



# PHARMACIST PUNCH

PHARMACIST COMPETITIVE EXAM PREPARATION

Theory Book



**BASED ON LATEST SYLLABUS**

**FULLY COLOURED BOOK**

**START YOUR PREPARATION WITH US!**

**USEFUL FOR**

RRB, AIIMS, DSSSB, ESIC, RAILWAY, CGHS, ISRO, NHM, SECL, NTPC, NCL, CCL, SEPOY, STATE & CENTRAL GOVT. PHARMACIST EXAMINATION

## FEATURES

- Fully Coloured book
- Based on Latest Syllabus
- Non Pharma Concepts Covered
- Tricks to remember also covered
- Topic wise theory and concepts covered





# PHARMACIST PUNCH

PHARMACIST COMPETITIVE EXAM PREPARATION

*As Per The Latest Exam Pattern*

**USEFUL FOR**



**STATE & CENTRAL GOVT. PHARMACIST EXAMINATIONS**



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# PHARMACIST SYLLABUS

## PHARMACEUTICS

1. Introduction to Pharmacopoeias
2. Pharmaceutical Packaging
3. Pharmaceutical Aids & Preservatives
4. Metrology
5. Packaging of pharmaceuticals
6. Unit Operations
7. Sterilization
8. Study of immunological products like sera, vaccines, toxoids & their preparations.
9. Dispensing Pharmacy
10. Dispensed Medications I.Solid Dosage Forms II.Liquid oral Dosage III.Semi-Solid Dosage Forms
11. Dental and cosmetic preparations
12. Sterile Dosage forms
13. Basic structure, layout, sections, and activities of pharmaceutical manufacturing plants
14. Quality Control and Quality Assurance Novel Drug Delivery System

## PHARMACEUTICAL CHEMISTRY

1. Sources and types of errors, Impurities in Pharmaceuticals
2. Volumetric and Gravimetric Analysis
3. Acids, bases and buffers
4. Antioxidants
5. Gastrointestinal agents
6. Topical Agents
7. Dental Products
8. Inhalants
9. Respiratory stimulants

10. Expectorants and Emetics
11. Antidotes
12. Inorganic official compounds of Iron, Iodine and Calcium, Ferrous Sulphate and Calcium Gluconate.
13. Radiopharmaceuticals and contrast media
14. Quality control of Drugs and pharmaceuticals
15. Identification tests for cations and anions as per Indian Pharmacopoeia.
16. Introduction to the nomenclature of organic chemical systems with particular reference to hetero-cyclic system containing up to 3 rings.
17. Antiseptics and Disinfectants
18. Sulphonamides
19. Antileprotic Drugs
20. Anti-tubercular Drugs
21. Antimoebic and Anthelmintic Drugs
22. Antibiotics, Antifungal agent
23. Antimalarial Drugs
24. Tranquilizers
25. Hypnotics
26. General Anaesthetic
27. Antidepressant Drugs
28. Analeptics
29. Adrenergic drugs
30. Adrenergic antagonist
31. Cholinergic Drugs
32. Cholinergic Antagonists
33. Diuretic Drugs
34. Cardiovascular Drugs
35. Hypoglycaemic Agents
36. Coagulants and Anti coagulants
37. Local Anaesthetics
38. Histamine and Anti-histaminic Agents
39. Non-steroidal anti-inflammatory agents
40. Thyroxine and Antithyroid
41. Diagnostic Agents
42. Anticonvulsants

# PHARMACIST SYLLABUS

8. Total parenteral nutrition
9. Radio Pharmaceuticals
10. Application of computers in Hospital Pharmacy Practice
11. Clinical Pharmacy
12. Daily activities of clinical pharmacists
13. Pharmaceutical care
14. Medication Therapy Management, Home Medication Review

15. Clinical laboratory tests
16. Poisoning
17. Drugs and Poison Information Centre and their services
18. Pharmacovigilance
19. Medication errors
20. Drug Interactions

## NON-PHARMA

S.NO.	SUBJECT	SYLLABUS
1.	General Intelligence & Reasoning	Analogies, Coding-Decoding, Relationships, Jumbling, DI & Sufficiency, Similarities & Differences, Classifications, Statement- Argument & Assumptions, Alphabetical Series, Mathematical Operations, Syllogisms, Venn Diagram, Conclusion, Decision Making, Numerical Series, Analytical Reasoning, Directions
2.	General Aptitude/ General Mathematics	Number System, Decimals, LCM, Ratio & Proportion, Mensuration, Time & Distance, Profit & Loss, Geometry & Trigonometry, Square Root, Calendar & Clock, BODMAS, Fractions, HCF, Percentages, Time & Work, SI- CI, Algebra, Elementary Statistics, Age Calculations, Pipes & Cisterns
3.	General Knowledge	Knowledge of Current affairs, Indian geography, culture and history of India including freedom struggle, Indian Polity and constitution, Indian Economy, Sports, Awards, General scientific and technological developments etc.
4.	General Science	Physics, Chemistry and Maths (Based on CBSE Class 10th)
5.	Knowledge of Computers	Basic Computer Fundamentals, Operating Systems (OS), Microsoft Office Tools, Internet and Networking, Computer Security and Cybersecurity, Computer Applications in Healthcare, Basic Programming Concepts, Common Computer Shortcuts and Commands, Digital Literacy and Recent Trends, Troubleshooting Basics, Computer Terminologies.
6.	General English	Reading Comprehension, Cloze Test, Spellings, Phrases and Idioms, One Word Substitution, Sentence Correction, Error Spotting, Fill in the Blanks, Para Jumbles, Active/Passive, Narration
7.	General Hindi	व्याकरण, समानार्थी और विलोम शब्द, शब्दावली, मुहावरे और वाक्यांश, वाक्य संरचना, समझ

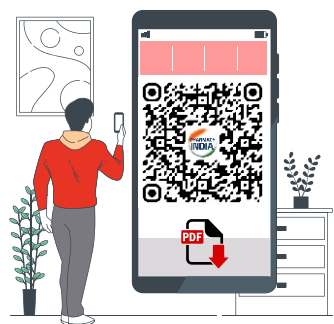


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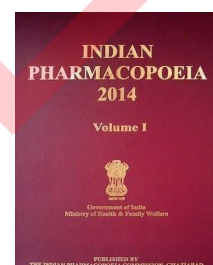
# PHARMACEUTICS

## Introduction of Pharmacopoeias

### Introduction to Pharmacopoeia

- A **Pharmacopoeia** is an official book of standards for drugs, chemicals, and medicinal preparations, recognized by the law of a country. It is published by an officially recognized authority, appointed by the government.
- The term derives from the Greek word "**pharmakon**" (drug) and "**poeia**" (to make).
- The head office of the **Indian Pharmacopoeia Commission (IPC)** is located in Ghaziabad. **(Rajasthan NHM 2025)**

Year	Pharmacopoeia	Place
1601	Pharmacopoeia Augustana (First pharmacopoeia)	Augsburg in Bavaria
1618	Pharmacopoeia Londinensis	London (England)
1699	Edinburgh Pharmacopoeia	Edinburgh
1807	Dublin Pharmacopoeia	Dublin
1864	British Pharmacopoeia (1 <sup>st</sup> Edition)	United Kingdom
1820	United States Pharmacopoeia (USP) (1 <sup>st</sup> Edition)	U.S.A
1955	Indian Pharmacopoeia (1st Edition)	India



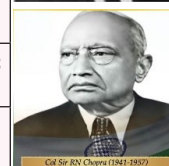
### History of the Pharmacy Profession in India

#### History of the Pharmacy Profession in Relation to Industry

YEAR	FOUNDER	NAME OF SHOP / INDUSTRY
1811	Mr. Bathgate (East India Company)	1st Chemist Shop in Kolkata
1901	Acharya Praffula Chandra Ray	Establishment of Bengal Chemicals and Pharmaceutical Works at Calcutta
1903	Prof. T.K Gajjar	Laid a Factory at Parel (Bombay)
1907		Laid Alembic Chemical Works, Baroda

#### History of the Pharmacy Profession in Relation to Education

YEAR	COLLEGE / ASSOCIATION
1842	First pharmacy college in Asia started in Goa by the Portuguese, known as "Escola Medica De Goa".
1912	The International Pharmaceutical Federation founded, with its head office in the Netherlands.
1932	Banaras Hindu University started a course under the leadership of Professor Mahadev Lal Schroff.
1937	BHU became the first university in India to start a 3-year B. Pharm course.
1939	The United Provinces Pharmaceutical Association (UPPA) was renamed as Indian Pharmaceutical Association (IPA).
December 1948	The First Indian Pharmaceutical Congress was organized at Calcutta with Prof. M.L. SCHROFF as its first President.
Every Year on 6th March	National Pharmacy Education Day - in honour of the birth anniversary of Professor Mahadeva Lal Schroff



### Indian Pharmacopoeia (IP)

#### Overview and History

- The **Indian Pharmacopoeia (IP)** is the official book of standards for drugs in India. It is published by the **Indian Pharmacopoeia Commission (IPC)** on behalf of the **Ministry of Health and Family Welfare**, Government of India. **(ESIC PHARMACIST-2014)**
- The **British Pharmacopoeia** was made official in India in **1885**. **(MHPSC PHARMACIST-2023)**
- The Government of India constituted a permanent **Indian Pharmacopoeia committee in 1948** under the chairmanship of Col. R. N. Chopra. **(HPSSB PHARMACIST-2020)**
- Indian Pharmacopoeia has adopted an **alphabetical** type of classification system for monographs. **(MP PHARMACIST-2023 P-2)**
- The IP uses the **Metric system** of weights and measures. **(HP- PHARMACIST - 2020)**

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**National Formulary of India (NFI)**

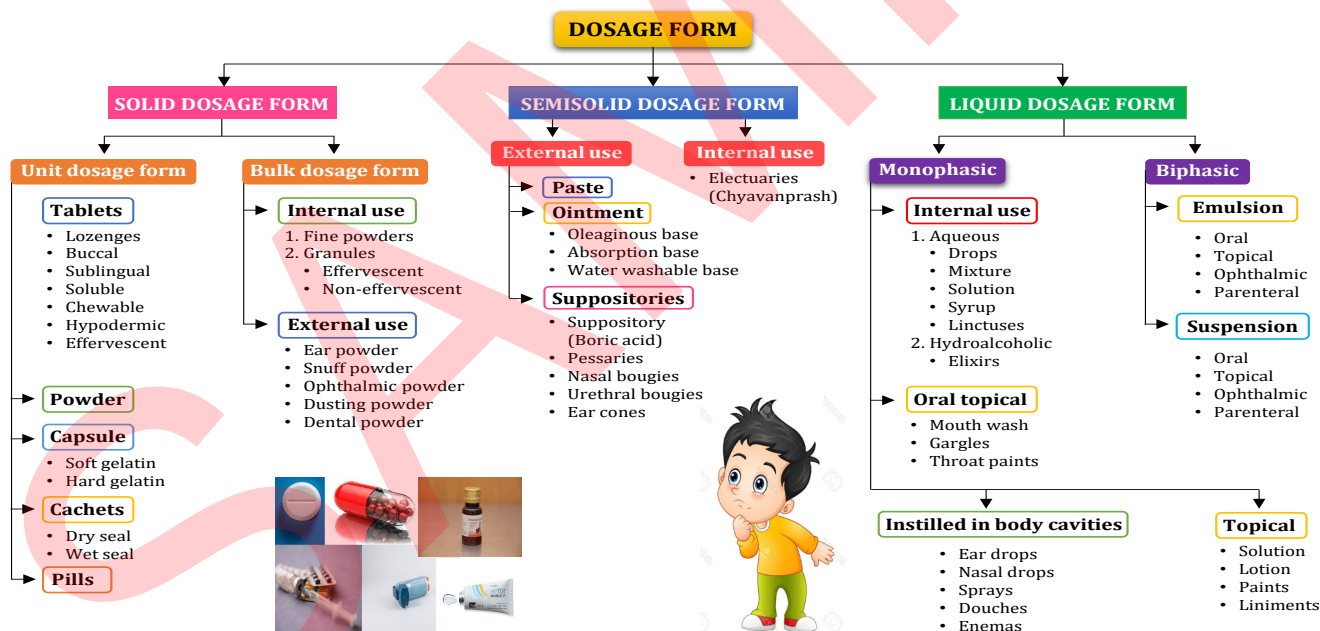
The National Formulary contains a list of medicines and other important information for the guidance of the medical and pharmaceutical professions.

YEAR	EDITION	LAUNCHED BY
1960	1st edition	Government of India, Ministry of Health
1966	2nd edition	Dr. B. N. Ghosh (chairman)
1979	3rd edition	Dr. B.D. Nag Chaudhari (chairman)
2011	4th edition	Ministry of Health & Family Welfare, Govt of India
2016	5th edition	Ministry of Health & Family Welfare, Govt of India
2021	6th edition	Dr. Mansukh Mandaviya (Ministry of Health & Family Welfare, Govt of India)

**EXAM PUNCH**

- As per Indian Pharmacopoeia, a tablet should **not be star-shaped.** (MC-ND PHARMACIST-2022)
- **Unofficial** books of standards include the Merck Index, Remington's Pharmaceutical Sciences, and The United States Dispensatory.
- The test for **Uniformity of colour** is NOT an official test as per the Indian Pharmacopoeia for tablets. (HPSSC PHARMACIST-2020)
- The mercury-in-glass thermometers mentioned in the Pharmacopoeia of India have their column above the liquid filled with **Nitrogen.** (Rajasthan NHM 2025)

**INTRODUCTION TO DIFFERENT DOSAGE FORM**



Dosage Form	Definition	Examples
<b>Tablet</b>	A <b>tablet</b> is a solid unit dosage form of medicament with or without suitable excipients and is prepared either by <b>compression or molding</b> .	Paracetamol tablet, Metformin HCl tablet
<b>Powder</b>	A <b>powder</b> is a dry, finely divided solid substance containing one or more drugs with or without diluents, meant for <b>internal or external</b> use.	ORS powder, Antacid powder
<b>Capsule</b>	A <b>capsule</b> is a solid dosage form in which the drug is enclosed in a <b>hard or soft gelatin shell</b> , usually intended for oral administration.	Amoxicillin capsule, Omeprazole capsule
<b>Cachets</b>	<b>Cachets</b> are solid dosage forms made from <b>rice flour</b> used to enclose unpleasant-tasting drugs, sealed and intended for swallowing.	Quinine sulfate cachet, Aspirin cachet

<b>Warm</b>	Between 30°C to 40°C.B
<b>Freezer</b>	Between -5°C to -20°C

□ Evaluation Tests

Test	Description
<b>Powdered glass test</b>	Performed on crushed grains of a specific size and meant for type I, type III and type NP glass.
<b>Water Attack Test</b>	Assesses Type-II glass alkali content, ensuring it falls within specified limits.
<b>Thermal shock test</b>	Simulates product life cycle by varying temperatures.
<b>Compression test</b>	Measures the compressive strength of packages.
<b>Crease Stiffness Test</b>	Measures carton board's crease recovery after 90°C folding.
<b>Air Permeability test</b>	Determines the level of porosity and permeability.
<b>Water Vapors Permeability</b>	Measures the rate of water vapor permeation in a packaging material.

**EXAM PUNCH**

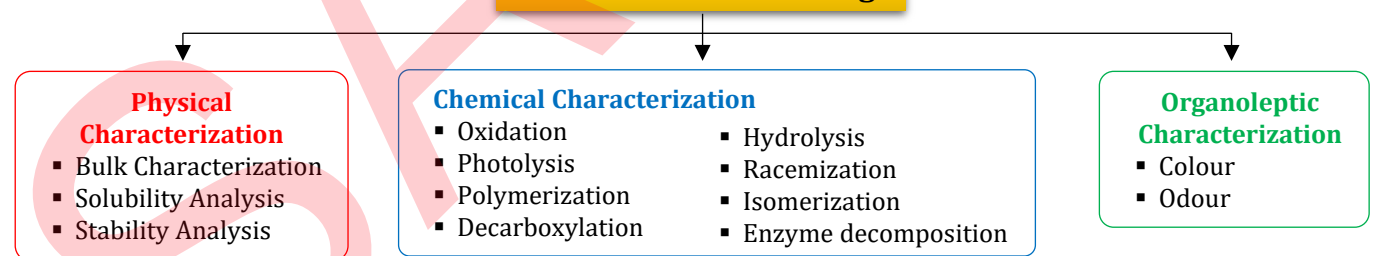
- **Blister Packages** are generally not **used by a pharmacist to fill a prescription.** (MH PHARMACIST-2012)
- **Bead sealing** is a method where the tip of an ampoule neck is heated to form a bead, which closes the opening.
- **A Type III Drug Master File (DMF)** provides detailed information regarding **packaging materials.** (PHARMACIST GRADE - III, 2013)
- **Thermolabile substances** must be stored in a **cool place.** (MP PHARMACIST 2023 P-1). The **Polio vaccine** should be stored below 0°C in a freezer. (BPKMC HOSPITAL PHARMACIST - 2014)
- **Primary packaging** used for tablets is commonly a **Blister Pack.** (DSSSB 7th May 2025 S2)

## PREFORMULATION STUDIES

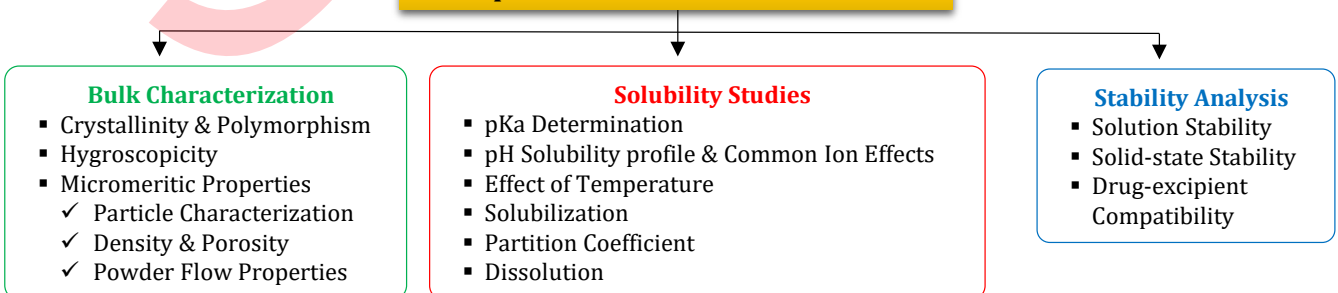
### Introduction to Preformulation Studies

- Preformulation is the stage of research where the physical and chemical properties of a new drug substance are characterized to develop a safe, stable, and effective dosage form.
- The primary purpose of these studies is to generate essential information to guide formulation development, predict potential issues, and ensure the manufacturability of the final product. (DSSSB PHARMACIST 2025)

### Characterization of Drugs



### Principle Areas of Preformulation Studies



## CAPSULES

### INTRODUCTION

- Capsules are solid dosage forms in which the drug substance is enclosed within either a hard or soft soluble shell, usually formed from gelatin.
- The term is derived from the Latin word capsula, meaning a small container. (KERALA PHARMACIST-2022), (MP PHARMACIST-2020 P-1)
- They are designed to be administered orally, although some may be used for rectal or vaginal insertion.

### Types of Capsules

Capsules are broadly classified into two main categories based on the nature and composition of their shell. (CGHS BANGALORE PHARMACIST-2019)

Parameter	Hard Gelatin Capsule (HGC)	Soft Gelatin Capsule (SGC)
<b>Composition of Shell</b>	Made up of <b>gelatin, sugar, and water</b> . Does not contain a plasticizer.	Made up of <b>gelatin, plasticizer (like sorbitol, glycerin), and water</b> . The plasticizer makes the shell elastic. (RJ PHARMACIST-2012 P-3)
<b>Structure</b>	Consists of <b>two separate parts</b> : a body and a cap. The body is longer and narrower than the cap. (HPSSC PHARMACIST-2020)	A <b>single, hermetically sealed one-piece shell</b> .
<b>Moisture Content</b>	Shell contains <b>12-16%</b> moisture. (DSSSB PHARMACIST-2021)	Shell contains <b>6-10%</b> moisture.
<b>Types of Fill</b>	Primarily filled with <b>dry solids</b> (powders, granules, pellets). (ISRO PHARMACIST-2017)	Primarily filled with <b>liquids, suspensions, or semi-solids</b> .
<b>Manufacturing</b>	Shells are manufactured first and then filled in a separate operation.	Filling and sealing are completed in a single continuous operation.
<b>Disintegration Time</b>	30 minutes.	60 minutes.
<b>Specialization</b>	Can be made into enteric-coated or sustained-release dosage forms.	Suitable for encapsulating oily or water-immiscible liquids.
<b>Preservatives in Shell</b>	Generally, not required due to low moisture content.	May contain preservatives like methyl and <b>propyl parabens to prevent</b> microbial growth. (KERALA PSC PHARMACIST-2021 P-1)

### GELATIN

**Gelatin** is a proteinaceous material derived from the partial hydrolytic extraction of animal collagen, which is sourced from skin, bones (especially green bones), and white connective tissues. (MP PHARMACIST-2020 P-2).



### Types of Gelatin

There are two main types of gelatin, classified based on the processing method used on the raw collagen.

Parameter	Type A Gelatin	Type B Gelatin
<b>Source</b>	Primarily derived from <b>pork skin</b> .	Primarily derived from <b>animal bones (green bone) and calf skin</b> . (AIIMS PHARMACIST- 2012)
<b>Treatment Process</b>	<b>Acid hydrolysis</b> (Acid treatment).	<b>Alkaline hydrolysis</b> (Alkali treatment).
<b>Ionic Nature</b>	Cationic.	Anionic.
<b>Isoelectric Point</b>	<b>pH 9.0</b>	<b>pH 4.7</b> (DSSSB PHARMACIST-2019 P-1)
<b>Alternative Isoelectric Point</b>	For acid bone gelatin, the isoelectric point can be between pH 5.5 - 6.0.	<b>From green bones</b> .

❑ Equipment Used in Capsule Manufacturing

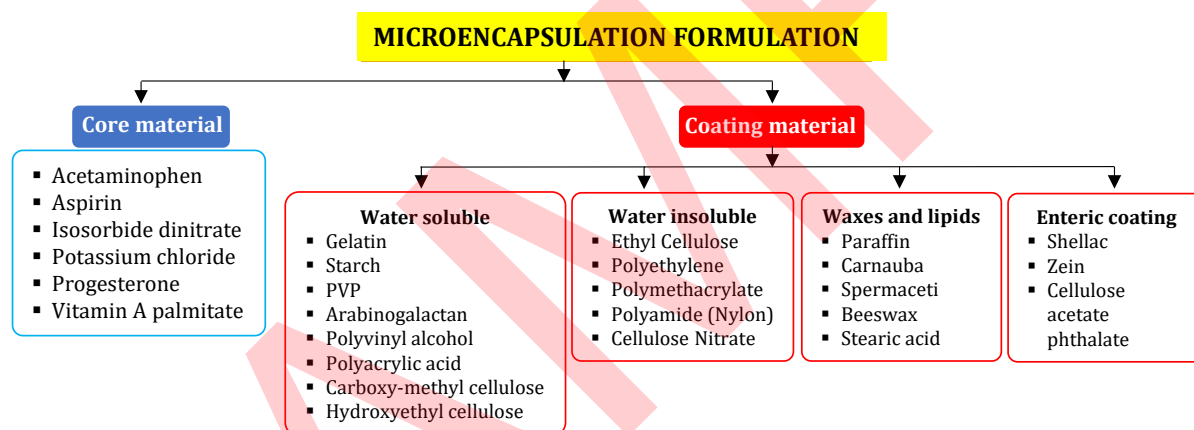
Equipment	Function / Use
<b>Rotofill (Eli lily company)</b>	A machine designed specifically for filling pellets into hard gelatin capsules. <b>(ISRO PHARMACIST-2017)</b>
<b>Rotosort</b>	An automated machine used for sorting filled capsules by weight, rejecting those that are under- or over-filled. <b>(NWR RJ PHARMACIST-2012)</b>
<b>Rotoweigh</b>	An automated system for weighing individual capsules to ensure weight uniformity. <b>(ISRO PHARMACIST-2021)</b>
<b>Fette machine</b>	Used to provide cool temperature

## MICROENCAPSULATION

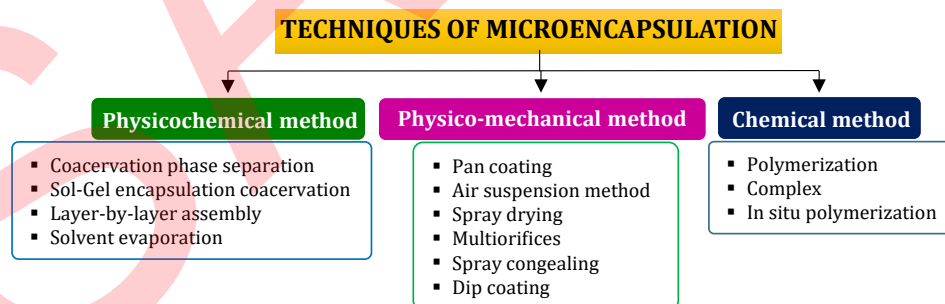
**Microencapsulation** is a process in which tiny particles or droplets are surrounded by a coating to give small capsules with many useful properties. It is a key technology used in the formulation of controlled-release and targeted drug delivery systems. One of the common techniques used for this process is **coacervation-phase separation**. **(SECL PHARMACIST - 2013)**

❑ MORPHOLOGY OF MICROENCAPSULES

- CORE MATERIAL
- COATING MATERIAL



❑ TECHNIQUES OF MICROENCAPSULATION



❑ MACHINES OF MICROENCAPSULATION

MICROENCAPSULATION METHOD	PARTICLE SIZ(MM)
<b>AIR SUSPENSION (WURSTER PROCESS)</b>	<b>35-5000</b>
<b>PAN COATING</b>	<b>600-5000</b>
<b>MULTIORIFICE CENTRIFUGAL PROCESS</b>	<b>1-5000</b>
<b>COACERVATION PHASE SEPARATION</b>	<b>2-5000</b>
<b>SOLVENT EVAPORATION</b>	<b>5-5000</b>
<b>SPRAY DRYING &amp; CONGEALING</b>	<b>6000</b>

USED FOR ENCAPSULATION OF SOLID ONLY.

BOTH FOR SOLID & LIQUED

### Types of flow in different semi-solid preparations

Types of Semisolids	Flow Property
<b>Creams</b>	Non – Newtonian, Pseudoplastic flow
<b>Gel</b>	Pseudoplastic flow
<b>Pastes</b>	Dilatant flow
<b>Ointments</b>	Pseudoplastic flow
<b>Jellies</b>	Non- Newtonian flow

### Evaluation Tests (BTSC 2025, DSSSB 6th May 2025 S1)

- Consistency test
- Penetration test
- Rate release test
- Patch test

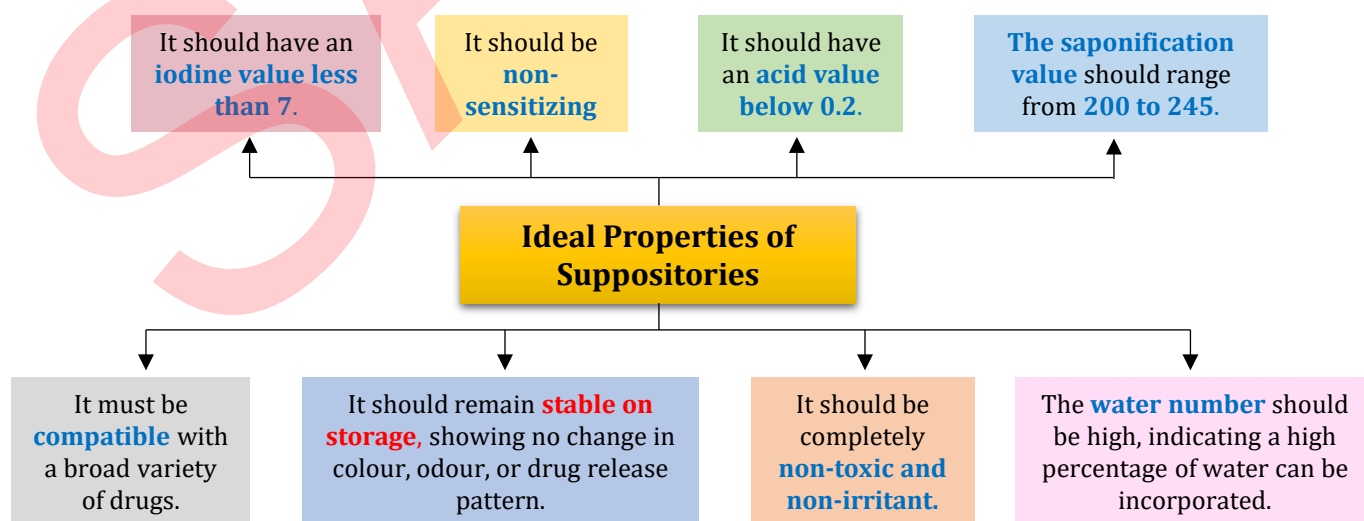
#### Exam Punch

- Medications applied to the skin or mucous membranes referred to as topical. (OSSC 2024)
- **Dimethyl sulfoxide** acts as penetration enhancer for topical formulations by denaturing proteins. (AMC 2022)
- **Hard Paraffin** is a purified mixture of solid hydrocarbons obtained from petrolatum. (Delhi Pharmacist 2021)
- The ointment base of mineral origin is paraffin wax. (ESIC 2014)
- In non-staining iodine ointment, arachis oil ingredients is added to bind iodine (Raj. Pharmacist 2011, 2012)
- **Light liquid paraffin IP** and light paraffin is differentiated by their flash point. (Raj. Pharmacist 2012 P3)
- Paste (oil paste) is an ointment containing more than 10% pulverized constituents. (HSSC 2024)
- **Methyl paraben or propyl paraben** may be used in the preparation of ointment as a preservative. (MPSC 2023)
- Emollients the substances that soften and moisturize the skin and decrease itching and flaking. (AIIMS Patna 2023)

## SUPPOSITORIES

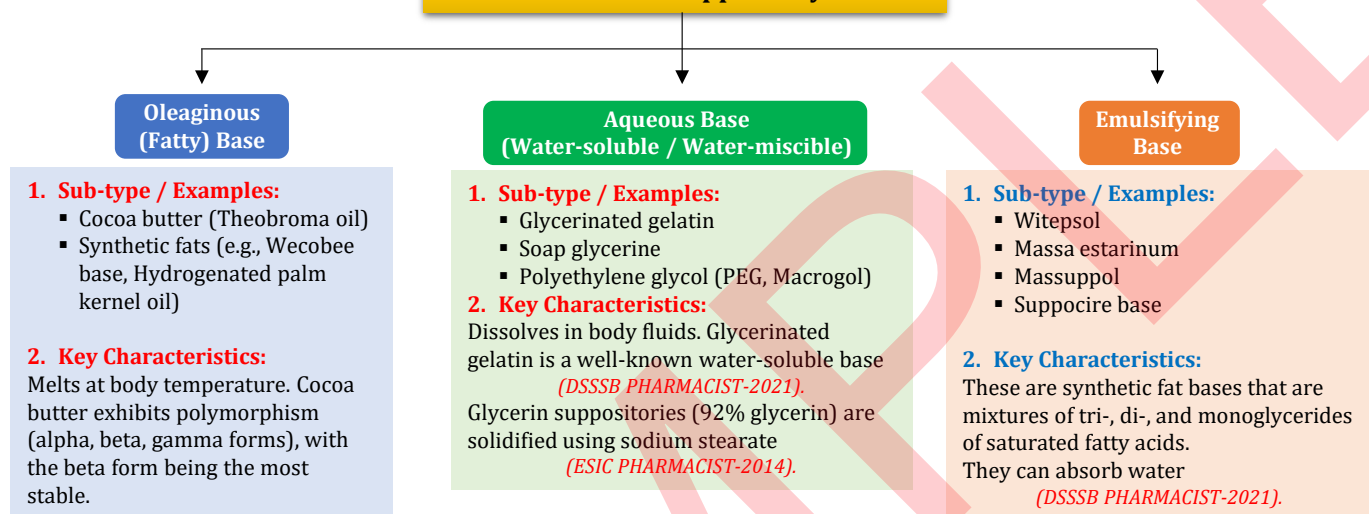
### Introduction

- **Suppositories** are ovoid or conical shaped medicated solid dosage forms intended for insertion into body orifices like the **rectum, vagina, or urethra**.
- They are designed to **melt, soften, or dissolve** at body temperature to release the drug and produce a local or systemic effect.
- The term is derived from the Latin *suppositus*, meaning "to place under".



<b>Water Number</b>	The amount of water in grams that can be incorporated in 100 g of fat.	It is an evaluation parameter for <b>absorption bases</b> . (MH PHARMACIST-2012).
<b>Acid Value</b>	The number of milligrams of KOH required to neutralize the free fatty acids in 1 g of fat.	A low acid value (< 0.2) is important for good suppository bases to prevent irritation.
<b>Solidification Point</b>	This value allows prediction of the time required for solidifying the base when it is chilled in the mold.	Important for manufacturing efficiency.

### Classification of Suppository Bases



#### ➤ Methods of Preparation

<b>Hand Moulding (Hand Rolling)</b>	The oldest method, suitable for small batches using a plastic-like mass, often with a cocoa butter base.
<b>Fusion Method (Molding)</b>	Involves melting the base, incorporating the drug, and pouring the melt into molds to congeal.
<b>Cold Compression Method</b>	A mixture of the grated base and drug is forced into a mold under pressure. This method is suitable for heat-labile drugs. (HPSSB PHARMACIST-2020).
<b>Machine Moulding</b>	An automated process used for large-scale production.

#### ☐ Packaging and Storage

➤ **Packaging:** Suppositories are usually packed individually in tin or aluminum foil, paper or in plastic containers.

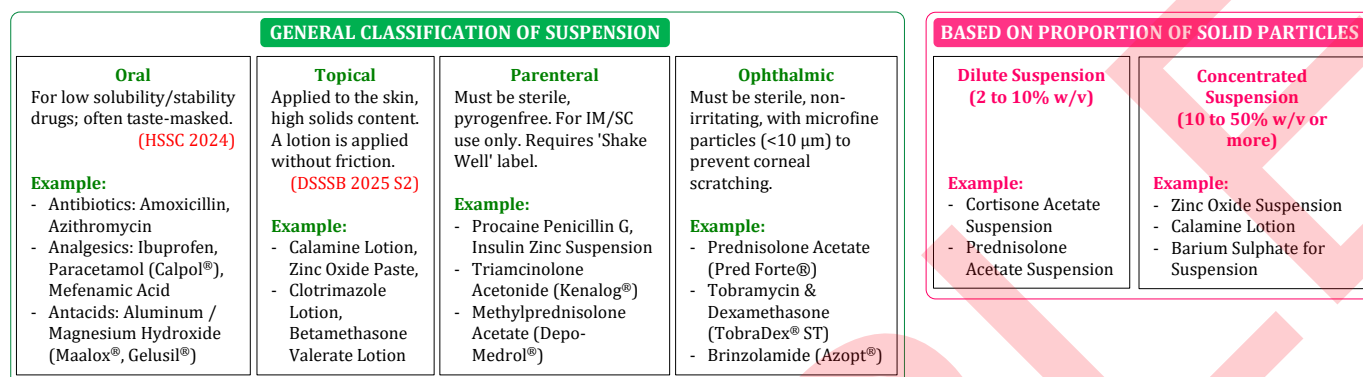
#### ➤ Storage Condition:

- General storage is at **10-15°C** in a used air-tight container.
- Suppositories with a **cocoa butter base** should be stored at temperatures **below 30°C**.
- Suppositories with a **glycero-gelatin base** should be stored at temperatures **below 35°C**.

#### ☐ Evaluation of Suppositories

Test	Description
<b>Test of Appearance</b>	Visual inspection for color, shape, and absence of cracks or pits.
<b>Test of Physical Strength (Hardness/Breakage Test)</b>	Measures the force required to break the suppository, indicating its ability to withstand handling.
<b>Test of Dissolution Rate</b>	Measures the rate at which the drug is released from the suppository in vitro.
<b>Test of Melting Range</b>	Determines the time it takes for the suppository to melt or soften at a specific temperature, often using a tablet disintegration apparatus.
<b>Weight Uniformity</b>	Individual suppositories are weighed to ensure consistency. Not more than two should deviate from the average weight by >5%, and none by >10%.

CLASSIFICATION OF SUSPENSIONS



□ Flocculated vs. Deflocculated Suspensions

Feature	Flocculated Suspension	Deflocculated Suspension
<b>Particle State</b>	Particles form loose aggregates (flocs) that create a porous, network-like structure. (ISRO PHARMACIST-2021)	Particles exist as separate, fine, individual entities.
<b>Interparticle Forces</b>	Net attractive forces (van der Waals) are dominant.	Net repulsive forces (from the electrical double layer) are dominant.
<b>Appearance</b>	Unpleasant; marked by a clear supernatant liquid above the sediment.	Pleasing; the liquid remains cloudy for a longer time due to slow settling.
<b>Rate of Sedimentation</b>	High. The large size of the flocs causes them to settle rapidly. (HPSSC PHARMACIST-2020, KERALA PHARMACIST-2022)	Low. Small, individual particles settle very slowly.
<b>Sediment Characteristics</b>	Loosely packed, high-volume, porous sediment.	Closely packed, low-volume, dense sediment.
<b>Caking</b>	Cake is not formed. The sediment is easy to redisperse.	Hard cake is formed. The sediment is very difficult to redisperse.
<b>Redispersibility</b>	Easy to redisperse with minimal shaking.	Difficult or impossible to redisperse.
<b>Bioavailability</b>	Comparatively less, due to the decrease in effective surface area within the floc.	Higher, due to the large total surface area of the individual fine particles.
<b>Rheological Flow</b>	Exhibits plastic or pseudoplastic flow.	Exhibits Newtonian flow at low concentrations and dilatant at high concentrations.

□ Formulation of Pharmaceutical Suspensions

Component	Function	Examples / Types	Important
<b>API (Drug)</b>	Exerts therapeutic effect	Antacids, Antibiotics, Antifungals	Core active ingredient
<b>Vehicle</b>	Acts as dispersion medium	Water, Glycerin (Solvents)	Helps in dissolving excipients and suspending drug
<b>Suspending (Thickening) Agents</b>	Increase viscosity and suspend particles	<p><b>1. Polysaccharides:</b> Sodium alginate, Acacia, Tragacanth, Xanthan gum</p> <p><b>2. Cellulose Derivatives:</b> MC, HEC, HPMC, CMC, MCC</p> <p><b>3. Hydrated Silicates:</b> Magnesium aluminum silicate (Veegum), Bentonite</p>	Reduces sedimentation rate (SSB 2023); Compound Tragacanth = protective colloid (KPSC 2024)
<b>Flocculating Agents</b>	Promote floc formation to prevent caking	<p><b>Synthetic: Carbopol, Cab-O-Sil</b></p> <p><b>1. Electrolytes:</b> NaCl, KCl</p> <p><b>2. Surfactants:</b> SLS, Tweens, Spans</p> <p><b>3. Polymers:</b> Carbowax, Gelatin</p>	Reduce zeta potential; help in controlled flocculation (KPSC 2025)

**EXAM PUNCH**

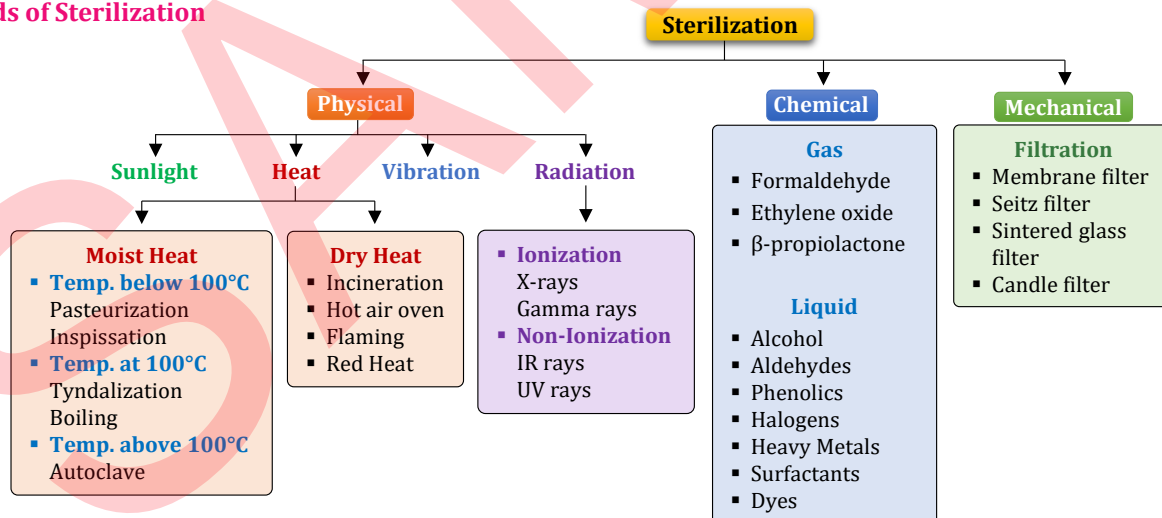
- The **typical particle size** range for a **conventional suspension** is **0.5 to 5.0 microns**. (MP PHARMACIST-2020)
- In an **ideal suspension**, particles should **settle slowly** and should **not form a hard cake** or clay at the bottom. (MHSRB Telangana 2024)
- **Slow settling** ensures accurate **dose withdrawal**, and **non-caking** guarantees usability during the **entire shelf life**.
- **High zeta potential** maintains a **deflocculated state**, but may lead to the formation of a **hard cake** if settling occurs. (HP PHARMCIST-2016)

**STERILIZATION**

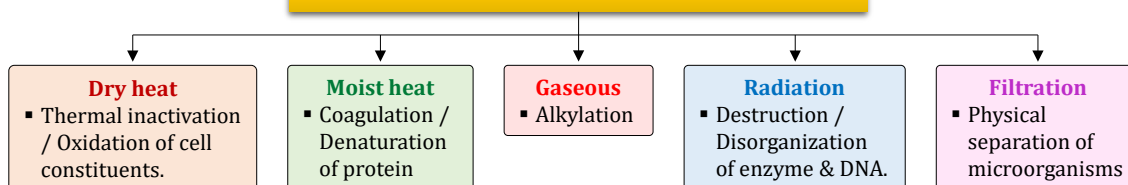
□ **Terms Related to Sterilization and Their Description**

TERM	DESCRIPTION
<b>Sterilization</b>	The process in which there is an absolute (100%) killing/elimination or inactivation of all viable organisms present in a specified region.
<b>Disinfectants</b>	Disinfection is defined as a process of destruction or removal of pathogenic microorganisms/ kills vegetative cells but not heat-resistant spores from the object.
<b>Antiseptic</b>	A chemical agent usually applied to living tissue in humans or animals in order to destroy harmful microorganisms. E.g, Dettol, Phenol, Savlon.
<b>Germicide</b>	Kills all vegetative cells but not the spore form of germs.
<b>D-Value or Decimal Reduction Time</b>	The time (for heat or chemical exposure) or Dose (for radiation exposure) required for the microbial population to decline by one decimal point (90%, one logarithmic unit, reduction).
<b>Z-Value or Thermal Destruction Value</b>	A term used in microbial thermal death time calculations. It is the number of degrees the temperature has to be increased to achieve a tenfold (i.e., 1 log <sub>10</sub> ) reduction in the D-value. The range is 10-15°C.
<b>F-Value</b>	The F value for a process is the number of minutes to kill a number of microorganisms with a specified Z-Value at a specific temperature. It is a measurement of sterilization effectiveness.

□ **Methods of Sterilization**



**Mechanism of Action of Sterilization Methods**



Theories of Filtration

Filtration Theories & Equations

**Poiseuille's Equation**  
 Poiseuille considered that the filtration process is analogous to the streamline flow of a liquid under pressure through capillaries.

$$Q = \frac{\pi \cdot r^4 \cdot \Delta P}{8 \cdot \eta \cdot L}$$

**Where:**

- Q = Rate of flow (volume per unit time)
- r = Radius of the tube
- ΔP = Pressure difference across the tube
- η = Viscosity of liquid
- L = Length of the tub

**Darcy's Equation**  
 In Darcy's model, the length of a capillary is considered as the thickness of the filter bed. A correction factor for the radius is applied to approximate and simplify the rate equation. The factors influencing the rate of filtration have been incorporated into this equation.

$$Q = \frac{K \cdot A \cdot \Delta P}{\mu \cdot L}$$

**Where:**

- Q = Rate of flow (volume per unit time)
- K = Permeability constant of filter medium and cake
- A = Surface area of filter medium
- ΔP = Pressure difference across the filter
- μ = Viscosity of the fluid
- L = Thickness of the filter bed or cake

**Kozeny-Carman Equation**  
 This equation makes Poiseuille's equation applicable to a porous bed by including additional parameters to account for the capillary-like structure of the filter medium. The resultant equation is widely used for filtration calculations.

$$V = \frac{A}{\eta S^2} \times \frac{\Delta P}{KL} \times \frac{\epsilon^3}{(1 - \epsilon)^2}$$

**Where**

- V = Superficial velocity (flow rate per unit area)
- A = Cross-sectional area of bed
- η = Viscosity of fluid
- S = Specific surface area of particles
- ΔP = Pressure drop across bed
- K = Kozeny constant (≈ 5)
- L = Thickness (length) of bed
- ε = Porosity (void fraction) of bed

**Sieving Theory**  
 This is a filtration theory applicable in cases where filtration occurs primarily through size exclusion and is used in the analysis of particle size distributions. [ITBP 2023]



**FILTER AIDS**

Filter aids are substances used to enhance the filtration process, particularly when dealing with fine or slimy particles that can clog the filter medium. In pharmaceutical filtration, the primary purpose of using a precoat layer is to prevent filter medium clogging. [SSB 2023]

- Mechanism:** A filter aid forms a surface deposit (precoat) which screens out the solids and prevents the plugging of the supporting filter medium.
- Examples:** Kieselguhr (also known as Diatomaceous Earth or "DE") [AIIMS Bhubaneswar 2023], Talc, Charcoal, Asbestos, Paper pulp, Bentonite, and Fuller's earth.

**FILTRATION EQUIPMENT**

Equipment	Principle/Type	Characteristics and Uses
<b>Sintered glass filter (Candle Filter)</b>	Depth Filtration	<ul style="list-style-type: none"> <li>Glass is made by sintering a bed of granules of borosilicate glass. Filter candles are made of borosilicate glass. [HPSSC PHARMACIST-2020, HAMIRPUR PHARMACIST-2021]</li> <li>Candle filters are prepared by heat-fusing finely powdered glass particles of graded sizes. [DL PHARMACIST-2021]</li> <li>Grade 3 and 4 are used for the clarification of non-sterile solutions.</li> <li>Grade 5 is used for sterile filtration, eye drops, etc.</li> <li>Cannot remove toxins and pyrogens.</li> </ul>
<b>Seitz filter</b>	Surface Filtration	<ul style="list-style-type: none"> <li>Consists of a pad of compressed asbestos as a filtering medium. Asbestos is used for filtration. [HPSSB PHARMACIST-2020]</li> <li>It is useful for sterile filtration and air filtration.</li> <li>It acts like a sieve.</li> </ul>
<b>Membrane filter</b>	Surface Filtration	<ul style="list-style-type: none"> <li>Filter sheets made of cellulose are membrane filters. [HPSSC PHARMACIST-2018, BFUHS PHARMACIST-2018]</li> <li>The typical pore size in a membrane filter used for sterilization is 0.22 μm. [RJ PHARMACIST- 2012 P-1]</li> <li>These are available with different pore sizes for various applications:                             <ul style="list-style-type: none"> <li>0.010 to 0.10 μm: Remove virus particles from air and water.</li> <li>0.03 to 0.65 μm: Remove bacteria.</li> <li>0.8, 1.2, 3.0 to 5.0 μm: Particle sizing and purifying aerosol, radioactivity.</li> </ul> </li> </ul>

**REYNOLDS NUMBER**

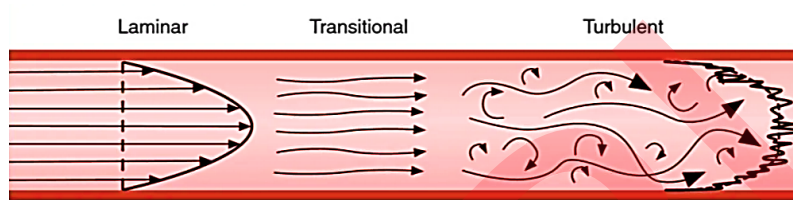
- Reynolds number is a **dimensionless number** used to classify the type of flow.
- It is defined as the ratio of inertial forces to viscous forces (**AIIMS Pharmacist - 2018**).

$$Re = \frac{D u \rho}{\eta}$$

Where:

- D = Diameter of pipe (m)
- u = Average velocity (m/s)
- ρ = Density of fluid (kg/m<sup>3</sup>)
- η = Viscosity of fluid (Pa·s)

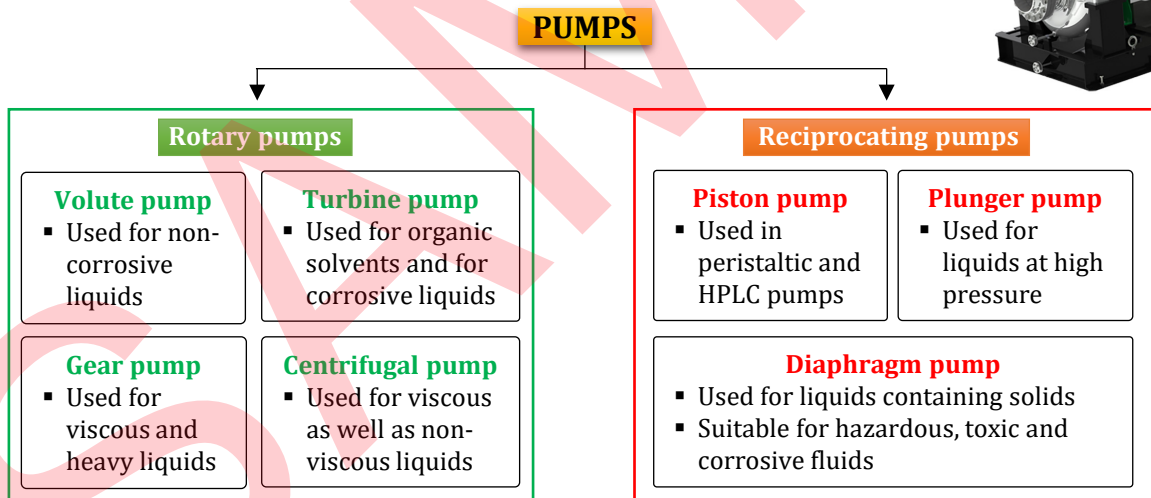
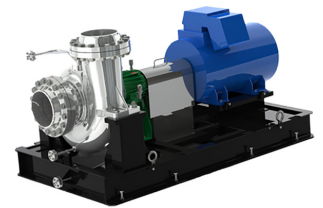
□ **Classification of flow**



Reynolds Number	Type of Flow	Characteristics
<b>Re &lt; 2000</b>	Laminar / Streamline flow	Flow in smooth layers, viscous forces dominate. Streamline flow taken at about 2000 ( <b>DSSSB Pharmacist - 2019</b> ).
<b>2000 - 4000</b>	Transitional flow	Flow may be laminar or turbulent depending on conditions.
<b>Re &gt; 4000</b>	Turbulent flow	Flow with eddies and mixing, inertial forces dominate. Large Re shows highly turbulent flow.

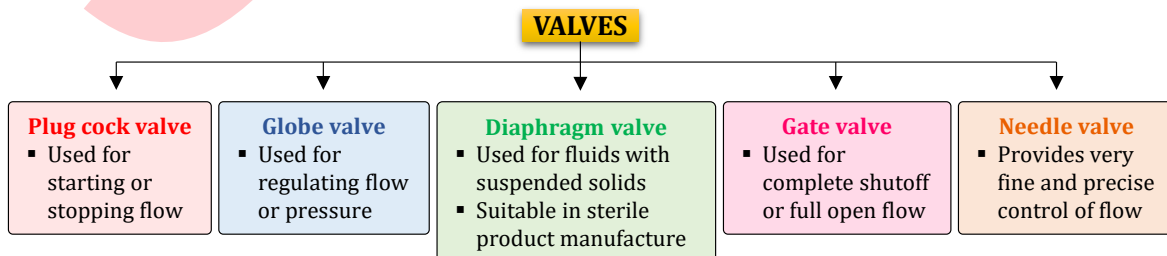
**PUMPS**

Pumps are mechanical devices used to increase the pressure energy of a liquid and transport it.



**VALVES**

Valves are mechanical devices used to control, start, stop, or regulate the flow of fluids.



# 3

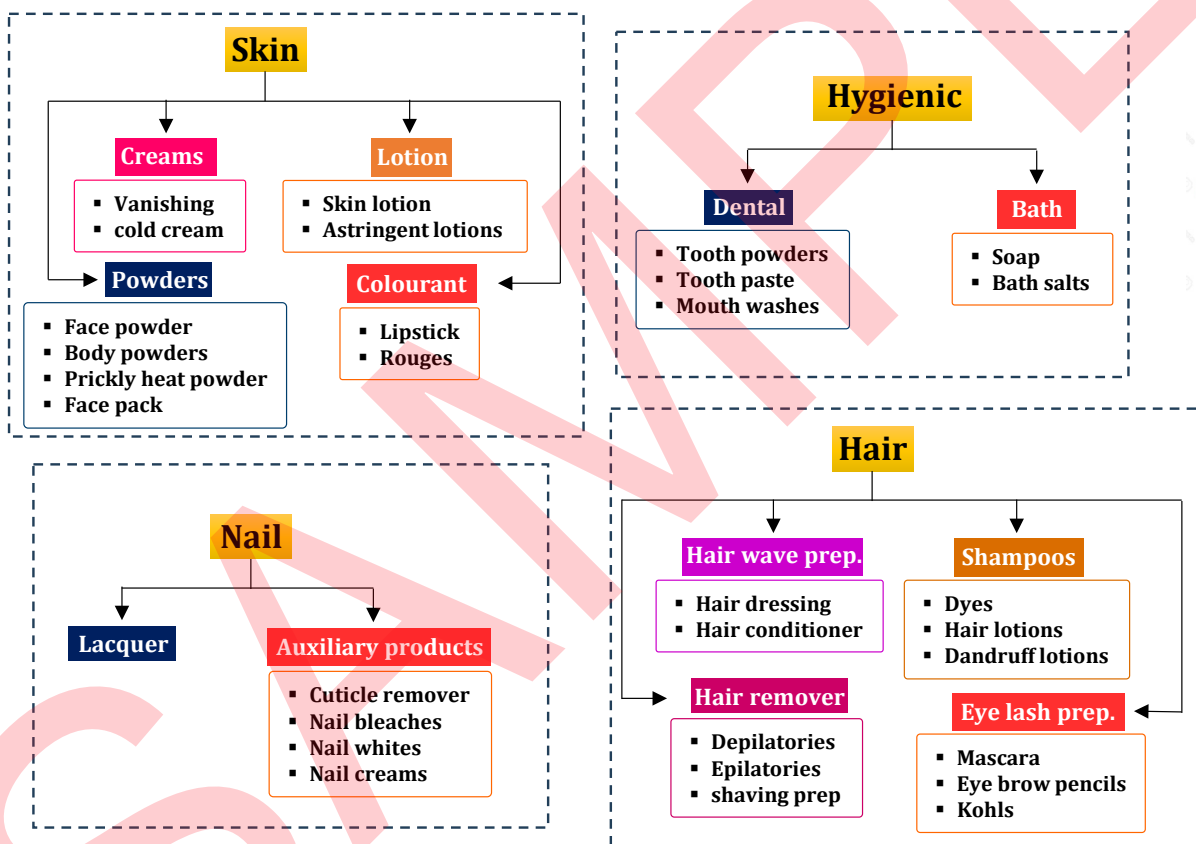
# COSMETICS TECHNOLOGY

## INTRODUCTION TO COSMETICS

- Cosmetics are products that have a **gentle effect** on the human body and are used for cleansing, beautifying, enhancing beauty, changing one's look, or supporting healthy skin and hair.
- They can be broadly divided into four major groups: **Skin, Hair, Nail, and Hygienic preparations** (which include dental and bath products).



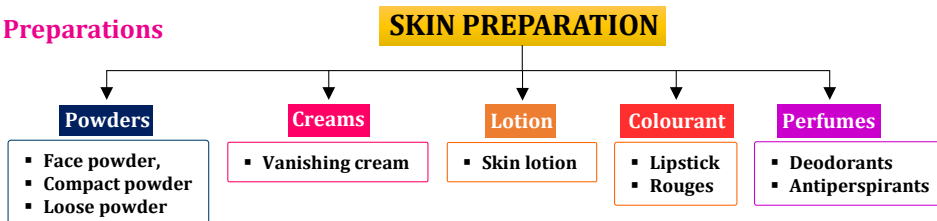
## Cosmetic



## COSMETICS FOR SKIN

Skin preparations are designed to **cleanse, moisturize, protect, and decorate the skin.**

### Types of Skin Preparations



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Fried's Formula	Child Dose = $\frac{\text{Age in months}}{150} \times \text{Adult Dose}$
Cowling's Rule	Child Dose = $\frac{\text{Age at next birthday (years)}}{24} \times \text{Adult Dose}$

□ Key Points:

- Young's rule is used to determine pediatric doses based on **Age**. [MP Pharmacist 2020 P1, Raj. NHM 2025]
- Fried's formula is used for **infants in months**. [KPSC 2017]
- Dilling's formula is used for calculating the dose of a child **from 12-20 years**. [MPESB 2023 P2]

□ Weight-based Rule (Clark's Formula)

Formula Name	Formula
Clark's Formula	Child Dose = $\frac{\text{Weight of child (lb)}}{150} \times \text{Adult Dose}$
	OR Child Dose = $\frac{\text{Weight of child (kg)}}{70} \times \text{Adult Dose}$

**EXAM PUNCH**

- Dose calculation based on **BSA** is depicted by Crawford Terry Rourke's formula. [MPSC 2023]  
Pediatric dose calculation using: {Proposed by Catzel} [DSSSB 2021]

$$\frac{\text{Surface area of child}}{\text{Surface area of adult}} \times 100 = \% \text{ Adult Dose}$$

- Dubois formula is used to calculate **BSA**. [ESIC 2016]
- Usual doses for infants and children (based on **Body Weight**) are given by Clark's Rule. [Raj. Pharmacist 2016 P1, HSSC 2024, MPPGCL 2024]
- Clark's formula is based on **Weight**. [MPSC 2023]

**SAMPLE CALCULATIONS (PYQS)**

1. Calculate the child dose if the age of the child is 5 years and the adult dose is 600 mg. (Using Young's Rule) [MHSRB 2024]

$$\text{Dose} = \frac{\text{Age (years)}}{\text{Age} + 12} \times \text{Adult Dose}$$

$$\text{Dose} = \frac{5}{5 + 12} \times 600 = \frac{5}{17} \times 600 = 176.47\text{mg}$$

2. The age of a child is 10 years. The adult dose is 500 mg. Calculate the dose using Young's rule. [MPSC 2023]

$$\text{Dose} = \frac{10}{10 + 12} \times 500 = \frac{10}{22} \times 500 = 227.27\text{mg}$$

3. What is the dose for a 6-year-old child if the adult dose is 250 mg? (Apply Young's rule) [MC-ND 2022]

$$\text{Dose} = \frac{6}{6 + 12} \times 250 = \frac{6}{18} \times 250 = 83.33\text{mg}$$

4. What is the dose for a 6-month-old infant if the adult dose is 300 mg? (Apply Fried's rule) [HPSSC 2020]

$$\text{Dose} = \frac{\text{Age (months)}}{150} \times \text{Adult Dose}$$

$$\text{Dose} = \frac{6}{150} \times 300 = 12\text{mg}$$

5. If the adult dose is 60 mg and child weight is 14 kg, calculate the child dose as per Clark's formula. [MP Pharmacist 2020 P2]

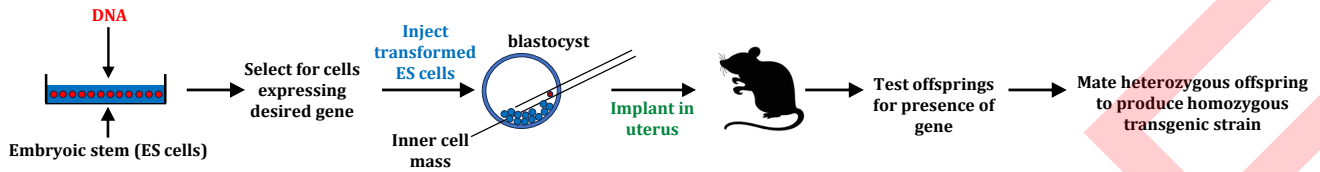
$$\text{Dose} = \frac{\text{Weight of child (kg)}}{70} \times \text{Adult Dose}$$

$$\text{Dose} = \frac{14}{70} \times 60 = 12\text{mg}$$

6. Adult dose of a drug is 240 mg, calculated dose for a child of age 12 years is? (Apply Young's Rule) [KPSC 2015]

$$\text{Dose} = \frac{12}{12 + 12} \times 240 = \frac{12}{24} \times 240 = 120\text{mg}$$

► Transgenic Animals



**Note** - The first transgenic animal is **mouse** and the first transgenic plant is **tobacco**.

**FERMENTATION TECHNOLOGY**

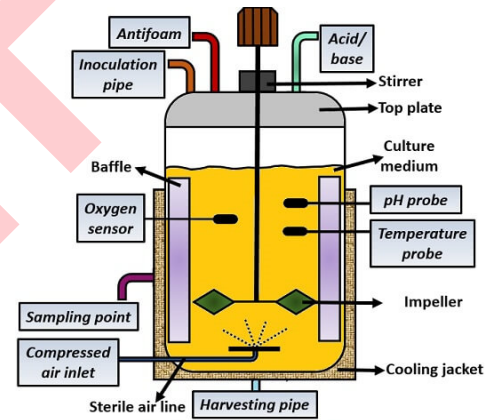
**INTRODUCTION**

- **Fermentation technology** is a field which involves the use of microorganisms and enzymes for the production of compounds which have application in the energy, material, pharmaceutical, chemical, and food industries.
- The process of growing microorganisms in a nutrient media by maintaining physicochemical conditions is called **fermentation**. [DSSSB 2025 S2]

**THE FERMENTER**

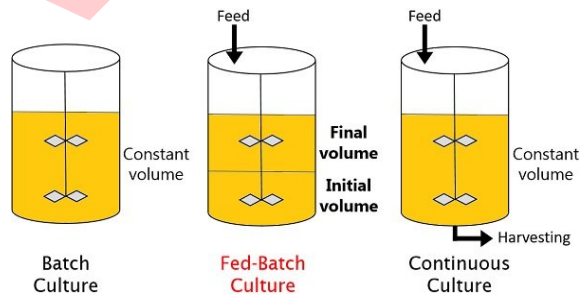
A fermenter (or bioreactor) is a closed vessel designed to carry out fermentation processes under controlled conditions.

Parts	Use / Function
<b>Baffles</b>	Prevent sedimentation on sides & proper mixing.
<b>PT 100</b>	Temperature sensor (platinum resistance electrode).
<b>Foam probe</b>	Keep above the medium level to sense foam formation.
<b>O<sub>2</sub> pump</b>	Monitor/dissolve oxygen.
<b>Heater pad</b>	Directly heats the medium.
<b>Cold finger</b>	A device for direct heating, used to cool vessel content.
<b>Rotameter</b>	Variable area-flow meter.
<b>Air pump</b>	Supply for air.
<b>Peristaltic pump</b>	To pump acid base, antifoam & medium.



**Design of a fermentor**

**TYPES OF INDUSTRIAL FERMENTATION**



Fermentation Type	Description
<b>Batch Culture</b>	A closed system where a fixed volume of sterile nutrient medium is inoculated with microorganisms. The fermentation runs for a limited period without adding more medium.
<b>Fed-Batch Culture</b>	A modification of batch fermentation where the substrate is added incrementally as the fermentation progresses.
<b>Continuous Culture</b>	Substrate is added continuously to the fermenter, and the product is harvested continuously.

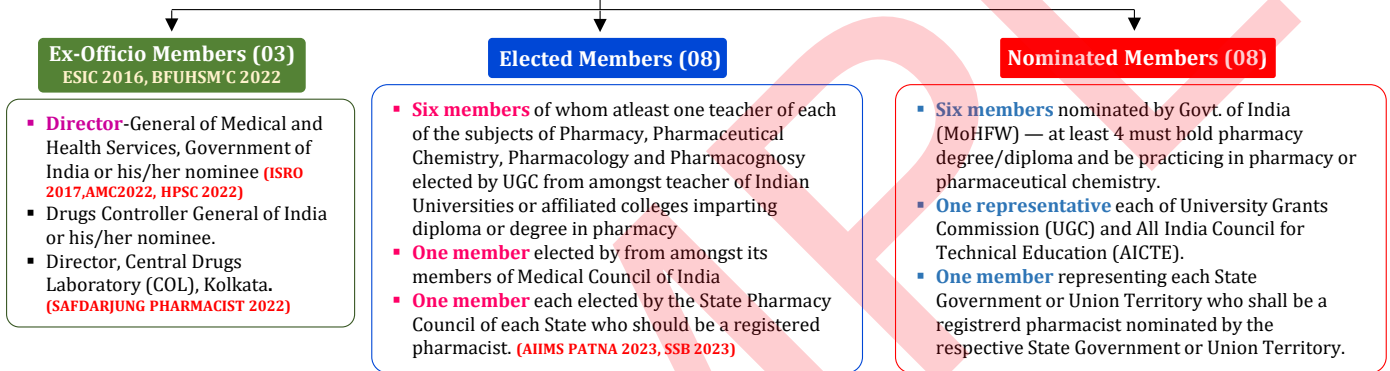
**Note** - The type of fermentation mainly used in the production of vitamins and antibiotics is **Type-III** (likely referring to a specific classification system where fed-batch or continuous processes are categorized as such). [DSSSB 2025 S3]

ACT	Point	Details
THE PHARMACY ACT, 1948	Purpose	"An Act to regulate the profession of pharmacy." (DGHS 2023)
	Extent	Applies to <b>whole of India</b> (except J&K at enactment).
	Authority	Enacted by <b>Ministry of Health &amp; Family Welfare, Govt. of India.</b>
	Structure	<b>5 Chapters</b> with <b>46 Sections.</b>
	Major Amendment	1950, 1976, 1981

**PHARMACY COUNCIL OF INDIA**

- On 9<sup>th</sup> March, 1949, the Pharmacy Council of India (PCI) was constituted to fulfil the objectives of the Pharmacy Act, 1948 (KPSC 2019, 2020)(ESIC 2014, ISRO 2017, MPESB 2023 )
- The composition of Central Council of PCI consists every 5 years by central govt. (RRB 2025 S2, SECL 2013)

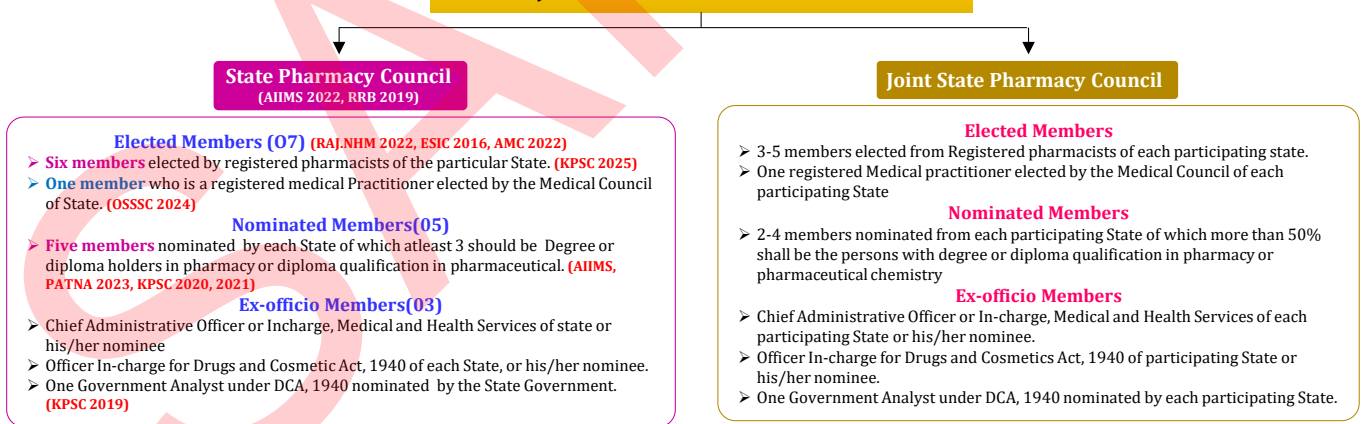
**PHARMACY COUNCIL OF INDIA**



**STATE PHARMACY COUNCIL (SPC)**

- The term of State Pharmacy Council is for 5 year.
- The Council elects President and Vice-president of State Pharmacy Council who hold office for 5 years, provided he/she continues as a member of Council.

**DIFFERENCE B/W STATE PHARMACY COUNCIL AND JOINT STATE PHARMACY COUNCIL**



**OFFENCES AND PENALTIES**

S. No.	Offenses	Penalties	
		1st Conviction	2nd Conviction
1.	Falsely claiming to be registered pharmacist	Rs. 500/-	Rs. 1000/ 6 month
2.	Dispensing by unregistered person	Rs. 1000/ 6 month	-
3.	Failing surrender certificate of registration	Rs. 500/	-
4.	For obstructing state pharmacy council inspector	Rs. 50/	-

➤ **Renewal**

- Valid up to **31 December** each year.
- Renewable annually with prescribed fee.

➤ **Offences and Penalties**

S. No	Offences	Penalties
1.	Falsely claiming to be registered pharmacist	1st Conviction - Rs. 500/- 2nd Conviction - Rs. 1000/ 6 month
2.	Dispensing by unregistered person`	Rs. 1000/ 6 month <b>(CG Vyapam 2016)</b>
3.	Failing surrender certificate of registration	Rs. 500/
4.	For obstructing state pharmacy council inspector	Rs. 50/

**Exam Punch**

- A person is eligible for pharmacy registration if she or he **has a degree or diploma in pharmacy from an Indian University or a State Government (RRB 2025 S2)**
- **Central Council** has the power to carry out withdrawal of approval for any institution. **(DSSSB 2025 S2)**
- **First Register** - Prepared by **Registration Tribunal (3 persons + registrar)**
- **Registered Pharmacist** is authorized to compound, prepare, mix or dispense any medicine on the prescription of medical practitioner. **(SECL 2013)**

## THE DRUGS AND COSMETICS ACT

**INTRODUCTION**

- Drugs and Cosmetics Act was passed on 10th April 1940 & Rule in 1945 by the Indian Legislature. **(ESIC 2016, CGHS 2018, BFHHS 2018 )**
- This Act was amended in 1955 by the Indian Parliament and Subsequently amended in 1960 1962, 1964, **(CG VYAPAM 2016, DHS ASSAM 2021)** 1972, 1982**(HPSSB 2020)**, 1986, 1995, 2000, 2008, 2011, 2016 **( KPSC 2021)** and 2018.
- It is divided into 5 chapters.
- To regulate the import, manufacture, distribution and sales of drugs. **(CG Vyapam 2016, KPSC 2025)**

Chapter	Title / Contents
<b>Chapter I</b>	Introductory
<b>Chapter II</b>	Drugs Technical Advisory Board (DTAB), Central Drugs Laboratory (CDL), and Drugs Consultative Committee
<b>Chapter III</b>	Import of Drugs and Cosmetics <b>(RRB 2019, AIIMS RAIPUR 2023)</b>
<b>Chapter IV</b>	Manufacture, Sale and Distribution of Drugs and Cosmetics
<b>Chapter IV(A)</b>	Provisions relating to Ayurvedic, Siddha, and Unani Drugs <b>(ESIC 2019, RAJ.NHM 2025)</b>
<b>Chapter V</b>	Miscellaneous

- There are 2 Schedules to the Act and 35 Schedules to the Rules framed under the Act.

□ **IMPORTANT DEFINITIONS**

- **Drug [Section 3 (b)]**
- All medicines (internal/external) and substances used for **diagnosis, treatment, mitigation, or prevention** of diseases in humans/ animals, including **preparations for repelling insects (e.g., mosquito repellents)**.
- **Drug store** - Licenses who employ the service of registered pharmacist and maintain a pharmacy for compounding against prescription. **(NCA 2015, KPSC 2015)**
- **Chemist and druggist means**, premises for sale of drug which have **qualified person but drugs are not compounded**. **(RRB 2015, KPSC 2021)**

**Example**

- |                         |  |
|-------------------------|--|
| ➤ Empty Gelatin Capsule | ➤ Bandages                                 |
| ➤ Water of injection    | ➤ Distilled water                          |
| ➤ I.V. Solution         | ➤ Gudakhu                                  |
| ➤ Sanitary pad          | ➤ Blood when used for treatment of disease |
| ➤ Boroline              | ➤ Mosquito repellent                       |
| ➤ Absorbent cotton wool |  |

Drugs and Cosmetics Act Rules are divided 18 parts. **(KPSC 2022)**

Schedule	Applied to	Trick to Learn
<b>A</b>	Performa for application for licenses, issue & renewal, sending memoranda under the Act <b>(Raj. NHM 20211, 2014, DSSSB 2021)</b>	A = Application
<b>B</b>	Rates of fee for test/analysis by Central or State Drug Labs <b>(Raj. NHM 2014)</b>	B = Bill (fees)
<b>B1</b>	Fee for test/analysis by Pharmacopeial Lab for Indian Medicine / Govt Analyst	B1 = Bill No.1 (special fees)
<b>C</b>	List of biological & special products (import, sale, distribution, manufacture under special provision) <b>(Raj. NHM 2011, MP Pharmacist 2020 P1)</b>	C = Cell products
<b>C1</b>	List of other special products under special provision <b>(MPESB 2017, BRKM 2018, MP Pharmacist 2020 P1)</b>	C1 = Cell +1 (others)
<b>D</b>	Drugs exempted from provisions for import <b>(SECL 2013, HPSSC 2020)</b>	D = Door open (Exempt)
<b>E</b>	List of poisonous substances (Ayurvedic, Siddha, Unani)	E = Evil = Poison
<b>E<sub>1</sub></b>	Poisonous drugs <b>(OSSSC 2021, 2023, ESIC 2019)</b>	
<b>F</b>	Requirements for blood bank & blood component preparation <b>(ESIC 2016, KPSC 2017)</b>	F = Fluid (blood)
<b>F1</b>	Part I – Vaccines; Part II – Sera; Part III – Diagnostic agents (bacterial origin) <b>(MPPGCL 2025)</b>	F <sub>1</sub> = First defense (vaccine/sera)
<b>F2</b>	Standards for surgical dressings <b>(HSSC 2017, ESIC 2019)</b>	F2 = First Aid (dressings)
<b>F3</b>	Standards for sterilized umbilical tapes <b>(DSSSB 2019)</b>	F3 = Fresh cord tape
<b>FF</b>	Standards for ophthalmic preparations ( SECL 2013, Raj.NHM 2012, ISRO 2017, KPSC 2015,2025, RRB 2015)	FF = Focused on eyes
<b>G</b>	List of substances to be used only under medical supervision (labelled accordingly) <b>(Raj. NHM 2012 P2, MH Pharmacist 2012, KPSC 2015)</b>	G = Guidance needed
<b>H</b>	List of prescription drugs <b>(DSSSB 2019, NCL 2020)</b> (SECL 2013, Raj. NHM 2012 P3, NCA 2015, KPSC 2015, ESIC 2016, MPESB 2017, BfUHS 2018, HPSSC 2020, CGHS Bangalore 2019, DHS MH 2021, MPESB 2022, BfUHS CM 2022, OSSSC 2021, 2023)	H = Handwritten Rx
<b>J</b>	List of diseases a drug may not claim to prevent/cure <b>(KPSC 2015, HPSSC 2016, KPSC 2025, NFL 2025 SET B)</b>	J = Jail claims
<b>K</b>	Drugs exempted from certain manufacturing provisions	K = Kind exemption
<b>L</b>	Good Laboratory Practice (GLP) & premises/equipment requirements <b>(KPSC 2021 P1)</b>	L = Lab rules
<b>M</b>	GMP for factory premises, plant & equipment (drugs) <b>(ESIC 2016, HPSSB 2020, AIIMS 2012, ESIC 2016, BfUHS 2018, RRB 2019, P1, P2)</b>	M = Manufacture GMP
<b>M1</b>	Requirements for homeopathic manufacture <b>(KPSC 2015, 2021 P2)</b>	M1 = Mother tincture
<b>M2</b>	Requirements for cosmetics manufacture <b>(AMC 2022)</b>	M2 = Mirror (cosmetics)
<b>M3</b>	Requirements for medical devices manufacture	M3 = Machine (devices)
<b>N</b>	Minimum equipment for efficient pharmacy running <b>(DSSSB 2019, HPSSC 2022, NFL 2025 SET B, KPSC 2020, DSSSB 2025 S2)</b>	N = Necessary items
<b>O</b>	Standards for disinfectant fluids <b>(ESIC 2011, Safdarjung Pharmacist 2012, DSSSB 2012, Raj. NHM 2012 P3, APCSCR 2015, ESIC 2016, ISRO 2017, DSSSB 2019 P2)</b>	O = Odor kill (disinfect)
<b>P</b>	Life period of drugs <b>(Raj. NHM 2012, ISRO 2017, CGHS BAN. 2019, MPPH 2020DHS MH 2021, MPESB 2022, KPSC 2022, ISRO 2024)</b>	P = Period (shelf life)
<b>P1</b>	Pack sizes of drugs <b>(HSSC 2012, MHSRB 2024)</b>	P1 = Packet size
<b>Q</b>	Approved colours, dyes & pigments in cosmetics <b>(RRB 2019 P1, P2)</b>	Q = Queen's makeup (colors)
<b>R</b>	Standards for condoms & contraceptives <b>(ESIC 2014, KPSC 2015 P2)</b>	R = Reproductive safety
<b>R1</b>	Standards for medical devices	R1 = Replacement (devices)
<b>S</b>	Standards for cosmetics <b>(SECL 2013, HPSSC 2016, ESIC 2019, ISRO 2021, KPSC 2021 P1)</b>	S = Skin (cosmetics)

## INVESTIGATION NEW DRUG APPLICATION

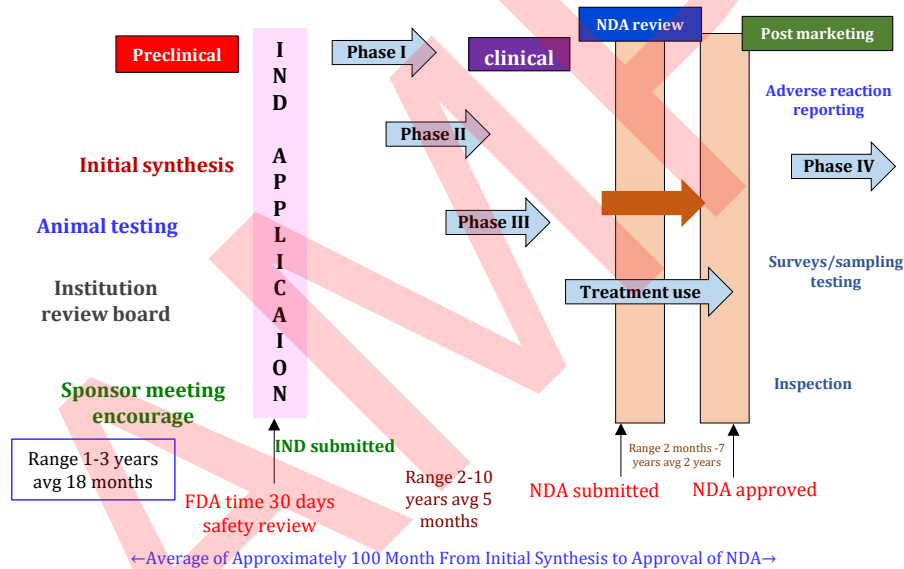
### INTRODUCTION

- In the US, the **Food, Drug, and Cosmetic Act** (Title 21 CFR) requires **FDA approval** before a new drug enters the market.
- In India, new drugs are regulated under the **Drugs & Cosmetics Act, 1940 and Rules, 1945 (Schedule Y)**.
- An **IND application (INDA)** is submitted to the FDA to request permission for **clinical trials** of a new drug.
- FDA approval of a **marketing application** is mandatory before interstate drug distribution.
- The **IND provides the FDA** with data to assess the safety of the drug and proposed clinical studies.

### OBJECTIVES

- To focus **FDA's attention during** early phase of clinical research on assuring the safety of human test subjects
- To provide sponsors with a greater measure of flexibility in conducting Phase I trial.
- To facilitate consultation between FDA and sponsors, especially after there is an indication that the new drug is safe and efficacious in humans.

### NEW DRUG DEVELOPMENT PROCESS



### TYPES OF INDA

Type of IND	Key Point / Purpose
<b>Investigator IND</b>	Submitted by a physician who initiates & conducts the study; drug given under their direct supervision
<b>Commercial IND</b>	Submitted by companies aiming for <b>marketing approval</b>
<b>Emergency Use IND</b>	FDA authorizes use of an experimental drug in <b>emergency situations</b>
<b>Treatment IND</b>	For use of <b>experimental drugs</b> in patients (before full approval)

### CODE OF FEDERAL REGULATIONS (CFR)

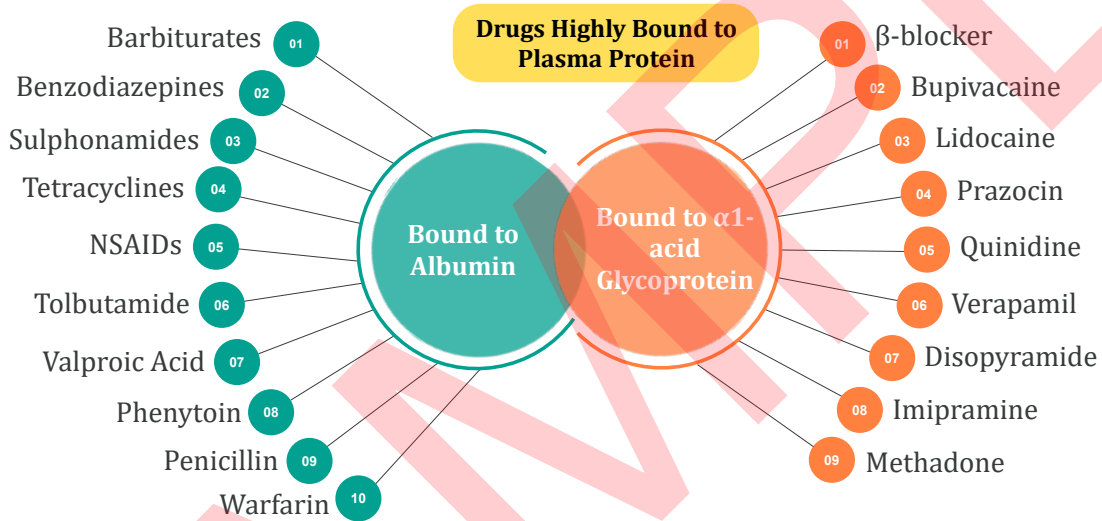
- The final regulations published in the Federal Register (daily published record of proposed rules, final rules, meeting notices, etc.) are **collected in the CFR**.
- The CFR is divided into 50 titles that represent broad areas subject to Federal regulations.
- The FDA's portion of the CFR interprets the **The Federal Food, Drug, and Cosmetic Act** and related statutes. Section 21 of the CFR contains most regulations pertaining to food and drugs.

CODE OF FEDERAL REGULATIONS (CFR)	
<b>21CFR PART 312</b>	Investigational new drug application
<b>21CFR PART 314</b>	INDA and NDA for FDA approval to market a new drug

L → Lignocaine	A → Amitriptyline
V → Verapamil	P → Propoxyphene
P → Propranolol (ESIC 2016)	P → Pethidine
S → Salbutamol	M → Methyl testosterone (KPSC 2015), Morphine
N → Nitroglycerine	H → Hydrocortisone

**DISTRIBUTION**

- Distribution is defined as the **reversible transfer** of drugs between body fluid compartments after **absorption a drug enters the systemic circulation** and is distribute in the body fluids. (DSSSB 2019)
- Apparent volume of distribution
- $$V_d = \frac{\text{Total amount of drug in the body}}{\text{Concentration of the drug in plasma}}$$
- Drugs which accumulate in tissues have a volume of **distribution** which exceeds total body water. E.g., chloroquine is the drug with highest Vd (1300 L/Kg) and digoxin (500 L).
- Acidic Drugs binds to plasma Albumin
- Basic drugs binds to alpha -1 **acid glycoprotein**



**METABOLISM OF DRUGS (BIOTRANSFORMATION / DETOXIFICATION)**

- Chemical alteration of the drug in a living organism is called biotransformation. (BRKM 2018)
- The metabolism of a drug usually converts lipid soluble and unionized compounds into water soluble and ionized compounds. (BTSC 2025)
- **Sites:** - liver is the main site of drug metabolism other sites are GI tract, kidney, lungs, blood, skin and placenta. (DSSSB 2019, BRKM 2018)
- Process of physicochemical and biochemical alteration of a drug in the body. (MH Pore 2021)

Active Drug	Active Metabolite
Amitriptyline	Nortriptyline
Codeine	Morphine
Diazepam	Oxazepam
Digitoxin	Digoxin
Imipramine	Desipramine (ESIC 2019, VMC 2021)
Phenacetin	Paracetamol
Primidone	Phenobarbitone
Spirolactone	Canrenone
Allopurinol	Alloxanthine
Morphine	Morphine-6-glucuronide

Inactive Drug (Prodrug)	Active Form
Proguanil	Cycloguanil
Levodopa (HCA 2015, KPSC 2015)	Dopamine
Enalapril (MRBTM 2023, KSSSCI 2024, HPSSC 2016)	Enalaprilat
Dipivefrine	Epinephrine
Sulindac	Sulfide metabolite
Prednisone	Prednisolone
Bacampicillin	Ampicillin
Sulfasalazine (NFL 2025)	5-Amino salicylic acid
Acyclovir (KPSC 2017)	Acyclovir triphosphate
Cyclophosphamide	Aldophosphamide, Acrolein

**Prodrugs**

- It is an inactive form of a drug which is converted to an active form after metabolism. (RRB 2015, CGHS Bangalore 2019)

**Nicotinic receptor (N)**

- They are rosette-like pentameric structures which enclose a ligand gated cation channel
- On the basis of location and selective agonists and antagonists two subtypes NM and NN

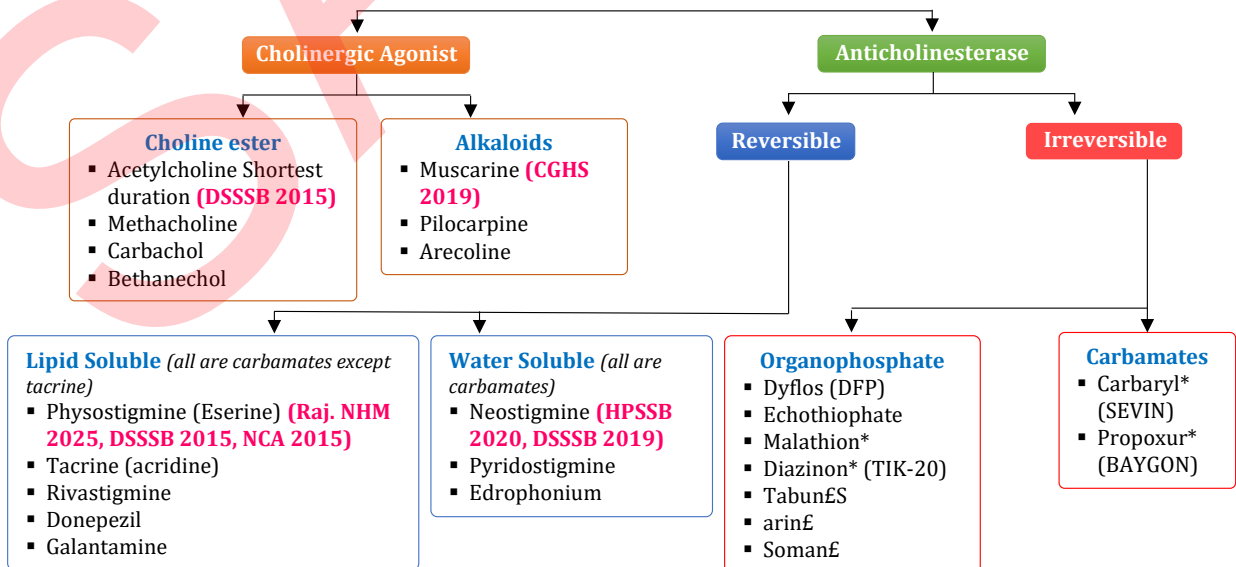
	NM	NM
<b>Location and specific function</b>	<b>Neuromuscular junction:</b> depolarization of muscle end plate (contraction of skeletal muscle) (KPSC 2017)	Autonomic ganglia: depolarization (postganglionic impulse) Adrenal medulla: catecholamine release <b>CNS:</b> site specific excitation or inhibition
<b>Nature</b>	intrinsic ion channel (ligand gated cation channel) (ESIC 2019)	intrinsic ion channel (ligand gated cation channel)
<b>Transducer mechanism</b>	Opening of cation (Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>2+</sup> ) channels	Opening of cation (Na <sup>+</sup> , K <sup>+</sup> ) channels
<b>Agonists</b>	Dimethyl phenyl piperidinium (DMPP), Nicotine	Phenyl trimethyl ammonium (PTMA), Nicotine
<b>Antagonists</b>	Hexamethonium, Trimethophan	Tubocurarine, (HPSSC 2020, ESIC 2016) Bungarotoxin

**Muscarinic receptor (M) (ISRO 2017, KPSC 2019)**

- These receptors are selectively stimulated by muscarine and blocked by atropine.
- Muscarinic receptors have been divided into 5 subtypes M<sub>1</sub>, M<sub>2</sub>, M<sub>3</sub>, M<sub>4</sub> and M<sub>5</sub>.
- The M<sub>4</sub> and M<sub>5</sub> receptors are present mainly on nerve endings in certain areas of the brain and regulate the release of other neurotransmitters.

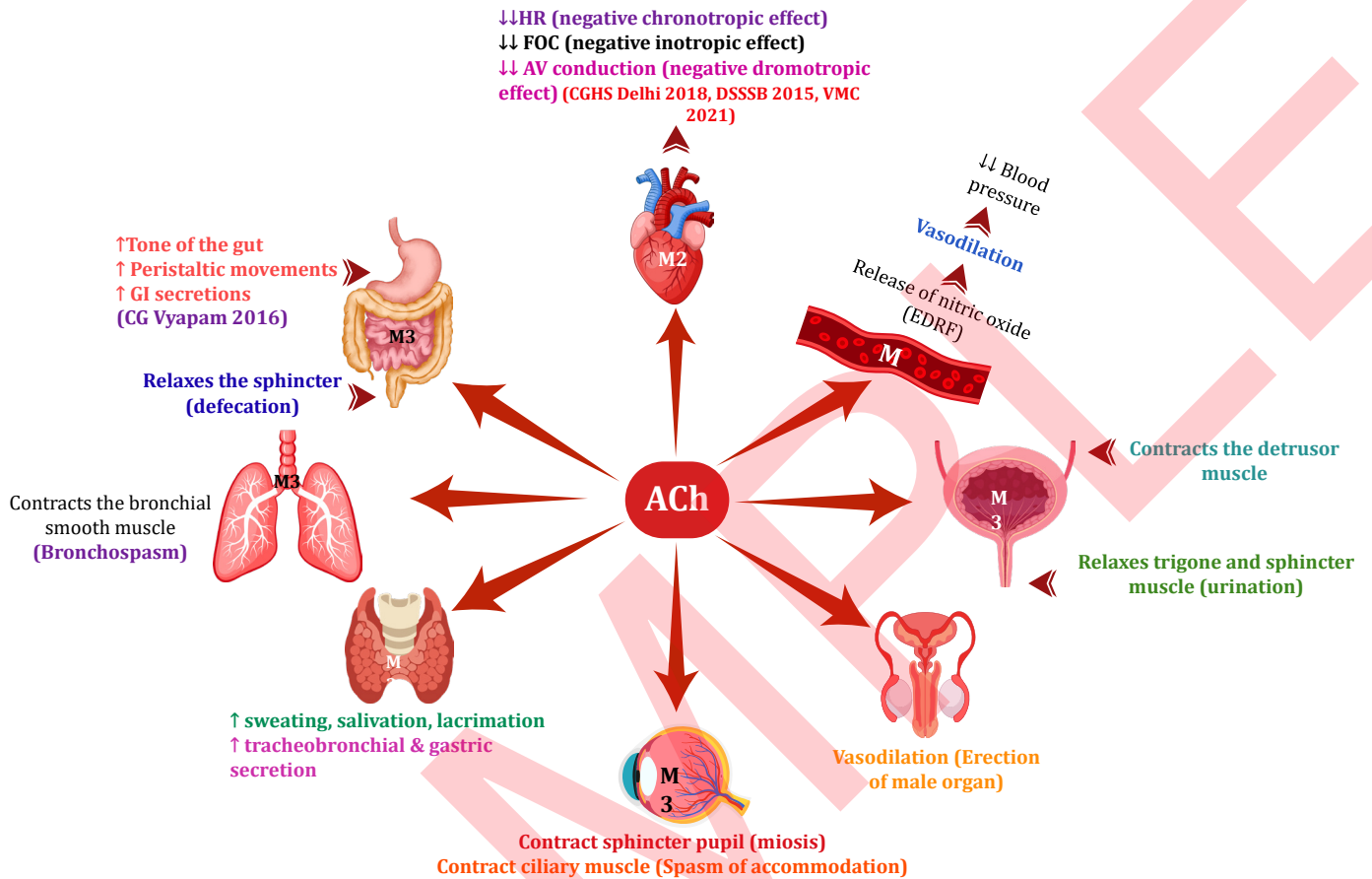
CHARACTERISTIC	M1	M2	M3
<b>LOCATION AND FUNCTION</b>	<b>Autonomic ganglia:</b> Depolarization <b>Gastric Gland:</b> Histamine release, Acid Secretion <b>CNS:</b> Learning, Memory, Motor activity.	<b>SA node:</b> Hyperpolarization, ↓se the rate of impulse generation. (Raj. NHM 2012) <b>AV node:</b> ↓se velocity of conduction <b>Atrium:</b> shortening of APD, ↓se contractility. <b>Ventricle:</b> ↓se the contractibility nerve Cholinergic <b>endings:</b> ↓se ACh release <b>CNS:</b> Tremor, analgesia, Visceral <b>smooth muscle:</b> Contraction	Visceral smooth muscle: Contraction <b>Iris:</b> contraction of pupil <b>Ciliary muscle:</b> Contraction Exocrine <b>gland:</b> secretion Vascular <b>endothelium:</b> release of NO cause → vasodilation
<b>NATURE</b>	<b>Gq - Protein coupled</b>	<b>Gq/Go-protein coupled</b>	<b>Gq -protein coupled</b>
<b>TRANSDUCER</b>	<b>IP3/DAG—</b> ↑se cytosolic Ca <sup>2+</sup> , <b>PLA2</b> ↑ses —PG synthesis.	<b>K<sup>+</sup> channel opening:</b> ↓se cAMP	<b>IP3/DAG—</b> ↑se cytosolic Ca <sup>2+</sup> , <b>PLA2</b> ↑ses —PG synthesis.
<b>AGONIST</b>	Oxotremorine	Methacholine	Bethanechol
<b>ANTAGONIST</b>	Pirenzepine, Talenzepine	Methoctramine, Tripitramine	Solifenacin, Dariferacin

**CHOLINERGIC AGENTS (Raj. NHM 2012)**



### Pharmacological Actions of Acetylcholine

Ach produces muscarinic and nicotinic effect by interacting with respective receptors on the effector cells.



### [B] Nicotinic actions

Organs/ Part of body	Pharmacological actions
<b>Autonomic ganglia</b>	Both sympathetic and parasympathetic ganglia are stimulated by Ach by the stimulation of NN receptor
<b>Skeletal muscles</b>	Iontophoretic application of ACh to muscle endplate causes contraction of the skeletal muscle fibre by the stimulation of NM receptor. <b>(CGHS HYD. 2018)</b>
<b>CNS</b>	ACh injected i.v. does not penetrate blood-brain barrier and no central effects are seen.

### □ DIRECTLY ACTING PARASYMPATHOMIMETIC DRUGS

Drugs	Description
<b>Pilocarpine</b>	<ul style="list-style-type: none"> <li>It is obtained from the leaves of Pilocarpus microphyllus. A Cholinomimetics Alkaloid . <b>(Safdarjung Pharmacist 2012)</b></li> <li>It is a ternary amine</li> <li>Produces both muscarinic and nicotinic effect.</li> <li>Pilocarpine is used only in the eye as 0.5- 4% drops.</li> </ul>
<b>Muscarine</b>	<ul style="list-style-type: none"> <li>It occurs in poisonous mushrooms Amanita muscaria and Inocybe species and has only muscarinic actions.</li> <li>Antidote - atropine</li> </ul>
<b>Arecoline</b>	<ul style="list-style-type: none"> <li>It is found in betel nut Areca catechu and has muscarinic as well as nicotinic actions.</li> </ul>
<b>Bethanechol</b>	<ul style="list-style-type: none"> <li>It has been used in postoperative/ postpartum nonobstructive urinary retention.</li> </ul>
<b>Methacholine</b>	<ul style="list-style-type: none"> <li>Maximum action on myocardium</li> </ul>

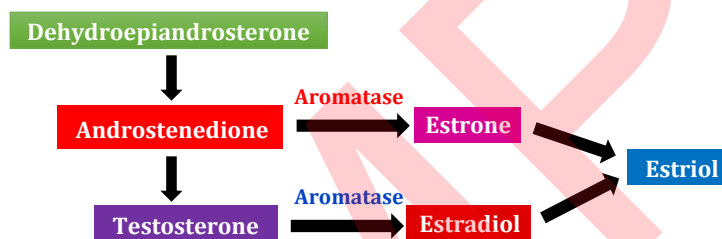
<b>Aromatase inhibitors</b>	Letrozole, Anastrozole, Exemestane
<b>Antiestrogen</b>	Clomiphene citrate
<b>Aromatase Inhibitors</b>	<b>1st generation</b> - Aminoglutethimide <b>2nd generation</b> - Formestane, Fadrozole, Rogletimide <b>3rd generation</b> - Exemestane, Anastrozole, Letrozole, Vorozole

□ **COMPARISON BETWEEN DIFFERENT ESTROGENS**

ESTROGEN	ESTRONE	ESTRADIOL	ESTRIOL
Known as	E1	E2	E3
Potency	Intermediate	Maximum	Minimum
Main estrogen in	Menopause	Reproductive age group	Pregnancy
Major site of production	Fat cells	Ovaries	Liver

**Natural Estrogens**

- **Estradiol** is the major estrogen secreted by the ovary.
- It is synthesized in the **graafian follicle, corpus luteum and placenta from cholesterol**.



- Estradiol is **rapidly oxidized in liver** to estrone which is **hydroxylated to form estriol**.
- All three are **active and circulate in blood**, but **estradiol is the most potent estrogen**.

**Synthetic Estrogens**

- Natural estrogens are inactive orally and have a short duration of action due to rapid metabolism in liver.
- To overcome this, synthetic compounds have been produced:
  - ♦ **Steroidal** → Ethinylestradiol, Mestranol, Tibolone.
  - ♦ **Nonsteroidal** → Diethylstilbestrol (stilbestrol) Hexestrol, Dienestrol

□ **Effect of Female Sex Hormone**

PARAMETER	ESTROGEN
<b>Menstrual cycle</b>	Proliferatory endometrium
<b>Lipid profile</b>	Decrease LDL, Increase HDL, Increase TG,
<b>Glucose tolerance</b>	Impair
<b>Fluid balance</b>	Retain Na* and water retention
<b>Thromboembolism</b>	Increase Antithrombin
<b>Risk of breast cancer</b>	Increase
<b>Risk of Endometrial cancer</b>	Increase
<b>Bone</b>	Decrease resorption
<b>Bile lithogenicity</b>	Increase

**Adverse Effects and Interactions**

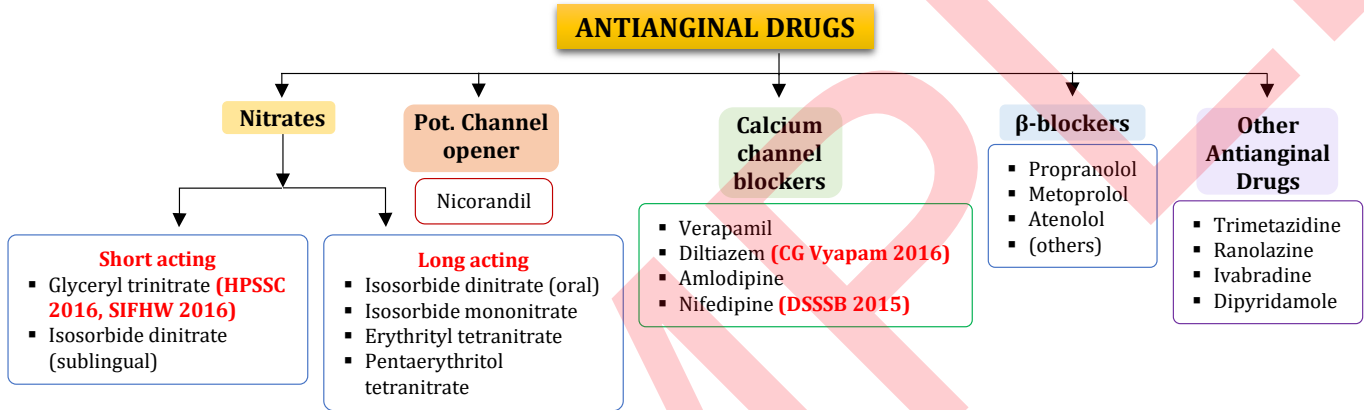
- Suppression of libido, gynecomastia and feminization in male.
- Fusion of epiphyses and reduction of adult stature in children.
- In postmenopausal woman, estrogen can increase of irregular bleeding and endometrial carcinoma
- Breast cancer.
- Migraine, epilepsy and endometriosis may be worsened by estrogen.
- Contraindicated in pregnancy

## ANTI-ANGINAL AND ANTI-ISCHEMIC DRUGS

□ TYPES OF ANGINAS

Classical angina /stable angina	Variant/prinzmetal/ vasospastic angina	Unstable angina
Provoked by exercise, emotion, eating or coitus	occurs at rest during sleep and are unpredictable (due to vasospasm)	mostly due to the rupture of an arteromatous plaque attracting platelet disposition & progressive occlusion of the coronary artery

□ CLASSIFICATION OF ANTI-ANGINALS

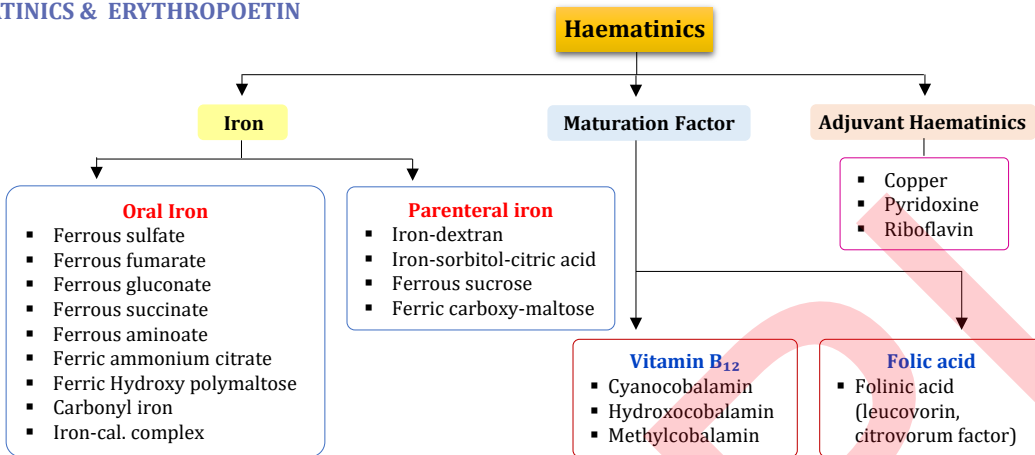


□ MECHANISM OF ACTION OF ANTI-ANGINALS

Class	Mechanism of action
<b>Nitrates</b>	<p style="text-align: center;"> </p>
<b>β - blockers</b>	<p style="text-align: center;"> </p>
<b>Calcium channel blockers</b>	<p style="text-align: center;"> </p>
<b>Potassium channel opener</b>	<p style="text-align: center;"> </p>

## HAEMATINICS AND ERYTHROPOETIN

### HAEMATINICS & ERYTHROPOETIN



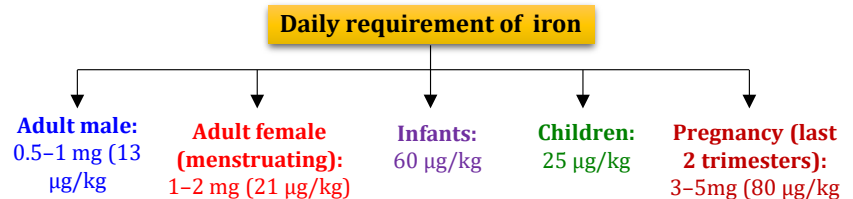
### IRON

- Storage form of Iron in the human body – **Ferritin**. (CCF 2014, ISRO 2021)
- Adverse effect - **constipation** (DSSSB 2015)
- **Ascorbic acid** increases absorption of Iron from intestine. (DSSSB 2015)

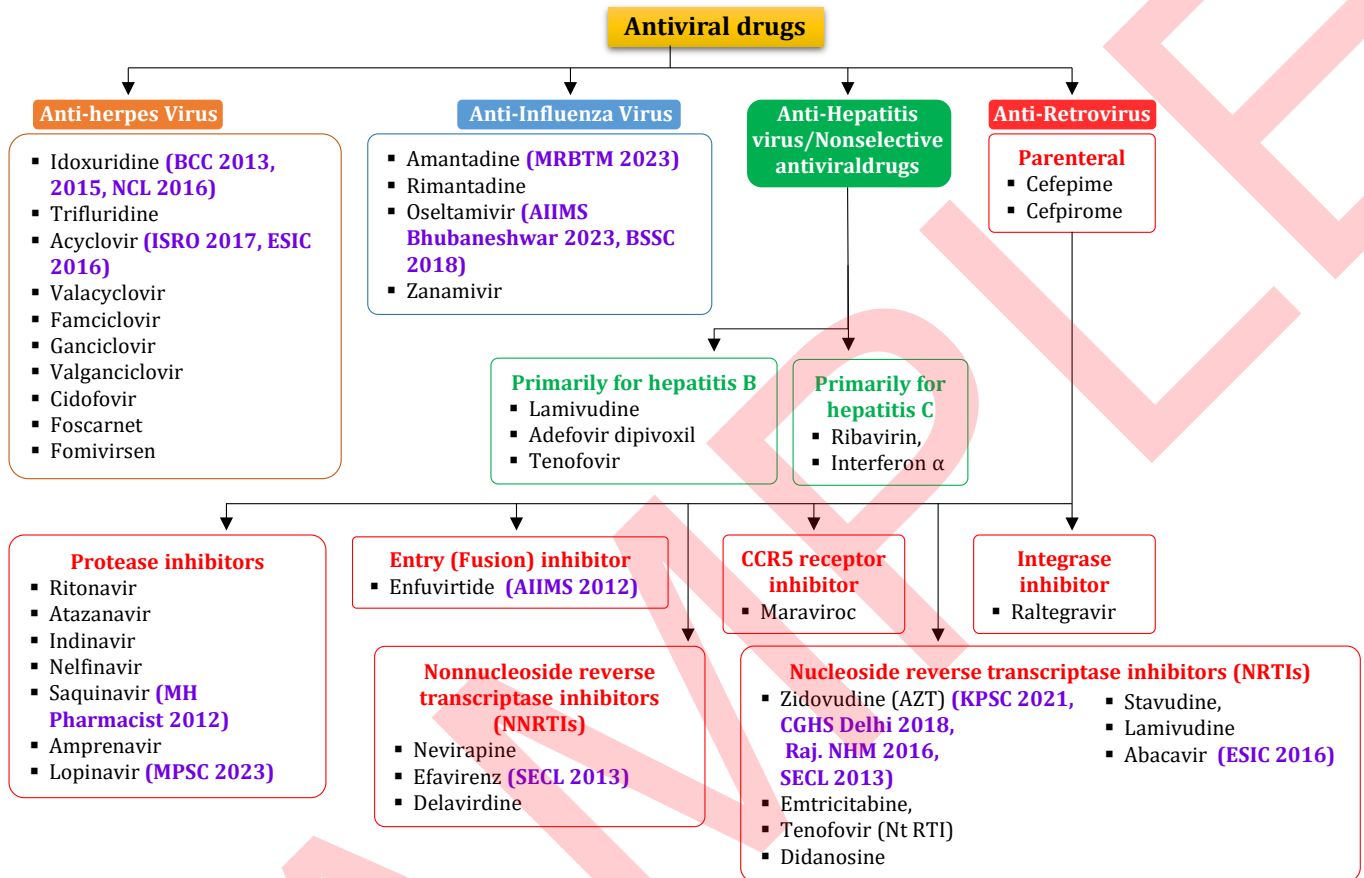
<b>Iron</b>	<ul style="list-style-type: none"> <li>• Iron is absorbed mostly in the duodenum in the ferrous form (Fe<sup>2+</sup>).</li> <li>• Oral preparations include ferrous sulphate, gluconate, succinate etc. Ferrous sulphate contains 20% elemental iron.</li> <li>• In pregnancy, iron should be started in the second trimester.</li> <li>• Parenteral iron preparations are iron-dextran and iron-sorbitol- citrate.</li> <li>• The antidote of acute iron poisoning is Desferrioxamine.</li> </ul>
<b>Folic acid</b>	<ul style="list-style-type: none"> <li>• Maximum absorption occurs in jejunum.</li> <li>• It is reduced to first dihydrofolic acid (DHFA) and then to tetrahydrofolic acid (THFA), which is methylated to form methyl tetrahydrofolate.</li> <li>• Deficiency of folic acid results in megaloblastic anemia that is indistinguishable from that due to vitamin B<sub>12</sub> deficiency.</li> </ul>
<b>Vitamin B12 (Cyanocobalamin)</b>	<ul style="list-style-type: none"> <li>• Active forms of this vitamin are deoxyadenosyl-cobalamin and methyl-cobalamin.</li> <li>• Deficiency of vitamin B12 leads to megaloblastic anemia which is indistinguishable from folic acid deficiency. (SSB 2023)</li> </ul>
<b>Hematopoietic Growth Factors</b>	<ul style="list-style-type: none"> <li>• Growth factor for RBCs is erythropoietin, for WBCs.</li> <li>• Erythropoietin is secreted from kidney and helps in the formation of red blood cells.</li> </ul>

### □ CAUSES OF MEGALOBLASTIC ANAEMIA

Prime	Phenytoin, Primidone
<b>B</b>	B12 and Folic acid deficiency
<b>A</b>	Alcohol
<b>T</b>	Trimethoprim
<b>S</b>	Sulfasalazine
<b>M</b>	Metformin
<b>A</b>	Antifolates (Methotrexate, Pyrimethamine, Proguanil)
<b>N</b>	N2O

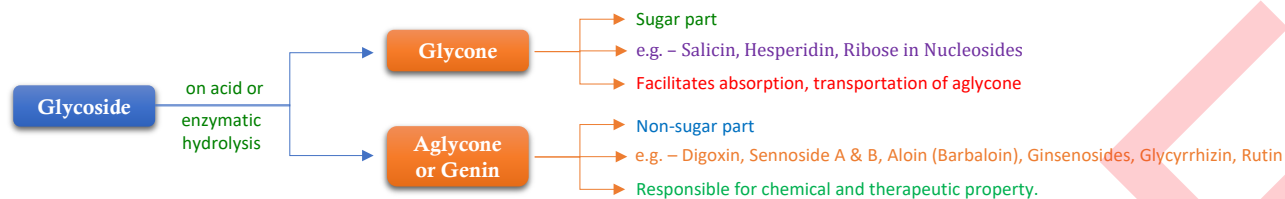


## ANTIVIRAL DRUGS

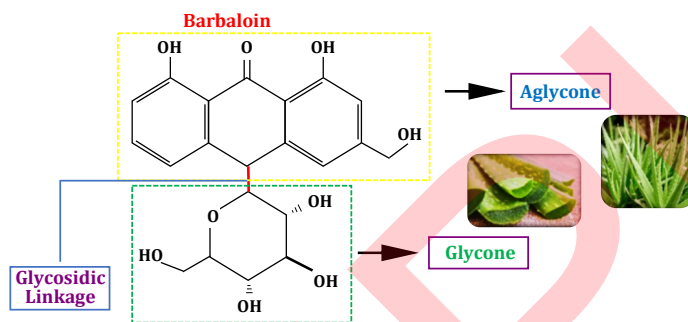


### ANTI-VIRAL DRUGS AND THEIR MECHANISM OF ACTION & SIDE EFFECTS

Drug	Mechanism of action	Side effects
<b>Amantadine &amp; Rimantadine</b> (ESIC 2016, BFUHS 2018)	↓ Attachment - uncoating & release of new viruses (BTSC 2015)	GIT disturbances C.V.S: ankle oedema CNS: Insomnia, Dizziness, Hallucination
<b>Acyclovir</b>	Inhibits herpes virus DNA polymerase competitively and stop lengthening of DNA strand (DSSSB 2015, ESIC 2016)	GIT disturbances Renal dysfunction Local irritation
<b>Idoxuridine</b>	Thymidine analogue in the presence of host cell kinase forms idoxuridine triphosphate → compete with thymidine and get incorporated in DNA → faulty DNA is formed, that breaks easily → this directs the synthesis of wrong viral protein	Highly toxic
<b>Zidovudine, Zalcitabin, Abacavir, Lamivudine, Stavudine, Zidovudine, Didanosine</b>	Zidovudine in the presence of host cell kinase forms zidovudine triphosphate → inhibits the RNA dependent DNA polymerase (reverse transcriptase) (MHSRB 2024, KPSC 2017)	Bone marrow depression Headache
<b>Ritonavir, Atazanavir, Indinavir, Nelfinavir, Saquinavir, Amprenavir, Lopinavir</b>	Inhibits HIV protease enzyme which is essential for conversion of translated inert proteins into functional & structural proteins	G.I.T disturbances Thrombocytopenia Hyperbilirubinemia Nephrolithiasis with Indinavir
<b>Ribavirin (Tribavirin)</b>	Inhibits viral GTP and viral RNA synthesis	Hepatotoxic Anemia Teratogenic
<b>Vidarabine</b>	Adenosine derivative selectively inhibits DNA Polymerase enzyme	-



- Glycosides are generally crystalline or amorphous substances, soluble in water and dilute alcohol, but insoluble in non-polar organic solvents like chloroform or ether. They are optically active, typically exhibiting **laevo-rotatory** effects



### CLASSIFICATION OF GLYCOSIDES

#### Classification Based on Glycosidic Linkage

Type of Linkage	Description	Examples
<b>O-glycosides</b>	The sugar moiety is linked to the aglycone through an oxygen atom (-O-), typically from a hydroxyl (alcoholic or phenolic) group.	<b>Sennosides</b> from Senna, <b>Barbaloin</b> , most cardiac glycosides.
<b>C-glycosides (KPSC 2015 P2)</b>	The sugar moiety is directly attached to a carbon atom of the aglycone. These are resistant to acid hydrolysis.	<b>Aloin (KPSC 2025)</b> and <b>Cascarosides</b> from Aloe and Cascara. . ( <b>Safdarjung Pharmacist 2012</b> )
<b>S-glycosides</b>	The sugar moiety is linked to a sulfur atom (-S-) of the aglycone.	<b>Sinigrin</b> from Black mustard. . ( <b>APCSCR 2015</b> )
<b>N-glycosides</b>	The sugar moiety is linked to a nitrogen atom (-N-) of an amino group in the aglycone.	<b>Nucleosides</b> (e.g., Adenosine).

#### Classification Based on Aglycone

Class of Glycoside	Aglycone Nature	Examples	Trick
<b>Anthraquinone Glycosides</b>	Anthracene derivatives	Senna, Aloe, Rhubarb, ( <b>OSSSC 2024</b> ) Cascara	<b>"SAR Cast"</b> – SAR = Senna, Aloe, Rhubarb, <b>Cast</b> = Cascara
<b>Steroidal or Cardiac Glycosides</b>	Steroidal nucleus (cyclopentanoperhydrophenanthrene)	Digitalis, ( <b>NFL 2025 Set-B</b> ), Strophanthus, Squill, Thevetia	<b>"Digi-Strong Squill TV"</b> – Digitalis, Strophanthus, Thevetia
<b>Saponin Glycosides</b>	Triterpenoid or Steroidal	Liquorice, Ginseng, Dioscorea, Shatavari, Senega	<b>"L-G DSS"</b> – Liquorice, Ginseng, Dioscorea, Shatavari, Senega
<b>Cyanogenetic Glycosides</b>	Mandelonitrile derivatives	Bitter almond, Wild cherry bark	<b>"Bitter Wild Cherry"</b> = direct association
<b>Isothiocyanate Glycosides</b>	Isothiocyanate derivatives	Black mustard	<b>"ISO = Mustard's kick"</b> – Isothiocyanate → pungent mustard
<b>Flavonoid Glycosides</b>	Flavone derivatives	Rutin, Ginkgo, Milk thistle	<b>"Routine GM"</b> – Rutin, Ginkgo, Milk thistle
<b>Coumarin &amp; Furanocoumarin Glycosides</b>	Coumarin or Furanocoumarin derivatives	Ammi, Psoralea, Visnaga	<b>"Ammi's Positive Vision"</b> – Ammi, Psoralea, Visnaga

## Pharmacognosy

<b>Ginseng (Panax)</b>		Dried root of Panax ginseng, (Family- Araliaceae)	Ginsenosides & panaxosides <b>(APCSCR 2015)</b> (triterpenoid saponins)	Adaptogen, tonic and stimulant
<b>Gokhru (Tribulus)</b>		Dried fruits Tribulus terrestris, (Family- Zygophyllaceae)	Steroidal saponins	Diuretic <b>(NCA 2015, KPSC 2018, MRBTN 2023)</b>
<b>Quillia (Soap bark)</b>		Dried inner bark of Quillia saponaria, (Family- Rosaceae)	Quillia saponoxin (triterpenoid saponin)	Reflex expectorant
<b>Safed musali</b>		Peeled tuberous roots of Chlorophytum borovillianum, (Family- Liliaceae)	Hicogenin	General tonic <b>(ITBP ASI 2023)</b>
<b>Senega</b>		Dried roots of Polygala senega, (Family- Polygalaceae)	Senegin, polygallic acid (triterpenoid saponin)	Stimulant expectorant
<b>Glycyrrhiza (Yasti, Mulethi) (HPSSC 2016, KPSC 2019, NFL 2025 Set-B)</b>		Dried roots and stolon of Glycyrrhiza glabra <b>(BFUHSMC 2022)</b> , (Family- Leguminosae)	Glycyrrhizin (triterpenoid saponin), 18-β-glycyrrhetic acid	Expectorant, treatment of peptic ulce
<b>Cyanogenetic or Cyanophoric Glycosides</b>				
<b>Bitter almond</b>		Dried ripe seeds of Prunus amygdalus <b>(ITBP ASI 2023)</b> , (Family- Rosaceae)	Amygdalin	Demulcent, sedative
<b>Wild cherry (Wild black cherry)</b>		Dried bark of Prunus serotina, (Family- Rosaceae)	Prunasin	Mild sedative, flavouring agent
<b>Isothiocyanate Glycosides</b>				
<b>Mustard seeds (Black mustard)</b>		Dried ripe seeds of Brassica nigra, (Family- Cruciferae)	Sinigrin <b>(Raj. NHM 2012, ITBP ASI 2023)</b>	Counter irritant <b>(ITBP ASI 2023)</b> , rubefacient externally and emetic internally
<b>Flavonoids</b>				
<b>Buck wheat</b>		Dried fruits of Fagopyrum esculentum, (Family- Polygonaceae)	Rutin (also from Ruta graveolens)	Treatment of capillary bleeding
<b>Ginkgo</b>		Dried leaves of Ginkgo biloba, (Family- Ginkgoaceae)	Ginkgolide A, B, C	Vascular disorders, allergy relief <b>(DSSSB 2021)</b>

□ Mechanisms of Cathartics / Purgatives

Type	Mechanism of Action	Examples
<b>Stimulants</b>	Act by local irritation of intestinal mucosa → stimulate peristalsis.	Senna, Rhubarb, Cascara, Podophyllum, Castor oil, Aloe, Bisacodyl, Phenolphthalein (KPSC 2017)
<b>Bulk Purgatives</b>	Contain non-digestible cellulose/fiber-like substances → swell in intestine → increase bulk → stimulate peristalsis.	Methylcellulose, Sodium CMC, Gum, Ispaghul (psyllium)
<b>Lubricants</b>	Soften intestinal contents by retaining water → facilitate smooth evacuation.	Liquid paraffin, Glycerin, Mineral oils
<b>Saline Cathartics/ Osmotic Purgative</b>	Increase osmotic load in intestine → absorb water → stimulate peristalsis. Poorly absorbable ions ( $\text{Ca}^{2+}$ , $\text{Mg}^{2+}$ , phosphate, sulfate, tartrate) act. (KPSC 2015)	Magnesium hydroxide (BPKMC 2014, MP Pharmacist 2020 P2), Magnesium sulfate (Epsom salt) (SHIFW 2016), Sodium sulfate, Sodium phosphate, Potassium bitartrate

Compounds	Synonyms	Formula	Uses
<b>Sodium potassium tartrate</b>	Rochelle's salt, seignette salt	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	Cathartic (ESIC 2016), Saline or osmotic purgative (Raj. NHM 2011, 2016 P1), Laxative (OSSSC 2021)
<b>Magnesium Sulphate</b>	Epsom salt (NCA 2015, BCCL 2013,2015, KPSC 2015, NCL 2016, RRB 2019 P2)	$\text{C}_4\text{H}_4\text{KNaO}_6 \cdot 4\text{H}_2\text{O}$	Saline purgative

**Exam Punch**

- **Milk of magnesia** is a preparation containing between 7 and 8.5% of **Magnesium hydroxide** (Raj. NHM 2012 P3, ESIC 2019)
- The drug used for treating hyperchlorhydria is **aluminum hydroxide**. (DSSSB 2025 S1)
- **Difference in particle size causes the difference in bulk density of light and heavy magnesium carbonate**. (BTSC 2025)
- Antidiarrheal agents are kaolin, pectin, diphenoxylate. (Raj. NHM 2011, 2016 P1)
- Heavy and light Magnesium oxides differ in their **Bulk density** (KPSC 2015)

**Topical Agents**

- **Topical agents:** Compounds applied locally on body surfaces (skin, mucous membranes).
- **Mode of action:** Mainly physical or mechanical. Effects are seen at the surface, rarely absorbed systemically → very little pharmacological action.
- **Sites of application:** Oral cavity, vaginal cavity, colonic cavity, etc.

□ Categories of Topical Agents

Category	Mechanism	Examples
<b>Protectives</b>	Form <b>coating</b> → protect exposed skin/mucous membrane from harmful/annoying stimuli.	Zinc stearate, Zinc oxide (dusting powders)
<b>Adsorbents &amp; Demulcents</b>	Work via <b>chemical surface action</b> → absorb moisture → reduce friction & irritation.	Talc, Starch
<b>Emollients</b>	Fatty substances → <b>soften &amp; soothe</b> skin, mucous membranes, or abraded tissues.	Waxes, Vegetable oils
<b>Astringents</b>	Cause <b>protein precipitation</b> → contraction & wrinkling of tissues.	Alum, Aluminium citrate, Calamine, Zinc oxide, Zinc sulphate

**PROTECTIVES**

The substances which are used to protect the skin from external environment and applied on skin are called topical protectives.

Compounds	Synonyms	Formula	Uses
<b>Talc</b>	Magnesium silicate	$3\text{MgO} \cdot 4\text{SiO}_2 \cdot \text{OH}$ (HPSSC 2020, Hamirpur Pharmacist-2021)	Dusting powder in cosmetic and pharmaceutical preparations, medicated powders (BSSC 2018)
<b>Zinc Oxide</b>	-	$\text{ZnO}$	Mild antiseptic and astringent.

<b>Borax</b>	Sodium borate	$\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$	Wet dressings for wounds, Astringent action
<b>Silver nitrate</b>	Mineral-derived drug ( <b>BTSC 2025</b> ) Prolonged use causes argyria ( <b>KPSC 2021</b> )	$\text{AgNO}_3$	Precipitating germicides ( <b>MPESB 2017</b> )
<b>Mercury yellow</b>	Mercury(II) oxide yellow	$\text{HgO}$	Mild antiseptic action. Local anti-infective and antibacterial. In mild inflammation of eyes (conjunctivitis)
<b>Ammoniated mercury</b>	Amino chloride of mercury	$\text{NH}_2\text{HgCl}$ ( <b>KPSC 2025</b> )	Treat impetigo, psoriasis, minor skin infections, and other skin disorders
<b>Sublimed sulphur</b>	Flower of Sulphur ( <b>KPSC 2021</b> )	S	Scabies ( <b>Raj. NHM 2014, Hamirpur Pharmacist-2021</b> )
<b>Selenium sulphide</b>	Reduce the disulphide linkage in the amino acid cysteine ( <b>KPSC 2018</b> )	$\text{SeS}_2$	In shampoos for anti-dandruff qualities ( <b>MPESB 2023, MRBTN 2023</b> )

### Exam Punch

- An oxidative antimicrobial agent is **Sodium hypochlorite** (**KPSC 2021**)
- Yellow phosphorus is soluble in **Carbon disulphide** (**Delhi Pharmacist 2021**)
- Chemical formula of Sodium Metabisulphite is  **$\text{Na}_2\text{S}_2\text{O}_5$**  (**Hamirpur Pharmacist 2021**)
- Benzoyl peroxide is a **keratolytic** (**RRB 2015**)
- Solution containing 6%w/v of Hydrogen peroxide corresponding to **20 times its volume of available oxygen**. (**KPSC 2015**)
- An organic acid widely used in the treatment of skin condition is **Benzoic acid** (**Raj. NHM 2012**)
- Calcium hydroxide is also known as **Slaked lime**. (**HPSSB 2020**)
- Chlorine reacts with Calcium hydroxide to produce **Chlorinated Lime** (**KPSC 2021**)
- Chlorinated lime and boric acid solution are also known as **eusol**. (**NTPC 2013, KPSC 2020**)
- The purpose of Clark's Process in water treatment is to remove temporary hardness of water by adding slaked lime. (**Raj. NHM 2025**)
- Use of Potassium Iodide in Iodine solution - **Increase the solubility of Iodine** (**KPSC 2015**)
- $\text{C}_{12}\text{H}_{22}\text{CaO}_{14}$  is the chemical formula of Calcium Gluconate. (**Raj. NHM 2025**)

## Dental Products

Dental products are agents used in the **treatment or prevention of dental and oral disorders**.

### □ Type of dental product

Category	Mechanism / Purpose	Examples
<b>Anticaries Agents</b>	Oral microorganisms act on carbohydrates → produce acids → decalcification of teeth → dental caries. These agents prevent caries by making enamel resistant to acid.	Sodium fluoride, Sodium monofluorophosphate, Stannous fluoride
<b>Abrasives/ Dentifrices</b> ( <b>RRB 2025 S4</b> )	<ul style="list-style-type: none"> <li>• Toothpaste used for cleaning teeth &amp; gums with finger/toothbrush</li> <li>• Dental preparation that is added to dentifrices to facilitate the mechanical removal of dental plaque (<b>BSSC 2025</b>)</li> <li>• Polish and clean teeth (<b>MP Pharmacist 2020</b>)</li> </ul>	Calcium carbonate ( <b>NCL 2016</b> ), Dibasic calcium phosphate, Calcium phosphate, Sodium metaphosphate, Strontium chloride, Pumice
<b>Desensitizing Agents</b>	Reduce tooth sensitivity to hot/cold, esp. in decay.	Strontium chloride ( <b>KPSC 2015</b> ), Zinc chloride
<b>Oral Antiseptics &amp; Astringents</b>	Inorganic chemicals for oral hygiene (antiseptic + astringent).	Hydrogen peroxide, Magnesium peroxide, Sodium perborate
<b>Mouth Wash</b>	Provide mild antiseptic, astringent, deodorant & desensitizing action.	Zinc sulphate, Zinc chloride, Potassium permanganate
<b>Cements &amp; Fillers</b>	Used temporarily to cover & protect teeth after dental surgery.	Zinc oxide

## ORGANIC CHEMISTRY

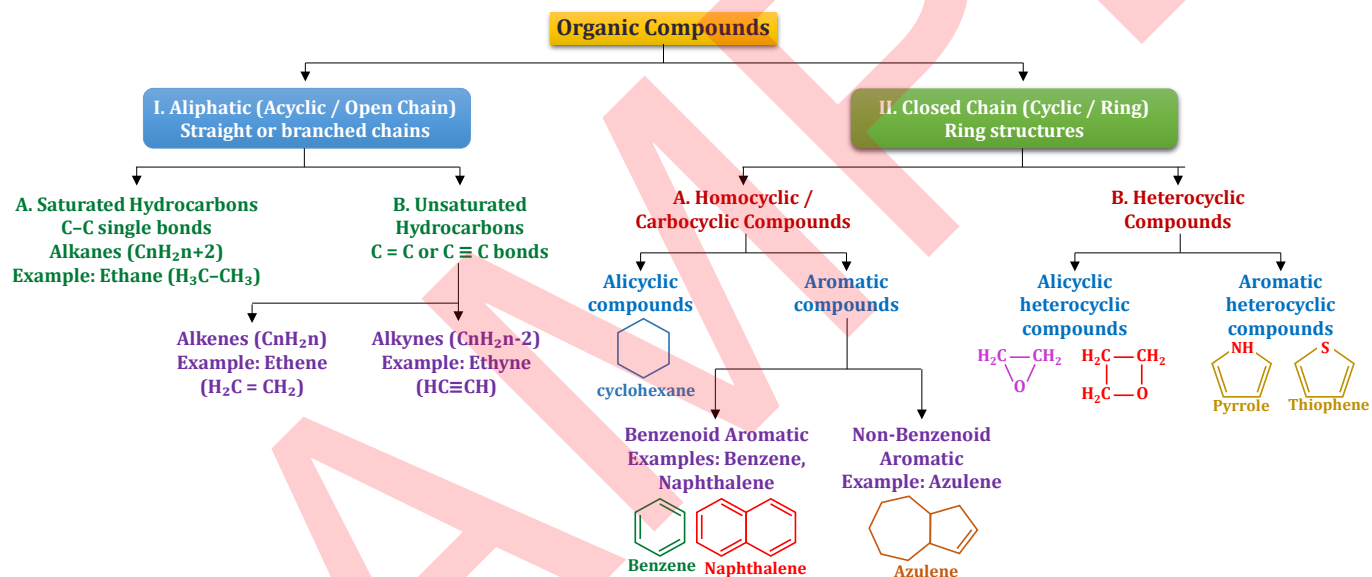
Classification & Nomenclature  
of Organic Chemistry

## INTRODUCTION

- Organic chemistry is the major branch of chemistry which deals with the scientific study of preparation, structure, properties, composition and reactions of carbon containing compounds.
- In organic chemistry, not only hydrocarbons are studied but also compounds in which carbon is bonded with any other atoms like oxygen, halogens, nitrogen, phosphorus and sulfur etc.

## CLASSIFICATION BASED ON STRUCTURES

Organic compounds are broadly classified based on their carbon skeleton.

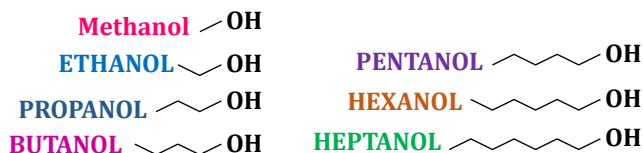


## CLASSIFICATION BASED ON FUNCTIONAL GROUPS

- A functional group may be defined as an atom or a group of atoms present in a molecule which largely determines the chemical properties.
- In chlorocresol, the functional groups attached to its benzene ring are a methyl group, a hydroxyl group, and a chlorine atom.  
(Hamirpur Pharmacist 2021)

## HOMOLOGOUS SERIES

- A homologous series is defined as a group of structurally similar organic compounds all members of which contain the same functional group, show a gradation in physical and similarity in chemical properties and any two adjacent members of which differ by a  $-CH_2$  group.
- The adjacent members are differed by a  $-CH_2$  group or ( $CH_2 = 12 + 2 \times 1 = 14$ ) 14 atomic mass unit.



Functional Group	General Formula	Functional Group	General Formula
Alkane (C-C)	$C_nH_{(2n+2)}$	Carboxylic Acid	R-COOH
Alkene (C=C)	$C_nH_{(2n)}$	Ester	R-COO-R'
Alkyne (C $\equiv$ C)	$C_nH_{(2n-2)}$	Acid anhydride	(RCO) $_2$ O
Halides (X=F,Cl,Br,I)	R-X	Amines	R-NH $_2$
Alcohol	R-OH	Amide	R-CONH $_2$
Ether	R-O-R'	Nitro	R-NO $_2$
Aldehyde	R-CHO	Isocyanide	R-NC
Ketone	R-CO-R'	Cyanide	R-CN
Acid Halides	R-CO-X	Thiol	R-SH

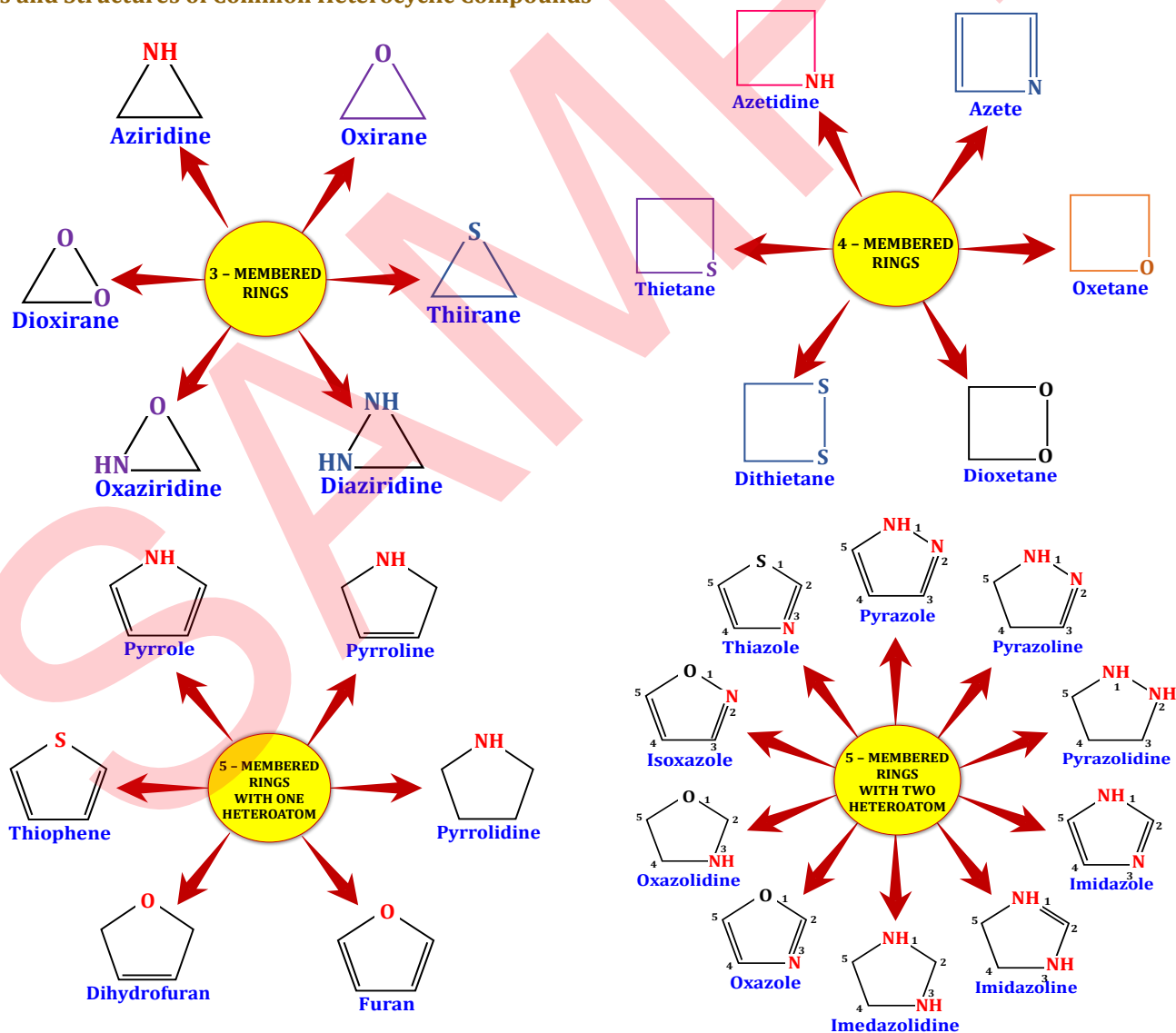
**EXAM PUNCH**

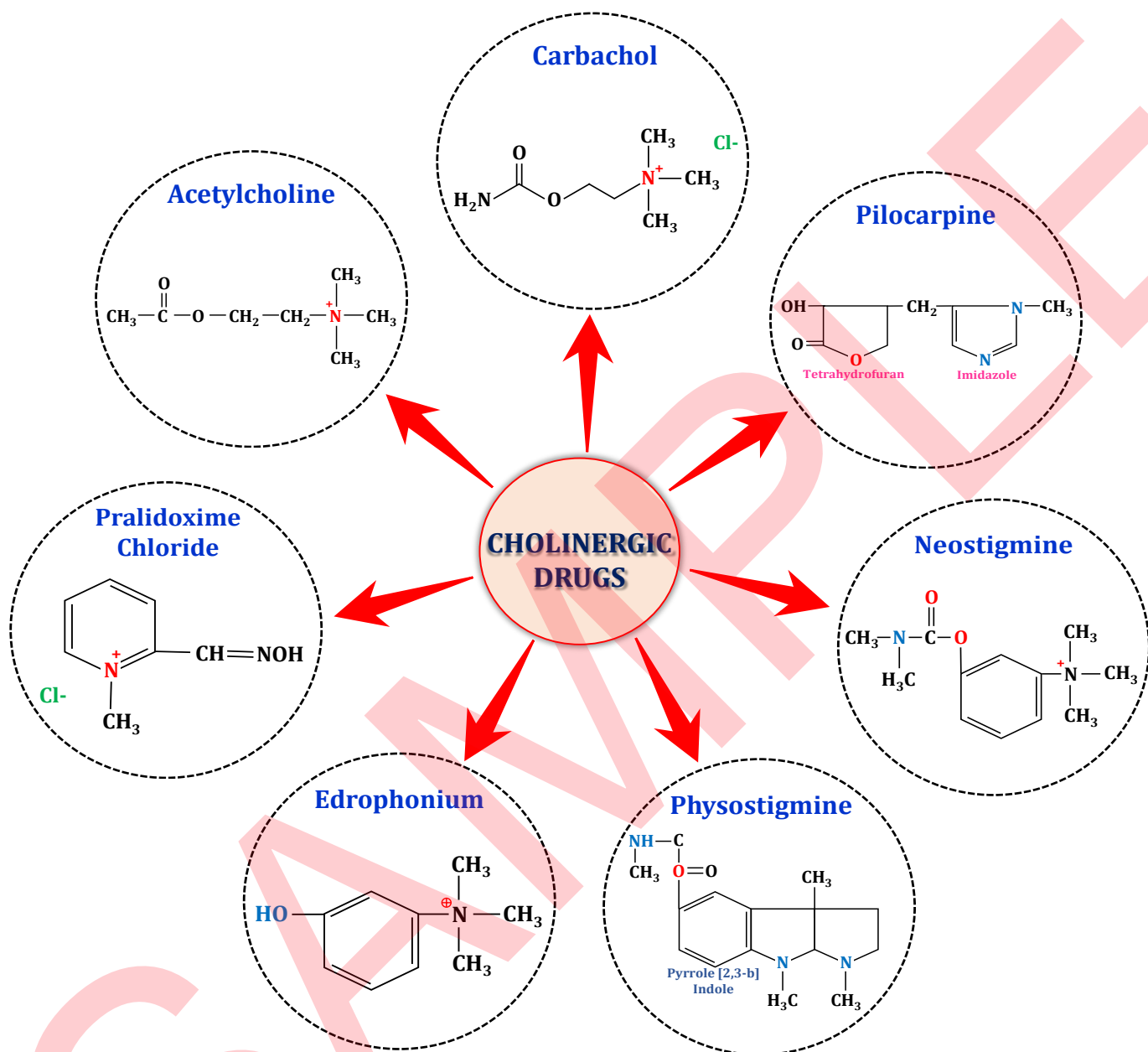
- **Aniline:** The common name for **amino benzene** (DSSSB 2025 S3).
- **Liquefied Phenol:** A formulation that has **80% of phenol by weight in water** (HPSSC 2022).
- **Azo Compounds:** Compounds containing the **-N=N-** functional group, such as **Azobenzenes**, are specific synthetic compounds that have major commercial importance in the **dye industry** (DSSSB 2025 S2).
- **Edman's Reagent:** A chemical used in protein sequencing, which is chemically **Phenyl isothiocyanate** (HPSSC 2016).
- **Valency of Carbon:** The valency of carbon, the backbone of organic chemistry, is **4** (BSSC 2018).

## Heterocyclic Compounds

**INTRODUCTION**

- **Heterocyclic compounds** are defined as **cyclic compounds** where one or more ring atoms are elements other than carbon.
- These non-carbon atoms are called **heteroatoms** (RRB 2019 P2). The most common heteroatoms found in these rings are **nitrogen (N), oxygen (O), and sulfur (S)**.
- Well-known examples include Pyrrole, Furan, and Thiophene.

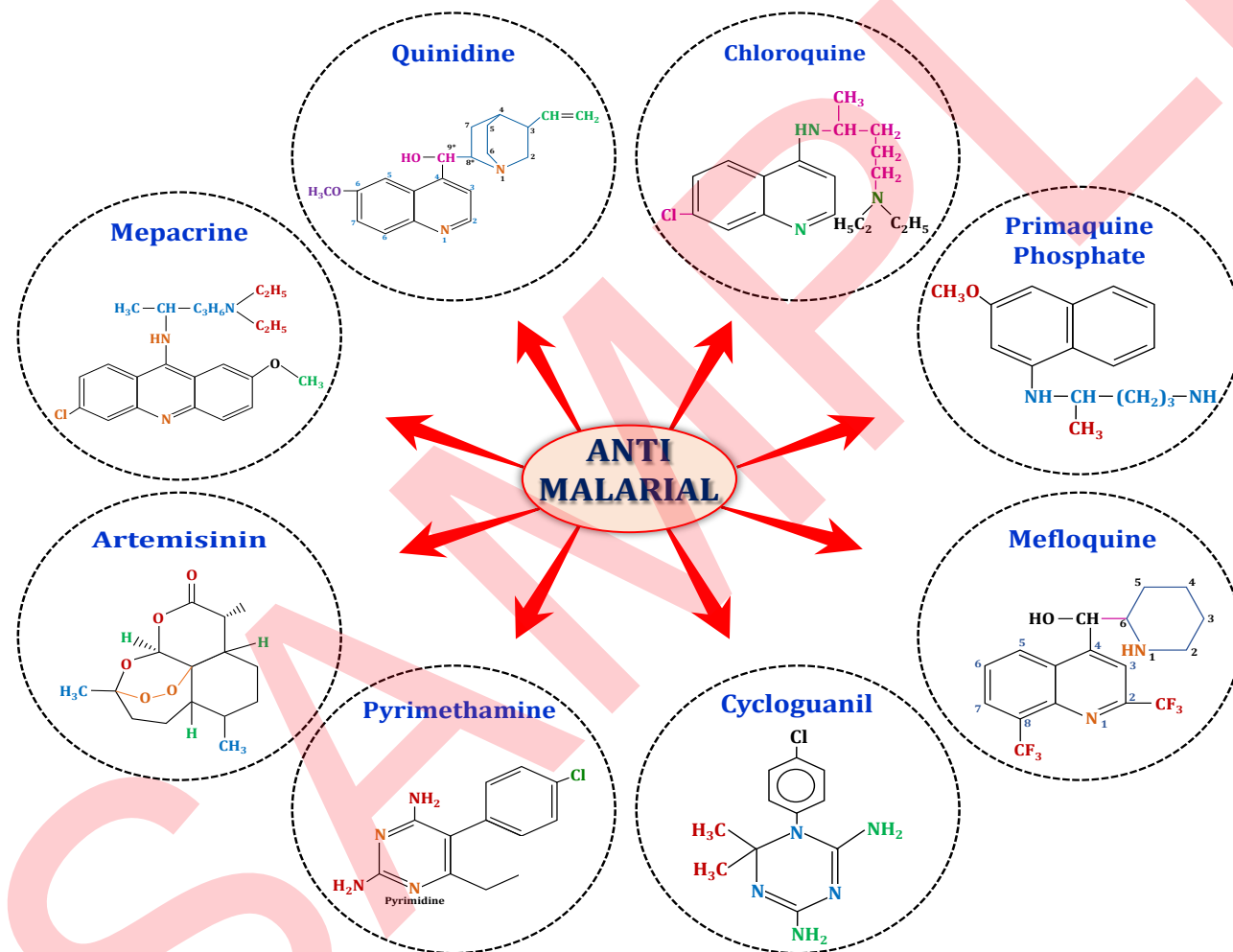
**Names and Structures of Common Heterocyclic Compounds**



Drugs & IUPAC Name	Uses & Brand Names	Features
<b>Acetylcholine</b> 2- Acetoxy - N,N,N Trimethyl-ethanaminium	<b>Uses:</b> Bronchial asthma, heart block, open angle glaucoma. <b>Brand Name:</b> Adrenar, Nordrin	<ul style="list-style-type: none"> <li>A potent quaternary ammonium parasympathomimetic agent.</li> <li>It is levorotatory.</li> </ul>
<b>Carbachol</b> [H2NCOO.CH2CH2N+ (CH3)3].Cl- Choline chloride carbamate; Carbamoylcholine chloride; Ethanaminium, 2-[[aminocarbonyl] oxy] N, N, N-trimethyl-chloride	<b>Uses:</b> Cholinergic agent, induces miosis, treatment of glaucoma, stimulates micturition. <b>Brand Name:</b> Carbatstat, Carboptic, Mio-stat, Isopto	<ul style="list-style-type: none"> <li>Quaternary ammonium chloride with muscarinic &amp; nicotinic actions</li> <li>It possesses both muscarinic and nicotinic action <b>(AMC 2022)</b></li> <li>The amino group decreases electrophilicity of the carbonyl group <b>(AMC 2022)</b></li> </ul>
<b>Pilocarpine</b> 3-Ethylidihydro-4-[1-methyl-1H-imidazol-5-yl]methyl]-2(3H)-furanone	<b>Uses:</b> Anti-glaucoma drug <b>Brand Name:</b> Chibro pilocarpine, Ocusert Pilo, Almocarpin, Pilominton, Isopto carpine, Pilovisc	<ul style="list-style-type: none"> <li>It is an alkaloid</li> <li>Contains Tetrahydrofuran and imidazole nucleus <b>(ESIC 2019)</b></li> <li>Colourless, translucent, bitter crystals or viscous hygroscopic oily liquid</li> </ul>

## Antimalarial Drugs

- **Antimalarials** are chemotherapeutic agents which are used for the prevention and treatment of **malaria**.
- The causal organisms responsible for malaria belong to the genus **plasmodium** which is of the class of **protozoa** known as **sporozoa**.
- **Four different species:**
  - Plasmodium malariae - quartan malaria
  - Plasmodium vivax - benign tertian malaria
  - Plasmodium falciparum - malignant or subtertian malaria
  - Plasmodium ovale - mild type of tertian malaria.



Drugs & IUPAC Name	Uses & Brand Names	Features
<b>Mecaprine</b> N'-(6-chloro-2-methoxyacridin-9-yl)-N,N-diethylpentane-1,4-diamine	<b>Uses:</b> antiprotozoal, antirheumatic, and an intrapleural sclerosing agent <b>Brand Name:</b> Maladin	<ul style="list-style-type: none"> <li>• Contains acridine nucleus (<b>BCCL 2013</b>)</li> <li>• <b>Chloro substitution (-Cl at C-6)</b> → increases lipophilicity and activity against parasites.</li> <li>• <b>Methoxy group (-OCH<sub>3</sub> at C-2)</b> → modulates electronic properties of acridine nucleus.</li> <li>• Related to <b>chloroquine and mefloquine</b>.</li> </ul>
<b>Quinine Sulphate</b> (6-Methoxyquinolin-4-yl)[-5-vinylquinuclidin-2-yl]methanol	<b>Uses:</b> malaria, cerebral malaria, relieve muscle cramps in myotonia congenita <b>Brand Name:</b> Vigotab, flue-foe	<ul style="list-style-type: none"> <li>• <b>Levo rotatory alkaloid</b> obtained from <b>cinchona bark</b>.</li> <li>• <b>d-isomer quinidine</b> is used as an antiarrhythmic</li> <li>• <b>Quinoline nucleus</b> - Aromatic bicyclic system (benzene + pyridine fused) → responsible for the drug's antimalarial activity.</li> </ul>

## ANALYTICAL ERRORS

## ERROR

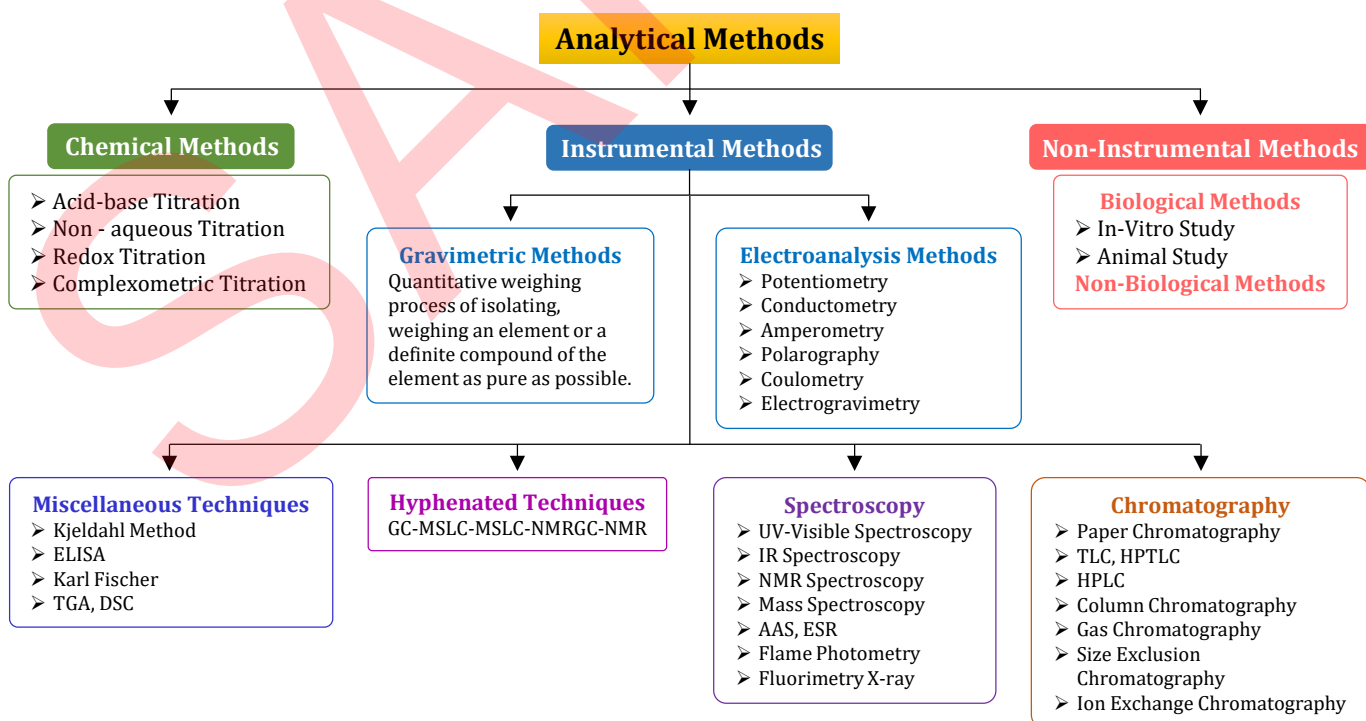
- Error is the difference between the true result (accepted true result) and the measured result.

## TYPES OF ERROR

Type of Error	Description / Cause	Example
<b>DETERMINATE or SYSTEMATIC ERROR (DSSSB 2019)</b>	Certain errors whose causes can be identified. These are usually one-sided and can be minimized or eliminated by careful working and proper planning.	
<b>Personal Error</b>	Occurs due to <b>improper working or carelessness</b> of the analyst.	Parallax error while reading burette
<b>Instrumental or Reagent Error</b>	Due to defective apparatus or impure reagents.	Wrong pH meter/ UV Spectrophotometer reading
<b>Error of Method</b>	Caused by <b>incomplete reactions, solubility of precipitate, or decomposition</b> during analysis.	<b>Incomplete precipitation or loss of compound</b> during ignition in gravimetric analysis.
<b>Additive Error</b>	The <b>error value remains constant</b> in a series of determinations and is <b>independent of sample size</b> .	In titration, if <b>0.1 mL extra titrant</b> is needed for visible color change, the same 0.1 mL error persists even when the sample size doubles.
<b>Proportional Error</b>	The <b>magnitude of the error increases proportionally</b> with the sample size.	Contaminants in sample causing proportional deviation
<b>INDETERMINATE or RANDOM ERROR (DSSSB 2019)</b>	Also known as <b>accidental errors</b> . Their causes may or may not be known. They are <b>not one-sided</b> , and <b>cannot be completely eliminated</b> even with high-quality reagents and instruments.	

## Quality Control

Quality control is to analyze a drug for quality and quantity. Following are various methods used for quality control.



## Carbohydrates

### Carbohydrates

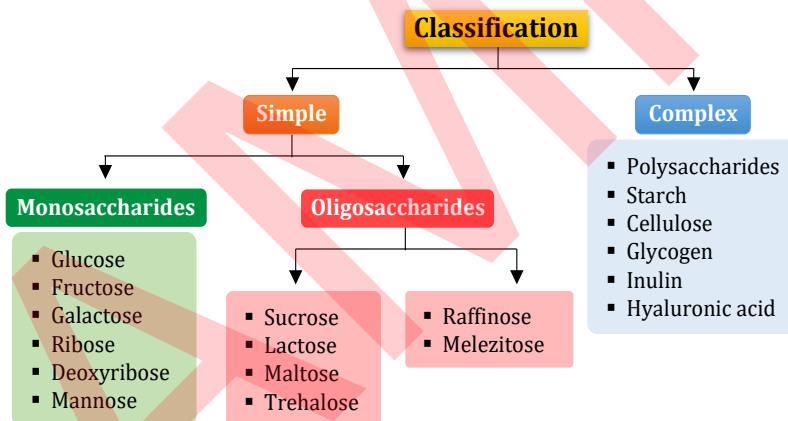
- Carbohydrates are the most abundant organic molecules in nature.
- They are made up of three elements — carbon, hydrogen, and oxygen, usually in the ratio of 1:2:1.
- The word "carbohydrate" comes from "hydrates of carbon," because their structure looks like carbon combined with water.
- "Carbohydrates may be defined as polyhydroxy aldehydes or ketones or compounds which produce them on hydrolysis".

### History

- **1811:** Andreas Marggraf isolated **glucose** from raisins — first major sugar discovery.
- **1838:** The term "carbohydrate" was coined by Schmidt and Tollens.
- **1854:** Louis Pasteur discovered that yeast ferments sugar, linking carbohydrates to metabolism.
- **Late 1800s:** Emil Fischer studied sugar structures, stereochemistry, and introduced D/L system.

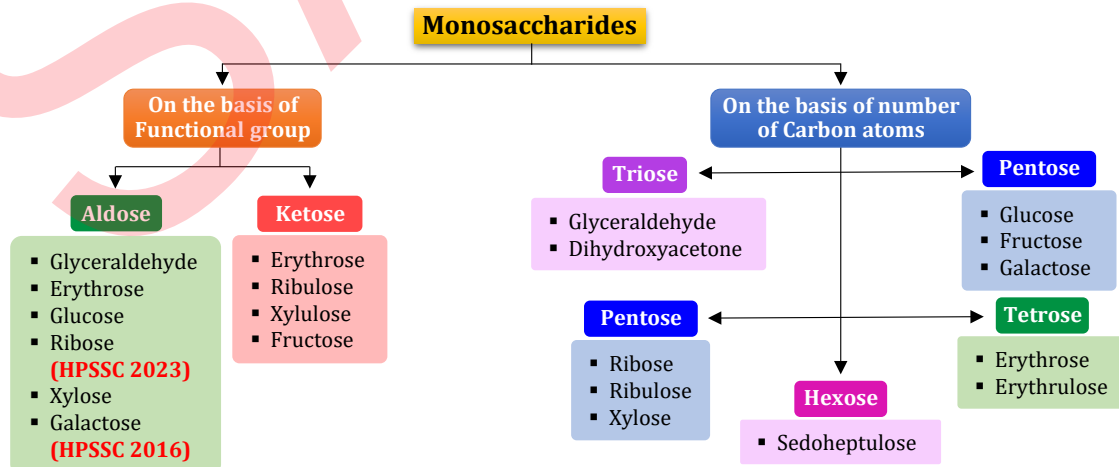
### Functions of carbohydrates

1. They are the most abundant dietary source of energy (**4 Cal/g**) for all organisms.
2. Carbohydrates (as glycoproteins and glycolipids) participate in the structure of **cell membrane**.
3. Carbohydrates also serve as the storage form of energy (**glycogen**) to meet the immediate energy demands of the body.

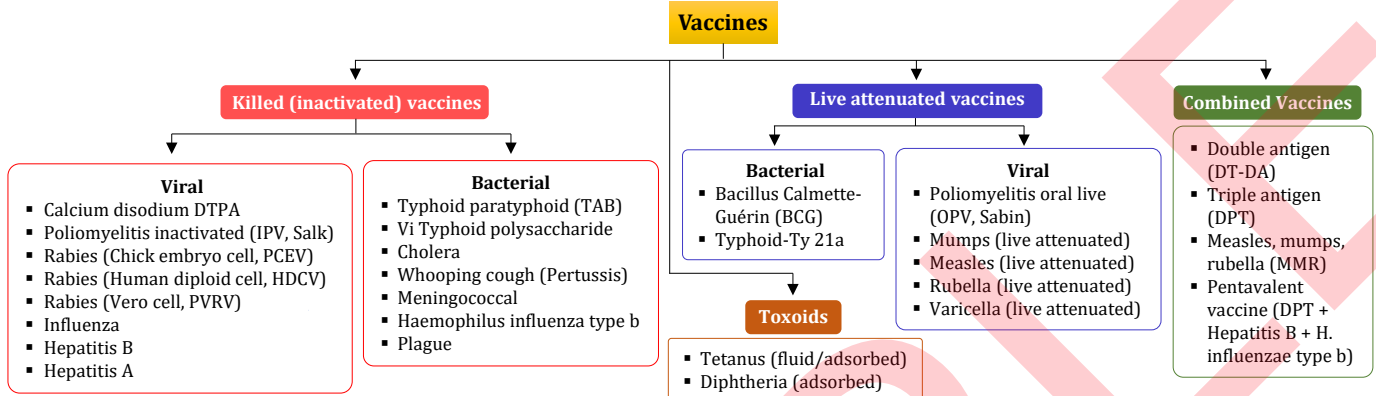


### Monosaccharides

- Monosaccharides are the simplest form of carbohydrates that **cannot be hydrolyzed** into smaller sugar units.
- They are also called **simple sugars** and act as the building blocks for di-, tri-, and polysaccharides.

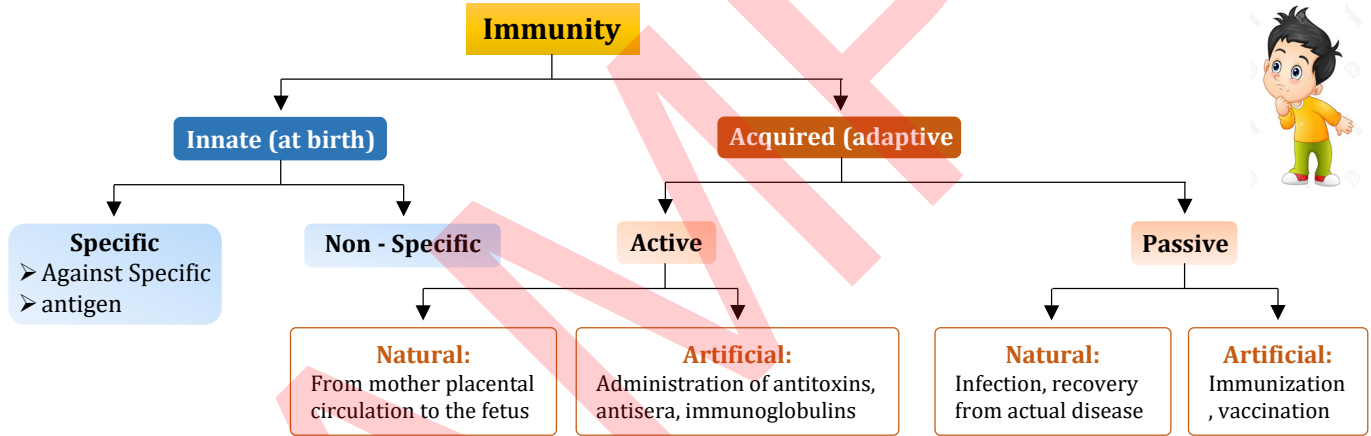


<b>Toxoid vaccine</b>	Tetanus, Diphtheria
<b>Conjugate polysaccharide-protein vaccine</b>	Pneumococcal, Meningococcal



**IMMUNITY**

Immunity is the power of the body to resist effect of invasion of pathogenic microorganism in the body.



**Types of Immunity**

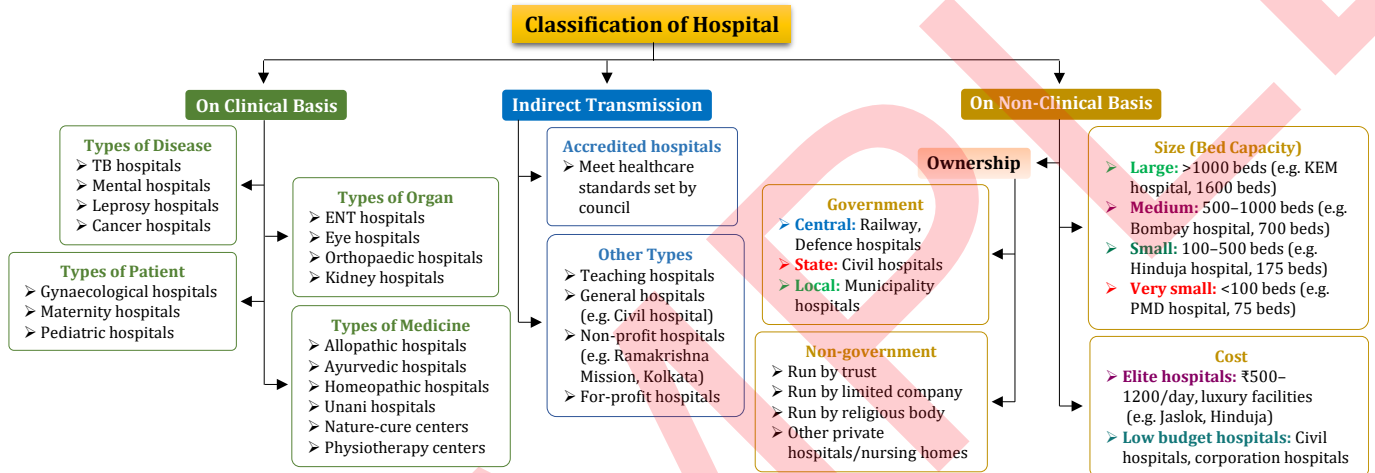
Type	Definition	Key Features	Examples / Defense Against
<b>Innate Immunity</b>	Immediate, antigen- <b>nonspecific</b> defense present since birth.	Acts as first line of defense; no induction required.	General defense against any pathogen.
<b>Adaptive (Acquired) Immunity</b>	Antigen- <b>specific</b> , induced defense; develops over days.	Provides long-lasting, memory-based protection.	Vaccination, exposure to infections.
<b>Humoral Immunity (AMI)</b>	Antibody-mediated immunity.	<b>B-lymphocytes</b> → produce antibodies (immunoglobulins).	Extracellular pathogens, toxins.
<b>Cell-mediated Immunity (CMI)</b>	Cellular immunity via antigen-specific cells.	<b>Cytotoxic T cells (CTLs)</b> , macrophages.	Intracellular pathogens, parasites, transplanted tissue, cancer cells.
<b>Active Immunity</b>	Host develops adaptive response, producing own immune cells & antibodies.	Long-lasting (years to lifelong).	Natural infection, vaccines.
<b>Passive Immunity</b>	Host receives <b>pre-formed antibodies or lymphocytes</b> from another source.	Short-lived (weeks to months).	Maternal antibodies, antiserum, immunoglobulin therapy.

**Immunization**

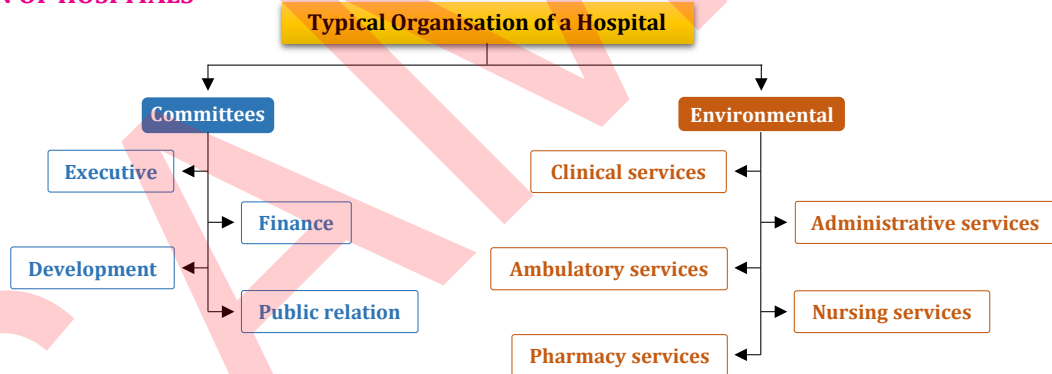
Immunization is the process whereby a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine.

## Hospital Pharmacy

### CLASSIFICATION OF HOSPITALS



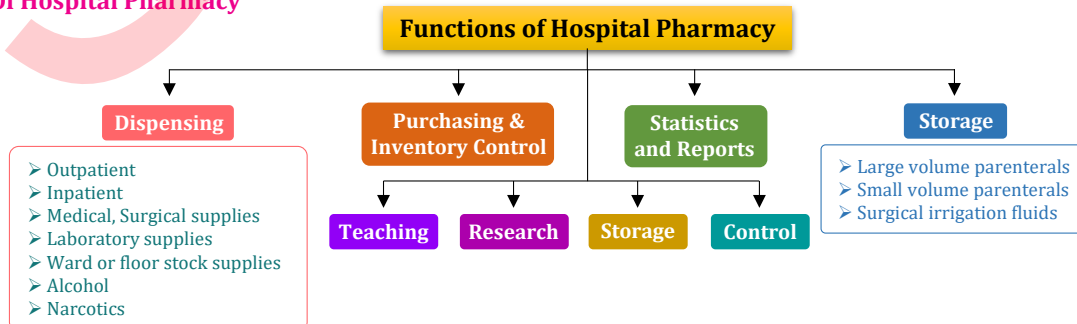
### ORGANIZATION OF HOSPITALS



### HOSPITAL PHARMACY

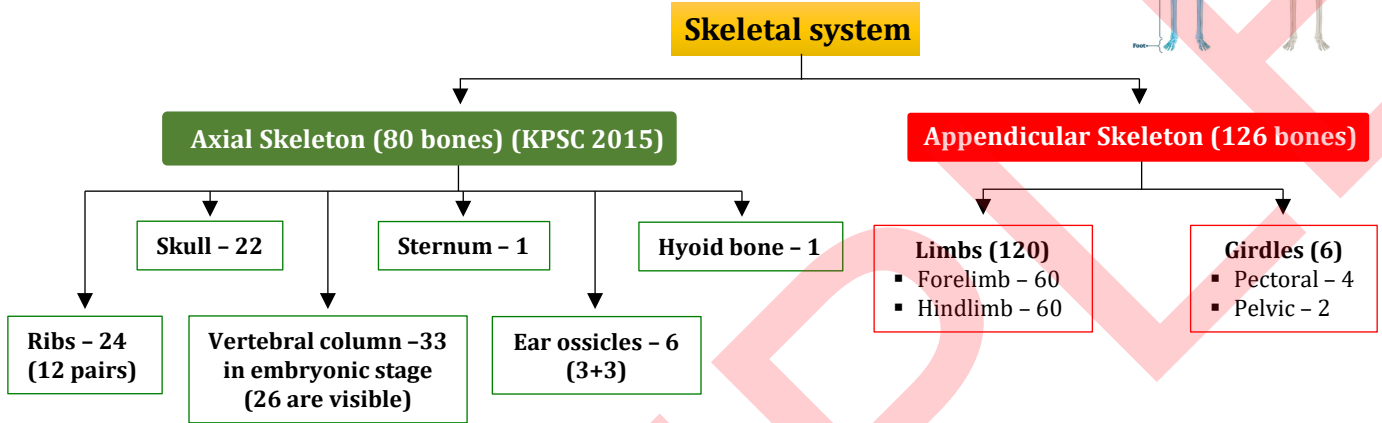
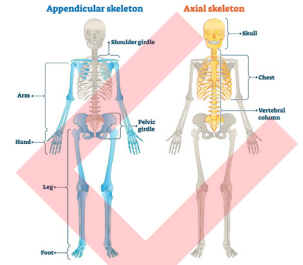
- Hospital pharmacy is the department, service or a domain in the hospital organization, managed under the direction of professionally competent legally qualified person.
- The first North American Hospital, Pennsylvania, started functioning in 1752 and Jonathan Roberts worked in it as a hospital pharmacist.

#### □ Functions Of Hospital Pharmacy



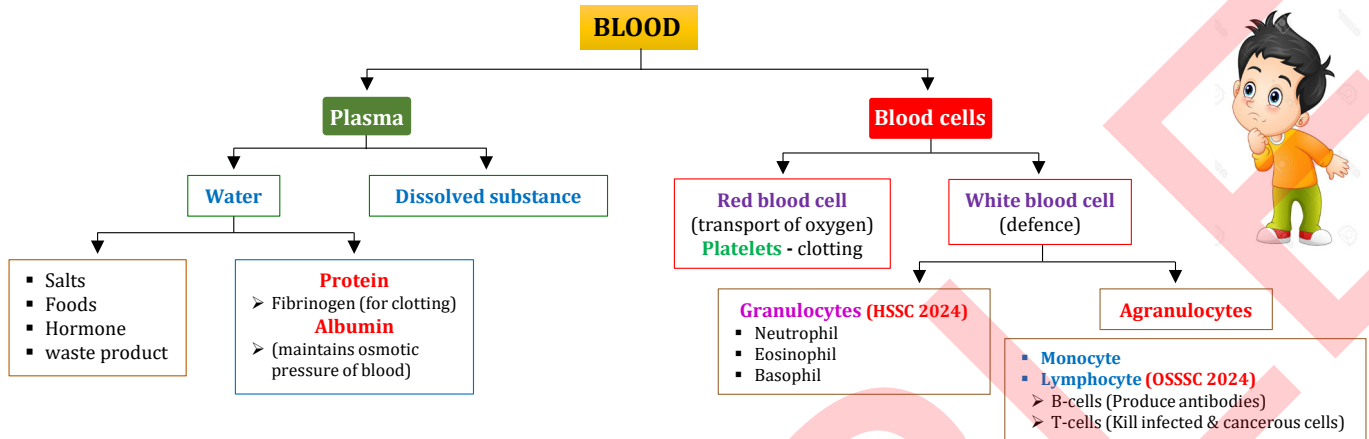
**DIVISION OF THE SKELETAL SYSTEM**

- Adult human skeleton consists of 206 bones (BSSC 2018, OSSC 2024)
- Most of which are paired, with one member of each pair on the right and left sides of the body.
- Skeletons of infants and children have more than 206 bones because some of their bones fuse later in life.
- Bones of the adult skeleton are grouped into two principal divisions:
  - axial skeleton
  - appendicular skeleton (DSSSB 2025 S1)



HUMAN SKELETON - 206 bones (BSSC 2018, OSSC 2024)			
Axial 80		Appendicular-126	
APPENDICULAR SKELETON - 126 BONES			
LIMB BONES - 120		GIRDLE BONES - 06	
Fore limb Bones - 60	Hind limb Bones - 60	Pectoral Girdle - 4	Pelvic Girdle - 2
Humerus - 1 x 2	Femur - 1 x 2 (BSSC 2018)	Scapula - 1 x 2 (DSSSB 2025 S1)	
Radius - 1 x 2	Patella - 1 x 2	Clavicle - 1 x 2	
Ulna - 1 x 2	Tibia - 1 x 2		(is formed by 2 hip bones and each hip bone is formed by fusion of 3 hip bones ilium, ischium and pubis)
Carpals - 8 x 2	Fibula - 1 x 2		
Metacarpals - 5 x 2 (RRB 2025 S4)	Tarsals - 7 x 2 (HSSC 2024)		
Phalanges - 14 x 2	Metatarsals - 5 x 2		
	Phalanges - 14 x 2 (HPSSC 2020)		
AXIAL SKELETON - 80 BONES			
SKULL SKELETON - 29		STERNUM - 01 (HSSC 2024)	RIBS - 24
SKULL BONES - 22 (DSSSB 2025 S4)			VERTEBRAL COLUMN - 26 (33 DSSSB 2025)
Cranial - 8 (RRB 2015)	Facial - 14 (HSSC 2024)		True - 14
Frontal - 1	Maxilla - 2		False - 10
Parietal - 2 (DSSSB 2015)	Palatine - 2		Cervical - 7
Temporal - 2	Zygomatic - 2		Thoracic - 12
Occipital - 1	Nasal - 2		Lumbar - 5
Ethmoid - 1	Lacrymal - 2		Sacral - 5
Sphenoid - 1	Inferior Turbinals - 2		Coccygeal - 4
	Mandible - 1		
	Vomer - 1		
ASSOCIATED SKULL BONES - 07			
Hyoid Bone - 1		Ear ossicles - 2x3 (Malleus, Incus, Stapes)	

□ BLOOD CLASSIFICATION FLOW CHART



□ PLASMA & PLASMA PROTEINS

Feature	Description
<b>Plasma</b>	Fluid portion of blood containing 90–92% water and dissolved/suspended substances. (HSSC 2024, AIIMS Raipur 2023, OSSSC 2020)
<b>Constituents of Plasma</b>	<ul style="list-style-type: none"> <li>Plasma proteins</li> <li>Inorganic salts</li> <li>Nutrients (from digested food)</li> <li>Waste materials</li> <li>Hormones</li> <li>Gases</li> </ul>
<b>Plasma Proteins</b>	~7% of plasma; too large to pass through capillary pores, hence retained in blood.
<b>Types of Plasma Proteins</b>	<ul style="list-style-type: none"> <li>Albumins</li> <li>Globulins</li> <li>Fibrinogen</li> </ul>
<b>Functions of Plasma Proteins</b>	<ul style="list-style-type: none"> <li>Maintain osmotic pressure of blood (fluid balance)</li> <li>Help in heat regulation</li> <li>Contribute to immunity &amp; clotting (via globulins and fibrinogen)</li> </ul>

□ BLOOD CELLS/ CORPUSCLES

- Synthesised mainly in red bone marrow.
- The process of blood cell formation is called haemopoiesis.
- In adults, haemopoiesis mainly occurs → in the skeleton is confined to flat bones, irregular bones and the ends (epiphyses) of long bones (main sites → sternum, ribs, pelvis and skull).

□ There are three types of blood cell:

- Erythrocytes (red cells)
- Platelets (thrombocytes)
- Leukocytes (white cells)

**ERYTHROCYTES (Red Blood Cells 45%) (MPESB 2023)**

Feature	Description
<b>Appearance</b>	Biconcave discs → ↑ surface area for gas exchange; thin center allows rapid diffusion of gases.
<b>Structure</b>	<ul style="list-style-type: none"> <li>Filled with hemoglobin (binds O<sub>2</sub> &amp; CO<sub>2</sub>)</li> <li>Lack intracellular organelles.</li> </ul>
<b>Hemoglobin Content</b>	~280 million molecules per RBC, each with 4 heme chains (iron-containing).
<b>Life Span</b>	~120 days. (RRB 2016)
<b>Destruction Site (Graveyard of RBCs)</b>	Spleen, bone marrow, liver.

## Analogy

An **analogy** is used to compare two things or to find a relationship between them.

In reasoning questions, options are given that may or may not follow the same relationship, and the candidate needs to identify the correct or odd one out.

### Types of Analogy Questions

#### 1. Numerical Analogy (Odd One Out)

- A set of numbers is given based on a certain pattern.
- One of them does not follow the pattern → identify the odd one.

#### 2. Numerical Analogy (Choose a Similar Pair)

- A pair of numbers is given showing a relationship.
- Candidates need to find another pair from the options that follows the same relationship.

#### 3. Alphabetical / Word Analogy (Odd One Out)

- Several words are given.
- One does not follow the given pattern → identify the odd one.

#### 4. Alphabetical / Word Analogy (Choose a Similar Pair)

- A pair of words is given showing a relationship.
- Candidates need to select another word pair that follows the same relationship.

### Examples

#### 1. Select the set in which the numbers are related in the same way as are the numbers of the following sets.

(NOTE: Operations should be performed on the whole numbers, without breaking down the numbers into their constituent digits. E.g. 13 - Operations on 13 such as adding/subtracting/multiplying to 13 can be performed. Breaking down 13 into 1 and 3 and then performing mathematical operations on 1 and 3 is not allowed.)

(35, 16, 361) (37, 19, 324)

- (a) (38, 20, 356) (b) (46, 32, 225)  
(c) (29, 12, 289) (d) (31, 16, 256)

Answer (c)

Step 1: Check relation in the first set (35, 16, 361)

$$35 - 16 = 19$$

$$(19)^2 = 361$$

So, the relation is: (First number - Second number)<sup>2</sup> = Third number

Step 2: Verify with the second set (37, 19, 324)

$$37 - 19 = 18$$

$$(18)^2 = 324$$

#### 2. Select the pair that follows the same pattern as that followed by the two pairs given below.

BEB : DGD, HKH : JM

- (a) CEA : EHE (b) CFC : DHD  
(c) CFC : EHE (d) CEA : DGD

Answer (c)

Pattern: Each letter shifts +2 positions in the alphabet.

#### 3. If Annual: One year, then Quinquennial: \_\_\_\_\_

- (a) Five years (b) Ten years  
(c) Hundred years (d) Thousand years

Answer (a)

The pair is based on the meaning of time periods.

Annual = 1 year

Quinquennial = 5 years

#### 4. Select the set of numbers that is similar to the following set of numbers. (5, 36, 343) (MPESB 2022)

- (a) (16, 25, 36) (b) (4, 25, 216)  
(c) (12, 4, 144) (d) (8, 9, 100)

Answer (b)

Step 1: Look for simple number relations

$$36 = 6^2$$

$$343 = 7^3$$

Numbers are consecutive: 5, 6, 7.

So the pattern is: (n, (n+1)<sup>2</sup>, (n+2)<sup>3</sup>)

Step 2: Check the given set (5, 36, 343)

$$n = 5$$

$$n+1 = 6 \rightarrow 6^2 = 36$$

$$n+2 = 7 \rightarrow 7^3 = 343$$

Step 3: Test options

(b) (4, 25, 216)

$$\text{Start} = 4$$

$$(4+1)^2 = 25$$

$$(4+2)^3 = 6^3 = 216$$

## Odd One Out/Classification

Classifying a number, word, letter or group of them on the basis of their particular type of property is called classification.

### Type of Classification

1. Series based
2. Number based
3. Alphabet based
4. Knowledge based
5. Science based
6. Word based
7. Vocabulary based
8. General intelligence based and more

### Examples

1. Based on the English alphabetical order, three of the following four letter-cluster pairs are alike in a certain way and thus form a group. Which letter-cluster pair DOES NOT belong to that group?

(Note: The odd one out is not based on the number of consonants/vowels or their position in the letter-cluster.)

- (a) FB - DZ (b) BX - ZV (c) UQ - SO (d) HD - ED

## NUMBER SYSTEM

## INTRODUCTION OF NUMBER SYSTEM

- **Natural Numbers (N):** Counting numbers  $\rightarrow \{1, 2, 3, \dots\}$ 
  - **Example:** What is the **sum** of the first 5 natural numbers?  
The first 5 natural numbers are: 1,2,3,4,5  
Now add them:  $1+2+3+4+5=15$
  - **Answer:** Sum=15
- **Whole Numbers (W):** 0 + Natural numbers  $\rightarrow \{0, 1, 2, \dots\}$ 
  - **Example:** What is the product of the first 4 whole numbers?  
The first 4 whole numbers are: 0,1,2,3  
Now multiply them:  $0 \times 1 \times 2 \times 3 = 0$
  - **Answer:** Product = 0
- **Integers (Z):** Negative, zero, positive  $\rightarrow \{\dots, -2, -1, 0, 1, 2, \dots\}$ 
  - **Example:** What is the result of this integer expression?  
 $(-3)+7-(-2)$
  - **Step-by-step Solution:**  
**Start with:**  $(-3)+7=4$
  - Then subtract -2 (subtracting a negative is like adding):  
 $4-(-2)=4+2=6$
  - **Answer:** 6
- **Rational Numbers (Q):** Numbers in form  $p/q$ , where  $q \neq 0$  (fractions, terminating or repeating decimals).
  - **Example:** Is 0.125 a rational number? If yes, write it in fraction form.
  - Step-by-step Solution: **0.125 is a terminating decimal**
  - **So, it's a rational number**
  - **Now, convert it to a fraction:**  
 $0.125 = \frac{125}{1000}$
  - **Now simplify:**  
 $\frac{125}{1000} = \frac{1}{8}$
  - **Answer:**  $1/8$
- **Irrational Numbers:** Non-terminating, non-repeating decimals (e.g.  $\sqrt{2}$ ,  $\pi$ ).
  - **Example:** Is  $\sqrt{5}$  a rational or irrational number?  
 $\sqrt{5} \approx 2.2360679\dots$  (non-terminating, non-repeating)
  - **Answer:**  $\sqrt{5}$  is Irrational Numbers
- **Real Numbers (R):** Rational + Irrational.
  - **Example:** Is the number  $\sqrt{3}+1/2$  a real number?
  - **Step 1:** Break it down  
 $\sqrt{3}$  is **irrational**  
 $1/2$  is **rational**
  - **Now add them:**  $\sqrt{3}+1/2$
  - Adding a rational and irrational number gives an irrational result, but it's still a real number.
  - **Answer:** Yes,  $\sqrt{3}+1/2 \in \mathbb{R}$

- **Imaginary / Complex Numbers:** In form  $a+ib$ , where  $i=\sqrt{-1}$ .

➤ **Example:** Simplify:  $\sqrt{-25}+2$

- **Step-by-step:**

$$-25=5i$$

**So:**

$$\sqrt{-25}+2=5i+2$$

- **This is in the form  $a+ib$ :**

$$2+5i$$

- **Answer:  $2+5i$  is a Complex Number**

## IMPORTANT PROPERTIES

➤ **Odd  $\pm$  Odd = Even, Odd  $\pm$  Even = Odd, Even  $\pm$  Even = Even**

➤ **Example 1: Odd  $\pm$  Odd = Even**

Calculate  $7+3$

Both 7 and 3 are odd numbers.

Add:  $7+3=10$

10 is **even**.

- **Odd  $\times$  Odd = Odd, Odd  $\times$  Even = Even, Even  $\times$  Even = Even**

➤ **Example 1: Odd  $\times$  Odd = Odd**

Calculate  $3 \times 5$

Both 3 and 5 are odd numbers.

Multiply:  $3 \times 5 = 15$

15 is **odd**

## DIVISIBILITY RULES FROM 2 TO 11.

- **Rule of 2 : Last digit even**

➤ **Examples:** 48

Last digit = 8  $\rightarrow$  even  $\rightarrow$  divisible by 2

$$48 \div 2 = 24$$

- **Rule of 3: Sum of digits divisible by 3**

➤ **Example:** Is 123 divisible by 3?

**Sum of digits:**  $1+2+3=6$

6 is divisible by 3

$$123 \div 3 = 41$$

- **Rule of 4: Last 2 digits divisible by 4**

➤ **Examples:** Is 316 divisible by 4?

**Last two digits:** 16

$$16 \div 4 = 4$$

So, 316 is divisible by 4

- **Rule of 5: Last digit 0 or 5**

➤ **Examples:** Is 145 divisible by 5?

**Last digit = 5**

So,  $145 \div 5 = 29 \rightarrow$  Yes, divisible

- **Rule of 6: Divisible by 2 & 3**

➤ **Examples:** Is 132 divisible by 6?

**Last digit = 2  $\rightarrow$  even** (passes rule for 2)

Sum of digits =  $1+3+2=6 \rightarrow 6 \div 3 = 2$  (passes rule for 3)

So, **132 is divisible by 6**

## STATIC GK

## □ Gallantry Awards

- The first three gallantry awards, namely Param Vir Chakra, Maha Vir Chakra, and Vir Chakra, were instituted by the Government of India on **26th January 1950**. (DSSSB 2025 S1)
- **Param Vir Chakra (PVC)**: India's highest wartime gallantry award, given for the most conspicuous bravery or some daring act of valour or self-sacrifice in the presence of the enemy. (DHS Assam 2021)
- **Maha Vir Chakra (MVC)**: Second-highest wartime gallantry award, for acts of gallantry in the presence of the enemy, whether on land, at sea, or in the air.
- **Vir Chakra (VrC)**: Third in precedence, awarded for acts of gallantry in the presence of the enemy.

2025			
Award	Name	Rank	Branch
Kirti Chakra	Major Manjit	Major	Army
	Naik Dilwar Khan (Posthumous)	Naik	Army
Shaurya Chakra	Major Ashish Dahiya	Major	Army
	Major Kunal	Major	Army
	Major Satender Dhankar	Major	Army
	Captain Deepak Singh (Posthumous)	Captain	Army
	Assistant Commandant Eshenthung Kikon	Assistant Commandant	Army
	Subedar Vikas Tomar	Subedar	Army
	Subedar Mohan Ram	Subedar	Army
	Havildar Rohit Kumar (Posthumous)	Havildar	Army
	Havildar Prakash Tamang	Havildar	Army
	Flight Lieutenant Aman Singh Hans	Flight Lieutenant	Air Force
	Corporal Dabhi Sanjay Hiffabai Essa	Corporal	Air Force
	Vijayan Kutty G	-	BRDB
	Vikrant Kumar	-	CRPF
	Jeffrey Hmingchullo	-	CRPF



## □ Indian Nobel Prize Winners

Year	Name	Field	Contribution / Reason
1902	Ronald Ross	Physiology or Medicine	Work on malaria — discovery of the transmission of malaria parasite by mosquitoes (pioneering malaria research)
1907	Rudyard Kipling	Literature	Recognized for originality, observation, and talent in his literary works
1913	Rabindranath Tagore (NFL 2025 Set-B)	Literature	Gitanjali (collection of poems in classical Bengali); first Asian Nobel Laureate
1930	C. V. Raman	Physics	Discovery of the <b>Raman Effect</b> (scattering of light, 1928)
1968	Har Gobind Khorana	Physiology or Medicine	Research on <b>genetic code</b> and its role in protein synthesis
1979	Mother Teresa	Peace	Humanitarian work — Missionaries of Charity, serving the poorest of the poor
1983	Subrahmanyan Chandrasekhar	Physics	Theoretical studies on the <b>structure and evolution of stars</b> (Chandrasekhar limit)
1989	14th Dalai Lama (Tenzin Gyatso)	Peace	Consistent non-violent struggle for Tibetan liberty

<b>Debendranath Tagore</b>	1817–1905	Revived Brahma Samaj (1840s); led Tattvabodhini Sabha; encouraged rational study of Hindu scriptures; opposed missionary criticism.
<b>Keshab Chandra Sen</b>	1838–1884	Popularised Brahma Samaj nationally; split (1866) → Adi Brahma (Debendranath) & Brahma Samaj of India (Keshab); later Sadharan Brahma Samaj (1878).
<b>Prarthana Samaj</b>	Founded 1867	Founded by Atmaram Pandurang; supported by Keshab Sen; leaders M.G. Ranade, R.G. Bhandarkar; advocated widow remarriage, women's education, caste abolition.
<b>Young Bengal Movement</b>	1820s–30s	Led by Henry Vivian Derozio at Hindu College; spread radical ideas → women's rights, peasants' cause, freedom of press.
<b>Ishwar Chandra Vidyasagar (RRB 2025 S2)</b>	1820–1891	Championed Widow Remarriage Act (1856); crusaded against child marriage; promoted women's education.
<b>Jyotiba Phule (RRB 2025 S2)</b>	1827–1890	Founded Satyashodhak Samaj (1873); pioneered women's & lower-caste education; wrote Gulamgiri.
<b>Swami Dayananda Saraswati</b>	1824–1883	Founded Arya Samaj (1875); slogan: "Back to the Vedas"; DAV schools promoted modern + Vedic education.
<b>Swami Vivekananda (RRB 2025 S2)</b>	1863–1902	Disciple of Ramakrishna; founded Ramakrishna Mission (1897); focus on service, education, religious unity; famous Chicago Speech (1893).
<b>Balshastri Jambhekar</b>	1812–1846	"Father of Marathi journalism."
<b>Gopalhari Deshmukh (Lokहितwadi)</b>	1823–1892	Rationalist reformer; social critic.
<b>Gopal Ganesh Agarkar</b>	1856–1895	Critic of orthodoxy; edited Sudharak journal.
<b>Gopal Krishna Gokhale</b>	1866–1915	Founded Servants of India Society (1905); promoted education, social service.
<b>Narayan Malhar Joshi</b>	1879–1955	Founded Social Service League; trade union leader.
<b>Behramji Malabari</b>	1853–1912	Founded Seva Sadan; fought child marriage.
<b>Sree Narayana Guru</b>	1855–1928	SNDP movement (Ezhas, Kerala); promoted social equality & temple entry.
<b>Radhaswami Movement</b>	Founded 1861	By Shiv Dayal Saheb; stressed guru-bhakti and spiritual reform.

□ **MUGHAL ART & ARCHITECTURE**

Mughal Ruler	Major Works / Monuments	Features
<b>Babur (1526–30)</b>	Jama Masjid (Sambhal), Babri Masjid (Ayodhya), gardens, mosques, madrasas	Early mosques, simple style; often built on temple sites.
<b>Humayun (1530–56)</b>	<b>Humayun's Tomb (Delhi)</b> – built by Haji Begum (1569)	First grand Mughal tomb; red sandstone + marble; Persian–Indian style; Charbagh garden concept.
<b>Akbar (1556–1605)</b>	<b>Agra Fort</b> (1565), <b>Fatehpur Sikri</b> (1569–74), <b>Buland Darwaza</b> , Akbar's Tomb (Sikandra) (RRB 2025 S2)	Blend of Persian, Central Asian & Hindu styles; extensive sandstone use; massive gateways.
<b>Jahangir (1605–27)</b>	<b>Itmad-ud-Daula's Tomb</b> (Agra), Lahore mosque	Use of <b>white marble</b> , pietra dura (inlay work); more Persian influence.
<b>Shah Jahan (1628–58)</b>	<b>Taj Mahal</b> (1632–48) (RRB 2025 S2), <b>Red Fort</b> (Delhi), Jama Masjid (Delhi) (RRB 2025 S2)	Golden age of Mughal architecture; symmetry, marble, pietra dura, domes, minarets; Taj as pinnacle.
<b>Aurangzeb (1658–1707)</b>	<b>Bibi ka Maqbara</b> (Aurangabad, 1679), <b>Badshahi Mosque</b> (Lahore)	Decline of Mughal art; Bibi ka Maqbara → imitation of Taj; simpler, less ornate style.

□ **REVOLUTIONARY MOVEMENT IN INDIA**

Event / Case	Year	Revolutionaries Involved	Details / Outcome
<b>Chapekar Brothers Case</b>	1897	Damodar, Balkrishna, Vasudeo Chapekar	Killed plague officer W.C. Rand in Pune for atrocities; all three were hanged.
<b>Alipore Bomb Case (RRB 2025 S4)</b>	1908	Khudiram Bose, Prafulla Chaki, Aurobindo Ghosh	Attempted to kill Magistrate Kingsford; instead 2 British women died. Khudiram hanged (18 yrs), Chaki committed suicide, Aurobindo acquitted.
<b>Curzon Wylie Assassination</b>	1909	Madan Lal Dhingra	Assassinated Curzon Wylie in London; linked to India House (Shyamji Krishna Varma, Madame Cama).

➤ Major River Projects of India

Project	River	State(s)
Bansagar Project	Son	Bihar, Uttar Pradesh, Madhya Pradesh
Bhakhra Nangal Project (DHS Assam 2021)	Sutlej	Punjab, Himachal Pradesh, Haryana, Rajasthan
Bheema Project	Pawana	Maharashtra
Damodar Ghati Project	Damodar	Jharkhand, West Bengal
Durga Barrage Project	Damodar	West Bengal, Jharkhand
Farakka Project	Ganga, Bhagirathi	West Bengal
Gandak Project	Gandaki	Bihar, Uttar Pradesh
Ganga Sagar Project	Chambal	Madhya Pradesh
Hasdeo Bango Project	Hasdeo	Madhya Pradesh
Hidkal Project	Ghatprabha	Karnataka
Hirakud Project	Mahanadi	Odisha
Indira Gandhi Canal Project	Sutlej	Rajasthan, Punjab, Haryana
Jawahar Sagar Project	Chambal	Rajasthan
Jayakwadi Project	Godavari	Maharashtra
Lower & Middle Ganga Canal	Ganga	Uttar Pradesh
Mahanadi Delta Project	Mahanadi	Odisha
Mayurakshi Project	Mayurakshi	West Bengal
Minimata Bango Project	Hasdeo Bango	Madhya Pradesh
Nagarjuna Sagar Project (DHS Assam 2021)	Krishna	Andhra Pradesh
Narmada Sagar Project	Narmada	Madhya Pradesh, Gujarat
Nathpa Jhakri Project	Sutlej	Himachal Pradesh
Panchet Project	Damodar	Jharkhand, West Bengal
Pochampad Project	Godavari	Andhra Pradesh
Ramganga Project	Ramganga	Uttar Pradesh
Rana Pratap Sagar Project	Chambal	Rajasthan
Sardar Sarovar Project	Narmada	Madhya Pradesh, Maharashtra, Rajasthan
Shivanasamudra Project	Kaveri	Karnataka
Tilaiya Project	Barakar	Jharkhand
Tulbul Project	Jhelum (Wular Lake, J&K)	Jammu & Kashmir
Tungabhadra Project	Tungabhadra	Andhra Pradesh, Karnataka

➤ Oceans of the World

Ocean	General Location	Key Facts
<b>Pacific Ocean</b> (CRPF ASI 2019)	Between <b>Asia/Australia</b> and the <b>Americas</b>	Largest & deepest ocean, covers ~1/3 of Earth's surface; Mariana Trench (deepest point).
<b>Atlantic Ocean</b>	Between the <b>Americas</b> and <b>Europe/Africa</b>	2 <sup>nd</sup> largest ocean; S-shaped; busiest shipping routes; Mid-Atlantic Ridge.
<b>Indian Ocean</b>	Between <b>Africa, Asia, Australia</b> , and the <b>Indian subcontinent</b>	3 <sup>rd</sup> largest ocean; warmest ocean; important trade routes; bounded by monsoons.
<b>Southern Ocean</b>	Surrounds <b>Antarctica</b> (south of 60° S latitude)	Recognized as the 5 <sup>th</sup> ocean (2000 by IHO); coldest, strong circumpolar currents.
<b>Arctic Ocean</b>	Surrounds the <b>Arctic region</b> (north of Europe, Asia & North America)	Smallest & shallowest ocean; mostly ice-covered; includes the North Pole.

## CHEMISTRY

## CHEMISTRY

Chemistry is the study of the structure of substances and of the way that they react with other substances.

## Matter and Its Nature

Type of Matter	Definition	Examples	Classification (if any)
<b>Element</b>	Pure substance made of identical atoms.	Hydrogen, Copper	Metals, Non-metals, Metalloids
<b>Compound</b>	Substance formed by atoms of two or more elements in definite proportion.	Water (H <sub>2</sub> O), Sugar	-
<b>Mixture</b>	Combination of two or more elements/compounds in any proportion.	Milk, Cement	-

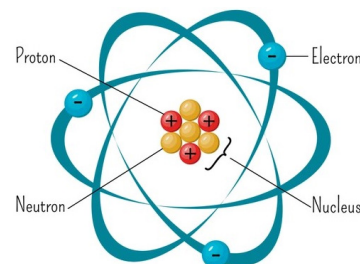
Type of Mixture	Definition	Examples
<b>Homogeneous</b>	Same composition throughout	Alloys, Solutions
<b>Heterogeneous</b>	Non-uniform composition, boundaries visible	Colloids, Emulsions, Suspensions

## GAS LAWS

Law / Concept	Statement	Key Relation / Note
<b>Boyle's Law</b>	At constant temperature, the pressure of a fixed mass of gas is inversely proportional to its volume.	$P \propto 1/V$ or $PV = \text{constant}$
<b>Charles' Law</b>	that at constant pressure, the volume of a given mass of gas is directly proportional to its absolute temperature (in Kelvin).	$V \propto T$
<b>Pressure Law</b>	At constant volume, the pressure of a fixed mass of gas is directly proportional to its absolute temperature (in Kelvin).	$P \propto T$
<b>Avogadro's Law</b>	At constant temperature and pressure, the volume of a gas is directly proportional to the number of moles (or number of molecules) of the gas.	$V \propto n$
<b>Gay-Lussac's Law</b>	At constant volume, the pressure of a given mass of gas is directly proportional to its absolute temperature (in Kelvin).	$V_A : V_B : V_{\text{products}} = \text{simple whole numbers}$
<b>Avogadro Number</b>	Equal volume of all gases contain same number of molecules.	$N_A = 6.022 \times 10^{23}$ particles
<b>Ideal Gas Equation</b>	Relation between P, V, T, n.	$PV = nRT$ ,
<b>Ideal Gas Concept</b>	Imaginary gas obeying all gas laws, volume = 0 at 0 K.	No real gas is perfectly ideal.

## STRUCTURE OF ATOM

Topic	Key Points
<b>Proton (p)</b>	<ul style="list-style-type: none"> <li>Discovered by <b>E. Goldstein</b>; positively charged;</li> <li>charge = <math>+1.6 \times 10^{-19}</math> C.</li> </ul>
<b>Electron (e)</b>	<ul style="list-style-type: none"> <li>Discovered by <b>J.J. Thomson</b> (cathode rays); named by G.J. Stoney (1891); negatively charged (<math>-1.6 \times 10^{-19}</math> C);</li> <li>charge measured by <b>R. Millikan</b> (Oil drop experiment); <math>e/m = 1.758820 \times 10^{11}</math> C/kg.</li> </ul>
<b>Neutron (n)</b>	Discovered by <b>J. Chadwick</b> ; no charge; mass $\approx$ proton; mass taken as 1 unit.
<b>Atomic Nucleus</b>	<ul style="list-style-type: none"> <li>Discovered by <b>Rutherford</b> (Gold foil experiment with <math>\alpha</math>-particles);</li> <li>mass of atom = protons + neutrons.</li> </ul>



<b>Antipyretics</b>	It is a drug used to lower body temperature.
<b>Analgesics</b>	It is a drug that is used to prevent or relieve pain. Eg. Aspirin.
<b>Antibiotics</b>	It is a drug that inhibits the growth of or destroys micro-organisms. Eg. Penicillin.
<b>Antihistamines</b>	It is a drug used to relieve symptoms of cold and allergies.
<b>Antispasmodic</b>	It is a drug used to relieve spasm of involuntary muscle, usually in stomach.
<b>Antacid</b>	It is a drug used for preventing or correcting acidity, especially in the stomach.
<b>Diuretics</b>	It is a drug that promotes the production of urine.
<b>Laxative</b>	It is a drug used to provide relief in constipation.

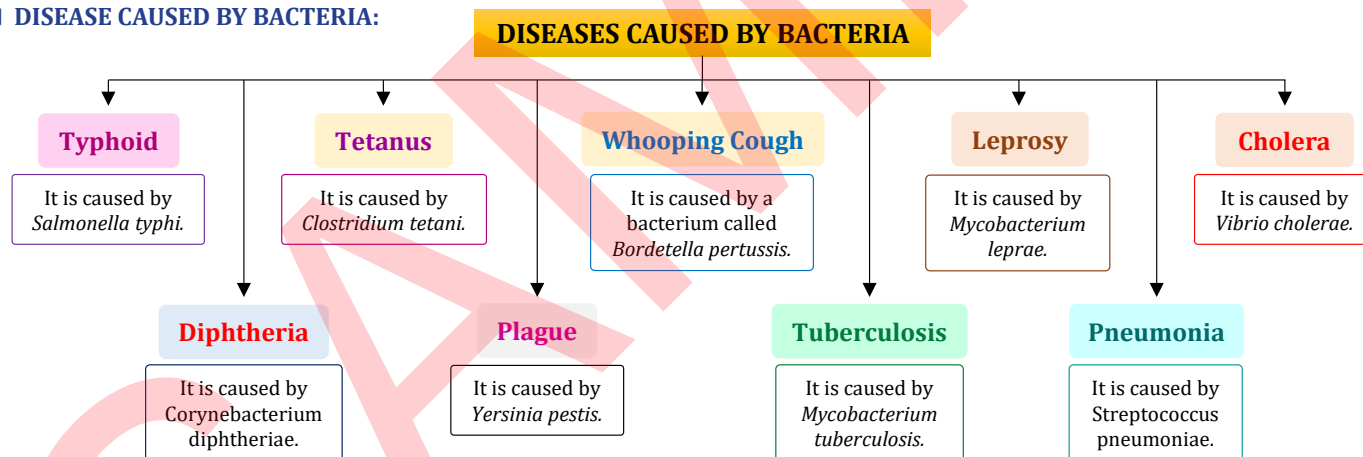
### TYPES OF DISEASES

List of Diseases caused by Virus, Bacteria, Protozoa and Worm:

#### □ DISEASES CAUSED BY VIRUSES

- 1. Chicken pox** – It is caused by Varicella-zoster virus.
- 2. Small pox** – It is caused by Variola virus.
- 3. Common Cold** – It is caused by Rhinovirus.
- 4. AIDS (Acquired Immuno Deficiency Syndrome)** – It is caused by Human Immunodeficiency Virus (HIV).
- 5. Measles** – It is caused by Measles virus.
- 6. Mumps** – It is caused by Mumps virus.
- 7. Rabies** – It is caused by Rabies virus (Rhabdoviridae family).
- 8. Dengue fever** – It is caused by Dengue virus.
- 9. Viral encephalitis** – It is an inflammation of the brain. It is caused by Rabies virus, Herpes simplex, Polio virus, Measles virus, and JC virus.

#### □ DISEASE CAUSED BY BACTERIA:



#### □ DISEASE CAUSED BY PROTOZOANS:

Disease	Cause/Pathogen	Additional Information
<b>Malaria</b>	It is spread by Anopheles mosquitoes. The Plasmodium parasite that causes malaria is neither a virus nor a bacteria	it is a single celled parasite that multiplies in red blood cells of humans
<b>Amoebic dysentery</b>	It is caused by Entamoebahistolytica	—
<b>Sleeping sickness</b>	It is caused by Trypanosomabrucei.	—
<b>Kala azar</b>	It is caused by Leishmaniadonovani.	—

#### □ DISEASE CAUSED BY WORMS:

Disease	Cause/Pathogen	Additional Information
<b>Tapeworm</b>	They are intestinal parasites. It cannot live on its own. It survives within the intestine of an animal including human.	—

## Computer Fundamentals



- **Computer:** A general-purpose electronic device that accepts **input**, processes it, and gives **output**.
- **Main Characteristics:** Speed, Accuracy, Diligence, Storage, Automation, Remembrance Power, Versatility.
- **Limitations:** No self-intelligence, decision-making, learning power, self-care, or emotions.

#### Types of Computers and Their Functions

Type of Computer	Description	Functions / Uses
<b>Supercomputer</b>	Fastest, most powerful, very expensive.	Weather forecasting, nuclear research, space exploration, scientific simulations.
<b>Mainframe Computer</b>	Large computers, support 100s-1000s of users simultaneously.	Banking, airlines, census, large enterprise data processing.
<b>Minicomputer</b>	Mid-sized, less powerful than mainframes.	Manufacturing, research labs, mid-size businesses.
<b>Microcomputer</b> (Personal Computer – PC)	Small, single-user computer (desktops, laptops).	Office work, education, gaming, internet access.
<b>Workstation</b>	High-performance single-user computer with advanced graphics & processing.	CAD/CAM design, 3D modeling, software development, scientific work.
<b>Laptop / Notebook</b>	Portable microcomputer with display & battery.	Mobile computing, education, business use.
<b>Tablet / Palmtop</b>	Very small, handheld computer.	Browsing, note-taking, e-learning.
<b>Smartphone</b>	Mobile computer + phone functionality.	Communication, apps, multimedia, internet.
<b>Server</b> (IIT Roorkee 2021)	Central computer providing services to clients in a network.	Web hosting, file storage, email, database management.
<b>Embedded Computer</b>	Built into devices, special-purpose.	ATMs, washing machines, automobiles, medical devices, IoT.
<b>Hybrid Computer</b>	Combines features of Analog (speed) + Digital (accuracy).	Used in hospitals (ICU monitoring), weather systems, controlling air traffic and radar of national defence.

#### Components of a Computer

Component	Function
<b>ALU</b>	Performs arithmetic & logical operations.
<b>Control Unit (CU)</b>	Directs and coordinates overall operations.
<b>Memory</b>	Stores data and instructions.
<b>I/O Devices</b>	Input → data fed; Output → processed information.

#### Hardware vs Software

- **Hardware:** Physical parts (CPU, Monitor, Keyboard, Mouse, etc.). An internal device which can be used to store information. (RRB 2019 P1)
- **Software:** Set of instructions/programs.
  - **System Software** → Controls system (OS, BIOS, Utilities). Used by the computer for general tasks (IIT Roorkee 2021)
  - **Application Software** → User-oriented programs (Word, Excel, Games).
  - **Bug** → Defect in software.

#### Data & Information

- **Data:** Raw facts.
- **Processing:** Converting data into useful form.
- **Information:** Organized data that adds knowledge.
- **Bit:** Smallest unit of information.

## वर्तनी शुद्धि

## 1. परिचय

वर्तनी का शाब्दिक अर्थ है 'पीछे चलना' या 'अनुसरण करना'। लिखने की रीति को वर्तनी या अक्षरी कहते हैं। किसी भी भाषा में शब्दों को उनके मानक रूप में सही वर्णों, मात्राओं और सही क्रम के साथ लिखने की क्रिया वर्तनी शुद्धि कहलाती है। अशुद्ध वर्तनी के कारण शब्द का अर्थ बदल सकता है या वह अर्थहीन हो सकता है, इसलिए भाषा की शुद्धता के लिए इसका ज्ञान अत्यंत महत्वपूर्ण है। सरकारी फार्मासिस्ट परीक्षाओं में वर्तनी शुद्धि एक महत्वपूर्ण खंड है, जिसमें उम्मीदवारों की शुद्ध शब्द पहचानने की क्षमता का मूल्यांकन किया जाता है।

## 2. वर्तनी के सामान्य नियम और विस्तृत शब्द-सूची

वर्तनी में होने वाली सामान्य अशुद्धियाँ अक्सर उच्चारण की भिन्नता, क्षेत्रीय प्रभाव या व्याकरण के नियमों की अज्ञानता के कारण होती हैं। नीचे दी गई विस्तृत तालिका में वे शब्द दिए गए हैं जिनमें अक्सर वर्तनी संबंधी अशुद्धियाँ होती हैं। यह सूची आपकी पुस्तक की सामग्री पर आधारित है और इसमें वे शब्द भी शामिल हैं जो पिछली फार्मासिस्ट परीक्षाओं में पूछे गए हैं।

क्रमांक	अशुद्ध शब्द	शुद्ध शब्द
1.	आर्शीवाद	आशीर्वाद
2.	उज्वल	उज्वल
3.	कवियत्री	कवयित्री
4.	शृंगार	शृंगार
5.	अंतर्धान	अंतर्धान
6.	अहिल्या	अहल्या
7.	आधीन	अधीन
8.	अनुगृहीत	अनुगृहीत
9.	कलस	कलश
10.	कौतुहल	कौतूहल
11.	अभ्यस्त (DSSSB 2025 S2)	अभ्यस्त
12.	अध्यन	अध्ययन (DSSSB 2025 S1)
13.	अतिथि	अतिथि
14.	उन्नति (DSSSB 2025 S1)	उन्नति
15.	अनुग्रह	अनुग्रह
16.	औद्योगिक	औद्योगिक
17.	ऐतिहासिक	ऐतिहासिक
18.	जिजीविषा	जिजीविषा
19.	तिरस्कार	तिरस्कार
20.	पुरन्दर (DSSSB 2025 S1)	पुरन्दर
21.	गृहणी	गृहिणी
22.	ज्योत्सना	ज्योत्स्ना
23.	निरोग	नीरोग
24.	प्रदर्शनी	प्रदर्शनी
25.	पूजनीय	पूजनीय
26.	बारात	बरात
27.	भागीरथी	भागीरथी
28.	व्यवहारिक	व्यावहारिक

क्रमांक	अशुद्ध शब्द	शुद्ध शब्द
29.	सन्यासी	संन्यासी
30.	शारीरिक	शारीरिक
31.	नैसर्गिक (MPESB 2022)	नैसर्गिक
32.	रचियता	रचयिता
33.	विरहणी	विरहिणी
34.	उपनिषद् (DSSSB 2025 S2)	उपनिषद्
35.	वाङ्मय	वाङ्मय
36.	संग्रहित	संगृहीत
37.	स्वास्थ्य	स्वास्थ्य
38.	स्थाई	स्थायी
39.	हिरण्यकश्यपु	हिरण्यकशिपु
40.	श्रोतागण (Raj. NHM 2025)	श्रोतागण
13.	अतिथि	अतिथि
14.	उन्नति (DSSSB 2025 S1)	उन्नति
21.	गृहणी	गृहिणी
41.	अनाधिकार	अनधिकार
42.	आजीविका	आजीविका
43.	आकांक्षा	आकांक्षा
44.	तात्कालिन	तात्कालिक
45.	दुरवस्था	दुरवस्था
46.	नरिदेशन	नदिरशन
47.	पुरुस्कार	पुरस्कार
48.	परीक्षा	परीक्षा
49.	प्रतिद्वंद	प्रतिद्वंद्वी
50.	प्रफुल्लित	प्रफुल्ल
51.	प्रामाणिक	प्रामाणिक
52.	मैथिलीशरण	मैथिलीशरण
53.	युधिष्ठिर	युधिष्ठिर
54.	लघूत्तर	लघुत्तर
55.	वापिस	वापस
56.	सृजन	सर्जन
57.	सृष्टा	स्रष्टा
58.	हस्ताक्षेप	हस्तक्षेप
59.	ब्राम्हण	ब्राह्मण
60.	आगामी	आगामी
61.	ईर्षा	ईर्ष्या
62.	रिती	रीति
63.	बिमार	बीमार
64.	समिती	समितिति

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