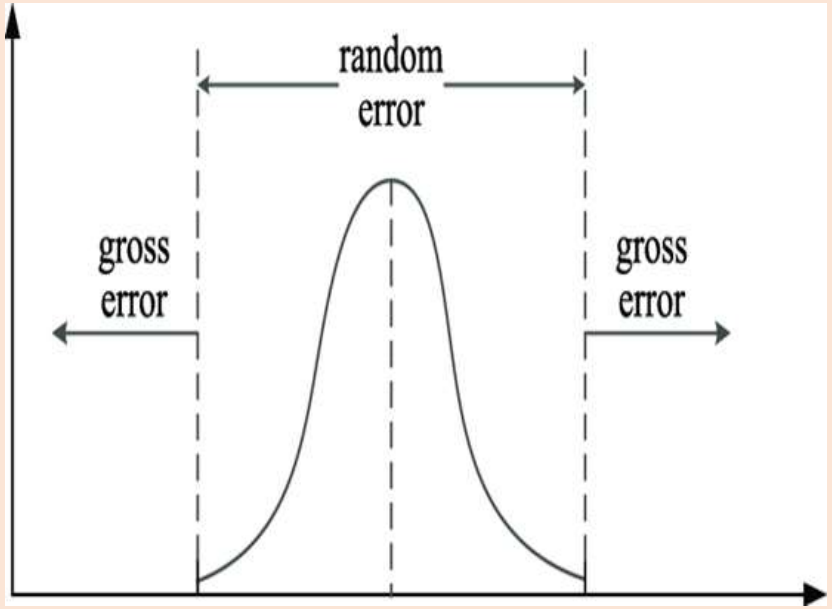
Leaking burette or pipette

Temperature fluctuations affecting readings



2. Types of Errors:-

Errors are broadly divided into **three types:**



a) Gross Errors:

Large and easily detectable errors.

Caused by **major mistakes** in procedure or calculation.

Example: Using the wrong reagent or wrong unit.

b) Systematic Errors:

Occur **regularly and predictably** due to faulty equipment, environment, or procedure.
Can be **identified and corrected**.
Example: Constant bias in balance or miscalibrated burette.

c) Random Errors:

Occur **unpredictably** and vary in magnitude and direction.
Caused by **uncontrolled variables** such as temperature, vibrations, or observer variations.
Example: Slight difference in colour perception during titration.

3. Minimization of Errors:-

To reduce errors:

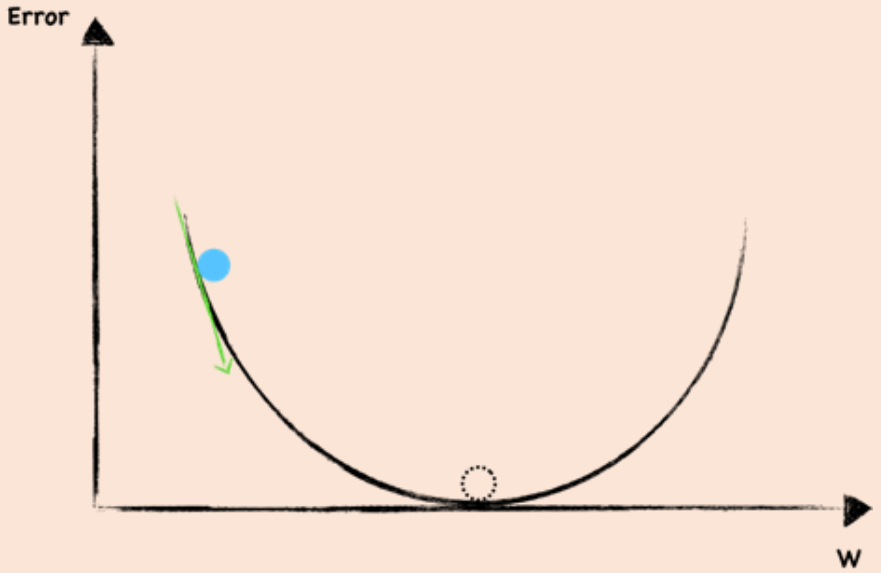
Calibrate instruments regularly

Follow standard operating procedures (SOPs)

Use high-purity reagents

Repeat experiments and take the mean value

Maintain proper environmental conditions



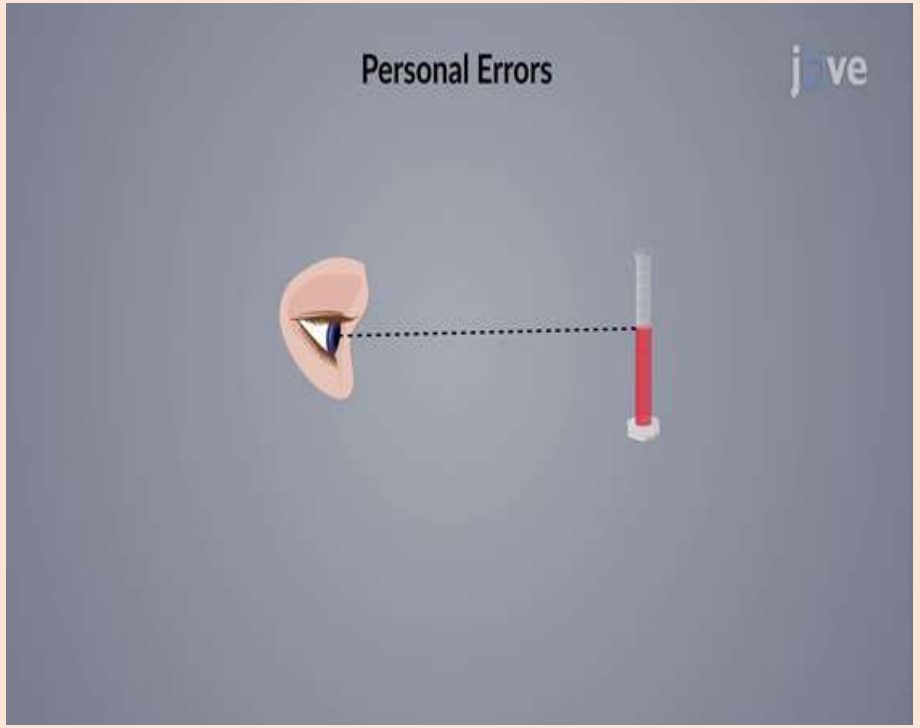
Analysis of Errors:-

1. Personal Errors

Analyst A **misread the burette** due to parallax error.

Analyst B **used wrong end-point colour judgment** in titration.

Analyst C **recorded values hastily**, leading to incorrect reading.



2. Instrumental Errors:-

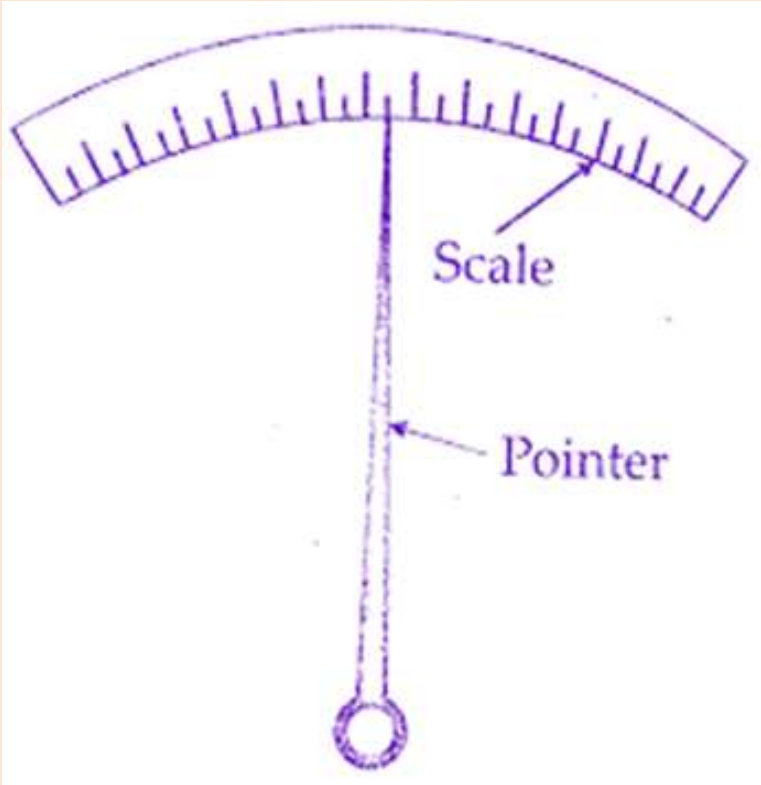
The **balance** used was **not calibrated** properly.

The **pipette tip was chipped**, causing incorrect volume transfer.

The **temperature variation** affected the burette readings.

Methods to Minimize Errors:-

- Regular calibration of instruments
- Proper training and supervision
- Following SOPs (Standard Operating Procedures)
- Avoiding parallax errors
- Conducting replicate experiments



Methods to Minimize Errors in Pharmaceutical Analysis

- Regular Calibration of Instruments
- Check for Zero Error and Drift
- Conduct Replicate Experiments
- Proper Training and Supervision
- Avoid Parallax Error (Correct Eye Level)
- Follow Standard Operating Procedures (SOPs)
- Use High-Quality Reagents and Standards
- Maintain Clean Instruments and Glassware
- Control Environmental Conditions (Temperature, Humidity)
- Recheck Calculations and Observations

Significant Figures:-

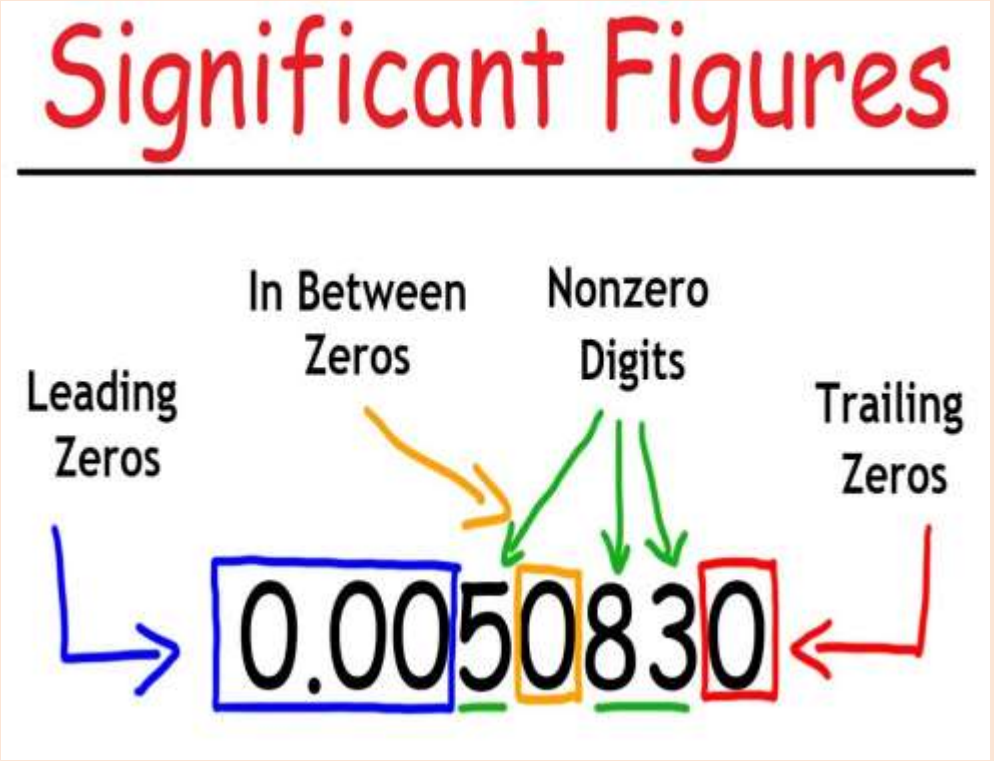
- **Definition:** Digits that represent meaningful measurement accuracy
- Includes all certain digits + one uncertain digit
- Example: 12.345 → 5 significant figures

Rules for Significant Figures:-

- All non-zero digits are significant.
- Zeros between digits are significant.
- Leading zeros are not significant.
- Trailing zeros are significant if decimal present.

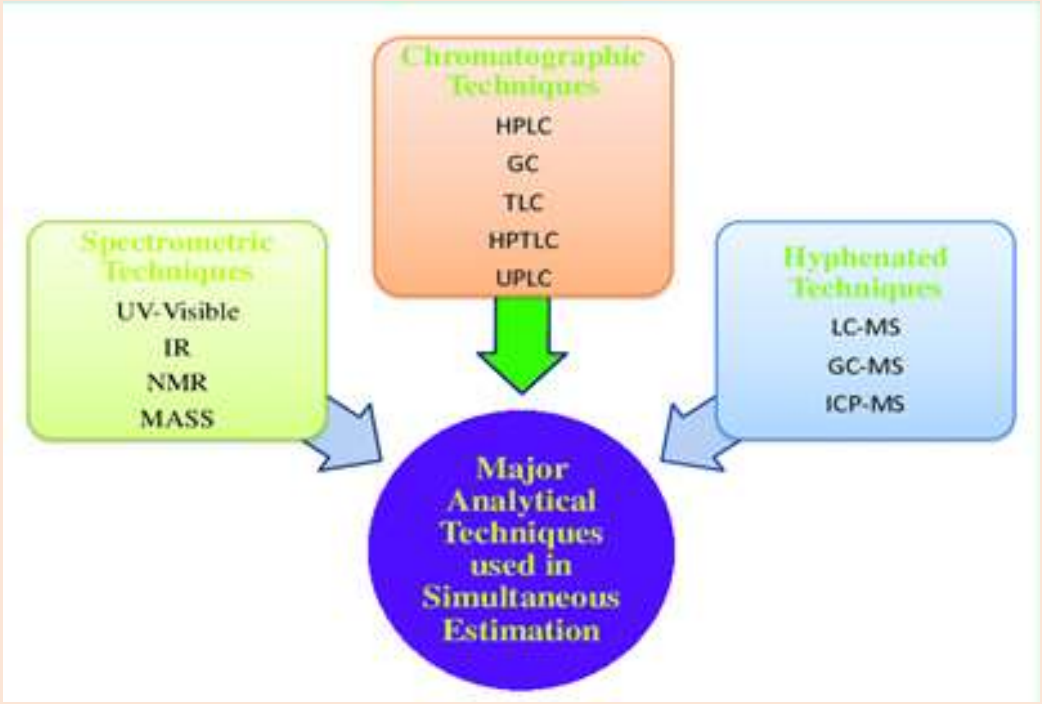
Rounding Off Rules:-

- If digit < 5 → retain.
- If digit ≥ 5 → increase previous digit by 1.
- Example: 12.346 → 12.35.



Applications in Pharmaceutical Analysis:-

- Drug assay calculations.
- Titration results.
- Spectrophotometric measurements.
- Ensures quality and compliance with pharmacopeia.



Case Study:

“The Mysterious Weight Loss of Paracetamol Sample”At PharmaLabs Pvt. Ltd., analyst Riya was assigned to analyze the purity of Paracetamol samples. During her experiment, she noticed that the measured weight of samples kept decreasing slightly each time she reweighed them. The analytical balance had not been recalibrated for months, and the air conditioner in the lab was malfunctioning, causing temperature fluctuations.Riya’s supervisor, Dr. Mohan, asked her to identify the cause of the inconsistency and correct it to ensure reliable results.

ASSESSMENT:

Choose the most appropriate answer.

1. What type of error is most likely responsible for Riya's inconsistent measurements?

A. Gross error B. Random error C. Systematic error D. Personal error

2. Which source of error mainly contributed to this problem?

A. Environmental and Instrumental errors B. Personal errors

C. Method errors D. Sampling errors

3. If Riya had accidentally recorded the wrong reading due to misalignment of her eye with the scale, what type of error would that be?

A. Instrumental error B. Random error

C. Personal error D. Method error

4. Suppose Riya spilled one sample while transferring it to the weighing boat. What category of error does this belong to?

A. Systematic error B. Random error

C. Gross error D. Method error

5. Riya's results became consistent and accurate. What did she achieve by these corrections?

A. Reduced precision but increased accuracy B. Improved both accuracy and precision

C. Reduced accuracy D. Only improved precision

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2. A.I. Vogel, Text Book of Quantitative Inorganic analysis.

3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry.

4. Bentleyand Driver's Textbook of Pharmaceutical Chemistry.

5. John H. Kennedy, Analytical chemistry principles.

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Thank You!