

GDC

Scoring in GPAT MADE EASY

GPAT AT YOUR FINGERTIPS



Theory Book



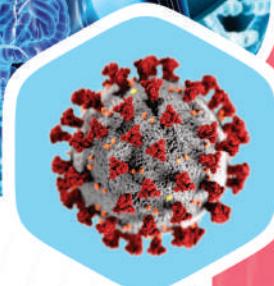
Topper's Trusted Book

**Chapterwise Student Friendly
Synopsis For Quick-and-Easy
Revision**

**SECOND
EDITION**

Features

- ▶ Easy to understand
- ▶ Rapid one shot Revision Guide
- ▶ Based on Latest Syllabus
- ▶ Section and Topicwise
- ▶ Designed by Team of Experts
- ▶ Full of Tricks and Mnemonics



**Boost Your GPAT Score
Essential for GPAT Examination**

Theory Book

Scoring in GPAT MADE EASY

GPAT AT YOUR FINGERTIPS



**Chapterwise Student Friendly
Synopsis For Quick-and-Easy
Revision**

Second Updated and Revised Edition

Boost Your GPAT Score

by

GDC EDITORIAL BOARD





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PREFACE AND ACKNOWLEDGEMENTS

Welcome to the **Second edition** of "**GPAT at Your Fingertips**" This book is an updated and revised version of the previous edition, and it is designed to provide comprehensive guidance to students preparing for the GPAT, NIPER and all other Pharma Competitive examinations.

The book is divided into various chapters covering all the important subjects of the GPAT and NIPER syllabus. Each section starts with an introduction to the topic, followed by a detailed explanation of the concepts. This updated edition includes new chapters and updated information, ensuring that the book is relevant to the latest syllabus and exam pattern.

We hope this book will help you in your preparation for the GPAT, NIPER, and all other Pharma Competitive exams and enable you to achieve your goals.

We would like to acknowledge the reviewers and critics who have provided insightful and constructive feedback on earlier versions of this book. Their comments and suggestions have helped us to refine our ideas and improve the overall quality of this work.

We would like to extend our sincere thanks to our contributors *Mr. Pratyush Swarnkar, Mr. Surya prakash Suryavanshi, Mr. Pradeep Sahu, Mr. Omprakash Patel, Mr. Krishna Kant, Miss. Bharti Vaishnav, Miss. Ahilya Kanwar, Miss. Sanskriti Nishad, Miss. Jyoti Yadav, Miss. Savita Dewangan, Miss. Mridula Singh, Miss. Divya Tripathi, Miss. Sheebu Sonwani*, for their scientific inputs.

We also wish to thanks *Mr. Vidyadhar Sahu, Mr. Chandranayan Sahu, Mr. Hitesh Pradhan* who have made this publication possible in very efficient manner.

Finally, we would like to thank our readers for their interest in this book. We hope that it will inspire, challenge, and entertain you as much as it has me.

Best of luck for your exams !

"The only way to do great work is to love what you do."

PEEYUSH JAISWAL
Director, GDC

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PART

1

PHARMACEUTICS



- ❖ Physical Pharmacy
- ❖ Dispensing Pharmacy
- ❖ Hospital Pharmacy
- ❖ Cosmetic Technology
- ❖ Pharmaceutical Engineering
- ❖ Pharmaceutical Technology
- ❖ Biopharmaceutics
- ❖ Pharmaceutical Jurisprudence



Physical Pharmacy

States of Matter

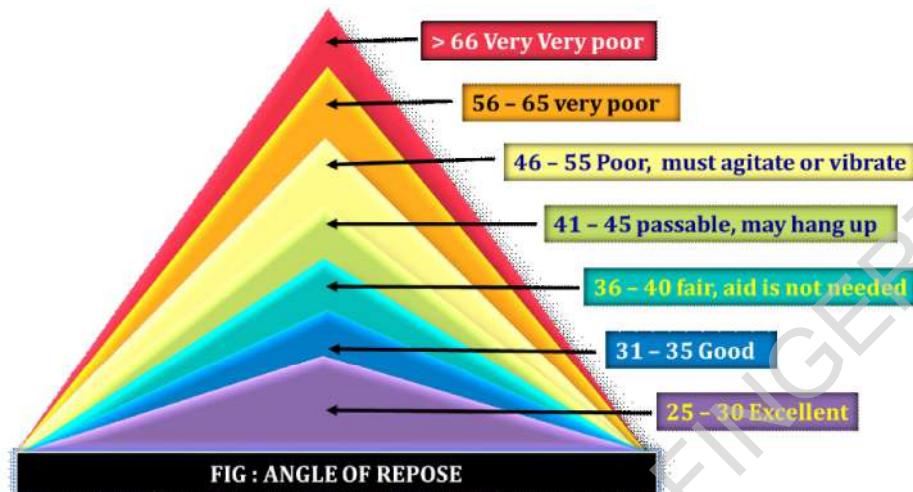
- Three states of matter are :- Solid , Liquid, Gas and Plasma is the fourth state of matter that seldom occurs on the earth.
- The state of matter that shows the uniformity of behavior.

SOLID	LIQUID	GAS	PLASMA
Have strong intermolecular force.	Weak intermolecular force.	Very weak intermolecular force.	Negligible
Very less intermolecular space.	Large intermolecular space.	Very large intermolecular space.	Particles are far apart as in a gas
Have definite shape and volume	Do not have definite shape but have definite volume	No definite shape and volume	Not have fixed shape
Have high density	Density is low	Very low density	Flow in all direction
Solids cannot be compressed	Liquids can be compressed	Gases can be highly compressed	Highly compressible

□ CRYSTALS

- Crystal lattice is constructed from repeating units called unit cells.
- External appearance of a crystal is described by crystal habits, such as needles, prisms, rosettes etc.
- Polymorphism is the ability of a compound to crystallize as more than one distinct crystalline species with different internal lattice.
- The crystal form of sulphacetamide is Orthorhombic.
- Molecules in the Smectic liquid crystals are characterized by Mobility in two directions and rotation in one axis.

- Rotating cylinder method
- Tilted box method
- Scale of flowability



B. Carr's consolidation index (Compressibility):-

- In a free-flowing powder, the bulk density and tapped density would be close in value, therefore, the Carr's index would be **small**.

$$\text{Carr's index} = \frac{\text{Tapped density} - \text{Bulk density}}{\text{Tapped density}} \times 100$$

- Scale of compressibility

HAUSNER RATIO	FLOW CHARACTER	COMPRESSIBILITY INDEX
1.0 – 1.11	Excellent	≤ 10
1.12 – 1.18	Good	11-15
1.19 – 1.25	Fair	16-20
1.26 – 1.34	Passable	21-25
1.35 – 1.45	Poor	26-31
1.46 – 1.59	Very poor	32-37
>1.60	Very- very poor	≥ 38

C. Dispersibility:-

The ability of a material to flow or pour easily over a plane.

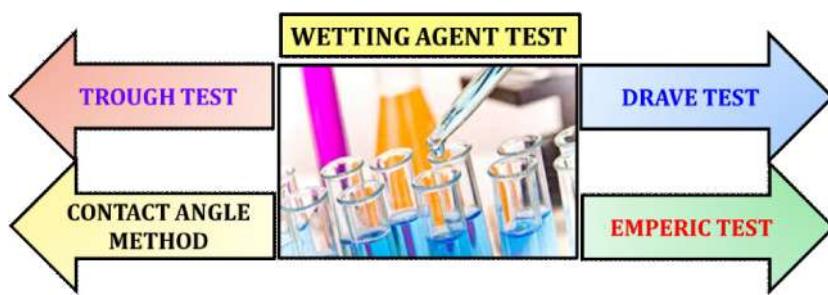
$$\text{Dispersibility (\%)} = \frac{\text{Weight of powder in a watch glass}}{\text{Initial weight of sample}} \times 100$$

D. Hausner's ratio :-

$$\text{Hausner's ratio} = \frac{\text{Tapped density}}{\text{Bulk density}}$$

❖ NOTE

- **Bulkiness is**
- ✓ The reciprocal of bulk density is bulkiness.
- ✓ Bulkiest substance will require container larger than required for less bulky substance
- ✓ Bulkiness increases with decrease in particle size



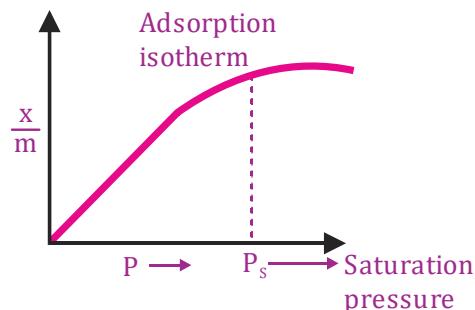
□ ADSORPTION

- **Adsorption** is the **adhesion of atoms, ions, or molecules** from a **gas, liquid, or dissolved solid** to an interface.
- There are **two general types** of adsorptions:

PHYSICAL ADSORPTION	CHEMICAL ADSORPTION OR CHEMISORPTION
<ul style="list-style-type: none"> ▪ The adsorbate is bound to the surface through the weak van der Waals forces. ▪ Weak, reversible ▪ Multilayer ▪ Absorbate free to move 	<ul style="list-style-type: none"> ▪ Involves the stronger valence forces. ▪ Seldom reversible ▪ Monolayer ▪ Not free to move

□ ADSORPTION ISOTHERM

- Amount of **gas absorbed** is plotted against **equilibrium pressure** of gas at **constant temperature**.
- **Equations** which defines **adsorption isotherms** are – **Freundlich, Langmuir and Brunner, Emmett and Teller (BET)**.



□ TYPES OF ISOTHERMS

S. NO.	TYPES	EQUATION	ABBREVIATION
1.	Linear Isotherm		
2.	Freundlich adsorption isotherm 	$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$ 	$y \rightarrow$ Mass of gas adsorbed per unit weight of absorbent $k, n \rightarrow$ Constant $p \rightarrow$ Equilibrium gas pressure



Dispensing Pharmacy

Prescription

It is an **order written by** a physician, dentist, veterinarian or a registered medical practitioner (RMP) to a **pharmacist** to **compound and dispense** a specific drug for the patient

The word “prescription” is derived from the **Latin term praescriptus.** (**Prae** - ‘before’ and **scribere** - meaning ‘to write’).

□ PARTS OF PRESCRIPTION

Superscription (Symbol Rx)	<ul style="list-style-type: none"> It is represented by Rx (Latin term) “recipe” which means “take thou” or “you take”. In olden days, the symbol was considered to be originated from the sign of Jupiter. Jupiter is the Greek God of healing. 	
Inscription (Medication prescribed)	<ul style="list-style-type: none"> It is the main part of the prescription. It contains the names and quantities of the prescribed medicaments. 	
Subscription (Direction to Pharmacist)	<ul style="list-style-type: none"> In this part the prescriber gives direction to the pharmacist regarding the dosage form to be prepared. 	
Signatura (Direction for Patient)	<ul style="list-style-type: none"> To be placed on the label. It is usually written as “Sig” The signatura written in English and use some Latin abbreviations like t.i.d (thrice a day), b.i.d (twice a day) and o.d (once a day). 	



Hospital & Clinical Pharmacy

HOSPITAL - A hospital is a **health care institution providing patient treatment with specialized health science and auxiliary healthcare staff and medical equipment.**



□ CLASSIFICATION OF HOSPITALS

Type I. On Clinical Basis & Ownership and control basis

CLINICAL-BASIS			NON-CLINICAL-BASIS	
Medicine	Surgery	Maternity	Governmental	Non-Governmental
1. Paediatrics	1. Orthopaedic	1. Short-term	• Army hospital	Private Hospitals for Profit
2. Psychiatric and Nervous diseases	2. Gynecology	2. Long-term	• Navy hospital	Non-Profit Church hospital
3. T.B. Hospital	3. ENT.		• City hospital	Community hospital
4. General medicine			• Civil hospital	Missionary hospital
			• Big hospitals	Charitable hospital
			• AIIMS/PGI etc.	

Type II - On size basis

Large Hospitals	Beds 1000 and above
Medium Hospitals	Beds between 500 - 1000
Small Hospitals	Beds between 100 - 500
Very small Hospitals	Beds less than 100

□ FLOOR SPACE REQUIREMENT

S.N.	AREA SQ. FT. FOR	50 BEDS	100 BEDS	200 BEDS
1.	Compounding and dispensing laboratory	205	320	495
2.	Parenteral solutions laboratory		185	200
3.	Store Room		125	200
4.	Manufacturing laboratory			120
5.	Office and Library			105
6.	Circulation			60
7	TOTAL	205	630	1,180



Pharmaceutical Engineering

Flow of Fluids

- **Flow of fluids** is the flow of substance (**liquids and gases**) that **does not permanently resist distortion**.
- Fluid mechanics is divided into **Fluid statics and Fluid dynamics**.
 - Fluid statics deals with **fluids at rest in equilibrium**.
 - It is employed in the **working of manometers**.
 - It is also applied for quantification of fluid flow as in **Bernoulli's theorem**.
 - Fluid dynamics deals with **fluids in motion**.
 - Manufacture of **dosage form**
 - Handling of **drugs for administration**

□ MANOMETER

- Manometers are the devices used for measuring the **pressure difference**.
 - **Different types of manometers**

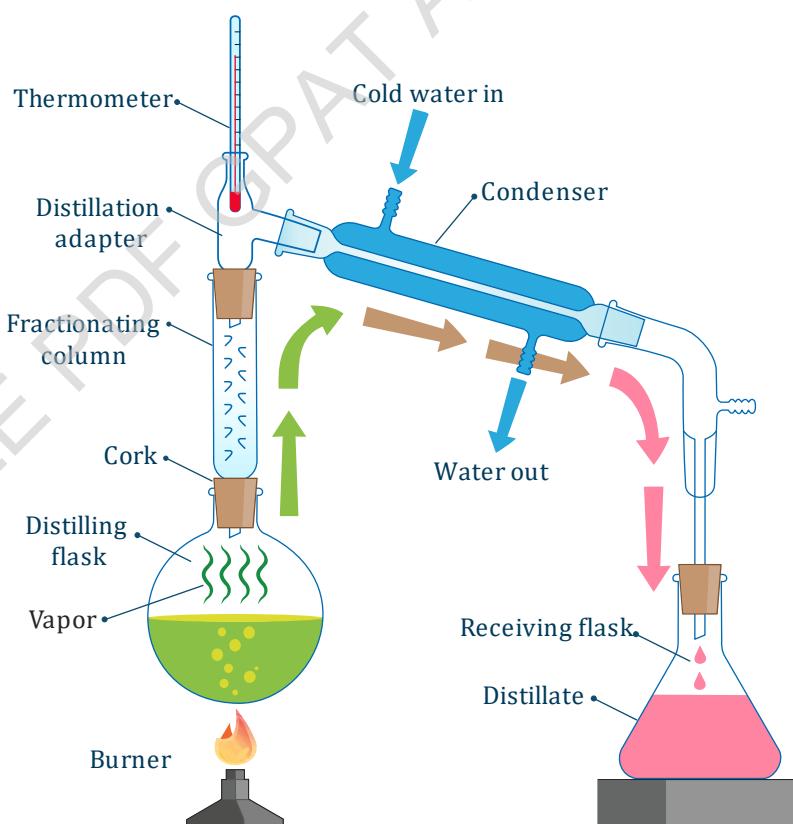
SIMPLE MANOMETER	DIFFERENTIAL MANOMETER	INCLINED MANOMETER
<ul style="list-style-type: none">• It is a device which measures pressure at a point in a fluid contained in a pipe or vessel.• U tube fluid manometer	<ul style="list-style-type: none">• It is a manometer which measure the difference of pressure between any two points in a pipe or vessel containing fluid.• Two-fluid U-tube manometer	<ul style="list-style-type: none">• It is a device which measures the minute pressure differences between any two points in a fluid contained in a pipe or vessel.
USES <ul style="list-style-type: none">• Used in measuring the consumption of gases in chemical reactions.• Used in conjunction with flow meters for measurement of flow of fluids	USES <ul style="list-style-type: none">• Useful for measuring even small gas pressures• Used in measurement of small pressure differences.	USES <p>This type of manometer increases the accuracy of the pressure determination of particularly for small head.</p>

EVAPORATION EQUIPMENTS

EVAPORATOR	USES
Evaporating pan (Steam jacketed kettle)	It contain liner as pan and use for aqueous and thermo-stat liquor.
Vacuum pan	Use for thermolabile materials.
Evaporating stills	Use for thermolabile materials.
Horizontal Tube Evaporator	Use for liquor that do not crystallize and not form scale and non-viscous.
Vertical tube Evaporator (CALANDRIA)	Use in sugar industry, concentrate cascara extract and not for foamy liquid.
Vertical tube (Basket type) evaporator	Use for sugar, salts and heavy chemical.
Climbing film (Kestner Tube) Evaporator	<ul style="list-style-type: none"> • Use for Insulin, Vitamin Blood plasma, Liver extract like thermolabile material and for foamy corrosive liquid. • Not for viscous liquids.

Distillation

- Distillation is defined as the **separation of the components** of a liquid mixture by a process involving **vaporization and subsequent condensation** at another place.
- **Jabir ibn Hayyan** is discovered **distillation**.





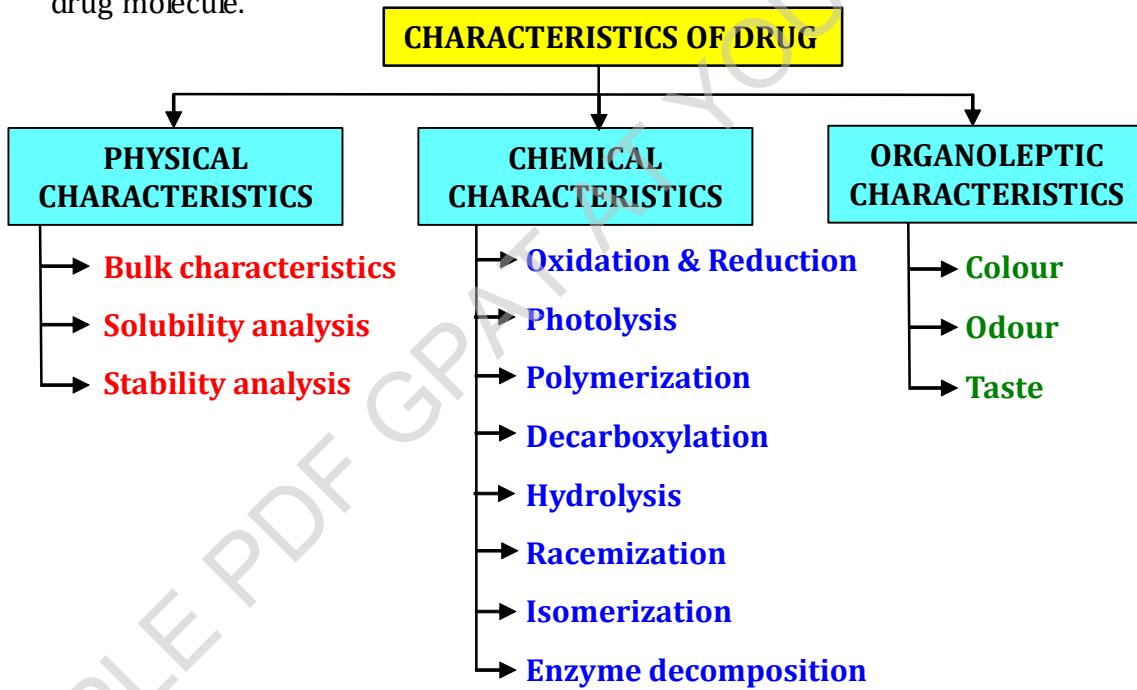
Pharmaceutical Technology

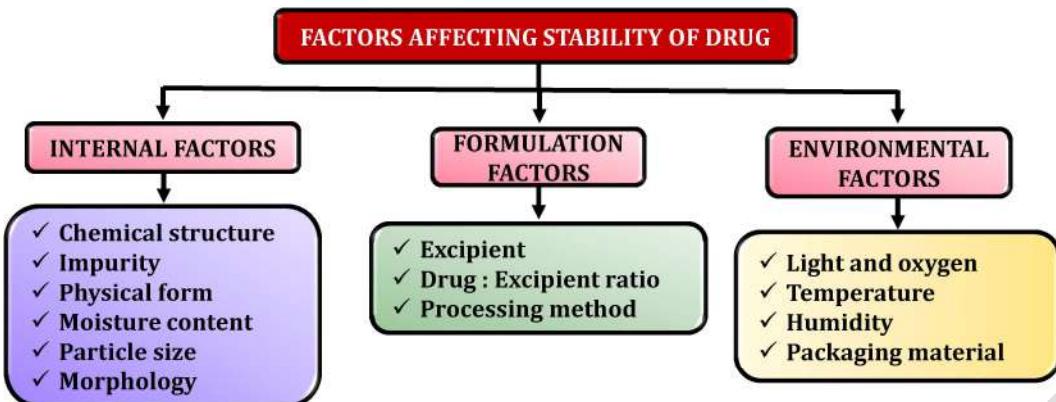
Preformulation

- This is an **investigation** of **physical and chemical properties** of drug substance alone and when **combined with excipients**.

□ OBJECTIVE

- To formulate an **elegant, safe, efficacious** dosage form with **good bioavailability**.
- To formulate **new dosage form** of an **already existing drug**.
- Determination of all the **properties of drug** and the best suitable dosage form for the drug molecule.





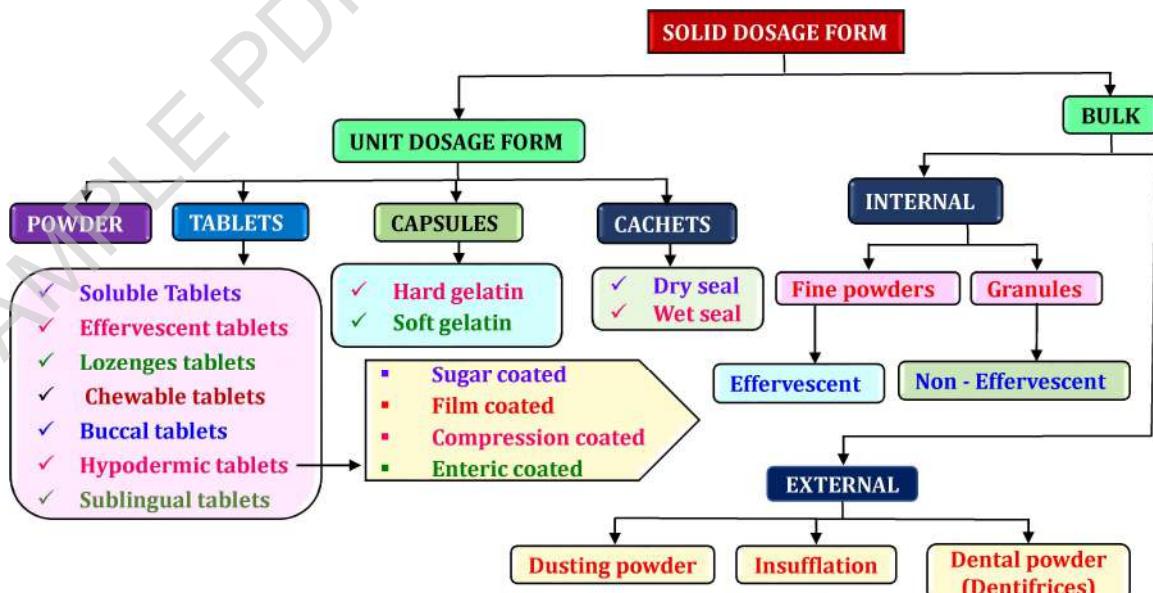
□ BIOPHARMACEUTICAL CLASSIFICATION OF DRUGS

- Proposed by GL. Amidon
- Maximum drugs falls under BCS class-II and IV

CLASS	SOLUBILITY	PERMEABILITY	ABSORPTION	EXAMPLE
I	High	High	Well absorbed	Diltiazem, Propranolol, Metoprolol
II	Low	High	Variable	Nifedipine, Carbamazepine, Naproxen
III	High	Low	Variable	Insulin, Metformin, Cimetidine
IV	Low	Low	Poorly Absorbed	Taxol, Chlorothiazide, Furosemide

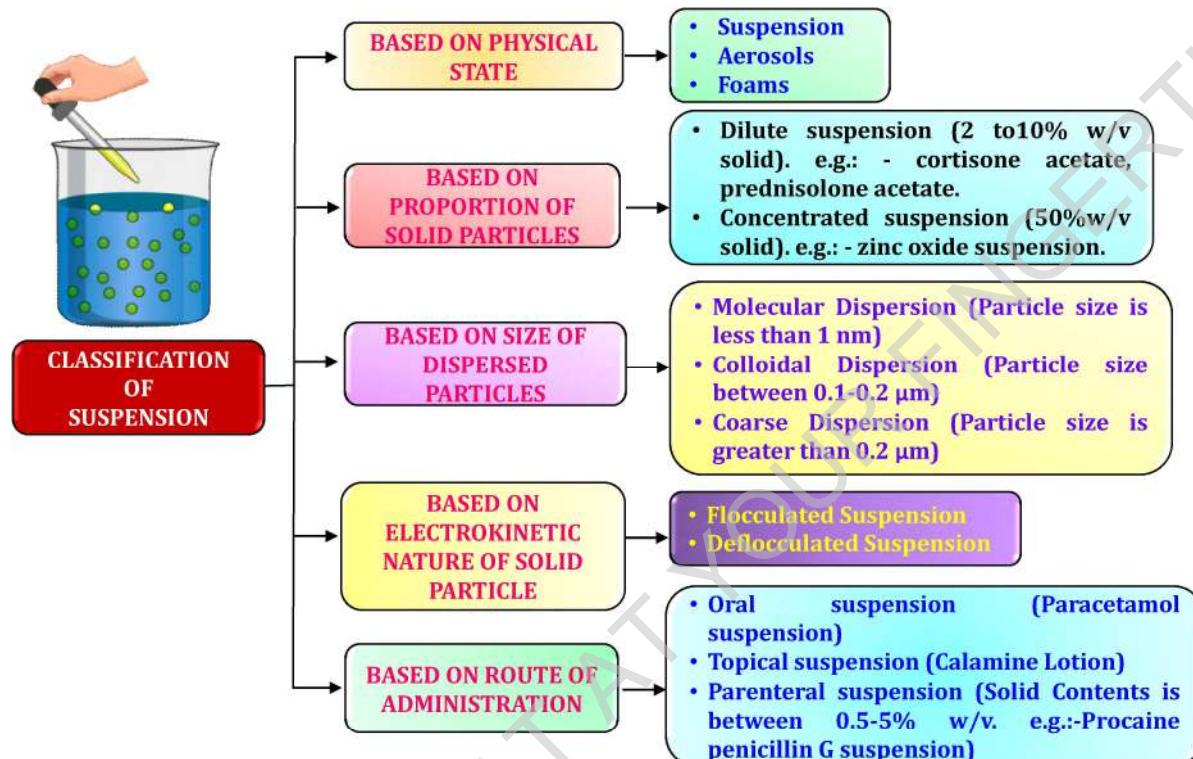
Classification of Dosage Form

□ SOLID DOSAGE FORM



SUSPENSION

- Dispersions where **Active Pharmaceutical Ingredient** of **low solubility** is dispersed in the external phase. Particle size range is **usually greater than $0.1\mu\text{m}$** .



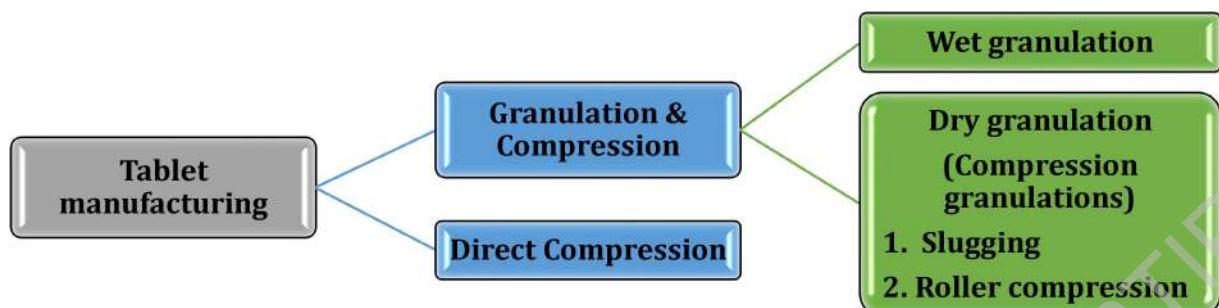
□ TERMINOLOGY RELATED WITH SUSPENSION

TERMS	DEFINITION
Swamping	Increase in concentration of ions in the solution decrease the thickness of double layer and therefore aggregation occur
Subsidence	Describe the settling of an aggregated system (flocculated system)
Ostwald ripening	Cyclization changes in temperature in suspension to form crystal bridging called Ostwald ripening
Freeze thaw cycling	Technique is particularly applicable to stressing suspension for stability testing purpose
Levigation	Particle size reduction by grinding
Pulverization	Process of powdering by a Micronization technique

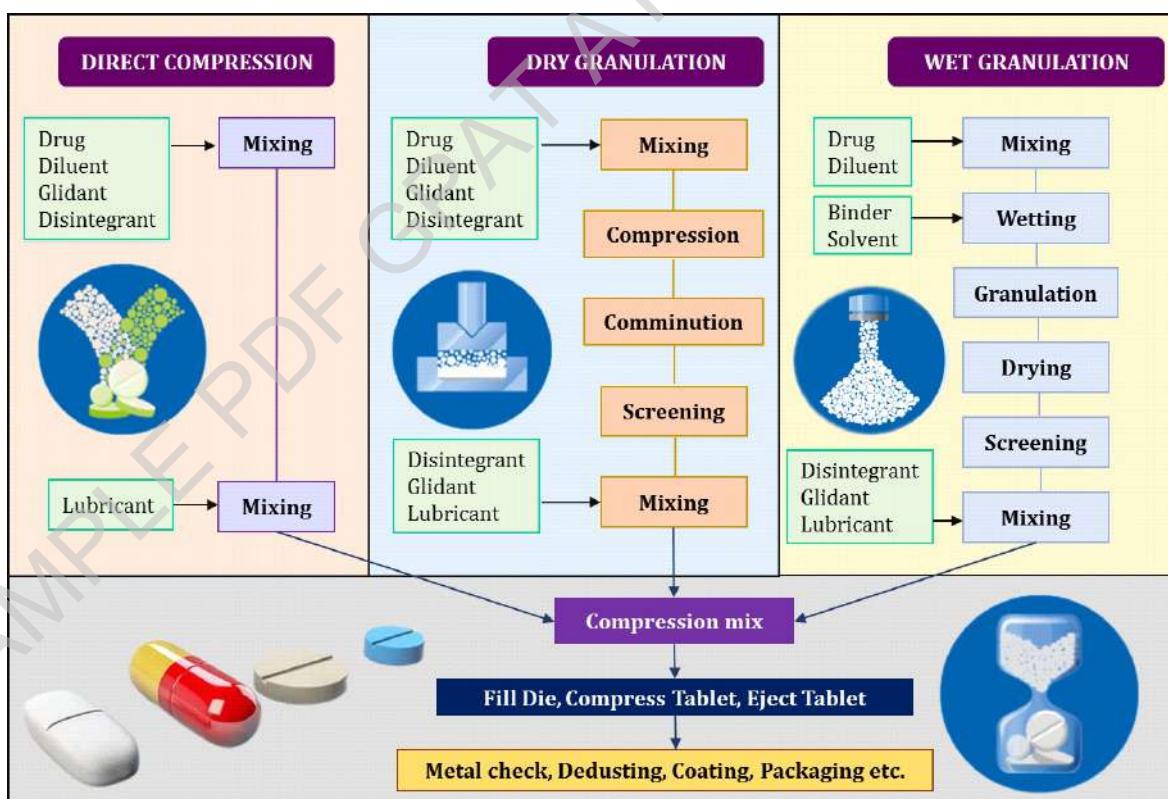
□ DIFFERENT BETWEEN FLOCCULATED & DEFLOCCULATED SUSPENSION

FLOCCULATED SUSPENSION	DEFLOCCULATED SUSPENSION
Particles settles as flocs	Particles settles as a separately due to low particle size
Supernatant liquid is clear	Supernatant liquid is cloudy
Suspending agent settles down rapidly	Suspending agent remains suspended for long time

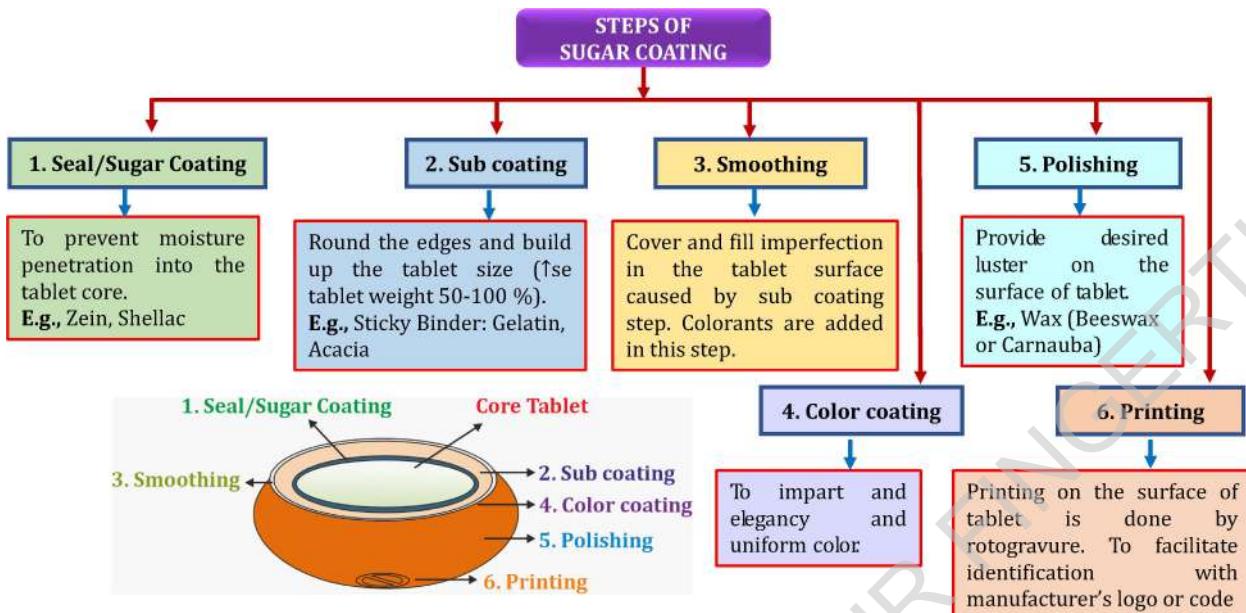
□ MANUFACTURING OF TABLETS



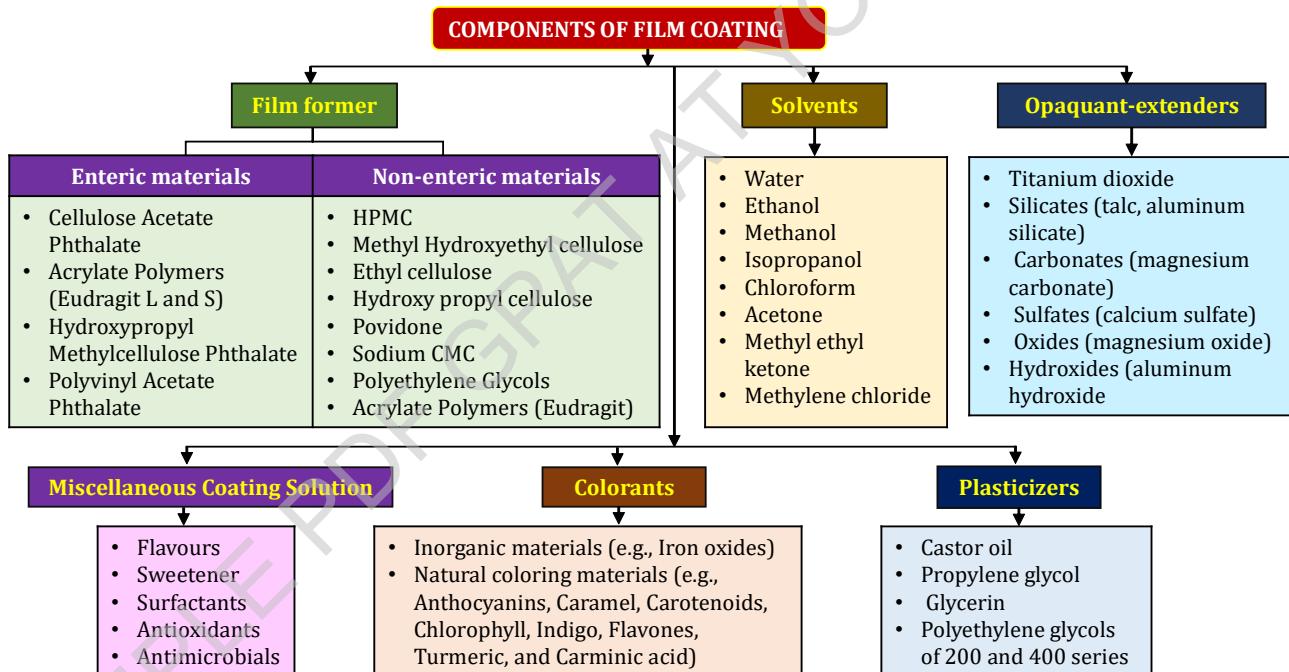
- ❖ **Granulation** :- Granulation process transforms fine powders into free-flowing, dust-free granules that are easy to compress. It is one of the **most significant unit operations** in the production of **mostly tablets and capsules**.
- ❖ **Compression** :- During the compression stage, the **top and bottom punch** come together by pressure within **the die to form the tablet**. After that top and bottom punches move between two large wheels **called compression rolls**.
- ❖ **Wet granulation** :- In wet granulation the **API and excipients** are **mixed with water or an organic solvent** to **make a dumb mass** and then **sieved into its fine granules**.
- ❖ **Dry granulation** :- Done when drug is **sensitive to heat and moisture**. eg - Aspirin, Vitamin. This process **doesn't contain any liquid solvent** for mixing.



□ STEPS OF SUGAR COATING



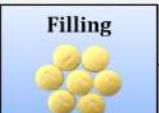
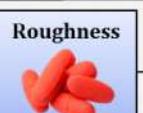
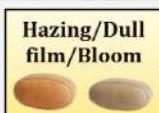
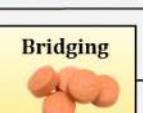
□ COMPONENTS OF FILM COATING



□ TERMS RELATED WITH TABLET COATING

TERMS	DEFINITION
Opalux	Opaquant colour concentrate for sugar coating
Opaspray	Opaquant colour concentrate for film coating.
Opadry	Complete film coating concentrate

□ TYPES OF FILM DEFECTS

Sticking 	Over wetting or excessive film tackiness	Filling 	Applying too much solution
Picking 	Piece of film adhered to the pan	Blistering 	Too rapid evaporation of the solvent from the core
Roughness 	Increase in pigment and polymer concentration/ Applied by spray	Hazing/Dull film/Bloom 	Too high a processing temp. / exposed to high humidity conditions
Orange-Peel effect 	Inadequate spreading of coating solution before drying	Cracking 	Internal stresses in the film exceed the tensile strength of the film
Bridging 	Decrease the incidence of bridging	Twinning 	Overwetting whereby two or more of the tablet cores are stuck together

□ EVALUATION OF TABLET



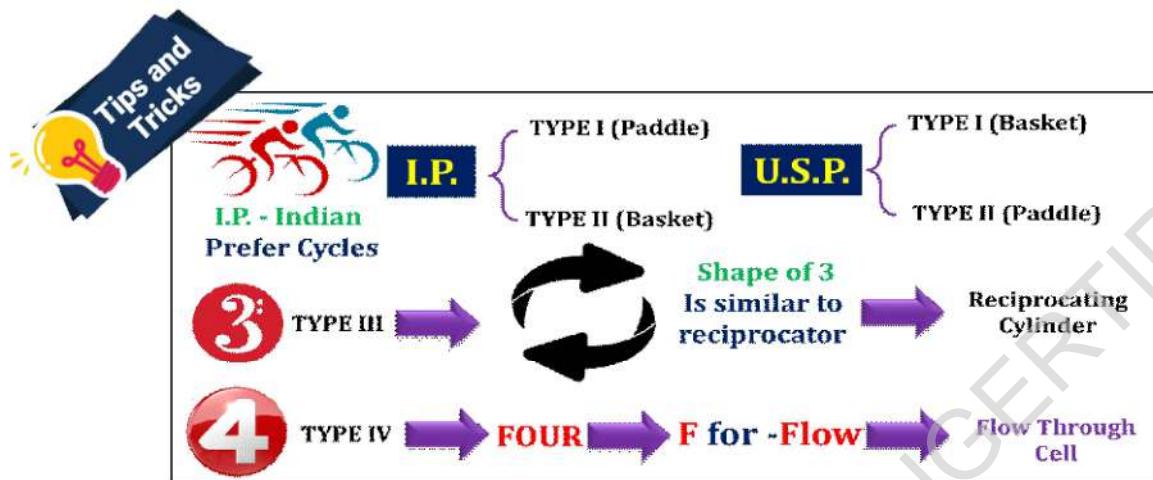
❖ NON OFFICIAL TEST

1. HARDNESS

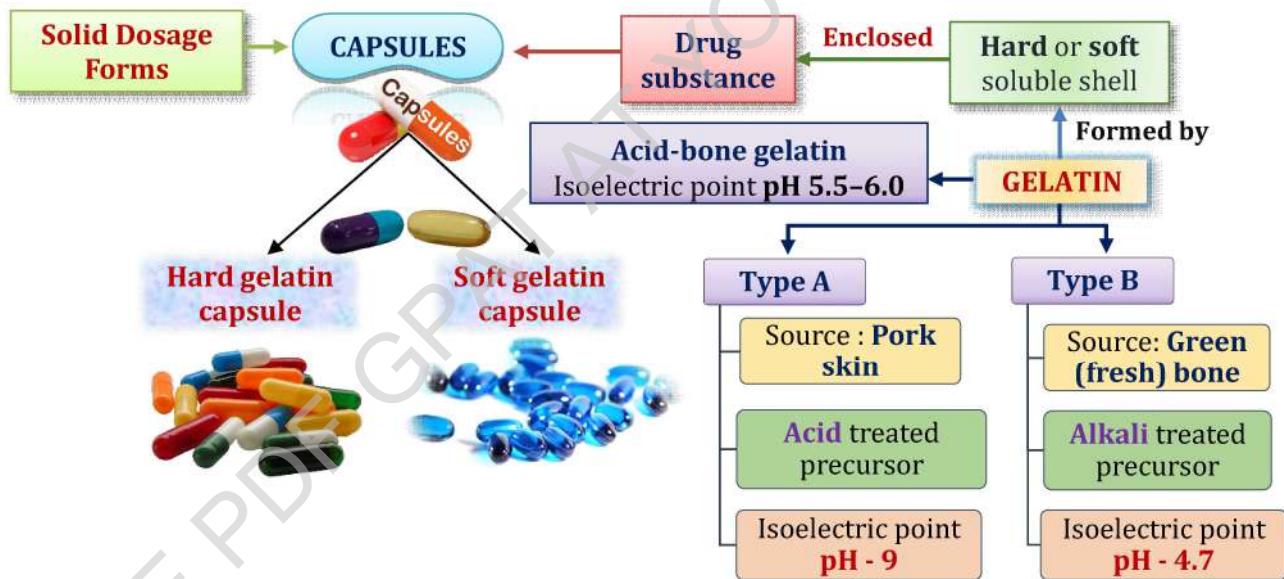
- Tablets require a **certain amount of strength**, or **hardness** and resistance to **friability**, to withstand **mechanical shocks** of **handling in manufacture, packing and shipping**

HARDNESS TESTER	COMMENTS
Monsanto Tester	Gives strength in Kgs
Strong-cobb Tester	Force applied by hydraulic pressure & later air Pressure
Pfizer Tester	Force applied by hydraulic pressure & later air Pressure
Erweka Tester	Gives strength in Kgs.
Schleuniger Tester	Gives strength in Kgs & strong cobb.
Vickers	Used to measure the surface hardness.
Webster & Van Abbe	Indicated edge damage during handling.

□ TRICK TO REMEMBER DISSOLUTION APPARATUS



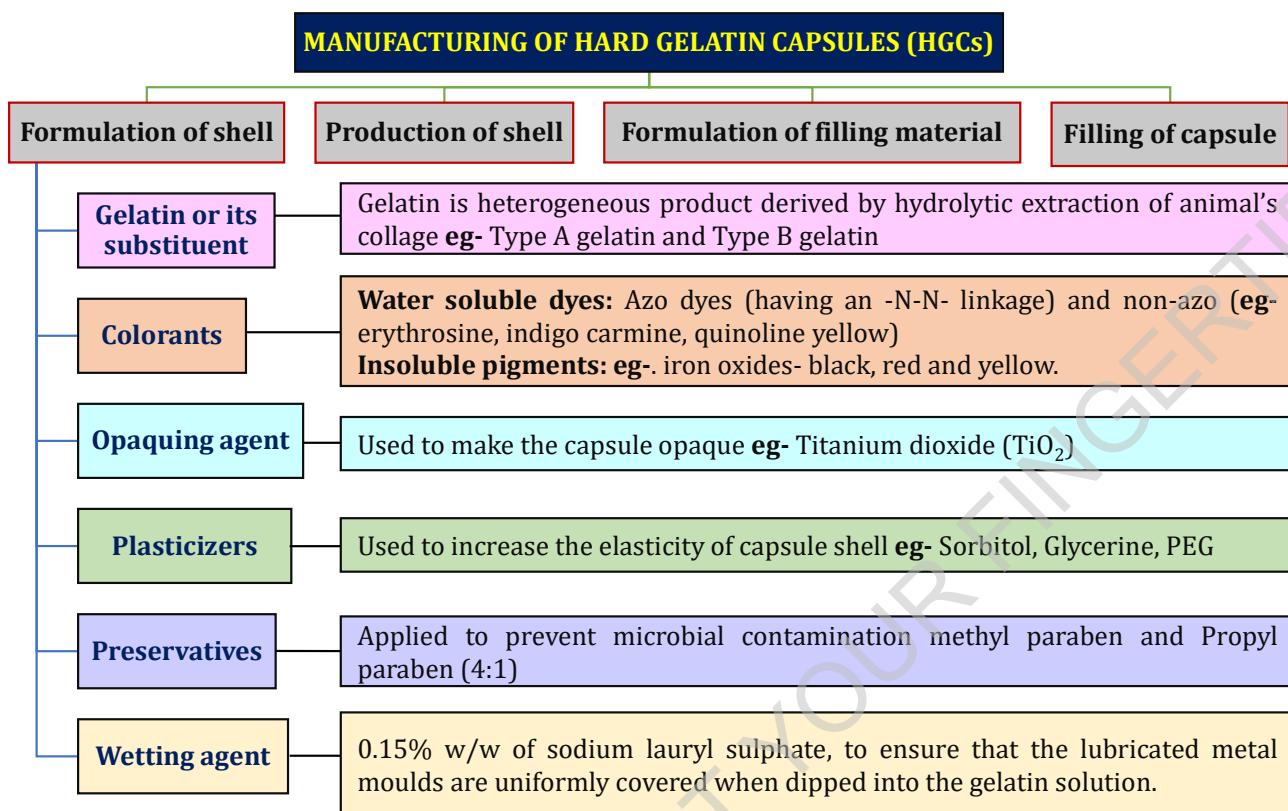
Capsules



□ DIFFERENCE BETWEEN HARD & SOFT GELATIN CAPSULES

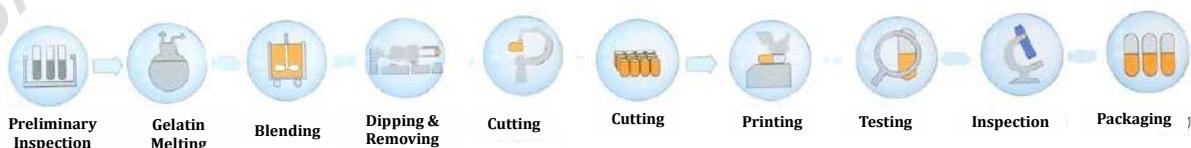
CRITERIA	HARD GELATIN CAPSULES	SOFT GELATIN CAPSULES
Shell	Not plasticized	Plasticized (Glycerin, Sorbitol, PEG)
Moisture	12-16%	6-10%
Sizes	Limited	Many
Shapes	Two-piece	One-piece
Content	Usually dry solids	Usually liquids or suspensions
Closure	Traditional friction-fit, mechanical interlock, banding	Hermetically sealed (Inherent)

□ MANUFACTURING OF HGCs INVOLVE FOLLOWING COMPONENTS



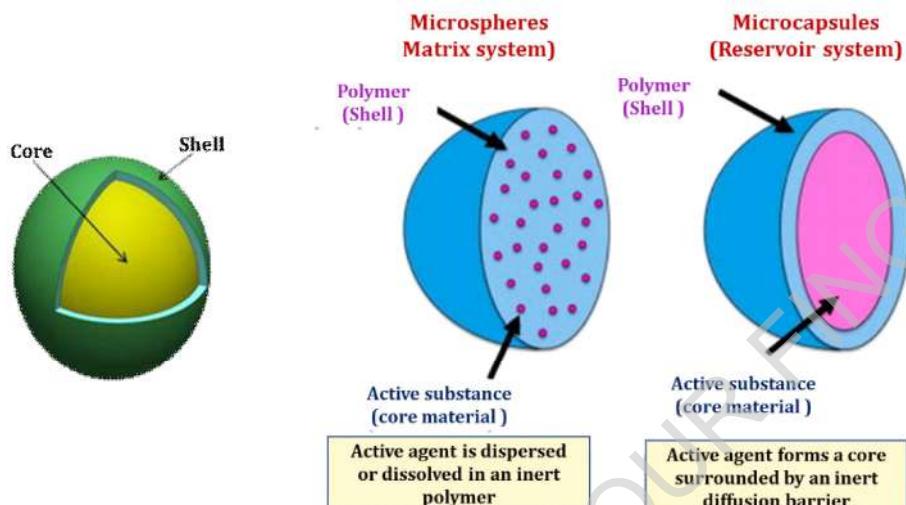
□ METHODS OF MANUFACTURING EMPTY GELATIN CAPSULE SHELLS

STEPS	DESCRIPTION
Dipping	Temperature of pins = $22^\circ C$, Solution temperature = $50^\circ C$ Time required = 12 seconds
Spinning	Pins are rotated to distribute the gelatin uniformly around the pins
Drying	By use of dry air and dehumidification
Stripping	By bronze jaws
Trimming	By stationary knives
Joining	Cap and body are joined
Polishing	Polishing by the polymer

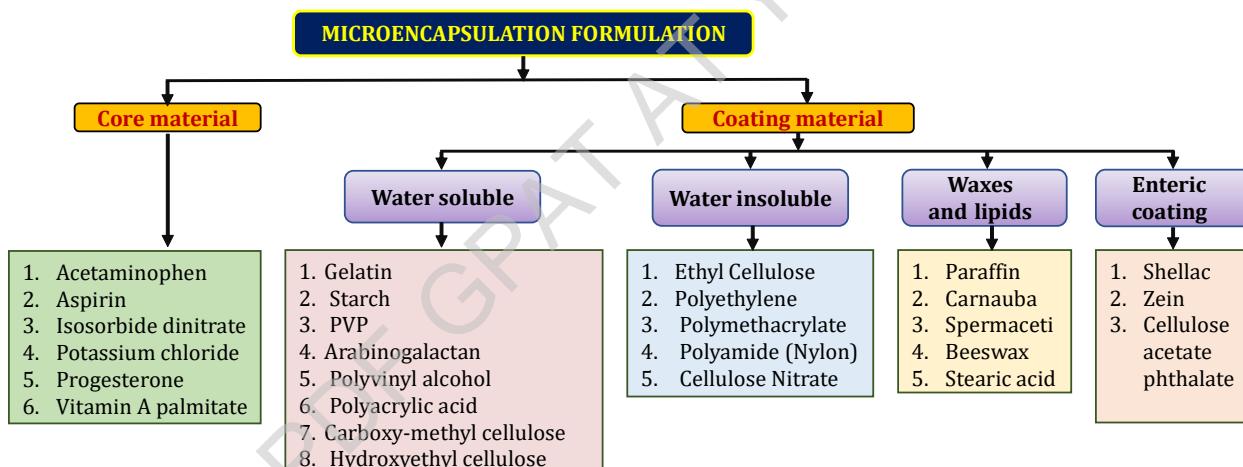


Microencapsulation

- Microencapsulation is the method of applying a **thin film or coating to small particles of solids or droplets of liquids or and dispersion.**
- Approximate particle size: **1 – 5000 microns**



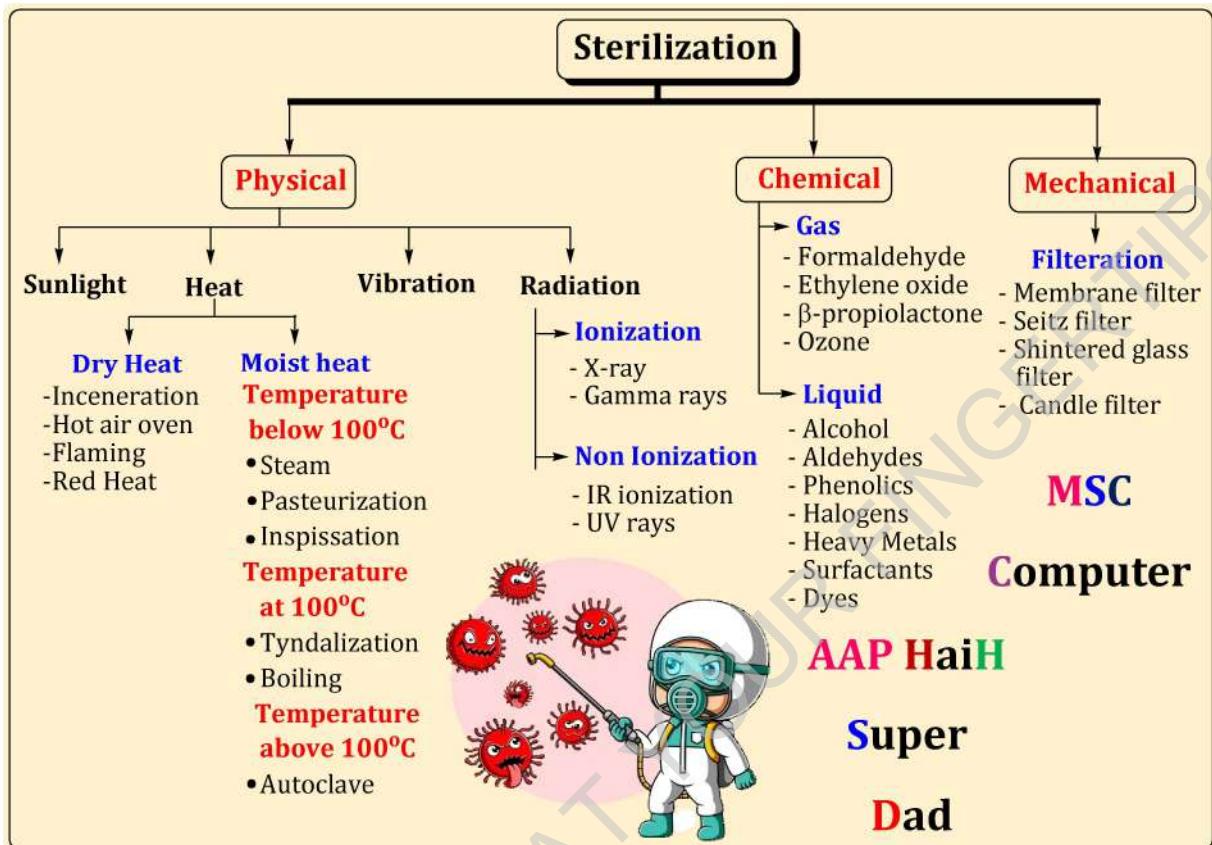
□ FORMULATION OF MICROENCAPSULATION



□ TECHNIQUES OF MICROENCAPSULATION

S.NO.	TECHNIQUES USED	METHODS
1.	Physicochemical method	<ul style="list-style-type: none"> • Coacervation phase separation • Sol-Gel encapsulation coacervation • Layer-by-layer assembly • Solvent evaporation
2.	Physicomechanical method	<ul style="list-style-type: none"> • Pan coating • Air suspension method • Spray drying • Multiorifice • Spray congealing Dip coating
3.	Chemical method	<ul style="list-style-type: none"> • Polymerization Complexation • In situ polymerization

□ CLASSIFICATION OF STERILIZATION METHOD



➤ HEAT STERILIZATION

Sterilization by heat is of two types:-

A) Dry heat - Killing effect is due to **protein denaturation**, **oxidative damage** and the toxic effect of **elevated metabolites**.

Method used are:-

1. Incineration:-It is used for **contaminated clothes, animal carcasses and pathological materials**.

2. Hot air oven:-It is used for **glassware, all glass syringes, swabs, liquid paraffin, dusting powder forceps, scissors, scalpels, fat and grease**.

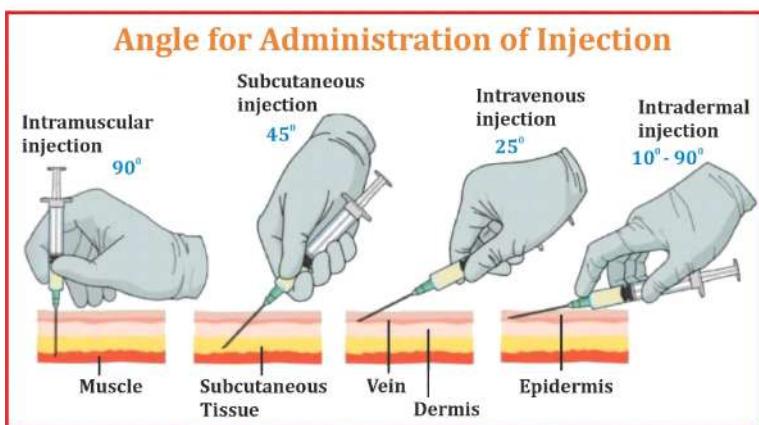
Method	Temperature (°C)	Holding time (in minutes)
Hot air oven	170	60
	160	120
	150	150
	140	180



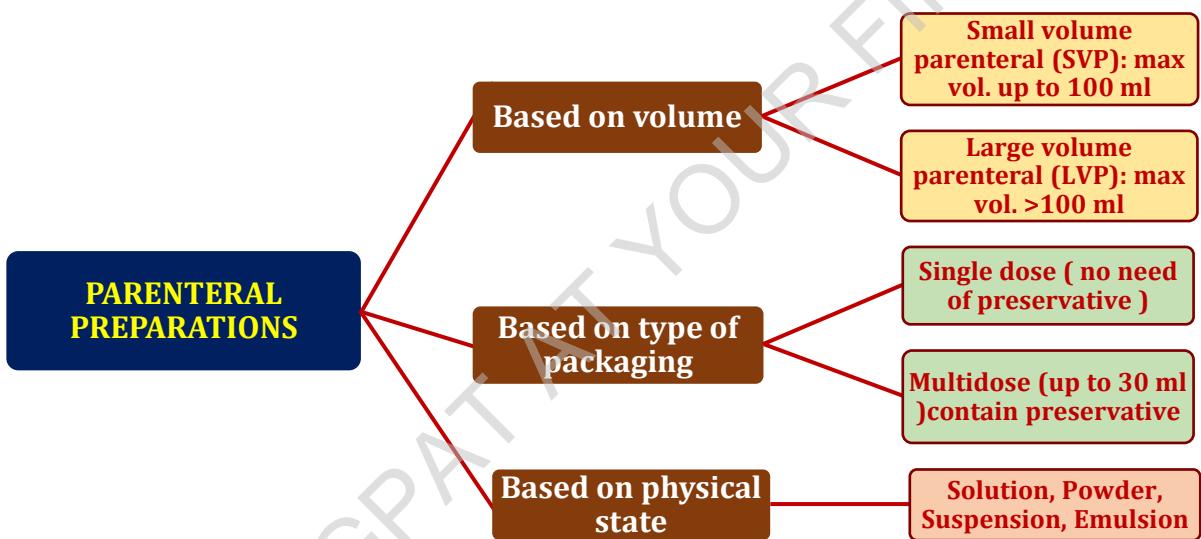
3. Flaming :- Involves exposure of metallic objects to flame for some time where the flame burns microbes and other **dust presents in the instrument**.

4. Red Heat :- Red heat sterilization is the process of instant sterilization by holding the instruments in a **Bunsen flame till they become red hot**.

□ TYPES OF PARENTERAL PREPARATION



□ CLASSIFICATION OF PARENTERAL PREPARATION

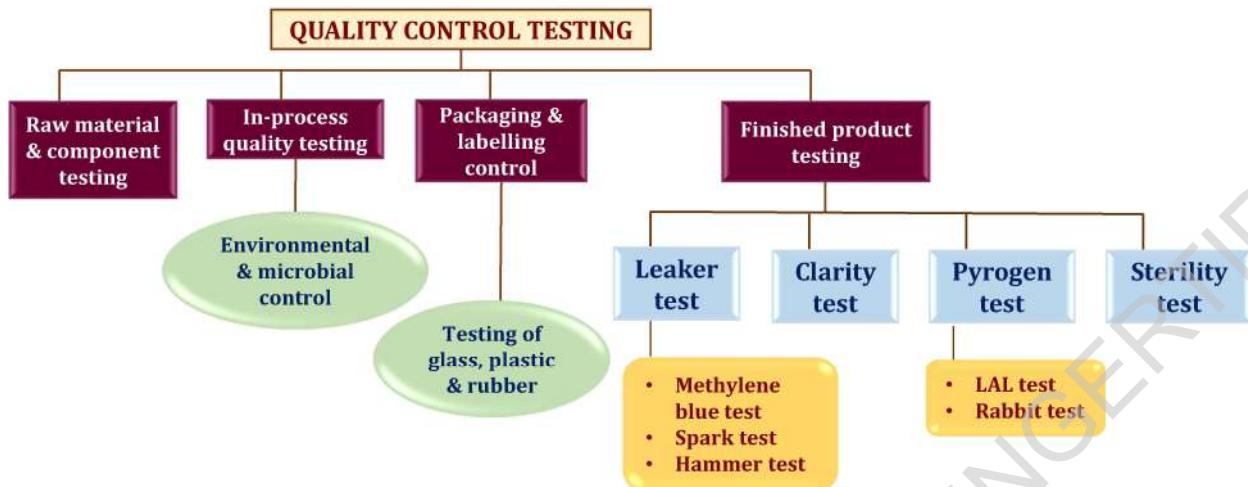


PARAMETER	SVP	LVP
1. Volume	100ml or less	101-1000 ml
2. Route	IV, IM & SC	IV & Non-IV
3. Dosage unit	Single or multiple	Single
4. Preservative & buffer	Used	Not used
5. Isotonicity & Pyrogenicity	Not essential	Essential

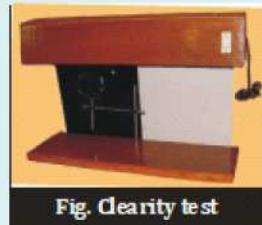
□ CHARACTERISTICS OF PARENTERALS

CHARACTERISTIC	DESCRIPTIONS
1. Sterility	<ul style="list-style-type: none"> Dosage forms administered parenterally, ophthalmic solutions and any medical devices used in conjunction with must be sterilized.
2. Freedom from particulate matter	<ul style="list-style-type: none"> Freedom from particulate matter (mobile, undissolved substances). Environmental control by the use of HEPA filters, precautions should be taken by the manufacturing personnel.

□ QUALITY CONTROL TESTING

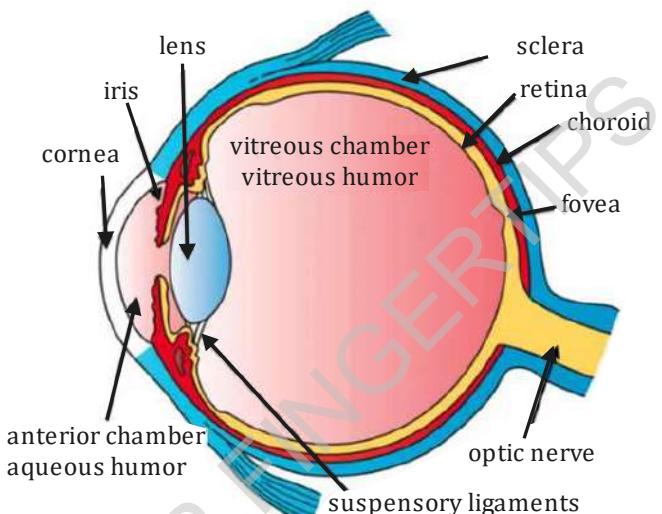


- Quality control testing of parenteral products

Leaker test (Packaging integrity test)	<ul style="list-style-type: none"> • Methylene Blue Test (for ampoules) 1% Methylene blue dye and vacuum used. • Hammer Test (for vials & bottles) Presence of vacuum is detected by striking base of bottle sharply to produce water hammer sound. 	 Fig. Leaker test
Clarity test (Particulate matter test)	<p>Instrument used-</p> <ul style="list-style-type: none"> • Light scattering (Nephelometer) • Light absorption, Electrical resistance (Coulter counter) <p>I.V. fluid meet the requirement- NMT 50 particle per ml of 10 µm and NMT 5 particle per ml of size 25 µm. (USP standard for Large volume preparations)</p>	 Fig. Clarity test
Sterility test	<p>Sterility testing is performed for detecting microorganism in parenteral product. Place parenteral product in culture media</p> <p>✓ Method</p> <ol style="list-style-type: none"> 1. Direct transfer method (Thioglycolate culture media) <ul style="list-style-type: none"> • Is used for identification of aerobic and anaerobic bacteria. • Soybean casein Culture media - Used for identification of fungi. 2. Membrane filtration technique <ul style="list-style-type: none"> • It is suitable for liquids, soluble powder with bacteriostatic or fungistatic oils, creams, and ointment. • It is done by passing the products from membrane filter with porosity of 0.45 mm with diameter 47mm with flow rate of 55-75 ml/per min. at a pressure 70 cm of mercury. 	

Ophthalmic Preparations

- Ophthalmic preparations are **sterile** preparations, designed to be **instilled on to the external surface of the eye** (topical), **administered inside** (intraocular) or **adjacent to the eye** (periocular).
- These products must be **isotonic with lachrymal secretions** to avoid discomfort and irritation. The **pH should be controlled up to 7.4** to avoid irritation.
- Ocular dosage forms **shows poor bioavailability (< 1%)** of drugs mainly due to the **precorneal loss factors**.



□ TYPES OF OPHTHALMIC PREPARATION

TYPES OF OPHTHALMIC PREPARATIONS

Solution

To produce the desire therapeutic effect. Care must be taken that solution remain in the eye.

Suspension

Should not contain particle size larger enough to produce eye irritation ($>10\mu$).

Ointment

These are prepared under aseptic condition and packed in sterile collapsible tubes.

Contact lens care solution

Facilitate the care of contact lenses to make them wearable.

Eye lotion

Drug is dissolved in a non-aqueous vehicle, such castor oil, and emulsified with water using a nonionic surfactant.

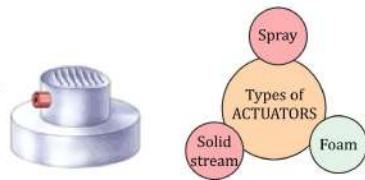
Ophthalmic insert

Sterile preparation containing solids or semisolids, whose size and shape are especially design to increase ocular residence, possibility of releasing drugs.



□ ACTUATORS

- Used to ensure that the aerosol product is delivered in the proper and desired form.



□ TYPES OF AEROSOL SYSTEMS

Solution system	Two phase system, active ingredient is soluble in the propellant, cosolvents such as ethanol or isopropanol may be used, propellant added for foam system is usually 5% and for inhalation 95% is required.
Water based system	Three phase system (propellant phase, water phase and vapor phase), used to emit formulation as spray or foam, cosolvent (ethanol) or surfactants (long chain fatty acids esters of polyhydroxylic compounds, 0.5-2%) are used.
Suspension or Dispersion system	Three phase system, difficult to formulate, physical stability of the system can be increased by the control of moisture content, reduction of particle size of 5μ (50 for topical), adjustment of density of propellants and /or suspension, use of dispersing agents.
Foam system	Consist active ingredient, aqueous or nonaqueous vehicles, surfactants, propellants. Produce quick stable or quick breaking foam. The liquefied propellant is emulsified and is generally found in the internal phase.
Aqueous stable foam Stable foam, lower propellant conc. (5%) required.	
Non-aqueous stable foam Use various glycols (polyethylene glycol)	
Quick breaking foam Mainly used for topical medication,	
Thermal foam Produce warm foam for shaving (not in use)	

□ EVALUATION OF PHARMACEUTICAL AEROSOLS

- All aerosol products that are shipped in interstate commerce are **subject to the regulations of the DOT (Department of Transportation)**.
- These regulations impose **limitations on the pressure within the container, flash points, flame extension, and flammability**.

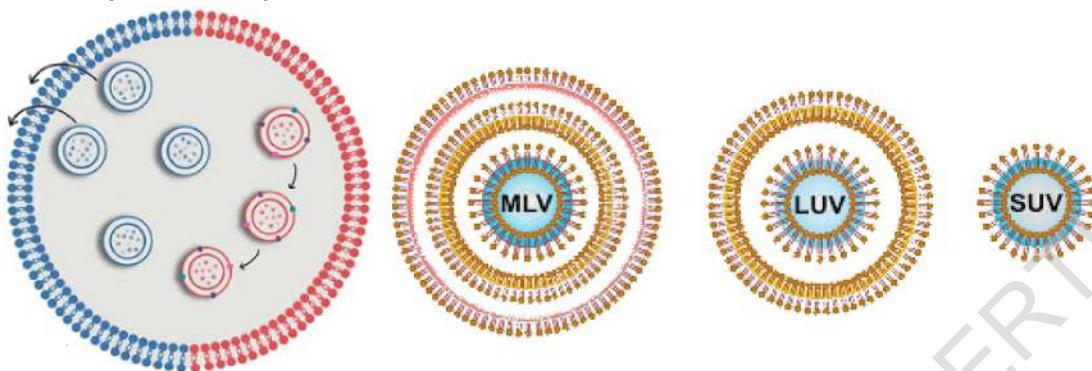
S NO.	PARAMETER	DETERMINE BY
		FLAMMABILITY AND COMBUSTIBILITY
1.	Flash Point	Product is chilled to -25° F and transferred to the test apparatus. The temp. of the test liquid increases slowly till its vapors ignite. This temp. is taken as flash point. Apparatus: Standard Tag open cup apparatus
2.	Flame projection	Indicate the effect of an aerosol on the extension of an open flame. For that product is sprayed for about 4 second in to a flame, the flame is extended and length can be measured by ruler.

PHYSICOCHEMICAL CHARACTERISTICS		
3.	Vapour pressure	Measured by pressure gauge and use of water bath
4.	Density	Measured by Pycnometer or Hydrometer
5.	Moisture	Measured by Karl Fischer or Gas chromatography
6.	Identification of propellants	Gas chromatography or Infrared Spectroscopy
PERFORMANCE		
7.	Aerosol valve discharge rate	<p>Determined by taking known weight and discharging the contents for given period of time using standard apparatus.</p> <p>To determine the magnitude of the valve delivery-</p> <p>Valve acceptance: The test procedure applies to two categories of metered aerosol valves having the following limits. For valves delivering:</p> <p>54 µl or less, the limits are ± 15%.</p> <p>55 to 200 µl, the limits are ± 10%.</p>
8.	Spray pattern	This method is based on the impingement of spray on a piece of paper that has been treated with a dye-talc mixture.
9.	Net content	Determined by the weighing empty container and reweighing after filling the container.
10.	Foam stability	Visual evaluations and use rotational viscometer
11.	Particles size determination	<ol style="list-style-type: none"> Optical microscope Cascade impactor Light scattering method Gamma scintigraphy

Pharmaceutical Packaging

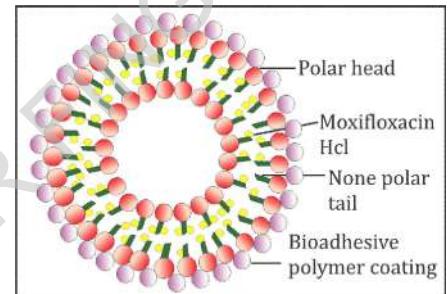


Multivesicular vesicles (Vesosomes)



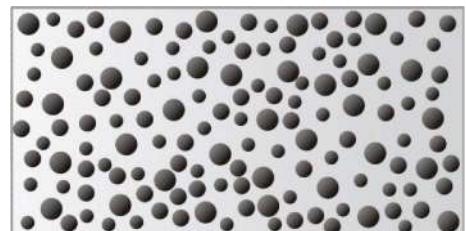
□ NIOSOMES

- **Non-ionic surfactant vesicles** (niosomes or NSVs).
Niosomes are promising vehicle for drug delivery.
- Niosome are **non-ionic surfactant vesicle + Cholesterol or other lipids.**
- Niosome have **better stability than liposome.**
- Their physical properties **are similar to liposomes.**



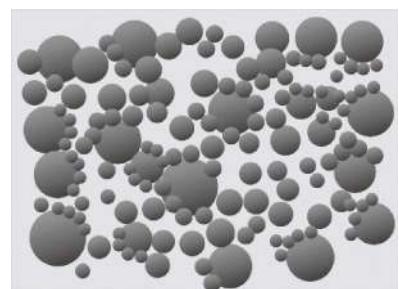
□ NANOPARTICLE

- Nanoparticles are **defined as particulate dispersion**, or solid particles having the size range 10- 1000 nm.
- **Biocompatible, Biodegradable**, offer complete drug protection.
- **Nanospheres – Polymeric matrix**
- **Nano capsules – Drug encapsulated in a shell**



□ MICROSFERES

- Microsphere are small spherical particles, with diameters in the micrometer range {Typically 1 mm to 1000 mm (1 mm)}.
- Microspheres are sometimes referred to as microparticles.
- **Drug is dispersed in polymeric matrix.**



□ RESEALED ERYTHROCYTES

- Prepared by dipping RBCs in hypotonic media which leads to **rupturing of cell membrane and formation of small pores.**
- When **RBCs are again placed in an isotonic media** at 37°C resealing of membrane takes place with drugs.

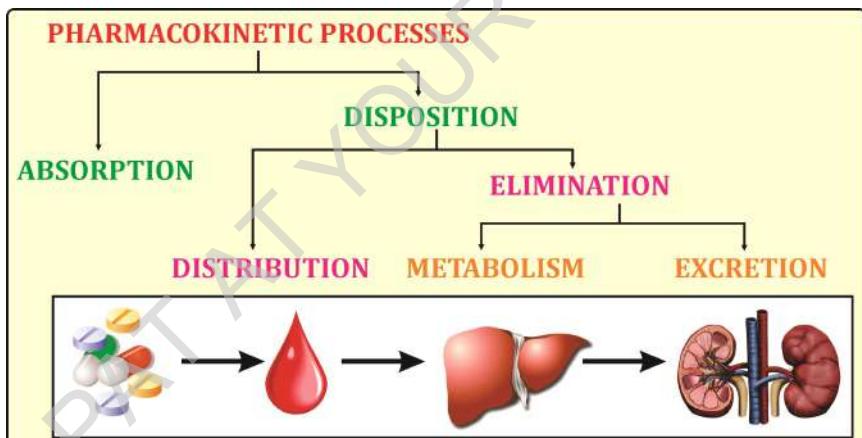


Biopharmaceutics

Biopharmaceutics is defined as the study of factors influencing the **rate and amount of drug** that reaches the **systemic circulation** and the use of this **information to optimize therapeutic** efficacy of drug products.

Pharmacokinetics

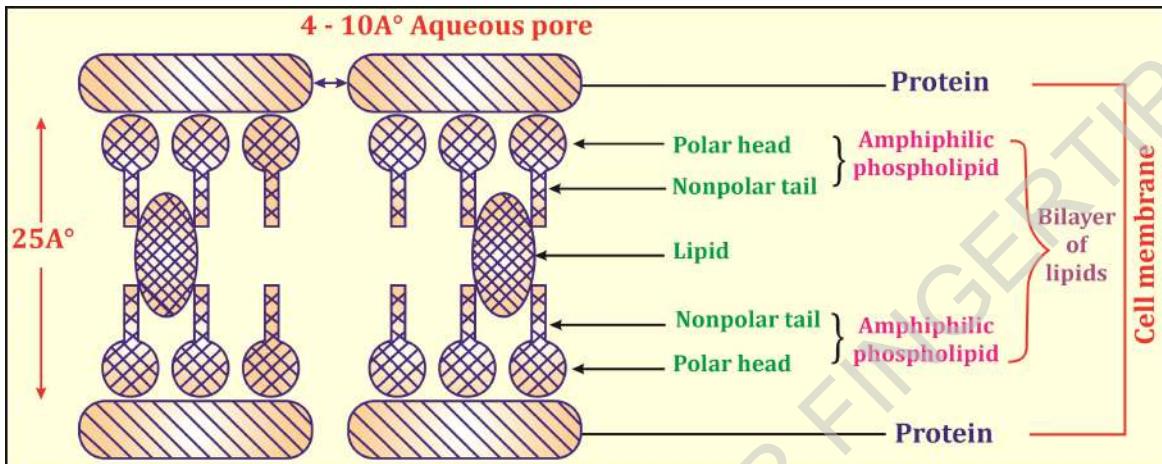
The term “**Pharmacokinetics**” is derived from Greek words **Pharmakon (drug)** and **Kinesis (movement)**. It is the **quantitative study of drug movement** into through and out of the **body and their relationship** with the **pharmacological, therapeutic or toxicological response in man or animals**. The frequency of administration of a drug in a particular dose is **called Dose regimen**.



ABSORPTION	DISTRIBUTION	METABOLISM	ELIMINATION
<p>The process of movement of unchanged drug from the site of administration to systemic circulation</p>	<p>The movement of drug between one compartment and the other (general blood and the extra-vascular tissues) is referred to as drug distribution</p>	<p>Chemical reactions that which are easier to eliminate. The products of these chemical reactions are called metabolites.</p>	<p>Elimination is defined as the process that tends to remove the drug from the body and terminate its action. Elimination occurs by two processes</p>

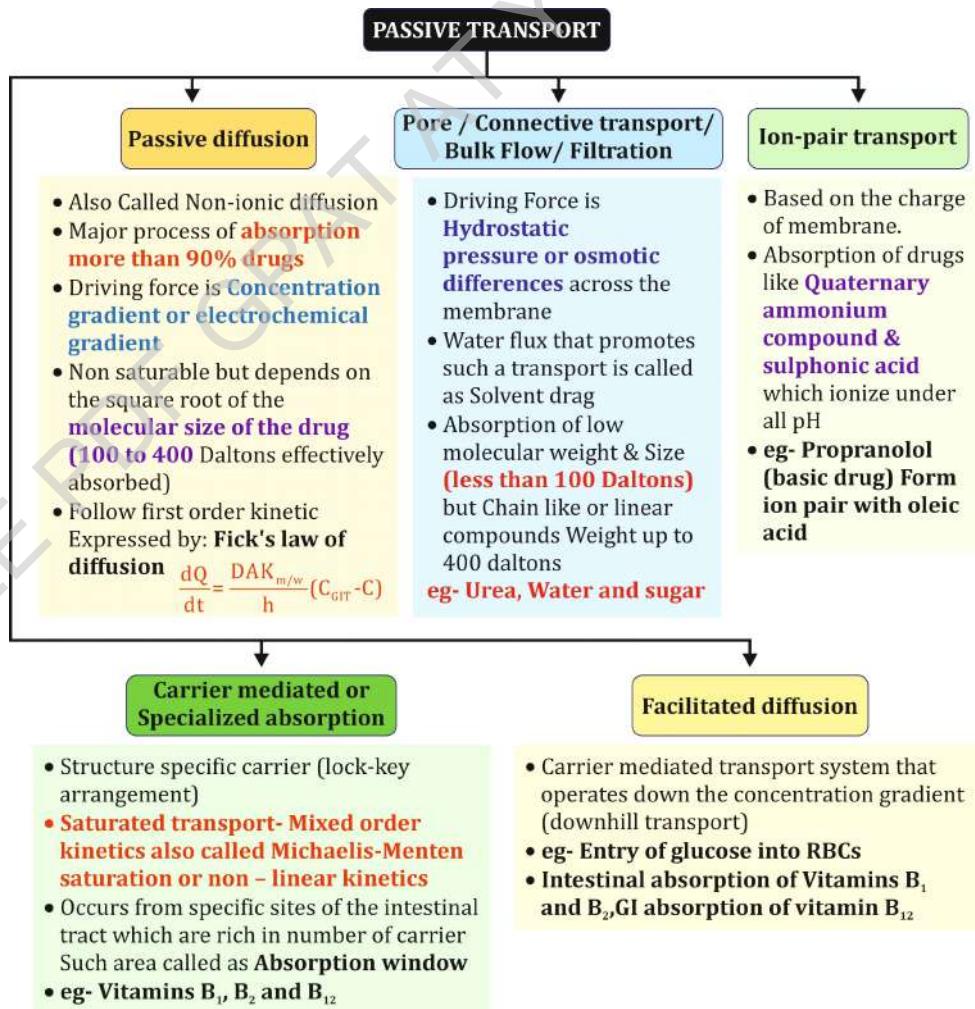
ABSORPTION

□ THE BASIC STRUCTURE OF FUNCTIONAL CELL MEMBRANE



□ MECHANISM OF ABSORPTION

1. TRANSCELLULAR / INTRACELLULAR – MOST COMMON PATHWAY FOR DRUG TRANSPORT



Blood brain barrier	<ul style="list-style-type: none"> Highly specialized Pericyte, Astrocyte and Capillary endothelium Less permeable to water soluble drug Allows highly lipid soluble unionized drugs. Approach for improve penetration of drug through BBB ✓ Used as penetration enhancer - Dimethyl sulphoxide (DMSO) ✓ Osmotic disruption by using - Mannitol ✓ Using drug carrier - Dihydropyridine redox 	
Blood testis barrier	<ul style="list-style-type: none"> Barrier located at sertoli cell junction. 	
Blood cerebrospinal fluid barrier	<ul style="list-style-type: none"> CSF formed from choroid plexus. Highly lipid soluble drugs can cross through barrier Sulphamethaxazole and Trimethoprim 	
Blood placental barrier	<ul style="list-style-type: none"> Drugs having molecular weight < 1000 daltons Highly lipid solubility. eg - Ethanol, Sulphonamide, Cross by endocytosis - immunoglobulin Cross by carrier mediated transport - Essential nutrients for fetal growth 	



Pharmaceutical Jurisprudence

Pharmaceutical Legislation in India

INTRODUCTION TO JURISPRUDENCE

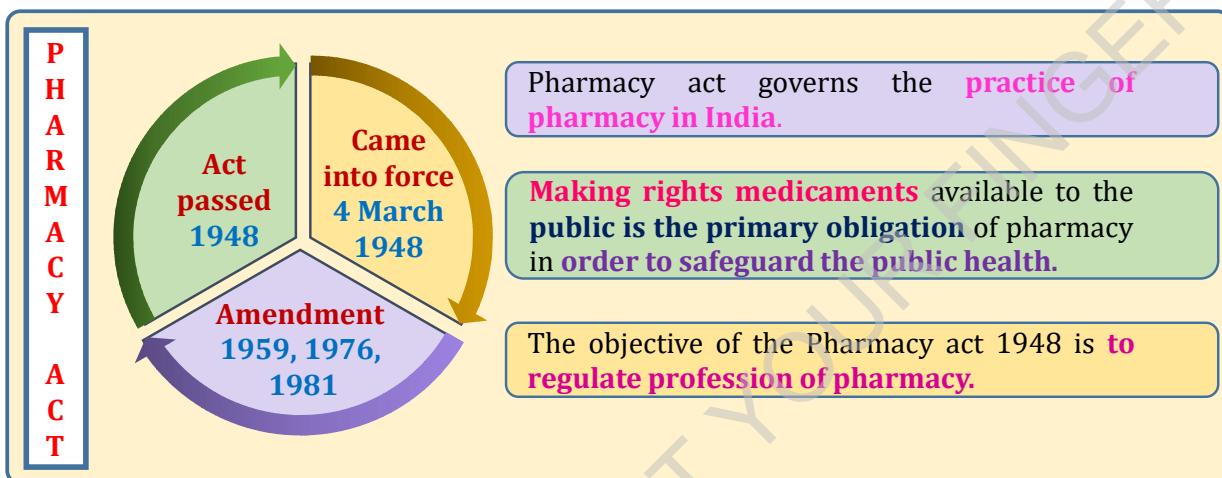
TERMS	DESCRIPTION
JURISPRUDENCE	The study of fundamental legal principles and is also science and philosophy of law .
ETHICS	Ethics is the science of human conduct . With reference to the human conduct there is the ideal moral code and the positive moral code .
LAW	Rules of human conduct binding on all person in a state or nation .
PHARMACEUTICAL JURISPRUDENCE	It is a branch of pharmacy which deals with the knowledge of laws relating to drugs and pharmaceuticals and about pharmacy profession .

HEALTH SURVEY AND DEVELOPMENT COMMITTEES

COMMITTEES	DESCRIPTION	CHAIRMANSHIP
BHORE COMMITTEE	• Oct. 1943 - Health Survey and Development Committee by Govt. of India	Sir Joseph William Bhore 
BHATIA COMMITTEE	• In 1953 - Pharmaceutical Enquiry Committee by Government of India	Major General S. L. Bhatia 
MUDALIAR COMMITTEE	• June 1959 - Health Survey and Planning Committee by Govt. of India	Dr. A. Lakshman swami Mudaliar 
HATHI COMMITTEE	• 8th February 1974 - Drug and Pharmaceutical Industry by Govt. of India	Jaisukhlal Hathi 

Thane	Central Drugs Testing Laboratory
Noida	National Institute of Biologicals
Coonoor	Pasteur Research Institute
Bangalore	National Centre for Biological Sciences (NCBS) National Institute of Unani Medicines

Pharmacy Act & Rule



CHAPTERS AND SECTIONS

CHAPTERS	DESCRIPTION	SECTIONS
Chapter I	Introduction	[1-2]
Chapter II	Pharmacy Council of India (PCI)	[3-18]
Chapter III	State Pharmacy Councils (SPC)	[19-28]
Chapter IV	Registration of Pharmacists	[29-40]
Chapter V	Miscellaneous	[41-46]

SECTIONS

SECTIONS	DESCRIPTION
Section 3	Central council constituted
Section 4	University Grants Commission (UGC)
Section 10	Education Regulations
Section 12	Approved courses of study and examinations
Section 14	Foreign qualification
Section 15A	Central Register

SECTIONS	DESCRIPTION
Section 16	Inspection (PCI)
Section 19	State council constituted
Section 20	Interstate agreement
Section 26A	Inspection (SPC)
Section 36	Removal from register
Section 46	Power to make rules

Central Drugs Standard Control Organization (CDSCO)

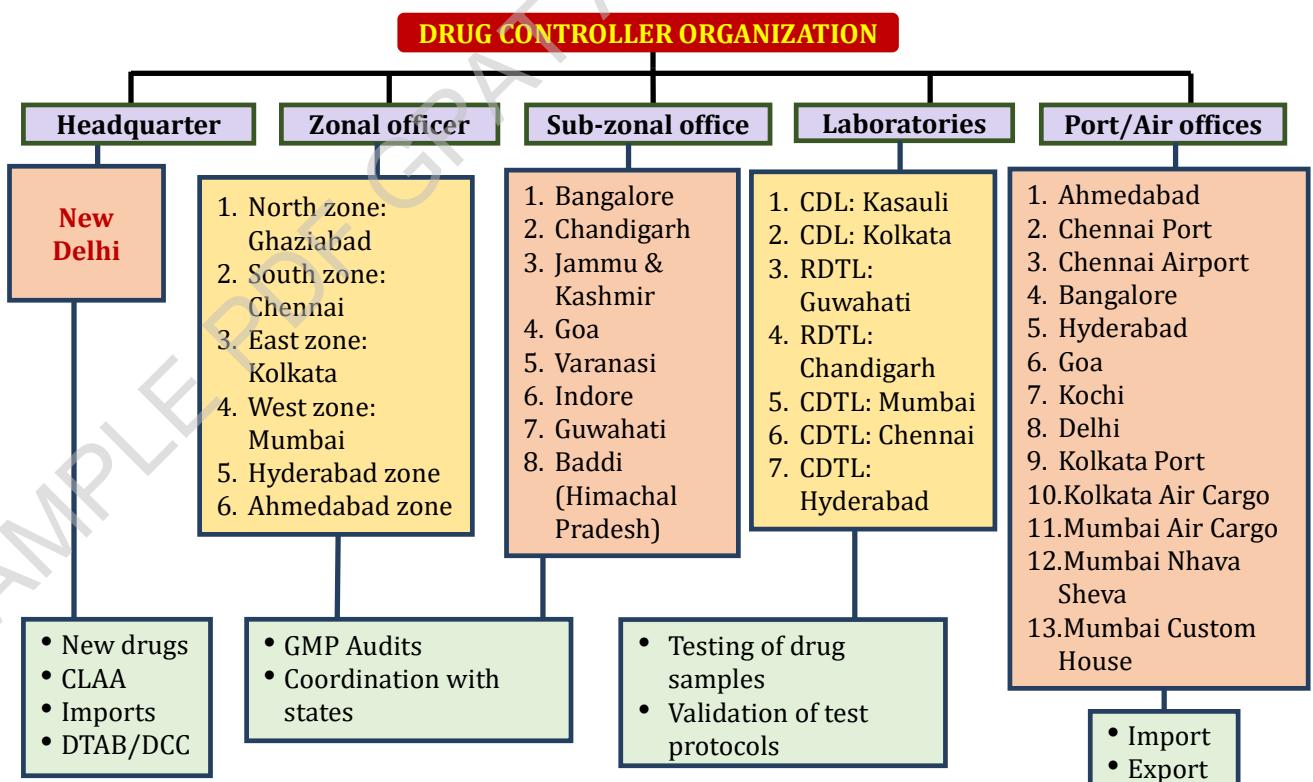
INTRODUCTION

- The CDSCO of India is **main regulatory body** for regulation of pharmaceutical, medical **devices and Clinical Trials**.
- Head office - **NEW DELHI**
- Functioning under the **control of Directorate General of Health Services, Ministry of health and family welfare Government of India**.
- **Drugs Controller General of India [DCGI]**, He/she is a responsible for approval of New Drugs, **Medical devices and Clinical Trials** to be conducted in India.
- **Minister of Health and Family Welfare – Dr. Mansukh Mandaviya**
- **Drugs Controller General of India - Dr. Rajeev Singh Raghuvanshi (1st Feb 2023)**



NOTE :- Minister of Health and Family Welfare and Drugs Controller General of India will change in future. So, go through Google.

ORGANIZATION OF CDSCO



PART

2

PHARMACOLOGY



- ❖ Human Anatomy & Physiology
- ❖ Pathophysiology
- ❖ Pharmacology

SAMPLE EDITION AT YOUR FINGERTIPS



Human Anatomy & Physiology

Cell Physiology

□ CELL

- The cell is the **basic unit of life, structural and functional unit of an organism.**
- Anton von leeuwenhoek** first saw and described a living cells.

□ CELL THEORY

- Cell theory was jointly put forward by **Matthias Jakob Schleiden** and **Theodor Schwann** in 1839.
- Rudolf Virchow** (1855) first explained that **cells divide** and **new cells** are formed from **pre-existing cells**.

❖ TYPES OF CELLS

- Two types
 - (i) Prokaryotes cells
 - (ii) Eukaryotes cells

□ DIFFERENCE TYPES OF PROKARYOTIC AND EUKARYOTIC CELL

PROKARYOTIC CELL	EUKARYOTIC CELL
<ul style="list-style-type: none">Single cellThe cell size is usually small (0.1- 5 μm).Cell division :- Binary fissionMembrane bounded cell organelles absent.Contain muramic acidCell organelles are absent, EXCEPT Ribosomes :- 70 SPili and Fimbriae may be presentExamples include Archaea, Bacteria & Cyanobacteria.	<ul style="list-style-type: none">Multicellular cellThe cell size is usually small (5-100 μm).Cell division :- MitosisMembrane bounded cell organelles present.Does not Contain muramic acidCell organelles are present, Ribosomes :- 80 SPili and Fimbriae may be AbsentExamples include Plants, Fungi, and Protozoa & Animals.

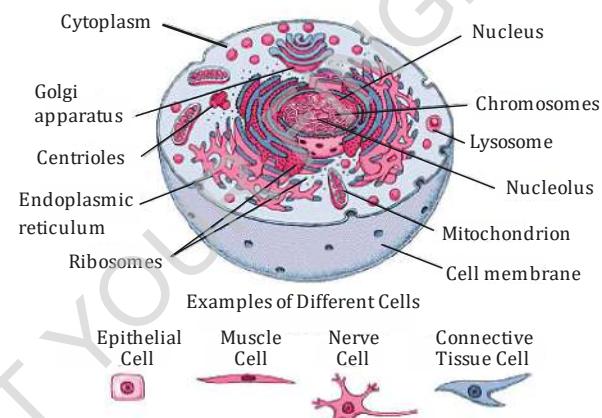


Fig :- Cell Structure

TYPES OF GASTRIC GLANDS

Cardiac gland

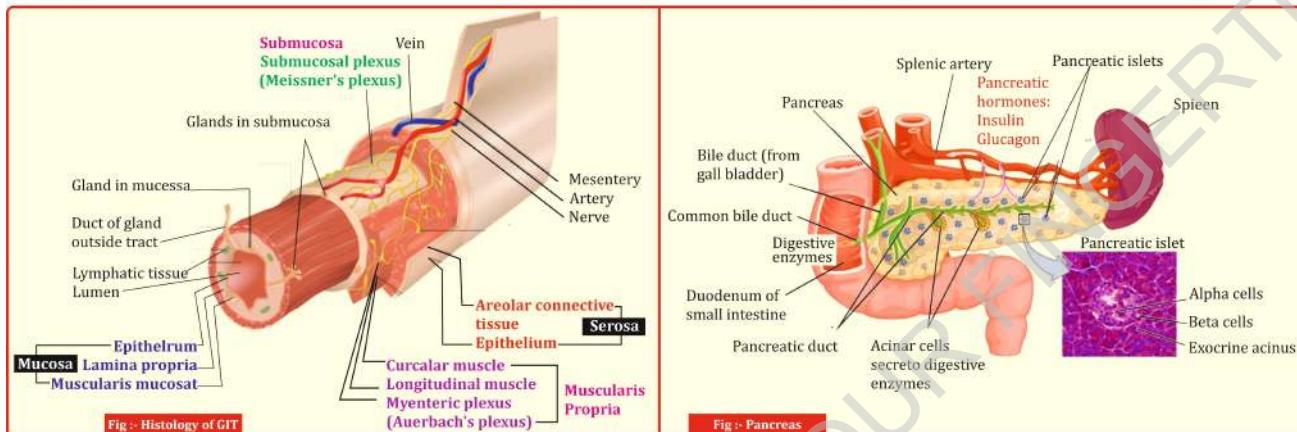
Cardiac glands are found in the Cardiac of the stomach **Secretes alkaline mucus**

Pyloric gland

These glands are formed by **G cells, mucus cells, EC cells and ECL cells.**
Secretes alkaline mucus

Fundic gland

Possess four types of cells: **chief or peptic (zymogen) cells, oxytic cells, goblet cells and argyrophilic cells**
Oxytic cells also known as **parietal cells**, secrete **HCl** and **intrinsic factor (Castle's intrinsic factor)**.



□ SALIVARY GLANDS AND THEIR LOCATION

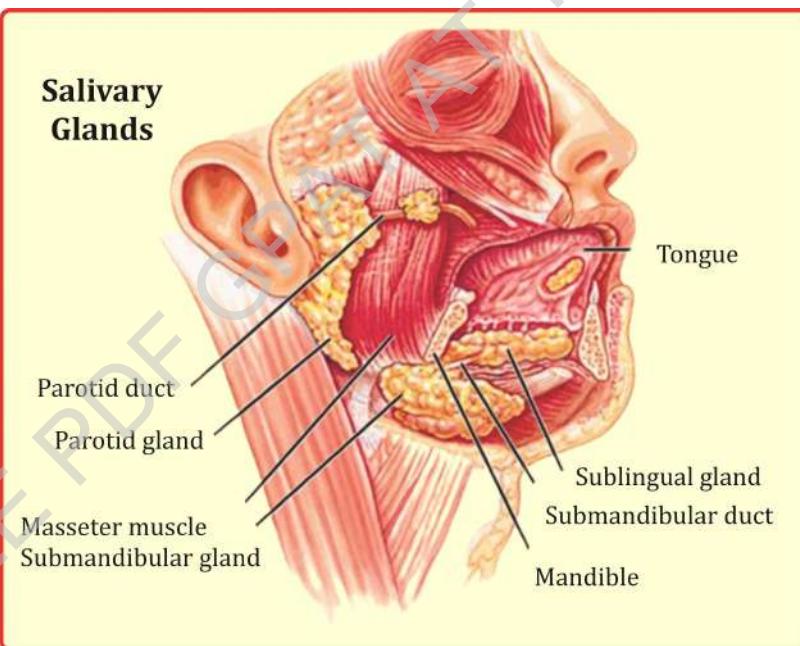
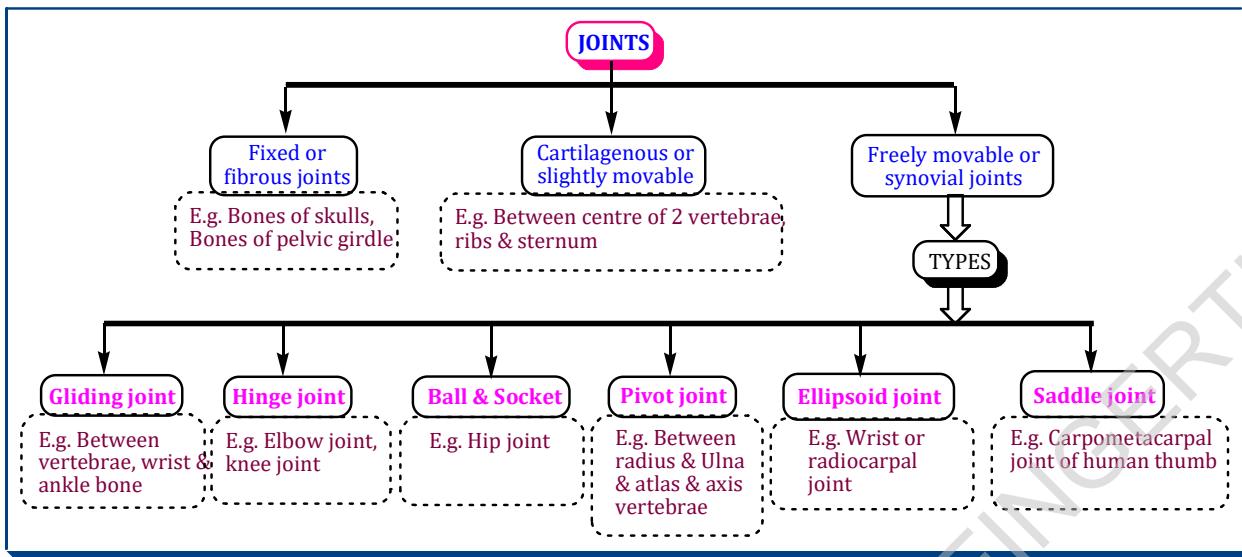


Fig : Anatomy of Salivary Glands

S.NO	SALIVARY GLANDS	SALIVARY GLANDS DUCT	LOCATION OF SALIVARY DUCTS ORIFICE
1.	Parotid or Stensen's duct	Largest, below and Infront of ears	Opens at papilla in buccal mucosa opposite maxillary second molar
2.	Submandibular	Wharton's duct	Opens at Sublingual papillae
3.	Sublingual	Bartholin's duct	Near Submandibular duct

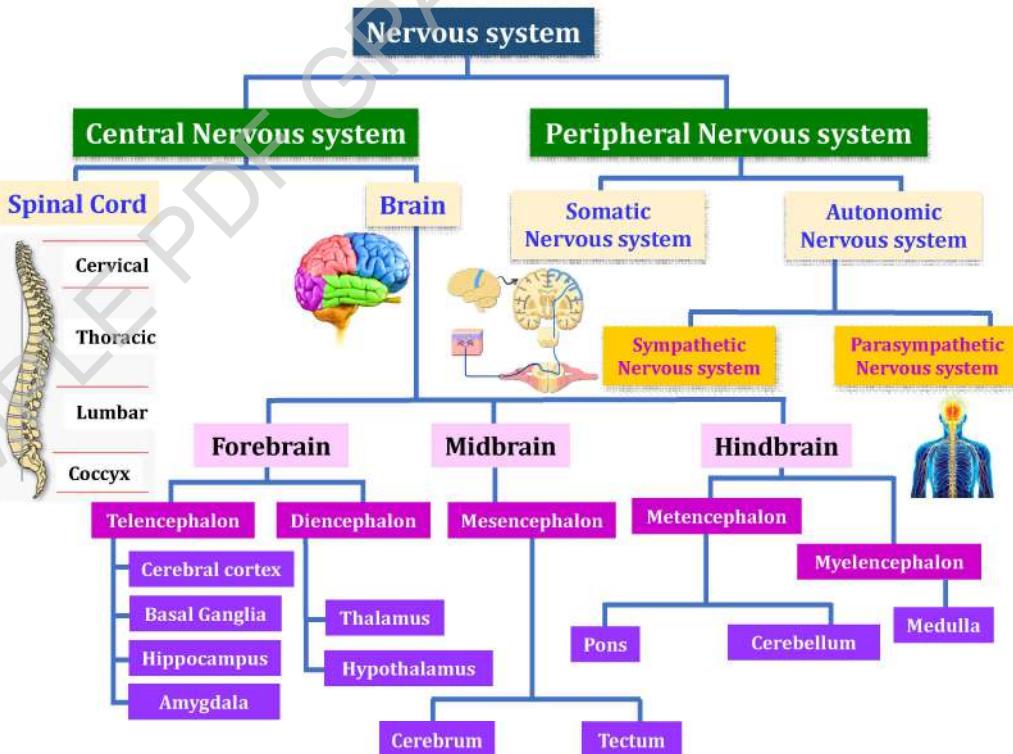
□ TYPES OF JOINTS IN HUMAN BODY



Central Nervous System

□ INTRODUCTION

- Nervous system is a system of **Neurons, Nerves and nervous organs** that coordinate and **control the activities of different parts** of animal body by **sending and receiving nerve impulses**.
- The **functional & structural unit** of nervous system is Neuron (**Nerve cell**).





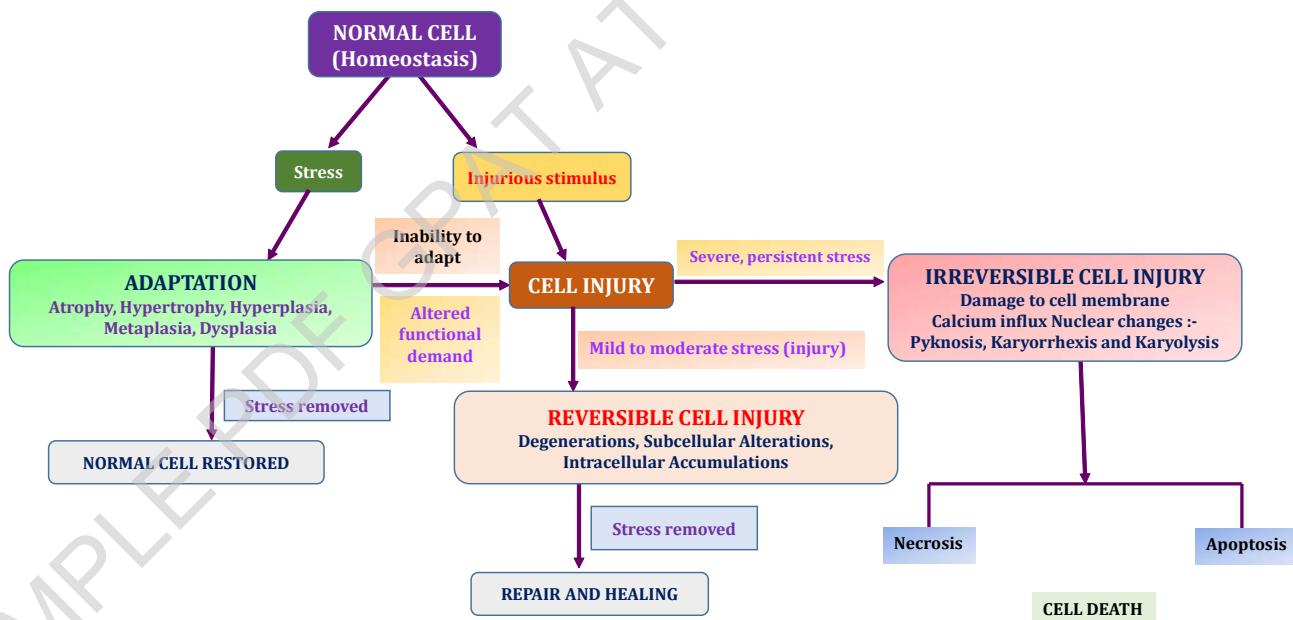
Pathophysiology

Pathophysiology is a science dealing with the study of diseases. Rudolf Virchow coined the term 'Cellular pathology'

- Four important components of pathology are
 - i. **Etiology** (causative factors)
 - ii. **Pathogenesis** (mechanism or process by which disease develops)
 - iii. **Morphology** (appearance of cells, tissues or organs)
 - iv. **Clinical features.**

Cell Injury & Adaptation

- When the cell is exposed to an **injurious agent/stress/stimulus**, and it **leads to injury of the cell**, it is termed **Cell injury**.



- **Hypoxia** :- Due to **decrease in oxygen supply to the cells**.
- **Ischemia** :- Ischemia is **insufficient blood flow to cells or organs** that to **maintain their normal function**.
- The major mechanism of damage to plasma membrane in ischemia is **Increased Ca⁺⁺ ions in the cytosol**
- **Caseous necrosis** is a good example of **Structure less necrosis**.



Pharmacology

General pharmacology

PHARMACOLOGY - Branch of biology deals with **study of drugs action on living system**.

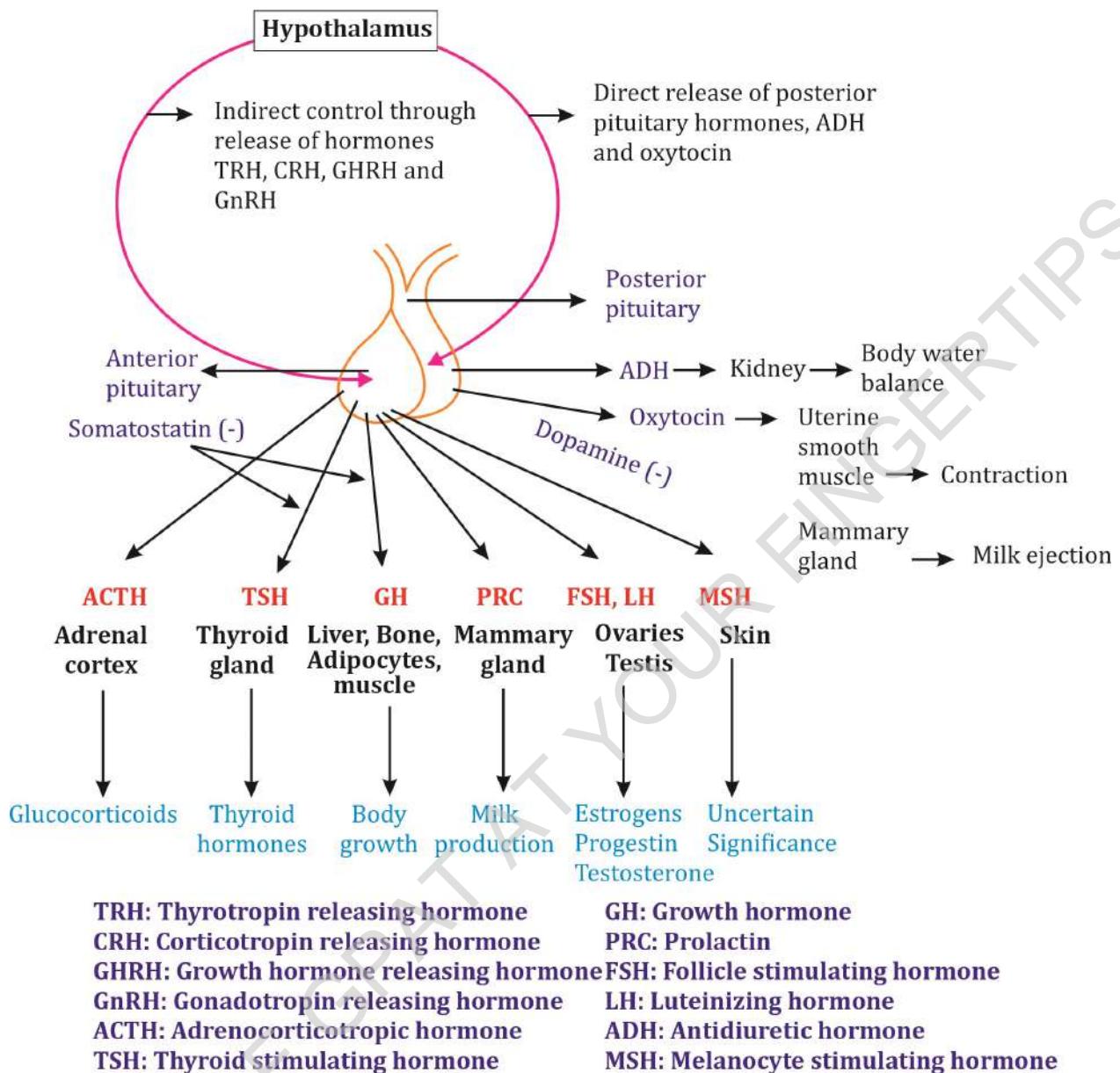
□ DISCOVERIES AND THEIR SCIENTIST NAME

DISCOVERIES	SCIENTIST
Father of Indian Pharmacology	Ram Nath Chopra
Father of Indian pharmacy education	Prof. Mahadeva Lal Schröff
Father of Pharmacology	Oswald Schmiedeberg
Father of chemotherapy	Paul Ehrlich
Father of medicine	Hippocrates
Founded first institute of Pharmacology	Rudolf Buchheim
Discovery of Penicillin	Alexander Fleming
Discovery of Streptomycin	Selman Waksman
Discovery of Insulin	Banting and Best
Discovery of antimicrobial effect of Prontosil	Gerhard Domagk
Discovery of Homeopathy	Samuel Hahnemann
Discovery of Blood types	Karl Landsteiner
Discovery of Vaccination	Dr. Edward Jenner
Discovery of Neurotransmitters	Otto Loewi

- **ORPHAN DRUG** – Used for diagnosis/prevention of rare disease.
- **Orphan drug** are also called as life saving drug.

Trick - SR DDLj Ka FAN hai		
SR	DDLj	FAN
S → Sumatriptan, Sodium stibogluconate, Sodium thiosulfate	D → Digoxin antibody L → Liyothyronine (T_3)	F → Fomipizole A → Amphotericin B Azacitidine N → Nitrates, Nilotinib
R → Rifabutin, Rifaximin, Rituximab		

- **ESSENTIAL DRUGS** – According to WHO, drug that **satisfy priority healthcare & need** of majority of the population. eg - Amoxicillin, Ciprofloxacin, Metronidazole
 - **WHO Model List of essential drug** – 1977 (First), 22nd list **2021 (Latest)** → 479 drugs.
 - **India National Essential Drug List** – 1996 (First), revised in 2011, 2015 & **2022 (Latest)**.



□ SITES AND MECHANISMS OF ACTION OF HORMONE

SITES AND MECHANISMS OF ACTION OF HORMONE

1. At cell membrane receptors

- Through alteration of intracellular cAMP concentration → **Adrenaline, Glucagon, TSH, FSH, LH, PTH, Calcitonin, Vasopressin (V_2)**.
- Through IP₃/DAG generation: release of intracellular Ca²⁺ and protein kinase activation → **Vasopressin, Oxytocin**
- Activation of tyrosine protein kinase → **Insulin, Growth hormone, Prolactin**

2. At cytoplasmic receptors:-

Steroidal hormone, Mineralocorticoids, Glucocorticoids, Androgens, Estrogen, Progestin, Calcitriol

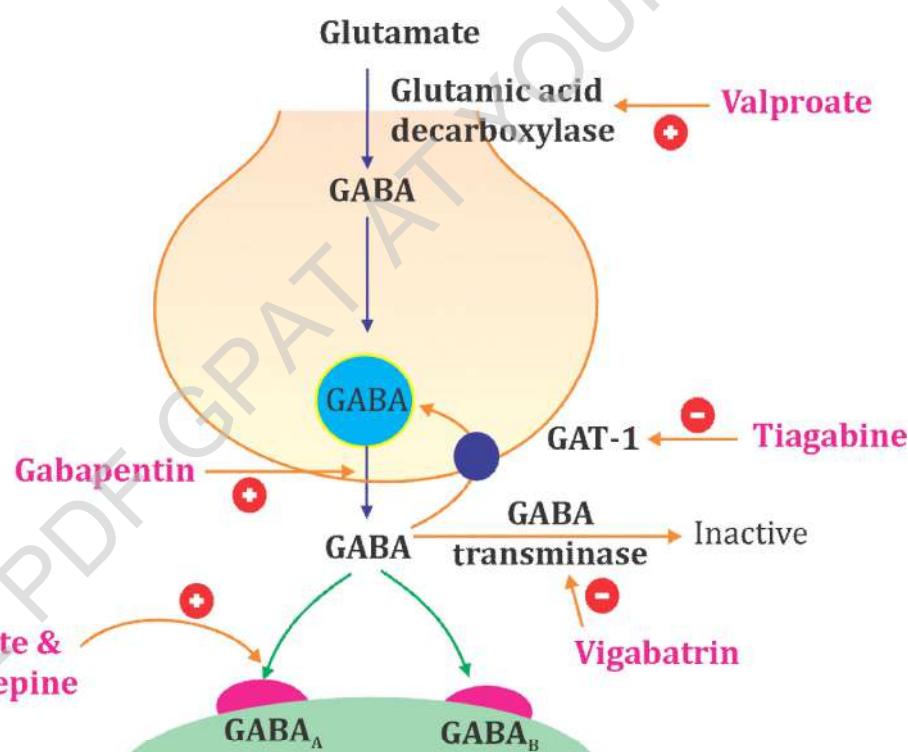
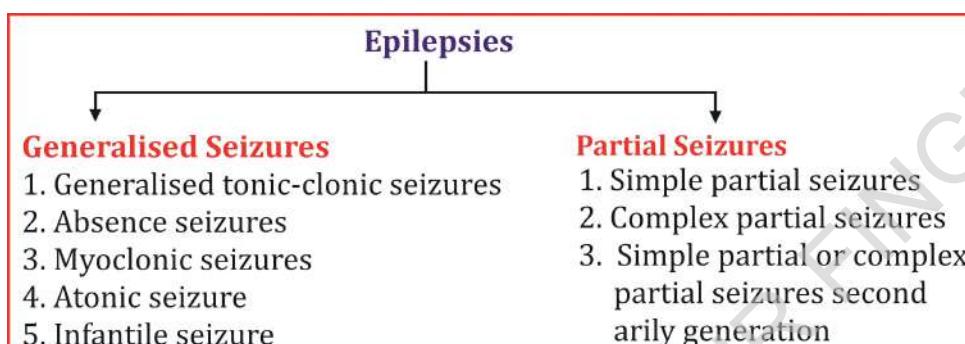
3. At nuclear receptor: -

Thyroid hormones-T₃, T₄, Estrogen, Vit. D, Retinoic acid.

ANTIEPILEPTIC DRUGS

INTRODUCTION

- Epilepsy is condition that causes **recurrent episodes of seizures & disturbance of consciousness.**
- Lamotrigine used for **depressive phase of bipolar disorder.**



CLASSIFICATION AND MECHANISM OF ACTION OF ANTIEPILEPTIC DRUGS

S.NO.	CLASS	DRUGS	MECHANISM OF ACTION
1.	Hydantoins	Phenytoin, Fosphenytoin	Prolongation inactivated state of voltage sensitive neuronal Na^+ channel that govern refractory period of the neurone.
2.	Iminostilbenes	Carbamazepine, Oxcarbamazepine	
3.	Phenyltriazines	Lamotrigine	

- Angiotensin I is subsequently **converted to angiotensin II** by the **enzyme angiotensin converting enzyme found in the lungs**.
- Angiotensin II** show the **pharmacological actions**.

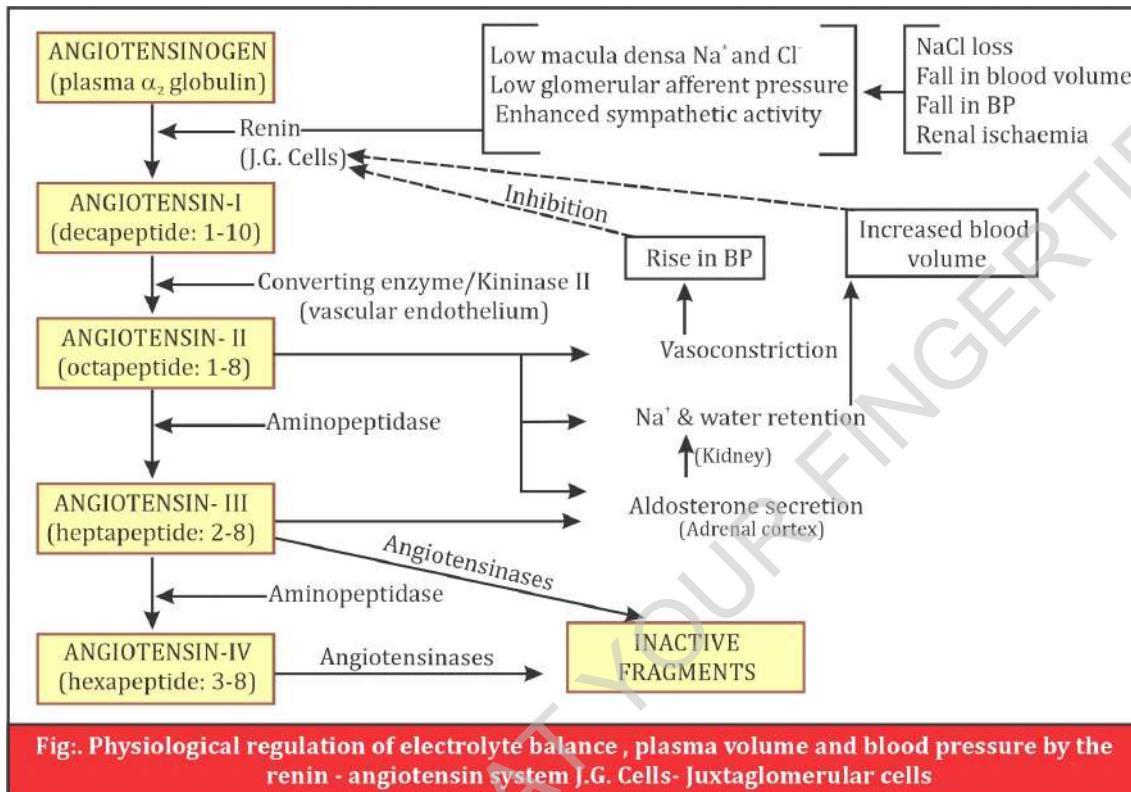
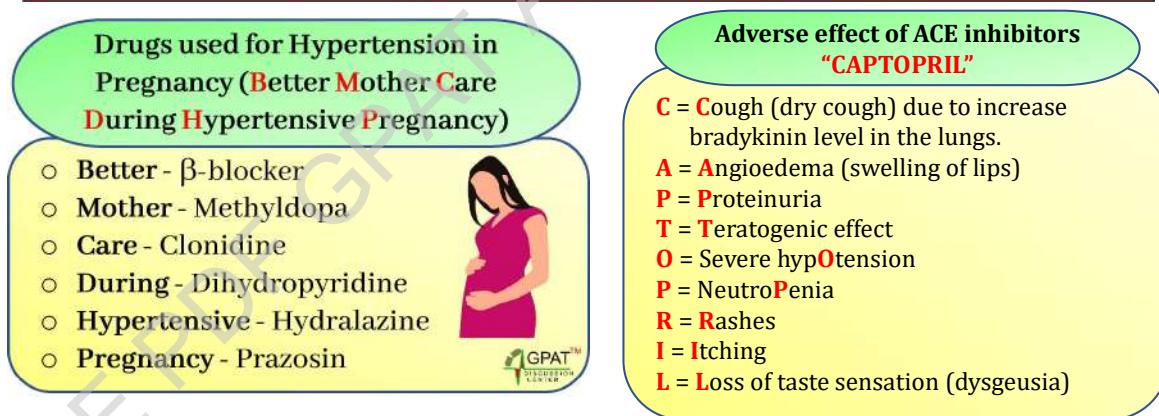
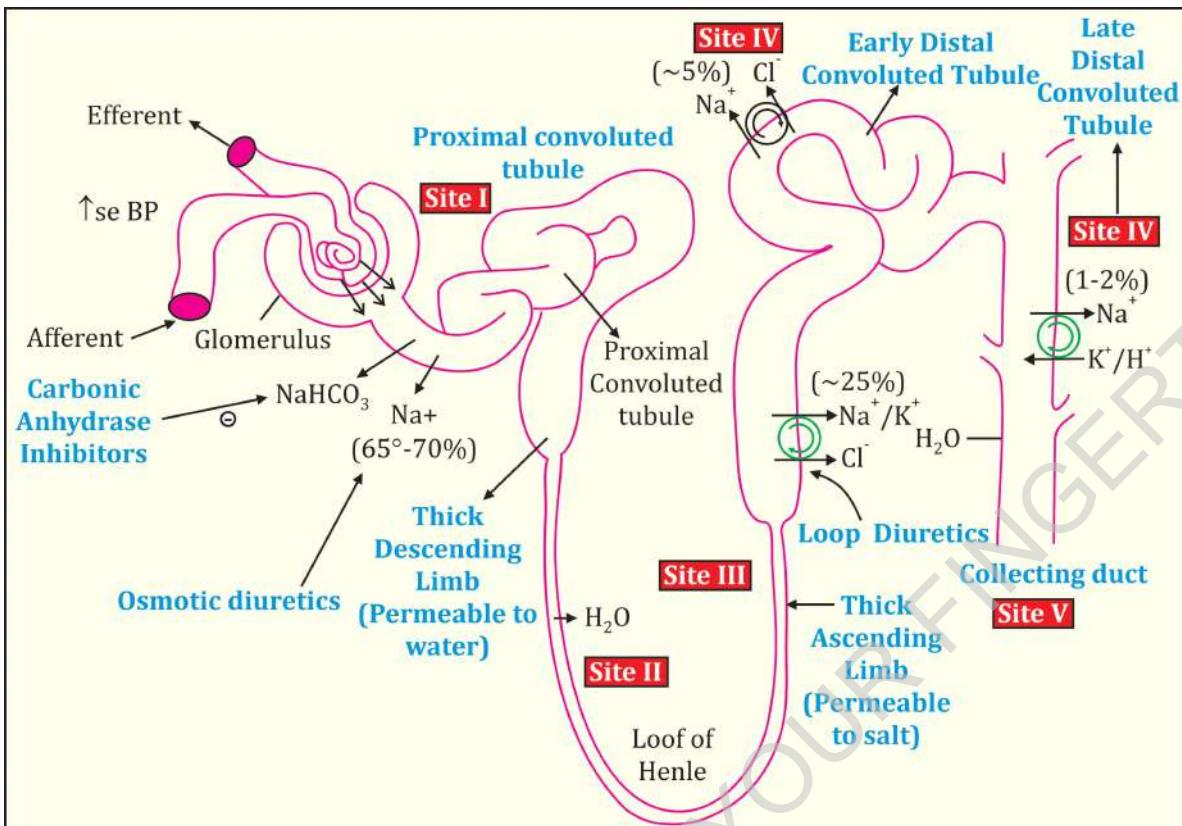


Fig.: Physiological regulation of electrolyte balance , plasma volume and blood pressure by the renin - angiotensin system J.G. Cells- Juxtaglomerular cells



□ IMPORTANT ONE-LINERS OF ANTIHYPERTENSIVE DRUGS

- All ACE-I inhibitors drugs are **prodrug** except **Captopril** and **Lisinopril**.
- Arteriolar dilators are **reducing after load**
- Venous dilators are **reduced preload**
- Moxonidine and Rilmenidine both drugs are selective for **Imidazoline Receptor** – that **modulate α_2 receptor**
- Indapamide** are vasodilator used as **anti-HTN in Diabetic patient**.
- Most **frequent side effect** of ACE inhibitor is **dry cough**.
- The most **prominent action of Angiotensin-II is vasoconstriction**.
- ACE inhibitors **prevent the conversion of angiotensin-I to angiotensin II**.



- **Highly ototoxic diuretic** → Ethacrynic acid
- Diuretics with longest half-life → Torsemide
- DOC for **lithium-induced diabetes insipidus** → Amiloride
- Aldosterone antagonists act at **interstitial site** of tubular cell whereas all other diuretics act from **luminal side**.
- **Dorzolamide & Brinzolamide** are used **topically for glaucoma**.
- Excessive use of diuretics can cause **Hypovolemic shock**.
- Metolazone is the only thiazide which is effective in severe renal failure.
- Hypokalemia – **Reduction of serum K⁺ level**
- Hyperkalemia – **Increase of serum K⁺ level**

□ PARTS OF NEPHRON AND THEIR MECHANISM OF WORKING

PARTS	MECHANISM OF WORKING
Part I (Proximal Convolute Tubule)	<ul style="list-style-type: none"> Most of the filtered Na^+ is actively reabsorbed (65-70%). Na^+ K^+ symport along with active reabsorption of glucose, amino-acids, organic anions and PO_4^{3-}. Carbonic anhydrase plays an important role in Na^+H^+ exchange and helps in the reabsorption of HCO_3^-. Water gets reabsorbed so tubular fluid in the PCT remains isotonic.
Part II (Descending Loop of Henle)	<ul style="list-style-type: none"> Osmotic diuretics acting on this site. The descending limb is impermeable to Na^+ and urea and highly permeable to water. Hence fluid in the loop becomes hypertonic.

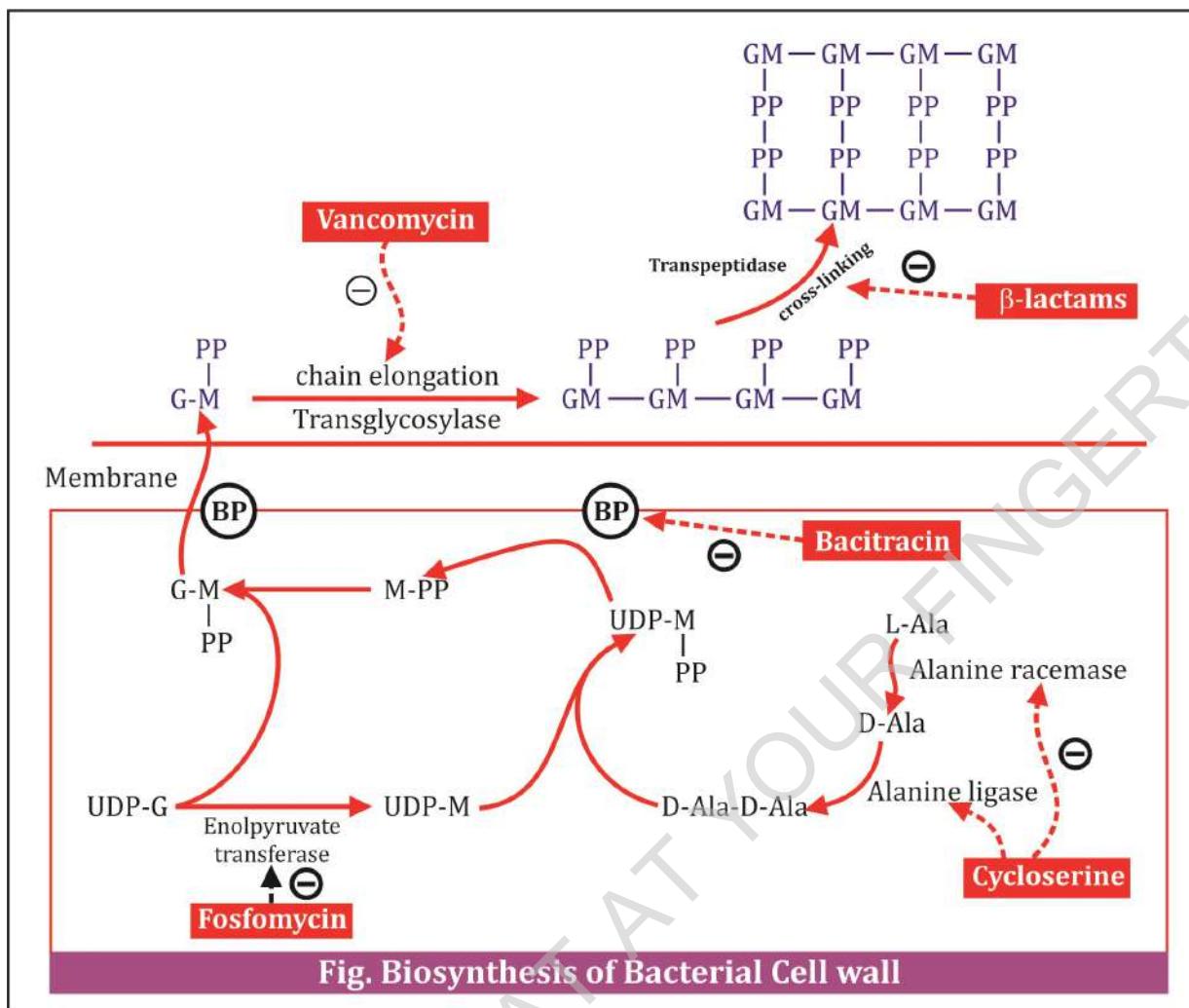
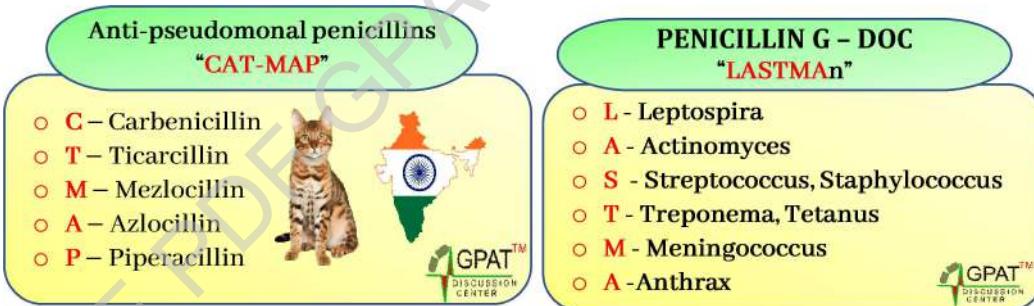


Fig. Biosynthesis of Bacterial Cell wall



□ IMPOTANT POINTS

- Penicillin **G** is the original Penicillin used clinically.
- Plasma $t_{1/2}$ of penicillin G in healthy adult is **30 minutes**.
- Probenecid has also been shown to **decrease the V_d of Penicillin**.
- All MRSA have multidrug resistance and **MRSA is treated by Vancomycin (DOC)**.
- Vancomycin resistance staph aureus (VRSA) is treated by **Linezolid or Streptogramins**.
- Penicillin can cause **hypersensitivity reaction**.
- Allergic reaction can be diagnosed by (**Scratch test**)
- Intradermal test (Benzyl Penicilloyl Polylysine)

- i. Dapsone + Rifampicin + Clofazimine.
- ii. Clofazimine + Ofloxacin + Clarithromycin.
- iii. Rifampin + Ofloxacin + Minocycline.

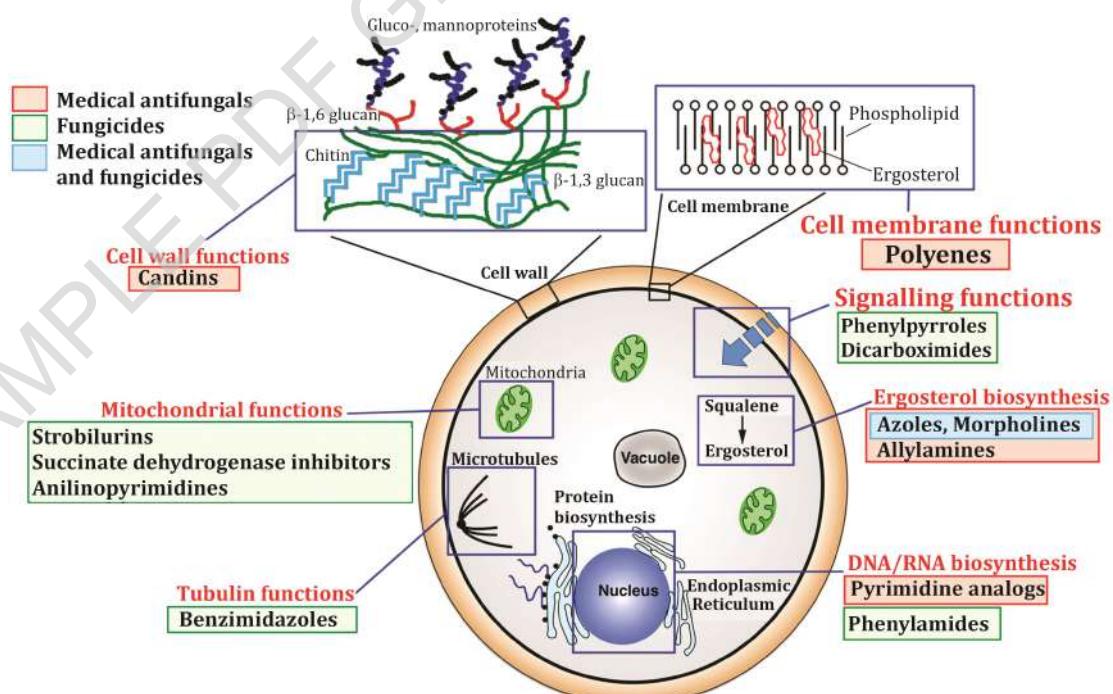
ANTIFUNGAL DRUGS

□ INTRODUCTION

- Amphotericin B binds the ergosterol and **alter the permeability of cell membrane**.
- Terbinafine acts as **selective non-competitive inhibitor of squalene epoxide**, inhibiting synthesis of lanosterol and indirectly inhibit the biosynthesis of ergosterol
- **Itraconazole** → Drug of choice for **blastomycosis**.
- Ketoconazole **decreases androgen production** from testis and it displaces testosterone from protein binding sites.
- Griseofulvin may also **inhibit synthesis and polymerization** of nucleic acid.
- It can also cause **Disulfiram like reaction** with alcohol.

□ CLASSIFICATION OF DRUGS ON THE BASIS OF MECHANISM OF ACTION

CLASS	MECHANISM OF ACTION
Polyenes antibiotics	Cell membrane inhibitors
Echinocandins	Cell wall synthesis inhibitors
Azoles	Ergosterol synthesis inhibitors by inhibiting the 14α -demethylase
Heterocyclic Benzofuran	Interfere with mitosis
Allylamines	Lanosterol synthesis inhibitors by inhibiting squalene epoxidase
Antimetabolites	Nucleic acid synthesis inhibitors

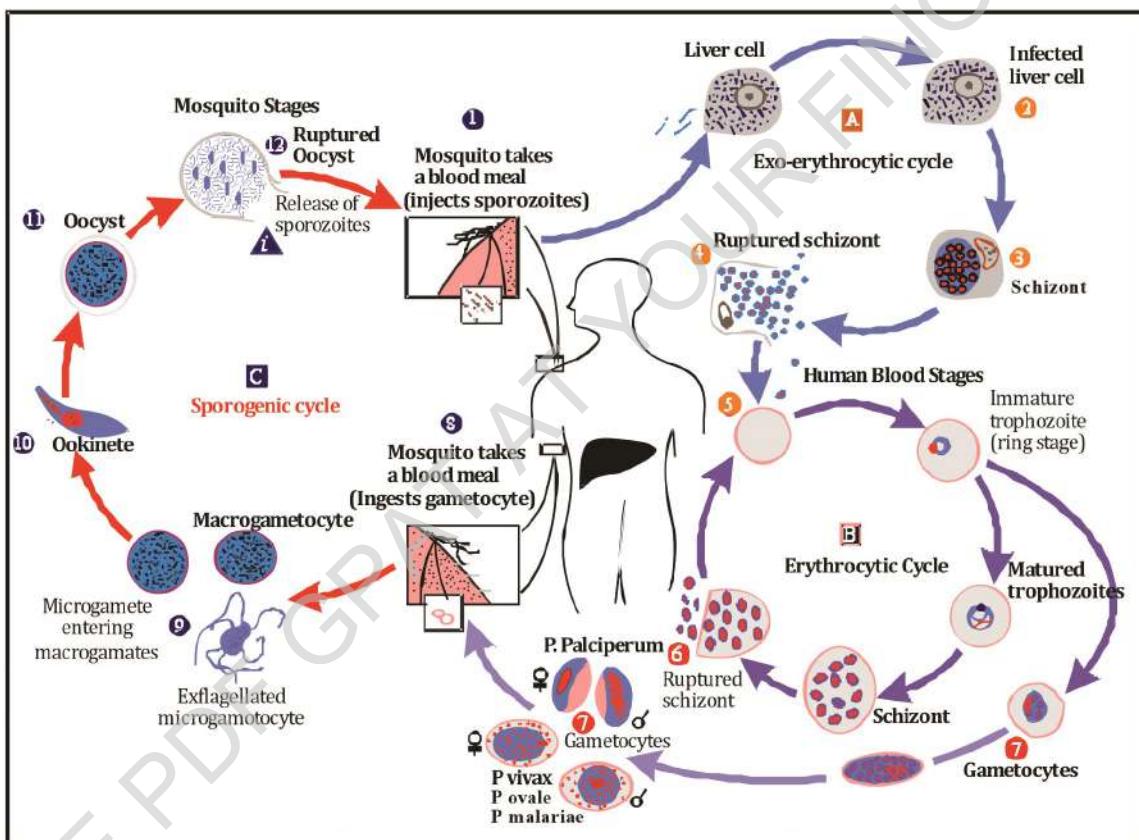


- Trifluridine is used as **ophthalmic solution** in Herpes keratitis.
- In **pregnancy safest** drug are -**Zidovudine, Indinavir and Lamivudine.**

ANTIMALARIAL DRUGS

□ INTRODUCTION

- Malaria is a **protozoal infection** caused by ***Plasmodium parasite***.
- Malaria caused by **four species of protozoal parasite** - ***Plasmodium vivax*, *P. ovale*, *P. malariae*, *P. falciparum***.
- **50% malaria cases** are due to ***Plasmodium falciparum***.



□ LIFE CYCLE OF MALARIAL PARASITE

Pre-erythrocytic cycle	<ul style="list-style-type: none"> Mosquito bites, sporozoites are injected with saliva into the blood stream. Primaquine for all species, Proguanil for <i>P. falciparum</i>
Erythrocytic cycle	<ul style="list-style-type: none"> The erythrocytic cycle inside human red blood cells (RBC) These are the drugs that kills schizonts in blood. Fastest acting - Chloroquine, Mepacrine, Quinine, Mefloquine. Slower acting - Proguanil, Pyrimethamine, Sulfonamide
Sporogonic cycle	<ul style="list-style-type: none"> The mosquito acquires gametocytes when it bites an infected person. These fertilize in gut & eventually migrate as sporozoites to the saliva.

PART 3

PHARMACOGNOSY



SAMPLE PDF AT YOUR FINGERTIPS



Pharmacognosy

Introduction of Pharmacognosy

- Pharmacognosy is defined as the scientific study of the **structural, physical, chemical and biological characters of crude drugs** obtained from natural source (plant, animal and mineral and marine). Derived from greek word



HISTORY OF PHARMACOGNOSY



Dioscorides

Father of Pharmacognosy **Materia Medica** (book) - In 1st century covered about 600 plant drug along with some animal & mineral product's.



Papyrus Ebers

Oldest document containing 700 medicinal herbs and more than 870 formulae.



Seydler

A German scientist ,who coined the term "Pharmacognosy" in 1815 in the title of his work "Analecta Pharmacognostica".



Theophrastus

Father of Botany
Know for his studies on plant kingdom.



Aristotle

Father of Zoology, Father of Natural History
Wrote on animal kingdom.



Hippocrates

Father of Medicine
Contribution on anatomy and physiology of human beings.



Galen

First pharmacist, Father of Experimental Physiology
Described the different methods of preparation containing active constituents of crude drugs. The branch dealing with extraction of plant and animal drugs known as Galenical Pharmacy.



Swede Linnaeus

Classified plant and introduce the system of naming of the plant (**Binomial nomenclature**).



Bentham & Hooker

Plant classification was further developed by them.

Arista & Asava	Arista	Asava
	The crude drugs are powdered and its decoction (kashaya) is prepared. The decoction is filtered and transferred to fermentation vessel . Sugar or jaggery as required is added to the vessel and boiled eg- Ashokarishta	The sugar or jaggery is added to water, boiled and cooled This is transferred to fermentation vessel and drugs in the powder form are added to it. eg- Punarnavasava
During soaking generating alcohol serves as preservative therefore have infinite period of self life		
	Prepared by repeatedly boiling the decoction and extract of drug and condensing with sugar or Jaggery. eg - Drakshavaleha	
	Powder of a substance obtained by calcination in which metal or minerals are converted into ash with herbal juice, fruits etc.	

HOMEOPATHY SYSTEM OF MEDICINE



- Was developed by German Physician **Hahnemann**
- "Like can be Cured by like" (**Similia similibus curantus**)

7 Principles of homeopathy



CHINESE SYSTEM OF MEDICINE

Shennong – Father of Chinese Medicines

Based on 2 Hypothesis:

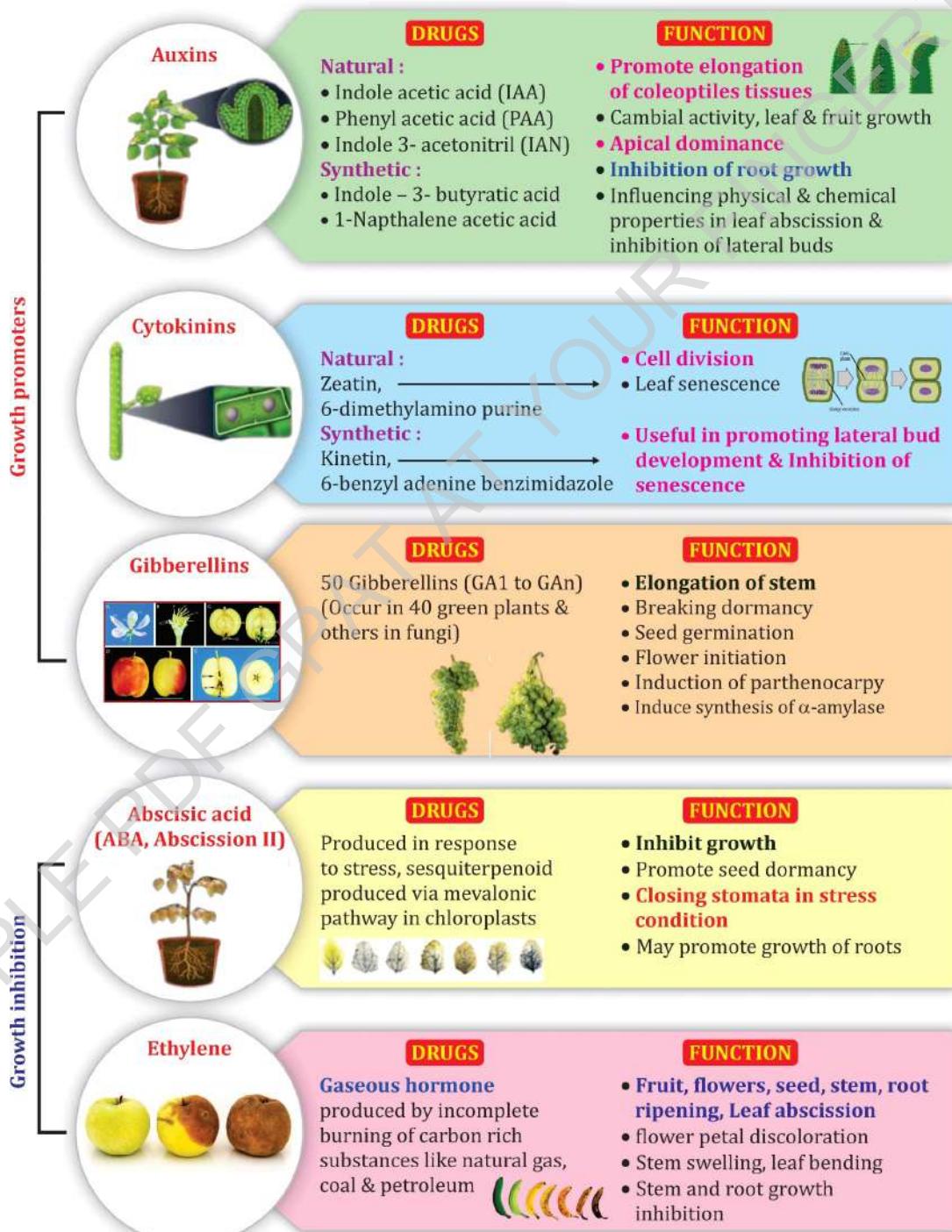
- Yin (Dark) and Yang (Light) theory**
- Five elements theory**
- Diseased conditions are the expressions of imbalance in yin and yang like excess or deficiency of either of them



PLANT HORMONES/PLANT GROWTH REGULATORS

The organic compounds, other than nutrients which **affect the morphological structure or physiological processes**

❖ PLANT HORMONES AND THEIR FUNCTIONS



CHEMICAL TEST FOR GLYCOSIDES

ANTRAQUINONE GLYCOSIDES				
Borntrager's test: (break -C- O-bond)	Drug Boiled with dil H_2SO_4	Get filtrate after filtration	Add chloroform or ether	Organic layer is separated
		Ammonical Layer become pink due to anthraquinone	Add NH_3	
Modified Borntrager's test : (break -C- C-bond)	In this acid + $FeCl_3$ use to break the -C-C- bond			
RHUBARB	FLUORESCENCE (in U.V light)	CHEMICAL TEST AND ACTIVITY	OTHER FEATURES	
Rhapontic (Chinese)	Blue	Contain rhaponticin having strong estrogenic activity	Sweet odour	
Indian	Deep violet	Not contain Rhaponticin, the characteristic odour of the essential oil is due to the presence of eugenol	Orange brown cork cells	
Other test for rhubarb	Shows red colour with addition of alkali, Give positive result for Modified Borntrager's test			

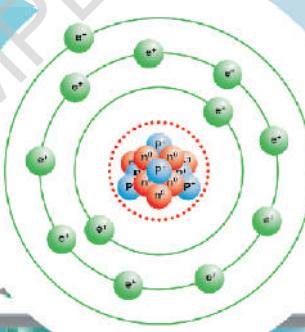
ALOES	VARIETY OF ALOES			
	CURACAO	CAPE	SOCOTRINE	ZANZIBAR
Modified Borntrager's test indicate presence of C-glycoside which is aloë emodin	Aq. Solution of drug + $FeCl_3$ + HCl → on hydrolysis gives free anthraquinone which is Collected add organic solvent organic layer separated and shaken with ammonia . Ammoniacal layer shows rose pink to cherry colour			
Nitrous acid test (This test is due to isobarbaloin)	Sharp pink to carmine color	Faint pink	Very less change in colour	
Nitric acid test	Deep brown red colour	Brown colour to Green	Pale brownish - yellow colour	Yellowish brownish
Cupraloin test (Klung's Isobarbaloin test) $CuSO_4 + NaCl + 90\% \text{ alcohol}$	Wine red persisting for 4 hrs	Faint colour to Yellow	No colour	

DIGITALIS	DESCRIPTION
Keller kiliani test (to detect the presence of digitoxose sugar)	1 gm Drug + 10 ml 70% Alcohol acetate $\xrightarrow{2-3 \text{ min.}}$ Extract + Lead $FeCl_3 \xrightarrow{\text{Glacial acetic acid}}$ Transferred to a tube containing 2 ml conc. $H_2SO_4 \rightarrow$ Reddish Green Color

PART

4

PHARMACEUTICAL CHEMISTRY



- ⚡ Physical Chemistry
- ⚡ Inorganic Chemistry
- ⚡ Organic Chemistry
- ⚡ Medicinal Chemistry
- ⚡ Pharmaceutical Analysis



Physical Chemistry

Basic Terms of Atomic Structure and Popular Units

□ POPULAR UNITS & THEIR SI EQUIVALENTS

PHYSICAL QUANTITY	UNIT WITH SYMBOL	EQUIVALENT IN SI UNIT
Mass	1amu	$1.6605 \times 10^{-27} \text{ kg}$
Energy	1eV	$1.602 \times 10^{-19} \text{ joule}$
Length	1 Å	$10^{-10} \text{ m} (10^{-1} \text{ nm})$
Volume	1 liter	$10^{-3} \text{ m}^3 = \text{dm}^3$
Force	1 dyne	10^{-5} N
Pressure	1 atm	760 torr (760 mm Hg)
	1 bar	101325 pa or 10^5 pa
	1 torr	133.322 N m ⁻²

□ TERMS ASSOCIATED WITH ATOMIC STRUCTURE

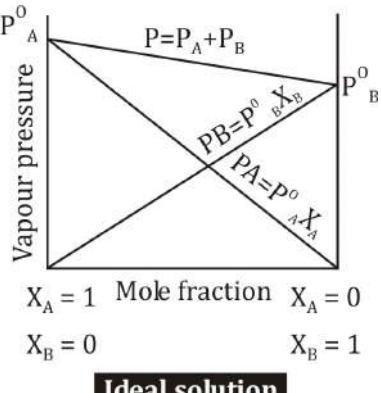
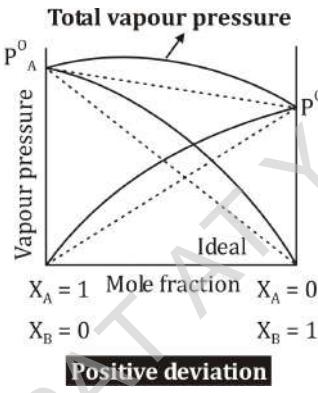
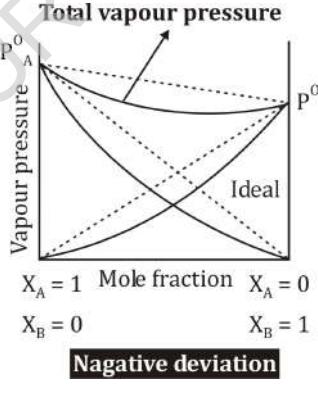
TERMS	DESCRIPTION	EXAMPLE
Isotopes	Same atomic number but different mass number	${}^6\text{C}^{12}, {}^6\text{C}^{13}, {}^6\text{C}^{14}$
Isobars	Same mass number but different atomic number	${}^1\text{H}^3, {}^2\text{He}^3$
Isodiaphers	Same difference of number of Neutrons & Protons	${}^5\text{B}^{11}, {}^6\text{C}^{13}$
Isotones	Having same number of Neutron	${}^1\text{H}^3, {}^2\text{He}^4$
Isosters	They are the molecules which have the same number of atoms & electrons	$\text{CO}_2, \text{N}_2\text{O}$
Isoelectronic	Species having same no. of Electron	Cl^-, Ar

□ MOLE CONCEPT

- A mole is defined as the **amount of substance** which contains **same number of elementary particles** (atoms, molecules or ions) as the **number of atoms** present in **12g of carbon (C-12)**.

$$\text{Number of moles} = \frac{\text{Amount of substance (in gram)}}{\text{Molar mass}}$$

□ COMPARISON BETWEEN IDEAL & NON-IDEAL SOLUTIONS

IDEAL SOLUTION	NON-IDEAL SOLUTION	
	SOLUTION HAVING POSITIVE DEVIATION	SOLUTION HAVING NEGATIVE DEVIATION
It obeys Raoult's law	Do not obey Raoult's law	Do not obey Raoult's law
$A-B = A-A \text{ or } B-B$ interactions	$A-B << A-A \text{ or } B-B$ interactions	$A-B > A-A \text{ or } B-B$ interactions
$\Delta H_{\text{mix}} = 0$	$\Delta H_{\text{mix}} > 0$	$\Delta H_{\text{mix}} < 0$
$\Delta V_{\text{mix}} = 0$	$\Delta V_{\text{mix}} > 0$	$\Delta V_{\text{mix}} < 0$
Does not form an azeotrope	Forms azeotrope mixture	Forms azeotrope mixture
Example: Benzene and Toluene, Hexane and Heptane, All the Dilute solutions nearly behave as an ideal solution	Example: Acetone and Carbon disulphide, Acetone and Benzene, Carbon Tetrachloride and Toluene, Acetone and Ethanol, Ethanol and Water	Example: Chloroform and Benzene, Chloroform and Diether, Acetone and Aniline, Nitric Acid and Water, Acetic Acid and Pyridine, Hydrochloric Acid and water
 <p>Vapour pressure</p> <p>P_A^0 P_B^0</p> <p>$P = P_A^0 + P_B$</p> <p>$P_B = P_B^0 X_B$</p> <p>$P_A = P_A^0 X_A$</p> <p>$X_A = 1 \quad \text{Mole fraction} \quad X_A = 0$</p> <p>$X_B = 0 \quad \quad \quad X_B = 1$</p> <p>Ideal solution</p>	 <p>Total vapour pressure</p> <p>P_A^0 P_B^0</p> <p>$X_A = 1 \quad \text{Mole fraction} \quad X_A = 0$</p> <p>$X_B = 0 \quad \quad \quad X_B = 1$</p> <p>Positive deviation</p>	 <p>Total vapour pressure</p> <p>P_A^0 P_B^0</p> <p>$X_A = 1 \quad \text{Mole fraction} \quad X_A = 0$</p> <p>$X_B = 0 \quad \quad \quad X_B = 1$</p> <p>Negative deviation</p>

□ AZEOTROPIES

- Azeotropes are **binary mixtures** having the **same composition in liquid and vapour phase** and boil at a constant temperature.

Colligative properties

□ DEFINITION

- The properties that **depend on the number of solute particles** irrespective of their **nature relative to the total number of particles present in the solution** are called colligative properties.
- There are four colligative properties:

S.NO	NAME OF THE COLLIGATIVE PROPERTY
1.	Relative Lowering of vapour Pressure
2.	Elevation in Boiling Point
3.	Depression in freezing point
4.	Osmotic pressure



Inorganic Chemistry

Limit Test

- Limit test** is defined as quantitative or semi quantitative test designed to identify and control small quantities of impurity which are likely to be present in the substances.
- Identified by simple comparison of **Opalescence, turbidity, or colour** is compared with the **fixed standards** as prescribed in the pharmacopoeias.
- Usually the limits are prescribed in **parts per million (PPM)**.

SUBSTANCE	PRINCIPAL/ REACTION	RESULT
CHLORIDE	<p>Limit test of chloride based on reaction between chloride ion and silver nitrate in the presence of dilute nitric acid.</p> $\text{Cl}^- + \text{AgNO}_3 \xrightarrow{\text{dil. HNO}_3} \text{AgCl} \downarrow + \text{NO}_3^-$ <p>Chloride ion Silver nitrate White PPT Silver chloride</p>	<ul style="list-style-type: none"> Reaction produces silver chloride as white precipitate. Opalescence produce in sample solution should not be greater than standard solution
SULPHATE	<p>Limit test of sulphate based on reaction between sulphate ion and barium chloride in the presence of dilute hydrochloric acid.</p> $\text{SO}_4^{2-} + \text{BaCl}_2 \xrightarrow{\text{dil. HCl}} \text{BaSO}_4 \downarrow + 2\text{Cl}^-$ <p>Sulphate ion Barium chloride Barium sulphate Chloride ion</p>	<ul style="list-style-type: none"> Reaction produces barium sulphate. Alcohol prevent super saturation. Turbidity of test solution is less than that of standard solution the compound will pass the limit test of sulphate.
IRON	<p>Limit test of iron based on reaction between iron interact with thioglycollic acid in the presence of citric acid and ammonical alkaline solution.</p> $\text{Fe}_4^+ + 2 \text{HSCH}_2\text{COOH} \xrightarrow{\substack{\text{Citric acid} \\ \text{Ammonical alkaline sol}}} \text{ferrous thioglycolate} \quad (\text{Purple colour complex})$ <p>Ferrous ion Thioglycollic acid ferrous thioglycolate (Purple colour complex)</p>	<ul style="list-style-type: none"> Reaction produces iron thioglycolate complex as purple color Citric acid form soluble complex with iron and prevent precipitation. Color develops only in presence of alkali and color forms due to co-ordination compound.

□ APPLICATIONS OF RADIOPHARMACEUTICALS

RADIO NUCLIDE	APPLICATIONS
Ammonium Bromide Injection (Br-82)	Extracellular water measurement.
Calcium chloride Solution (Ca-45/Ca-47)	Study of calcium metabolic disorders, bone cancer and other bone lesions.
Chlormerodrin Injection (Hg-197/Hg-203)	Scintillation scans of kidney.
Chromatid serum album injection (Cr-51)	Plasma volume determination and placental localization procedures
Chromic chloride injection	Study of protein loss from GIT and Absorption.
Colloidal gold Injection (Au-198)	Scintillation scan of liver, study of RES, treatment of the carcinomas of pleural and peritoneal cavities.
Cyanocobalamin Capsules and Injection (Co-57, Co-58, Co-60)	Co-57/58 → Diagnosis of pernicious anemia. Co-60 → Treatment of advanced stages of cancer involving cervix, vagina, uterus, bladder and mouth, tongue etc.
Ferric chloride/citrate (Solution and injections) Fe-59)	Study of iron metabolism and RBC formation.
Indium chloride in chelate form Injection (In-113)	Brain and renal scans & plasma volume measurement.
Iodinated Serum Albumin Injection (I-125)	Determination of plasma volume, total blood volume, circulation time and cardiac output, localization of neoplasm of the brain.
Iodinated Serum Albumin Injection (I-133)	Iodinated Serum Albumin Injection (I-133)
Potassium chloride Injection (K-42)	Study of (K^+) ion exchange
Rubidium chloride Injection (Rb-86)	Myocardial blood flow determination
Selenomethionine (Se-75)	Pancreas and Parathyroid gland scans.
Sodium chloride injection (Na-24)	Study of Na^+ exchange.
Sodium fluoride (F-18)	Bone scanning and study of bone metabolism
Sodium iodide solution (I-125)	Thyroid scanning and study of thyroid uptake
Sodium Iodide capsules and solution (I-131)	
Sodium iodohippurate Injection (I-131)	Renal scanning and study of renal function.
Sodium phosphate Solution (P-32)	Treatment of polycythemia vera (over production of RBC)
Sodium Rose Bengal Injection (I-131)	Liver scan, liver function test.
Sodium sulphate solution (S-35)	Extracellular fluid volume determination
Sodium Pertechnetate Injection (Tc-99)	Brain scanning, Thyroid function tests
Technetium Sulphide Colloidal solution (Tc-99)	Liver and spleen scans
Yb-169 DTPA (Diethylenetriaminopentacetate)	Brain scanning and determination of GFR in kidneys.



Organic Chemistry

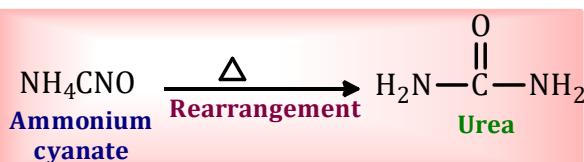
Introduction of Organic Chemistry

□ 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.**
 - Almost **all organic compounds contain atleast one carbon hydrogen bond (C-H) in it**

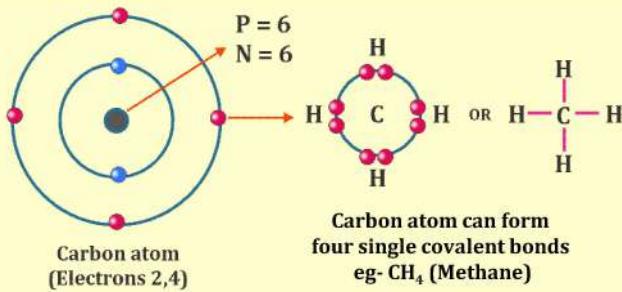
❖ **VFT (Vital Force Theory): By Berzelius in 1815.**

 - Upto 1815, any **organic compound could not be synthesized in lab.** So Berzelius suggested that there is a **mysterious force in living organisms** which was named as **Vital Force** and said that **organic compounds cannot be synthesized in lab.** This theory was called as VFT.
 - **But in 1828 a German scientist Wohler synthesized an organic compound in lab.** Which was 'urea'. So VFT was failed. Urea was synthesized in lab by heating of Ammonium cyanate (NH_4CNO).



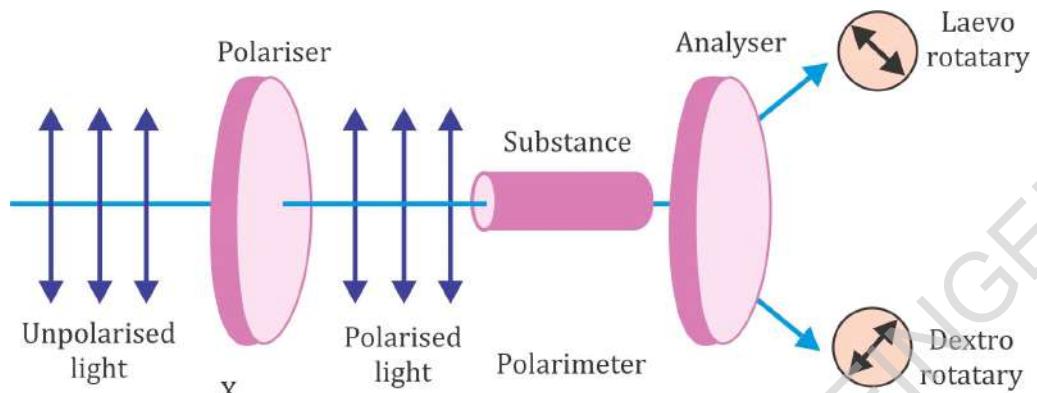
❖ CHARACTERISTICS OF CARBON ATOMS

- Atomic number of Carbon - 6
 - Electronic configuration - 2,4
 - Valence of electrons - 4
 - Tendency to form multiple bonds



❖ OPTICAL ACTIVITY

- The light whose **vibrations occur only in one plane** is termed plane polarised or simply polarised. The device that brings polarisation in light is called a polariser.
- Polarimeter:** An instrument used to measure optical activity



□ OPTICAL ISOMERISM

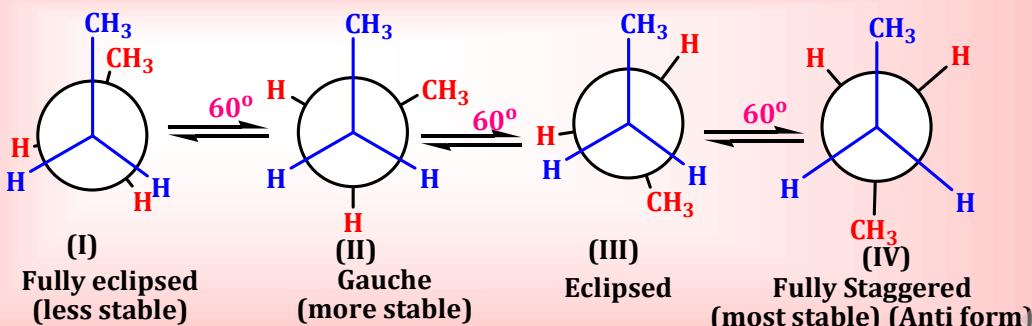
- Compounds having **similar physical and chemical properties** but **differing only in the behaviour towards polarised light** are called optical isomers and this phenomenon as optical isomerism.

✓ Condition for compound to show optical isomerism

- The compound must have **at least one asymmetric or chiral C-atom**.
- The compound must **not have plane of symmetry**.

Chiral molecules	<ul style="list-style-type: none"> A carbon atom attached with four different groups or atoms. Rotate plane polarised light. Does not contain plan of symmetry and inversion center. 	$\begin{array}{c} \text{COOH} & \text{COOH} \\ & \\ \text{H}-\text{C}^*-\text{OH} & \text{H}-\text{C}^*-\text{NH}_2 \\ & \\ \text{CH}_3 & \text{CH}_3 \end{array}$ <p>Lactic acid Alanine</p>
Meso compounds	<ul style="list-style-type: none"> A meso compound is an achiral molecule which has two or more chiral centers. It is optically inactive and it does not rotate the plane polarized light. It has plane of symmetry. 	$\begin{array}{c} \text{COOH} \\ \\ \text{HO}-\text{C}^*-\text{H} \\ \\ \text{HO}-\text{C}^*-\text{H} \\ \\ \text{COOH} \end{array}$ <p>meso-Tartaric acid</p>
Enantiomers	<ul style="list-style-type: none"> The non-superimposable mirror images of a chiral compound are known as enantiomers. 	$\begin{array}{c} \text{Cl} & \text{Cl} \\ & \\ \text{C}_2\text{H}_5-\text{C}^{\cdots\cdots}\text{H} & \text{H}^{\cdots\cdots}\text{C}-\text{C}_2\text{H}_5 \\ & \\ \text{CH}_3 & \text{H}_3\text{C} \end{array}$ <p>Enantiomers of 2-Chloro butane</p>
(1) Erythro enantiomers	<ul style="list-style-type: none"> The set or pair of enantiomers with similar groups on the same side of the carbon chain. 	$\begin{array}{c} \text{CH}_3 & \text{CH}_3 \\ & \\ \text{H}-\text{C}^*-\text{OH} & \text{OH}-\text{C}^*-\text{H} \\ & \\ \text{H}-\text{C}^*-\text{Cl} & \text{Cl}-\text{C}^*-\text{H} \\ & \\ \text{CH}_3 & \text{CH}_3 \end{array}$ <p>Erythro enantiomers</p>

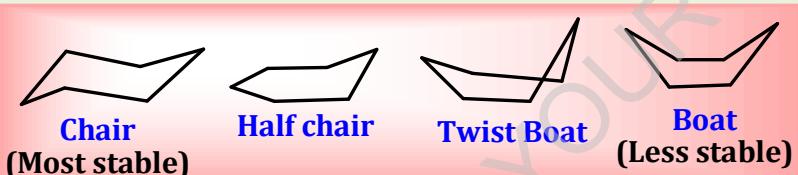
Conformation of Butane [$\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3$]



Stability - Fully Staggered > Gauche > Eclipsed > Fully eclipsed

Conformation of Cyclohexane

- Most common naturally available cyclic compounds contain six member rings because such rings exist in almost **completely strain free conformation**. This is called as chair conformation.



Stability - Chair > Twist Boat > Boat > Half chair

Bonds in Organic Compounds

INTRODUCTION

Chemical reactions occur by the **formation of bond between the atoms or breaking of bond between the atoms** and leads to formation of stable products.

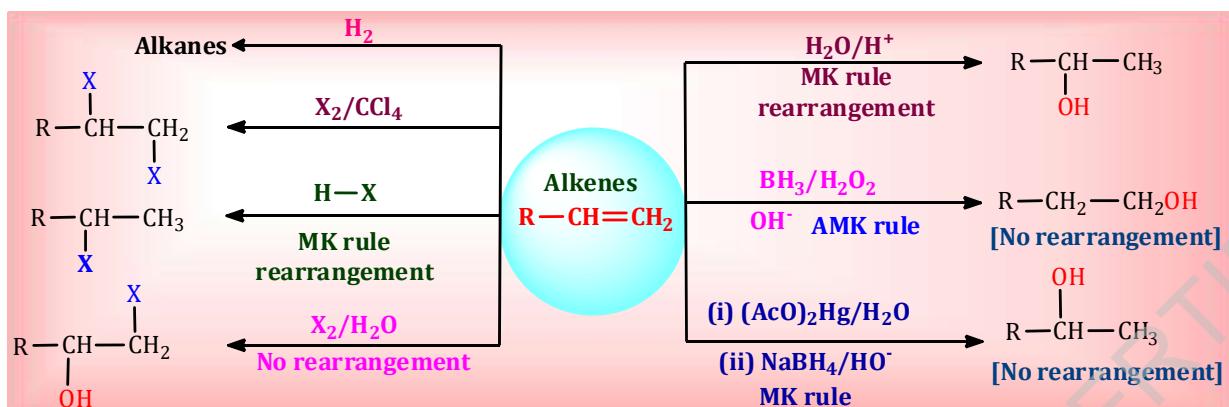
TYPES OF BONDS

Ionic bond or Electrovalent bond	This bond is formed due to the electrostatic attraction between no two oppositely charged stable ions . eg - NaCl , KCl & AlF_3 .
Covalent bond	Formed by mutual sharing of electrons between two atoms . eg - Single, Double & Triple bonds
Co-ordinate covalent bond or Dative bond	A bond formed by donating a pair of electrons to another atom. eg - Ozone (O_3) [$\text{O}=\text{O}\rightarrow\text{O}$]

SIGMA (σ) AND PI (π) BOND

SIGMA BOND (σ)	PI BOND (π)
This is formed due to overlapping of pure s-s, s-p, p-p or hybrid orbitals of two atoms along their inter-nuclear axis.	This bond is formed due to lateral or sidewise or parallel overlapping of pure 'p' orbitals of two atoms.

□ CHEMICAL REACTION OF ALKENES

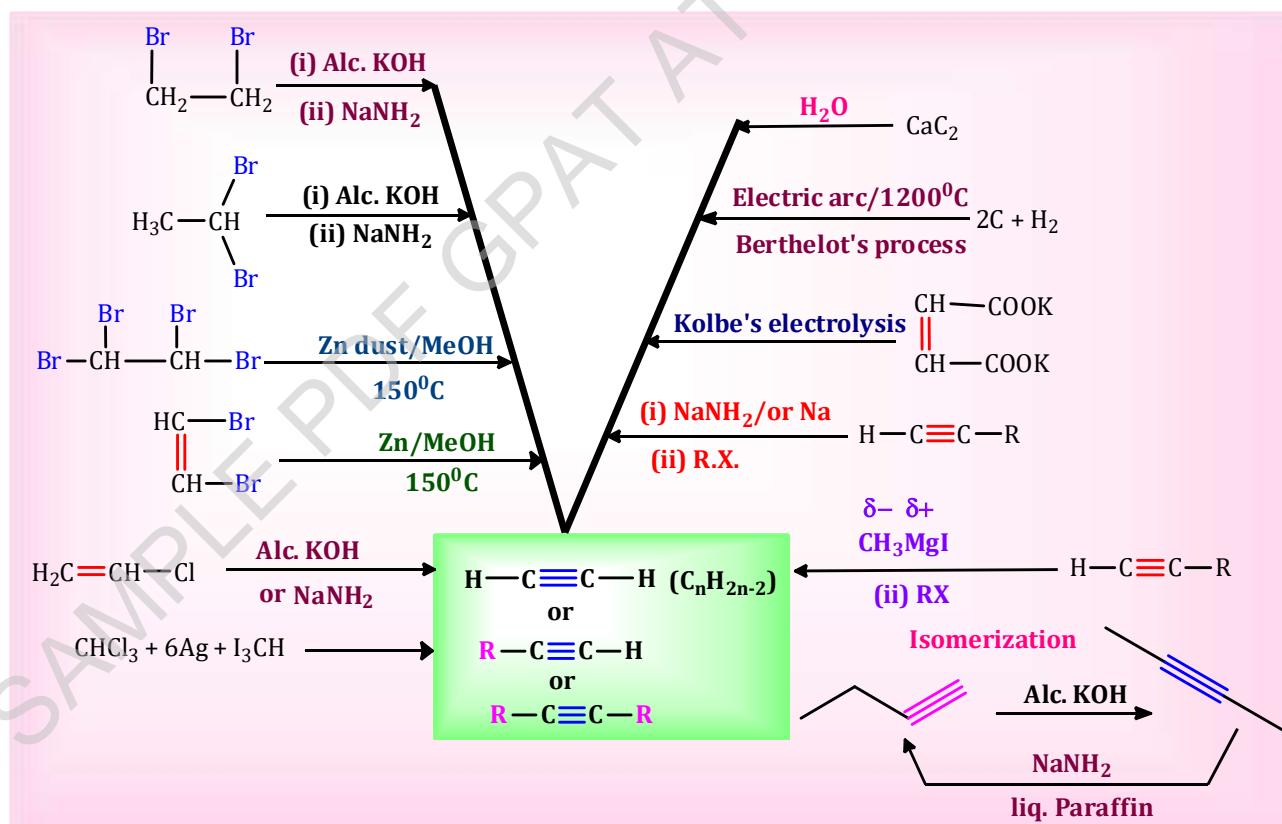


Alkynes

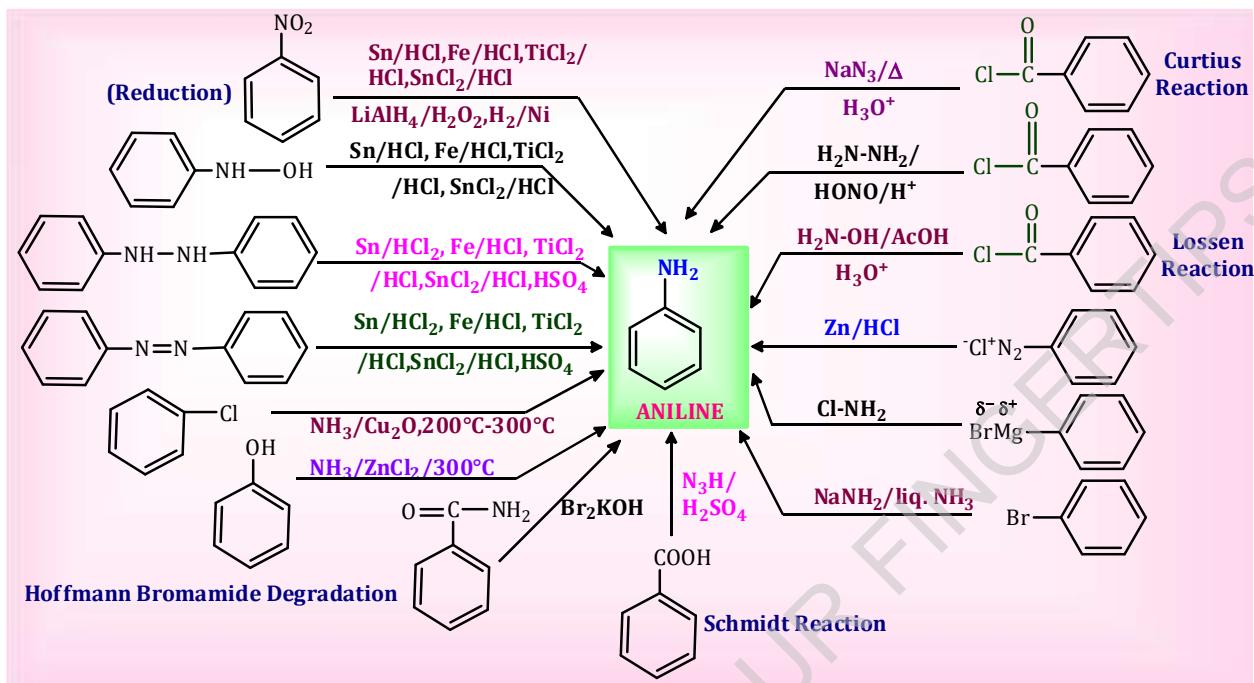
- Alkynes have a **general formula of $[C_nH_{2n-2}]$** .
- These are the acyclic hydrocarbons which contain **carbon-carbon triple bond is called alkynes**
- The hybridization of carbon atoms having triple bond ($C\equiv C$) in alkynes is **sp.**



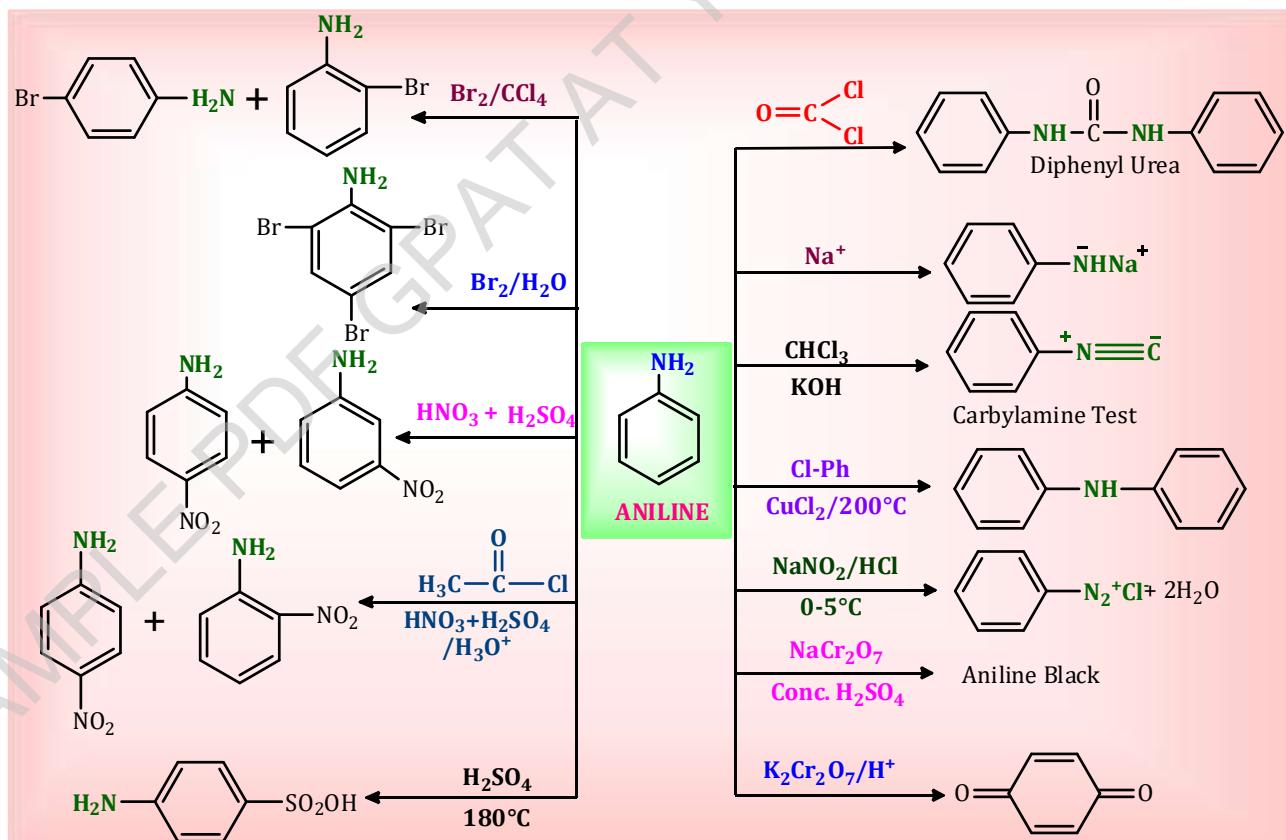
□ METHOD OF PREPARATION OF ALKYNES



□ METHOD OF PREPARATION OF ANILINE



□ CHEMICAL REACTION OF ANILINE

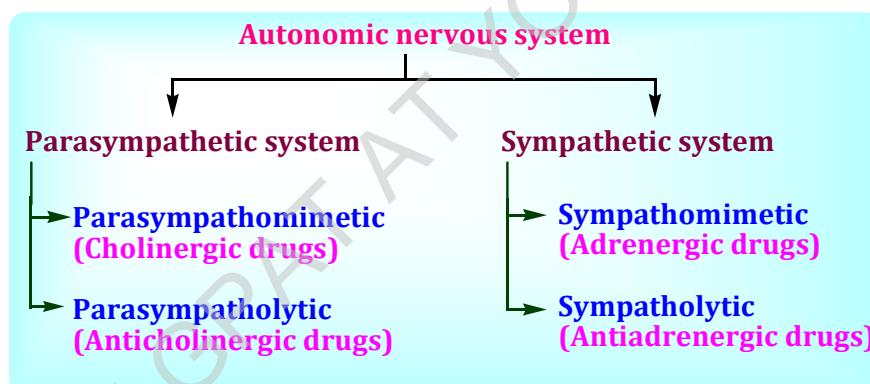
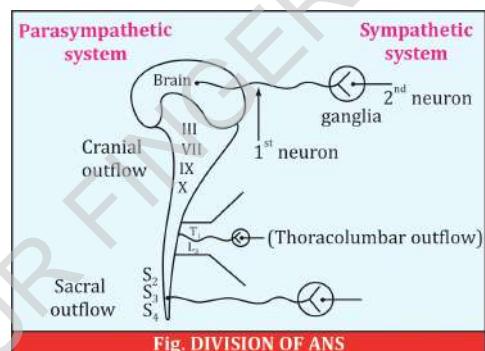




Medicinal Chemistry

Drugs Acting on ANS

- Autonomic nervous system (ANS) is involuntary in nature and the activity of this is maintained automatically
- The ANS has two divisions – Parasympathetic and Sympathetic. Sympathetic system is more widely than Parasympathetic activity.



□ CHOLINERGIC DRUGS (PARASYMPATHOMIMETIC)

- Acetylcholine receptor stimulants and cholinesterase inhibitors together comprise a large group of drugs, called as **cholinergic drugs** that mimic the actions of **acetylcholine**.
- **Cholinceptor stimulants** are classified pharmacologically by the spectrum of action depending on the type of receptor **muscarinic or nicotinic**.
- ❖ Basic moiety of Cholinergic drugs

DRUG NAME	BASIC MOIETY
Acetylcholine	Onium group
Muscarine	Tetrahydrofuran
Pilocarpine	Tetrahydrofuran and imidazole
Physostigmine	Indole and pyrrolidine

❖ Basic moiety of Sedatives & Hypnotics Drugs

DRUG NAME	BASIC MOIETY
Phenobarbitone, Pentobarbitone, Amobarbital, Barbital and Mephobarbitone,	Barbituric acid
Diazepam, Nitrazepam, Oxazepam & Prazepam	1,4-benzodiazepine-2-one
Chlordiazepoxide	1,4-benzodiazepine-4-oxide

❖ Structures and IUPAC Name of Drugs

BENZODIAZEPINES				
Diazepam	Nitrazepam	Oxazepam		
 7-Chloro- 1-methyl-5-phenyl 3H- 1,4-benzodiazepin-2-one	 7-Nitro-5-phenyl-1H-1,4-benzodiazepin-2-one	 7-Chloro-3-hydroxy-5-phenyl -1,4-benzodiazepine-2-one		
Chlordiazepoxide	Prazepam			
 7-Chloro-2-methylamino-5-phenyl-3H-1,4-benzodiazepine-4-oxide	 7-chloro-1-(cyclopropyl methyl)-5- phenyl- 2H- 1, 4-benzodiazepine -2-one			
BARBITURATES				
Phenobarbitone	Pentobarbitone	Amobarbital		
 5-Ethyl-5-phenyl barbituric acid	 5-Ethyl-5-(1-methylbutyl) barbituric acid	 5-Ethyl-5-(3-methylbutyl) barbituric acid		

SYMPATHETIC INHIBITORS		
$\alpha+\beta$ adrenergic blockers	α -adrenergic blockers	
Labetalol <p>2 hydroxy-5-(1-hydroxy-2-[(4-phenyl-2-butanyl)amino]ethylbenzamide</p>	Phenoxybenzamine <p>N-Benzyl-N-(2-chloroethyl)-1-phenoxypropan-2-amine</p>	
Central sympatholytics Clonidine <p>N-(2,6-Dichlorophenyl)-imidazol-2-amine</p>	CALCIUM CHANNEL BLOCKERS Verapamil <p>2-(3,4-Dimethoxyphenyl)-5-{[2-(3,4-dimethoxyphenyl)ethyl]-(methyl)amino}-2-prop-2-yl pentane nitrile</p>	
Nifedipine <p>3,5-dimethyl 2,6-dimethyl-4-(2-nitrophenyl)-1,4-dihydro pyridine-3,5-dicarboxylate</p>	Isradipine <p>3-methyl 5-propan-2-yl 4-(2,1,3-benzoxadiazol-4-yl)-2,6-dimethyl-1,4-dihydropyridine-3,5-dicarboxylate</p>	Diltiazem <p>5-[2-(dimethylamino)ethyl]-2-(4-methoxyphenyl)-4-oxo-2,3-dihydro-1,5-benzothiazepine-3-acetate</p>
ARTERIOLAR DILATOR Minoxidil <p>2,4-diamino-6-piperidino pyrimidine-3-oxide</p>	Deserpidine <p>Methyl-2-methoxy-3-[(3,4,5-trimethoxybenzoyl) oxy] indolo[2',3':3,4]pyrido[1,2-b]isoquinoline-1-carboxylate</p>	

✓ Note point-

- (R, R) isomer of labetalol is Clinically used.
- **Enalapril is ACE inhibitor**, used in treating cardiovascular disorder & synthesized from the natural amino acids L-alanine and L-proline.
- **Nifedipine** when exposed to day light and artificial light, is readily converted to a derivative **nitrosophenylpyridine**.



Pharmaceutical Analysis

Introduction of Pharmaceutical Analysis

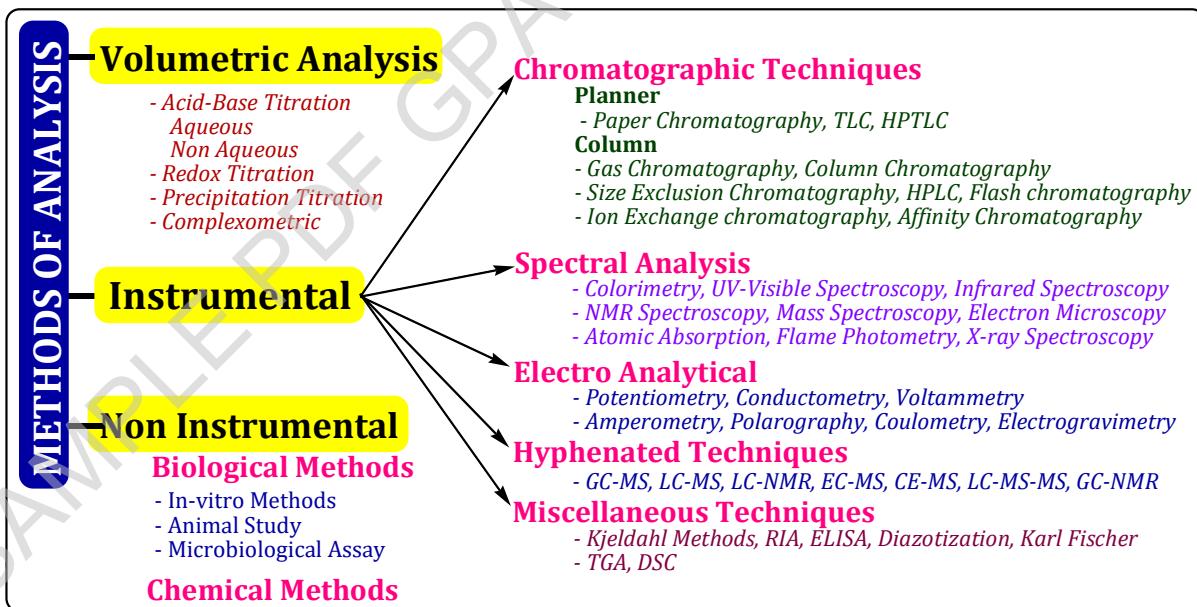
The pharmaceutical analysis is a **branch of chemistry**, which deals with the **process or sequences of processes to identify and/or quantify a substance or drug**, the component of pharmaceutical substance or determination of the structure of chemical compound used in the formulation of pharmaceutical product.

❖ DIFFERENT TECHNIQUES OF ANALYSIS

Analysis is broadly divided into two types:

QUALITATIVE ANALYSIS	QUANTITATIVE ANALYSIS
<p>It gives information about the identity of atomic and molecular species or the functional groups in samples. It is used only to determine the presence and absence of the compound.</p>	<p>It establishes the relative amount of one or more of the species (analyte) in numerical terms. It measures the concentration or amount of each substance in a sample.</p>

□ CLASSIFICATION OF ANALYTICAL METHODS

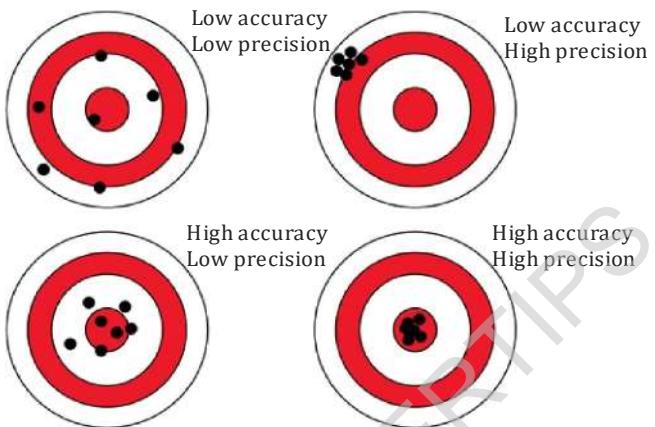


□ SOME IMPORTANT DEFINITIONS

Volumetric or Titrimetric Analysis	It consists of determination of volume of solution of accurately known concentration required to react completely with the solution of substance to be determined.
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□ ACCURACY AND PRECISION

❖ **Accuracy**- Accuracy is ‘the degree of agreement between the measured value and the true value’. An absolute true value is seldom known. So, the term accuracy refers to how near the observed value is to true or standard value. Or **“Closeness of a measured value to the true or accepted value”**.

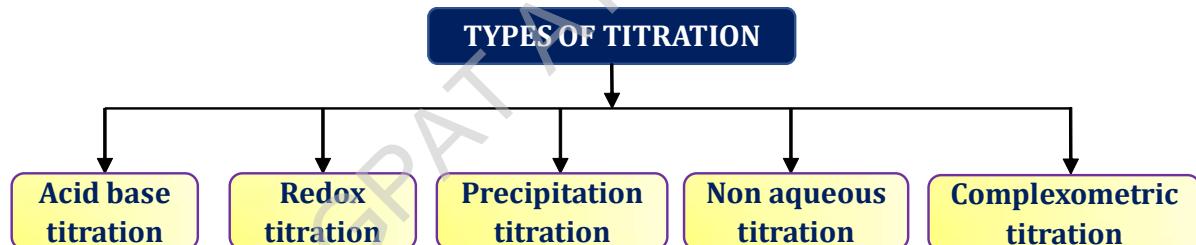


❖ **Precision**- Precision is defined as the **degree of agreement between replicate measurements of the same quantity**. It is the repeatability of a result. The precision may be expressed as the standard value. So, the term precision refers to nearness between several measurements of the same quantity.

Titration

❖ TITRATION

- A titration is a technique where a solution of **known concentration is used to determine the concentration of an unknown solution**.



ACID BASE TITRATION

- ACID BASE TITRATION** - An Acid-Base titration involves strong or weak acids or bases. Specifically, an acid-base titration can be used to figure out the following:
 - The concentration of an acid or base.
 - Whether an unknown acid or base is strong or weak.
 - pK_a of an unknown acid or pK_b of the unknown base.

ACID	BASE
<ul style="list-style-type: none"> An Acid is a substance that can release ion (H^+) when dissolved in water. Acid converts blue litmus paper to red having the pH < 7. <p>Example: $HCl \rightarrow H^+ + Cl^-$</p>	<ul style="list-style-type: none"> A Base is a substance that can release a hydroxyl ion (OH^-) when dissolve in water. Base converts red litmus paper to blue having the pH > 7. <p>Example: $NaOH \rightarrow Na^+ + OH^-$</p>

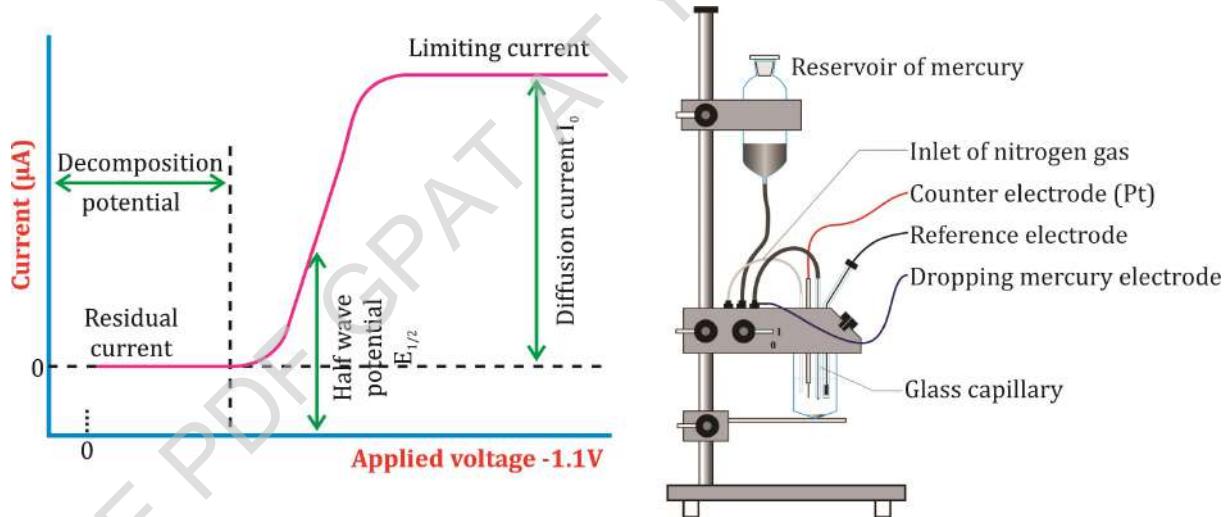
Strength of titrant	Same as that of titrate	5 or 10 times stronger than titrate
Dependency	Temperature dependent	Temperature dependent

POLAROGRAPHY

- **POLAROGRAPHY** is an electrochemical method of analysis based on the measurement of current flow resulting from the electrolysis of a solution at a polarisable microelectrode as a function of applied voltage.

PRINCIPLE in polarography is that a **gradually increasing negative potential (voltage) is applied between a polarisable and non-polarisable electrode and the corresponding current is recorded**. From the current voltage curve (Sigmoid shape), qualitative and quantitative analysis can be performed.

- **HALF WAVE POTENTIAL** The Half wave potential is the potential at the point of inflection in the current-voltage curve. $E_{1/2}$ is characteristic or specific for every electroreducible ion or functional group. At this potential, **50% of the reduced form and 50% of the oxidised form are present**.

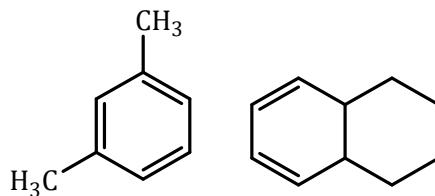


□ DIFFERENT TYPES OF CURRENTS USED IN POLAROGRAPHY

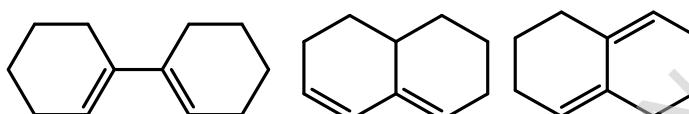
Residual Current (i_r)	It is a non-faradic current. This current increases linearly with the applied voltage, and it is observed even when the purest, air free solutions are used. It is the sum of the relatively larger condenser current (i_c) and a very small faradic current (i_f). $i_r = i_f + i_c$
Diffusion current (i_d)	Resulting from reduction or oxidation of sample: It is calculated by following equation known as Ilkovic equation $I_d = 607 \cdot n \cdot C D^{1/2} \cdot m^{2/3} \cdot t^{1/6}$

WOODWARD-FIESER RULE

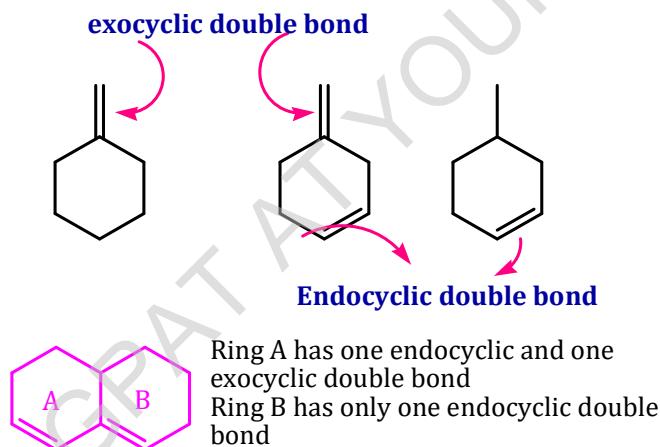
- **Homoannular Diene:** It is a cyclic diene having conjugated double bond in the same ring.



- **Heteroannular diene:** It is a cyclic diene in which double bonds in conjugation are present in different rings.



- **Endocyclic double bond:** A double bond present in a ring as shown in the example.
Exocyclic double bond: A double bond in which one of the double bond is a part of a ring system shown in ring B

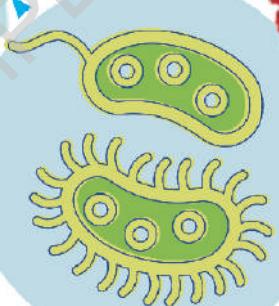
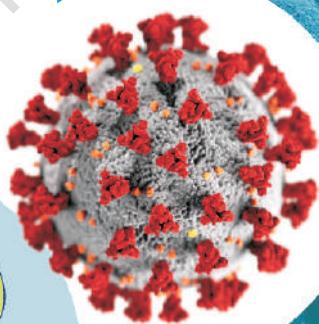
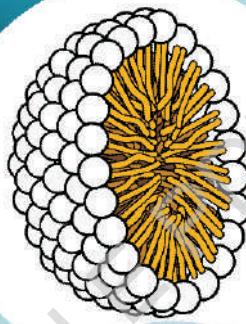


(A) For dienes, trienes and polyenes

FOR DIENES, TRIENES AND POLYENES		
Parent value	Homoannular conjugated diene	253 nm
	Heteroannular conjugated diene	215 nm
	Butadiene or a cyclic conjugated diene 	217 nm
Increments	Acyclic triene	245 nm
	Each alkyl substituent or Ring residue	+ 5 nm
	Exocyclic double bond	+ 5 nm
	Double bond extending conjugation	+ 30 nm

PART 5

OTHER SUBJECTS

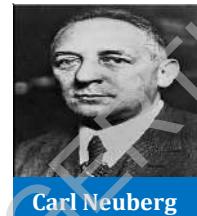


- ➡ Biochemistry
- ➡ Biotechnology
- ➡ Microbiology
- ➡ Pharmaceutical Management



Biochemistry

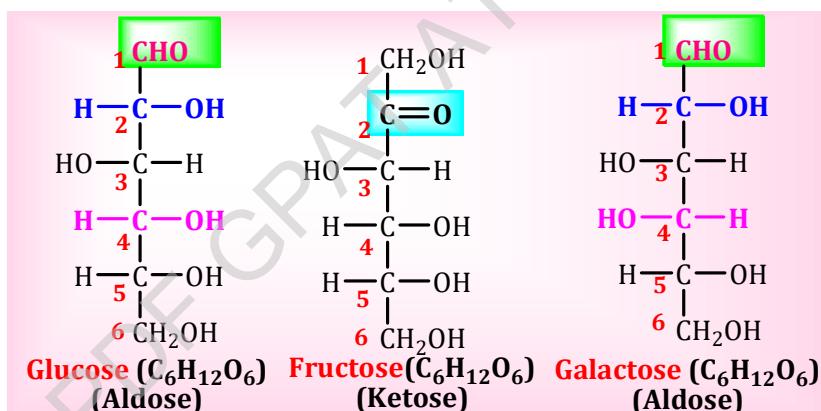
- Biochemistry can be simply defined as, “**chemistry of the living cell**”.
- The term **Biochemistry** was introduced by **Carl Neuberg** in 1903.



Carl Neuberg

Carbohydrates

- Carbohydrates are **organic compounds** with **general formula $C_n(H_2O)_n$** .
- Carbohydrates may be **defined chemically** as **aldehyde** or **ketone** derivatives of **polyhydroxy (more than one hydroxy group) alcohols** or as compounds that yield these derivatives on **hydrolysis**.
- The term ‘**sugar**’ is applied to **carbohydrates soluble in water and sweet to taste**.
- They are the most abundant dietary source of **energy (4 Cal/g)** for all organisms.

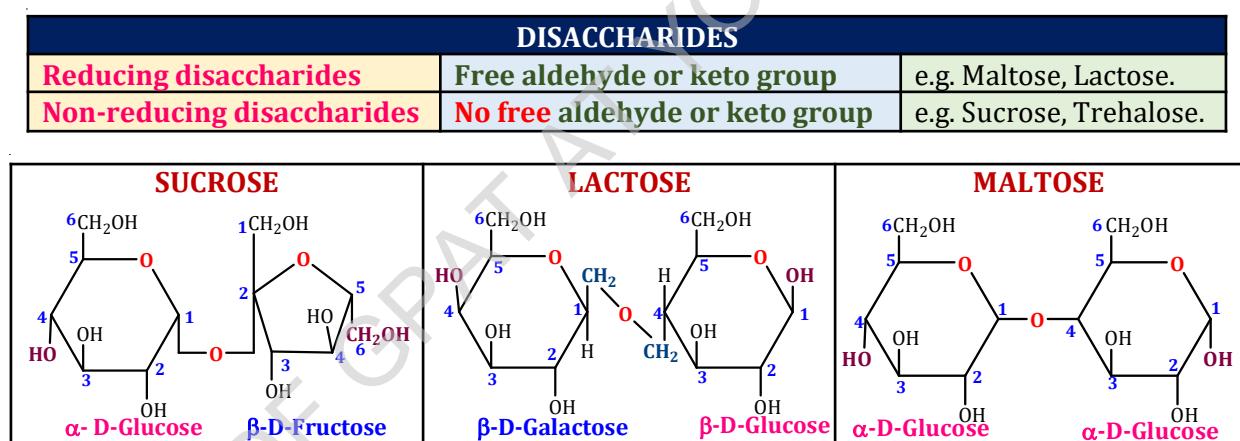


□ CLASSIFICATION OF CARBOHYDRATES

CLASSIFICATION	TYPES	EXAMPLES
MONOSACCHARIDES	Triose ($C_3H_6O_3$)	Glyceraldehyde, Dihydroxyacetone
	Tetrose ($C_4H_8O_4$)	Erythrose, Erythrulose
	Pentose ($C_5H_{10}O_5$)	Ribose, Ribulose, Deoxyribose, Xylose, Xylulose
	Hexose ($C_6H_{12}O_6$)	Glucose, Galactose, Mannose, Fructose
	Heptose ($C_7H_{14}O_7$)	D-Sedoheptulose

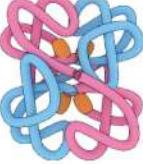
OLIGOSACCHARIDES	Disaccharides	Sucrose, Lactose, Maltose
	Trisaccharides	Raffinose, Gentianose
POLYSACCHARIDES	Homopolysaccharide	Starch, Dextrin, Inulin, Glycogen, Cellulose
	Heteropolysaccharides	Hyaluronic acid, Chondroitin, Heparin, Keratan sulphate, Dermatan sulphate.

ISOMERISM SHOWN IN MONOSACCHARIDES	
Epimers	Two monosaccharides differ from each other in their configuration around a single specific carbon glucose and galactose carbon 4 (C₄-epimers) . They differ in the arrangement of OH group at C ₄ .
Anomers	The α and β cyclic forms of D-glucose
Mutarotation	Change in the specific optical rotation → α and β forms of D-glucose to an equilibrium mixture.
Enantiomer	Mirror image of each other (D-Glucose & L-Glucose)
Diastereomers	Not mirror image of each other (D-Glucose [C₂, C₄], D-Mannose [C₂] & D-Galactose [C₄])

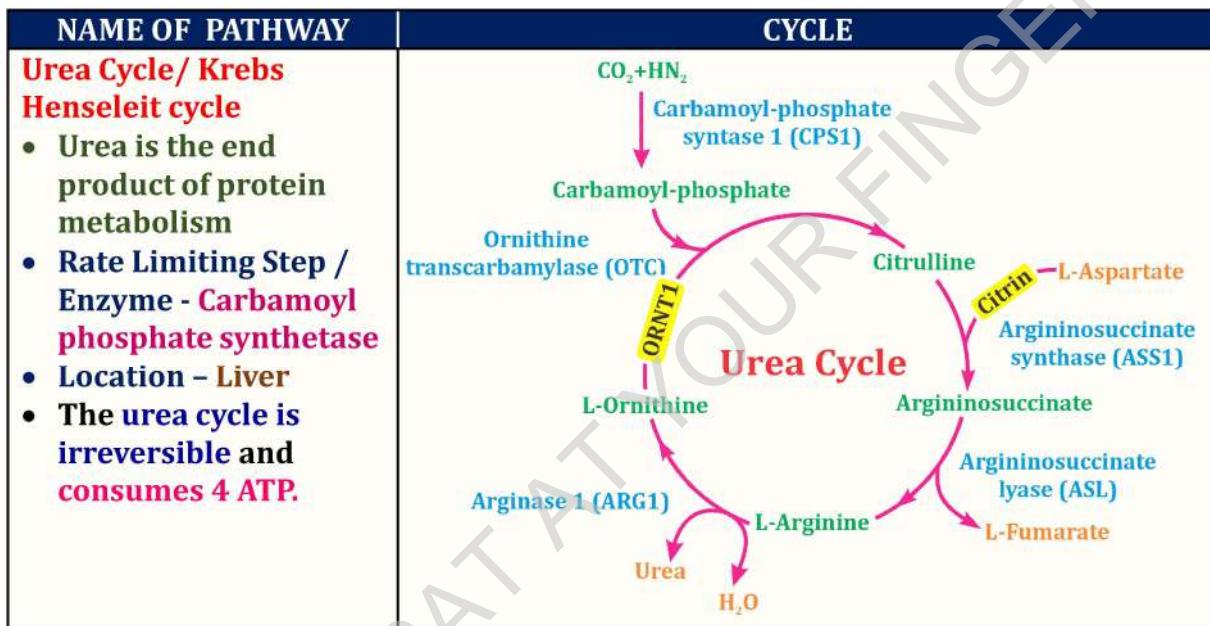


□ COMPOSITION AND GLYCOSIDIC LINKAGE OF CARBOHYDRATES

CARBOHYDRATES	SUGAR UNIT	LINKAGE
Sucrose (Cane sugar & Invert sugar)	$\alpha\text{-D Glucose} + \beta\text{-D Fructose}$	$\alpha, \beta (1 \rightarrow 2)$
Lactose (Milk Sugar)	$\beta\text{-D- Glucose} + \beta\text{-D- Galactose}$	$\beta (1 \rightarrow 4)$
Maltose	$\alpha\text{-D- Glucose} + \alpha\text{-D- Glucose}$	$\alpha (1 \rightarrow 4)$
Cellulose	Unbranched polymer of $\beta\text{-D- Glucose}$	$\beta (1 \rightarrow 4)$
Starch (Glucosan or Glucan)	Polymer of Glucose	Amylose - $\alpha - 1 \rightarrow 4$ Amylopectin - $\alpha - 1 \rightarrow 6$
Inulin	Polymer of Fructose	-

Quaternary Structure 	<ul style="list-style-type: none"> Only those protein having more than one polypeptide chain (polymeric) have quaternary structure. Bonds responsible for protein structure Covalent bonds - Peptide bond & Disulfide bonds, Non-covalent bonds - Hydrogen bonds, Hydrophobic bonds, Electrostatic bonds & Van der Waals forces. E.g.- Hemoglobin, Creatine kinase, Lactate dehydrogenase
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□ METABOLISM OF AMINO ACID



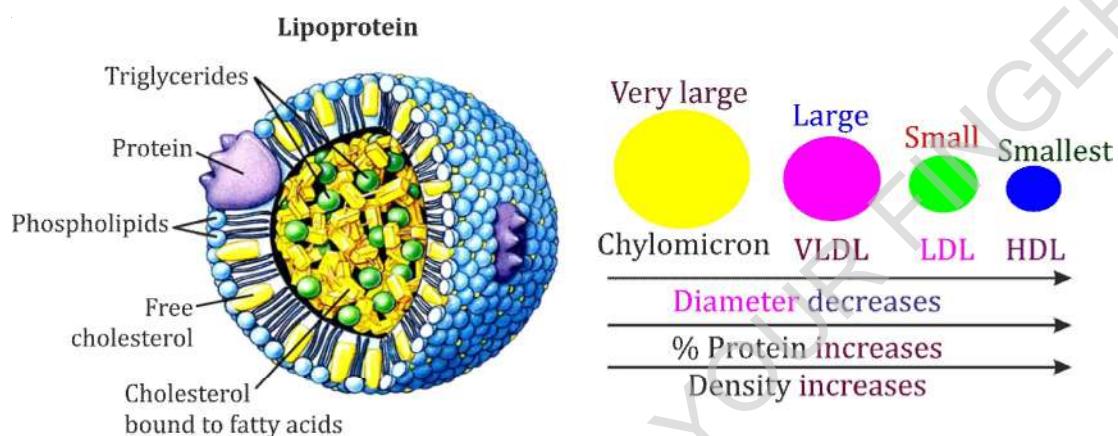
□ TEST FOR PROTEINS

TEST	REAGENT	OBSERVATION	AMINO ACID
Biuret Test	KOH + hydrated copper sulphate + sodium potassium tartrate	Purple color (Copper coordinate complex)	Confirms the presence of peptide bond / linkage (Protein)
Folin-ciocalteu Test	Sodium tungstate and sodium molybdate	For colorimetry assay	Phenolic group (Tyrosine)
Heller's Test	HNO ₃	White precipitate	Coagulation test for albumin in biological fluid including urine.
Hopkins-Cole reaction	Glyoxylic acid	Violet or Purple color	Indole ring (Tryptophan)
Millon's Test	Mixture of sulphuric acid and mercury sulphate + Sodium nitrite	Red	Phenolic (Tyrosine) Presence of soluble protein

Essential fatty acid: - Fatty acid that cannot be synthesized by human body, commonly they are polyunsaturated fatty acid (PUFA).

- Arachidonic acid
- Linoleic acid
- Linolenic acid

- **Lipoproteins consist** of a lipid core containing nonpolar **triacylglycerol** and **cholesterol ester** surrounded by a **single layer of amphipathic phospholipids** and free **cholesterol molecules** with some proteins (**apoprotein**).



□ CLASSIFICATION OF LIPOPROTEINS

LIPOPROTEINS	DIAGRAM	DIAMETER (nm)	TRIACYLGLY CEROL (%)	PROTEIN (%)	FUNCTION
HDL (High density lipoprotein)		10-20	12	40	<ul style="list-style-type: none"> • Formed in the liver • Deliver cholesterol from peripheral tissue to liver
LDL (Low density lipoprotein)		20-25	12	20	<ul style="list-style-type: none"> • Derived from VLDL remnant • They transport cholesterol from liver to other tissues.
VLDL (Very low-density lipoprotein)		30-90	55	10	<ul style="list-style-type: none"> • Formed in the liver • Carry endogenous triacylglycerol
Chylomicron		100-1000	88	2	<ul style="list-style-type: none"> • Formed in the intestine • Carry dietary triacylglycerol to various tissues

7.	Lipid storage diseases	
a.	Niemann Pick disease	Sphingomyelinase
b.	Farbers disease	Ceramidase
c.	Gaucher's disease	β -Glucosidase (glucocerebrosidase)
d.	Krabbe's disease	β -Galactosidase (Galactosylceramidase)
e.	Tay-sachs disease	Hexosaminidase A
f.	Fabry's disease	α -galactosidase

8.	Disorders of Nucleic Acid Metabolism	
a.	Hyperuricaemia	Elevation in serum uric acid
b.	Gout	Overproduction of uric acid resulting in deposition of sodium urate crystals in the joints causing inflammation
c.	Pseudogout	Deposition of calcium pyrophosphate crystals in joints
d.	Lesch-Nyhan syndrome (sex linked metabolic disorder, affects only males)	HGPRT (Hypoxanthine-guanine phosphoribosyl transferase)

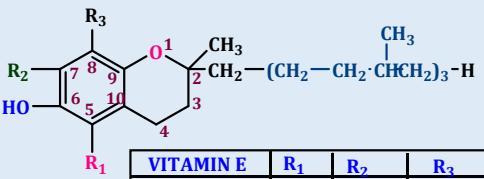
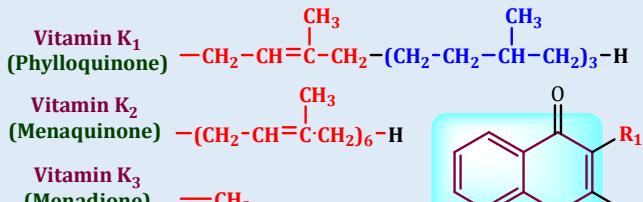
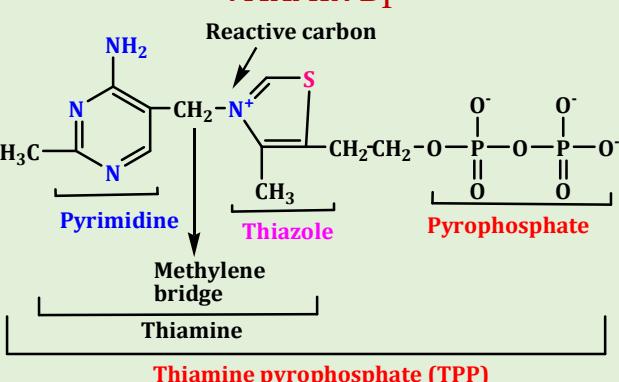
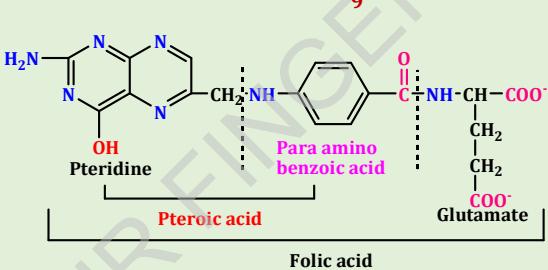
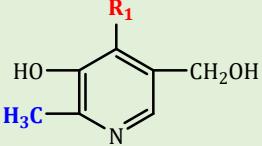
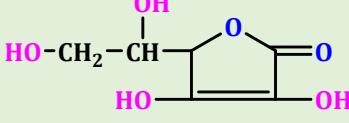
Biological Oxidation

□ ELECTRON TRANSPORT CHAIN

- The energy-rich carbohydrates (particularly glucose), fatty acids and amino acids undergo a series of **metabolic reactions and, finally, get oxidized to CO_2 and H_2O** .
- The reducing equivalents from various metabolic intermediates are transferred to **coenzymes NAD^+ and FAD** to produce, respectively, **NADH and FADH_2** .
- The **mitochondria are the centres for metabolic oxidative reactions** to generate **reduced coenzymes (NADH and FADH_2)** which, in turn, are utilized in ETC to liberate energy in the form of ATP.
- ✓ **Structural organization of respiratory chain**
- The **inner mitochondrial membrane** can be disrupted into **five distinct respiratory or enzyme complexes**, denoted as **complex I, II, III, IV and V**.
- The **complexes I-IV are carriers of electrons** while **complex V is responsible for ATP synthesis**.

□ OXIDATIVE PHOSPHORYLATION

- The process of **synthesizing ATP from ADP and Pi coupled with the electron transport chain** is known as oxidative phosphorylation.
- The **mitochondrial oxidation of NADH** with a classical **$\text{P} : \text{O ratio of } 3$** .

VITAMIN E  <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th>VITAMIN E</th><th>R₁</th><th>R₂</th><th>R₃</th></tr> <tr> <td>α-Tocopherol</td><td>-CH₃</td><td>-CH₃</td><td>-CH₃</td></tr> <tr> <td>β-Tocopherol</td><td>-CH₃</td><td>-H</td><td>-CH₃</td></tr> <tr> <td>γ-Tocopherol</td><td>-H</td><td>-CH₃</td><td>-CH₃</td></tr> </table>	VITAMIN E	R ₁	R ₂	R ₃	α-Tocopherol	-CH ₃	-CH ₃	-CH ₃	β-Tocopherol	-CH ₃	-H	-CH ₃	γ-Tocopherol	-H	-CH ₃	-CH ₃	VITAMIN K 
VITAMIN E	R ₁	R ₂	R ₃														
α-Tocopherol	-CH ₃	-CH ₃	-CH ₃														
β-Tocopherol	-CH ₃	-H	-CH ₃														
γ-Tocopherol	-H	-CH ₃	-CH ₃														
WATER SOLUBLE VITAMINS																	
VITAMIN B₁  <p>Thiamine pyrophosphate (TPP)</p>	VITAMIN B₉  <p>Folic acid</p>																
VITAMIN B₆  <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th>Vit B₆</th> <th>R₁</th> </tr> <tr> <td>Pyridoxine</td> <td>-CH₂OH</td> </tr> <tr> <td>Pyridoxal</td> <td>-CHO</td> </tr> <tr> <td>Pyridoxamine</td> <td>-CH₂NH₂</td> </tr> </table>	Vit B ₆	R ₁	Pyridoxine	-CH ₂ OH	Pyridoxal	-CHO	Pyridoxamine	-CH ₂ NH ₂	VITAMIN C 								
Vit B ₆	R ₁																
Pyridoxine	-CH ₂ OH																
Pyridoxal	-CHO																
Pyridoxamine	-CH ₂ NH ₂																

□ VITAMINS AND DEFICIENCY DISEASES (FAT SOLUBLE)

VITAMINS	DEFICIENCY DISEASES
Vitamin A	Night blindness, Xerophthalmia, Keratomalacia
Vitamin D	Rickets (In children), Osteomalacia (In adults)
Vitamin E	Sterility in males and abortions in females, Weak immune system
Vitamin K	Bleeding diathesis

□ VITAMINS, COENZYMES, DEFICIENCY DISEASES (WATER SOLUBLE)

VITAMINS	COENZYMEs	FUNCTIONS OF COENZYMEs	DISEASES
Thiamine (Vit. B ₁)	TPP (Thiamine pyrophosphate)	Oxidative decarboxylation Transketolase reactions	<ul style="list-style-type: none"> • Beriberi Wernicke - Korsakoff syndrome



Biotechnology

Introduction of Biotechnology

- Biotechnology is a branch of **biology** involving the use of **living organisms** and **bioprocesses** in **engineering**, **technology**, **medicine** and other fields using **bio products**.
- The **father of biotechnology** is **Louis Pasteur**.
- **Insulin** was the **first pharmaceutical product** of **recombinant DNA technology** approved for human use.



□ HISTORICAL BACKGROUND OF BIOTECHNOLOGY

NAME AND YEAR	DISCOVERIES
Karl Ereky 1917	Term biotechnology
Robert hooke 1665	Cell
Robert brown 1833	Nucleus (Plant cell)
Johann friedrich 1869	DNA
Watson and crick 1953	DNA structure
Wilhelm ludvig Johannsen 1909	Gene
Thomas hunt morgan 1919	XY (male) , XX (female)
Marshall Nirenberg 1964	Genetic code
William j rutter 1987	Genetically engineered vaccine against hepatitis B
Boyer and cohen 1973	Recombinant DNA technology
Kohler and Milstein 1975	Production of monoclonal antibodies
Yuet wai kan 1976	Sickle cell anaemia
Albrecht kossel 1879	Nucleic acid
Edouard van beneden 1882	Specific no. of chromosomes
Oswald T. avery 1944	Genetic information

Plant Tissue Culture

- The **father of plant tissue culture** is **Gottlieb Haberlandt (1902)**.
- **Plant tissue culture** is a practice used to **propagate plant under sterile condition** often to produce clone of plant.

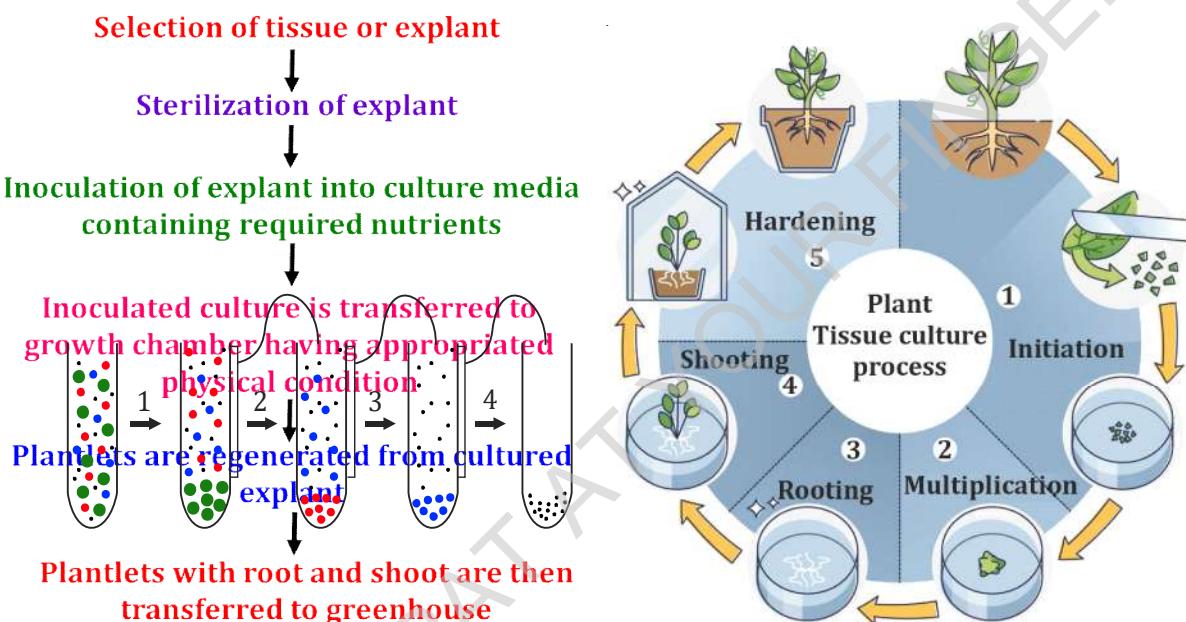
TWO UNIQUE PROPERTIES OF PLANT TISSUE

Totipotency (Toti= Total, Potency = ability)
Plant cell ability to develop into the whole plants

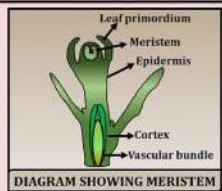
Plasticity (Plant cell adaptability property)
In nutrient medium plant cell adaptation to grow

□ EXPLANT

- An excised **piece of differentiated tissue** or organ is regarded as an **explant**.
 - ✓ General steps involved in tissue culture



□ TYPES OF TISSUE CULTURE

	DESCRIPTION	DIAGRAM
	<p>Callus culture is an unorganized mass of cell when cell or tissue are cultured on solid medium.</p> <p>Callus cells are parenchymatous in nature.</p> <ul style="list-style-type: none"> • Pair of hormones required for a callus to differentiate are Auxin and Cytokinin. • A temperature in the range of 22-28°C is suitable. 	 
Suspension culture	<p>It suspension of individual or clumps of cell formed when cell or tissue culture in liquid.</p>	
Meristem culture	<p>Meristem culture is undifferentiated cultivation of apical meristem called meristem culture</p>	

PREPARATION OF PLANT TISSUE CULTURE MEDIA

Add the micronutrient and macronutrient solution in the desired amount of distilled water and stir it well

Add the other components such as hormones, sucrose, and agar powder. Add vitamins and auxins after autoclave to achieve better results

Add more water to achieve the final volume of the medium

Measure the pH of the medium and adjust it to pH 5.7 by adding 0.1N NaOH or 0.1N HCL

In case of solid medium add agar in this medium and heat the solution to dissolve the agar properly.

Disperse the medium into different culture vessels and plug them by using non-absorbent cotton wool.

Autoclave them at 121 degrees centigrade under 15 psi

The medium to cool down at room temperature

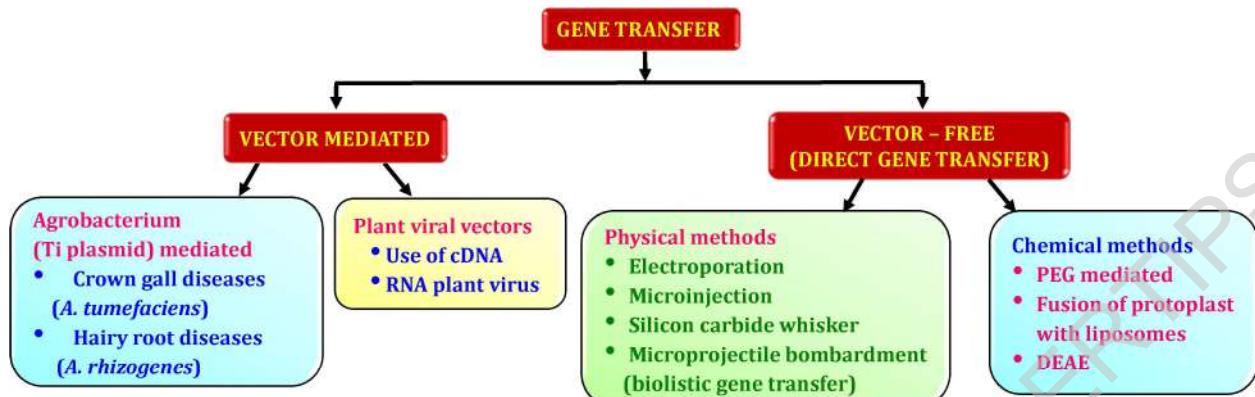
MAJOR TYPES OF MEDIA

White's medium	It is developed for root culture .
MS medium	Murashige and Skoog originally formulated a medium to induce organogenesis and regeneration of plants in cultured tissue.
B₅ medium	Developed by Gamborg . It is used for protoplast culture .
N₆ medium	Developed by Chu . It is used for cereal anther culture .
Nitsch's medium	Developed by Nitsch . It is used for anther culture .

TISSUE TRANSPLANTATION

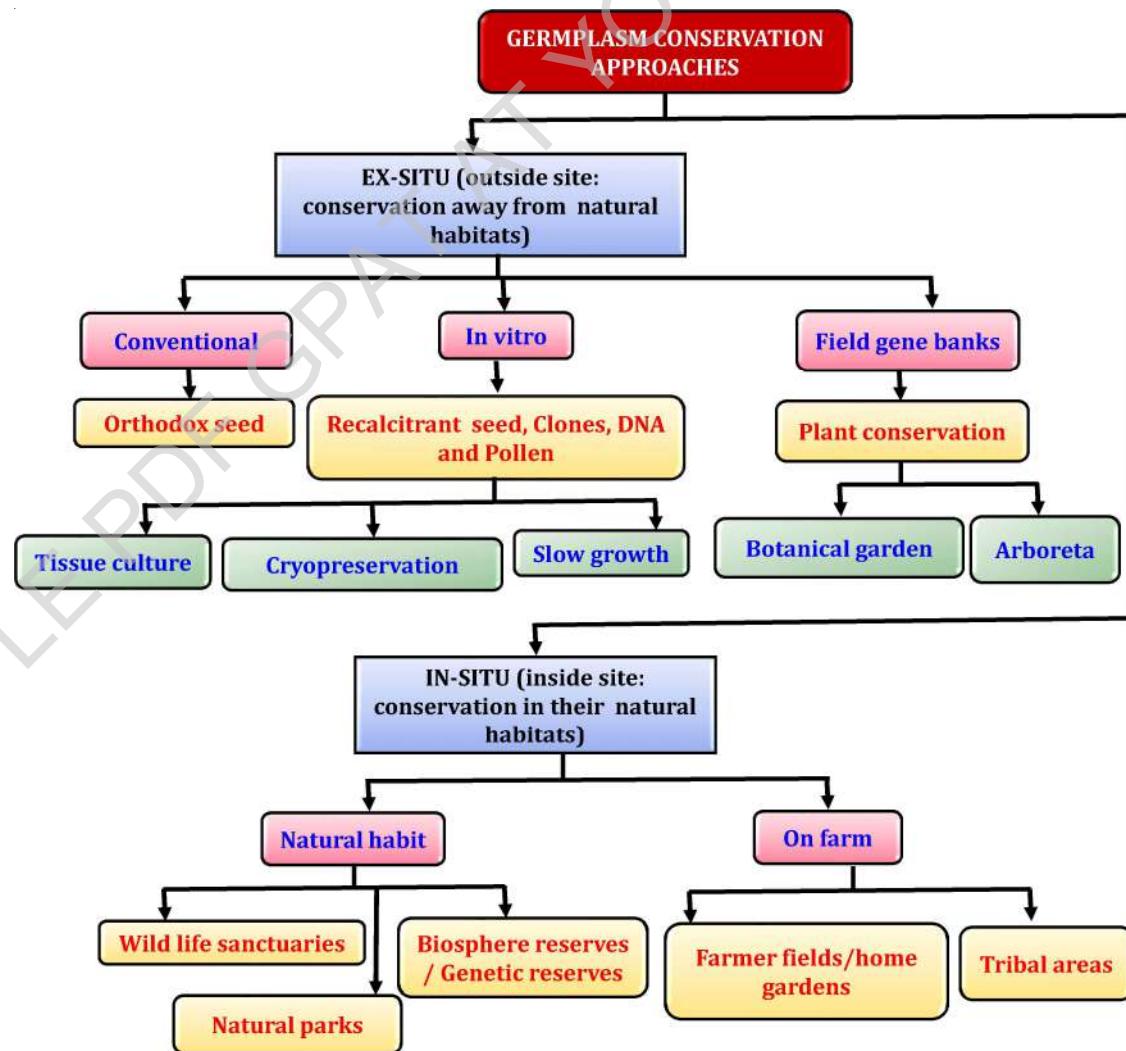
TERMS	DEFINITION
Autograft	Tissue transferred from one side to another side within the same individual organism .
Isografts	Tissue transferred from one site to another between genetically identical individuals , e.g. uniovular twins.
Allografts	Grafts between genetically different individuals of the same species .
Xenografts	Grafts between different species .

□ GENE TRANSFER TECHNIQUES



□ GERMPLASM CONSERVATION

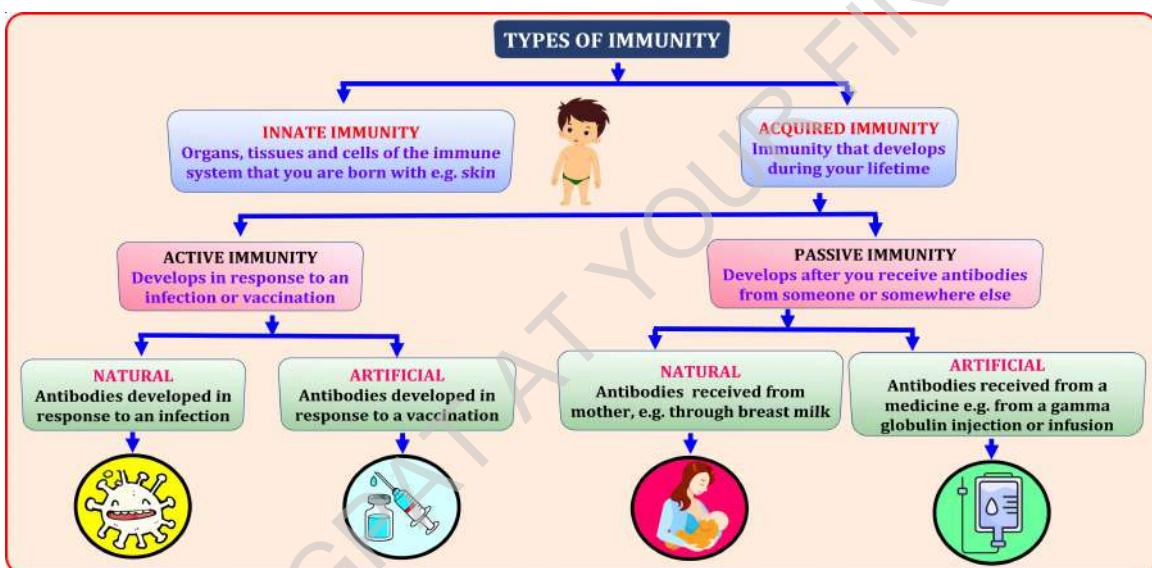
- The most successful method to **conserve the genetic traits** of **endangered and commercially valuable species**.
- Germplasm is a **live information source** for all the genes present in the **respective plant**, which can be conserved for **long periods and regenerated** whenever it is required in the future.



Renaturation	As the temperature of the mixture is slowly cooled to about 55 °c , the primers base pair with the complementary regions flanking target DNA strands .
Synthesis	Taq polymerase is commonly used for this purpose. It is done at a temperature of 75-80 °C (72°C) . The DNA polymerase adds nucleotides in the 5'-3' direction and synthesis the complementary strand of the DNA template .

Immunology

- The **father of immunology** was **Edward Jenner (1749 – 1823)**
- The **immune system** way of **protecting the body against an infectious disease**.



□ DIFFERENCE BETWEEN INNATE AND ACQUIRED IMMUNITY

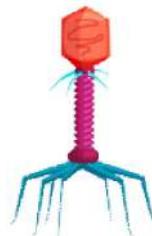
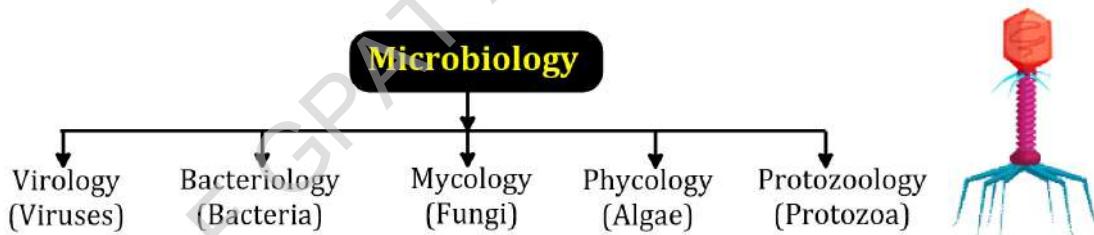
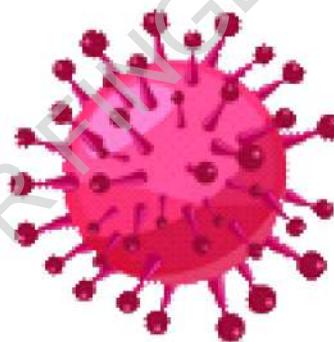
INNATE IMMUNITY	ACQUIRED / ADAPTIVE IMMUNITY
Resistance to infection that an individual possesses from birth .	Resistance to infection that an individual acquires during his lifetime .
Immune response occurs in minutes .	Immune response occurs in days .
Prior exposure to the antigen is not required .	Develops following the antigenic exposure .
Diversity is limited, acts through a restricted set of reactions .	More varied and specialized responses .
Immunological memory responses are absent .	Immunological memory responses are present .
Components :- Skin, Mucosa, Neutrophils, Macrophages, Monocytes, Natural killer, Mast cells, Dendritic cells and Cytokines (IL-1, IL-6, IL-8, IL-12, IL-16, IL-18)	Components :- T cells, B cells and Cytokines (IL-2, IL-4, IL-5, IFN- γ)



Microbiology

Introduction of Microbiology

- Microorganisms are **living organisms** that are usually **too small to be seen clearly with the naked eye**.
- Microorganisms are used to make different products. (e.g. Penicillin, Streptomycin, Chloromycetin), vaccines, vitamins, enzymes and many more important products.
- At present there is general agreement to include five major groups as microorganisms. The subdivisions are
- The diameter of microorganisms are 1 mm or less
- Microorganism play an important role in the recycling of organic and inorganic material like C, N and S cycles, and maintain the stability of the biosphere.



□ DISCOVERY OF MICROBES & THE DAWN OF MICROBIOLOGY

- The term microbiology was given by French chemist **Louis Pasteur (1822-95)**.
- **Antonie van Leeuwenhoek** is considered as the “**Father of microbiology**” & “**Father of bacteriology**”.
- Pasteur in 1862 suggested that mild heating at **62.8°C (145°F)** for **30 minutes**
- The process was called **Pasteurization**.
- **Domagk** was awarded **Nobel prize in 1939** for the discovery of the **first sulpha drug**.
- Recombinant Hepatitis B vaccine developed in 1982.
- The discovery of microbiology as a discipline could be” traced along the following historical eras:

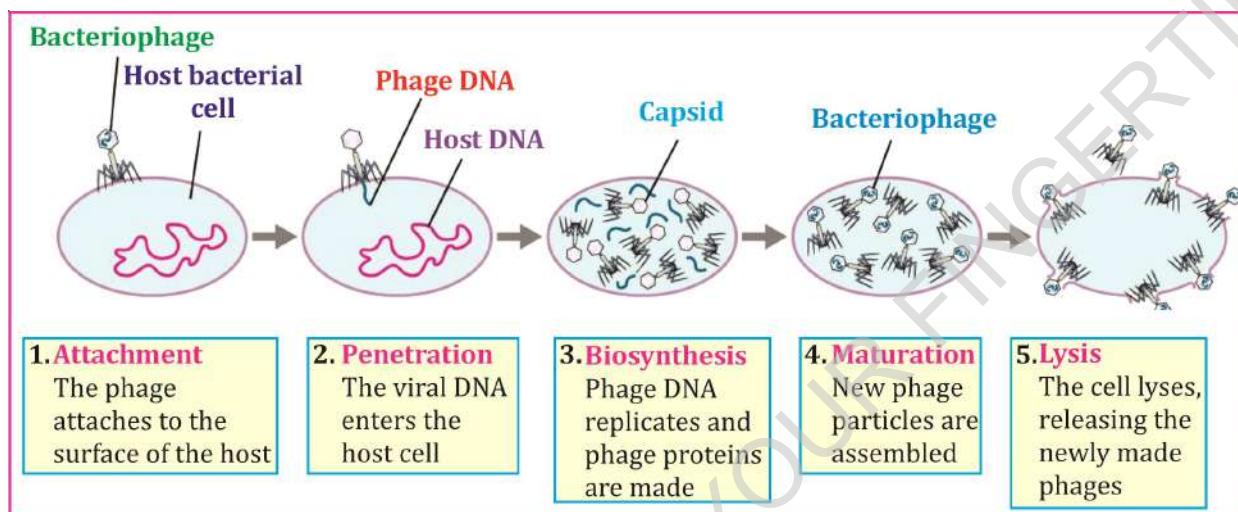
Discovery Transition Golden In 20th Century:

(2) Peplomer

- Peplomer are the glycoprotein and appear as projecting spikes.
- It helps for attachment.

(3) Nucleic acid

- It contains DNA or RNA at a time.

□ REPRODUCTION OF VIRUS**□ VIRAL DISEASES AND THEIR CAUSITIVE MICROORGANISMS**

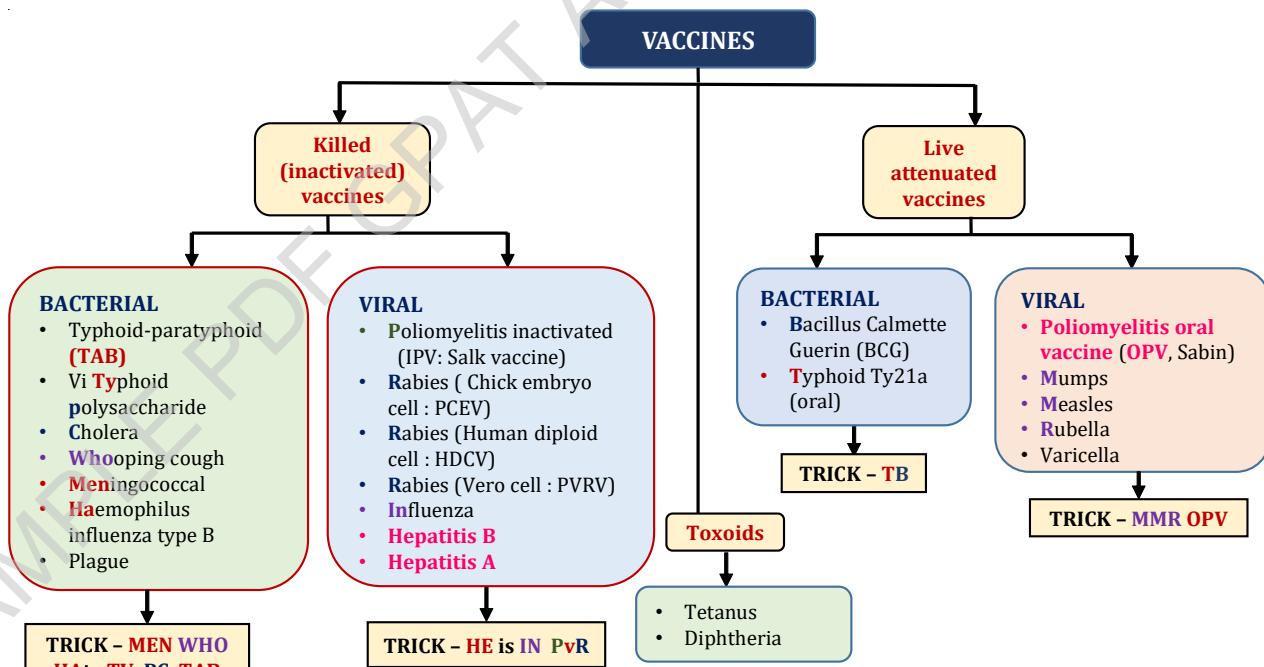
S.NO	VIRUS	DISEASE
1	Adenovirus	Respiratory tract infection and conjunctivitis
2	Arbovirus	Yellow fever, dengue, Dandy fever
3	Corona virus	Lymphocytic Chriomeningitis
4	Herpes	Respiratory tract infection & GIT
5	Myxo virus	Herpes simplex, (cold sore), chicken pox
6	Papova virus	Papilloma virus
7	Paramyxo virus	Mumps, new castle, measles
8	Picrona virus	Larger group include <ul style="list-style-type: none"> • Poliomyelitis • Epidemic myalgia • Common cold due to rhinovirus • Foot & mouth in domestic animal
9	Pox virus	Respiratory tract infection and diarrhea
10	Retro virus	AIDS
11	Rhabdo virus	Rabies
12	Hepatitis B & hepatitis C virus	Hepatocellular carcinoma
13	Papillomavirus	Cervical carcinoma, anal carcinoma
14	Epstein-Barr virus	Hodgkins disease, nasopharyngeal carcinoma

14	Framycetin	<i>Bacillus pumilus</i> <i>Bacillus subtilis</i>	A	32-35° C
15	Neomycin	<i>Staphylococcus epidermidis</i>	A	32-35° C
16	Novobiocin	<i>Staphylococcus epidermidis</i>	A	32-35° C
17	Oxytetracycline	<i>Staphylococcus aureus</i>	A/B	32-35° C
18	Spiramycin	<i>Bacillus pumilus</i>	A	32-35° C
19	Tetracycline	<i>Staphylococcus aureus</i>	A/B	32-35° C
20	Tylosin	<i>Staphylococcus aureus</i>	B	32-35° C

Vaccines and Sera

□ DEFINITIONS

Vaccines	Vaccine is biological preparation that provide acquired immunity to a particular disease. It contain agent resembles to disease causing microorganism. Edward Jenner discovered first vaccine (Small Pox)
Toxoids	Toxoids are the inactivated toxin in which toxicity is suppressed by heat or chemical which promote immune response against bacterial toxins.



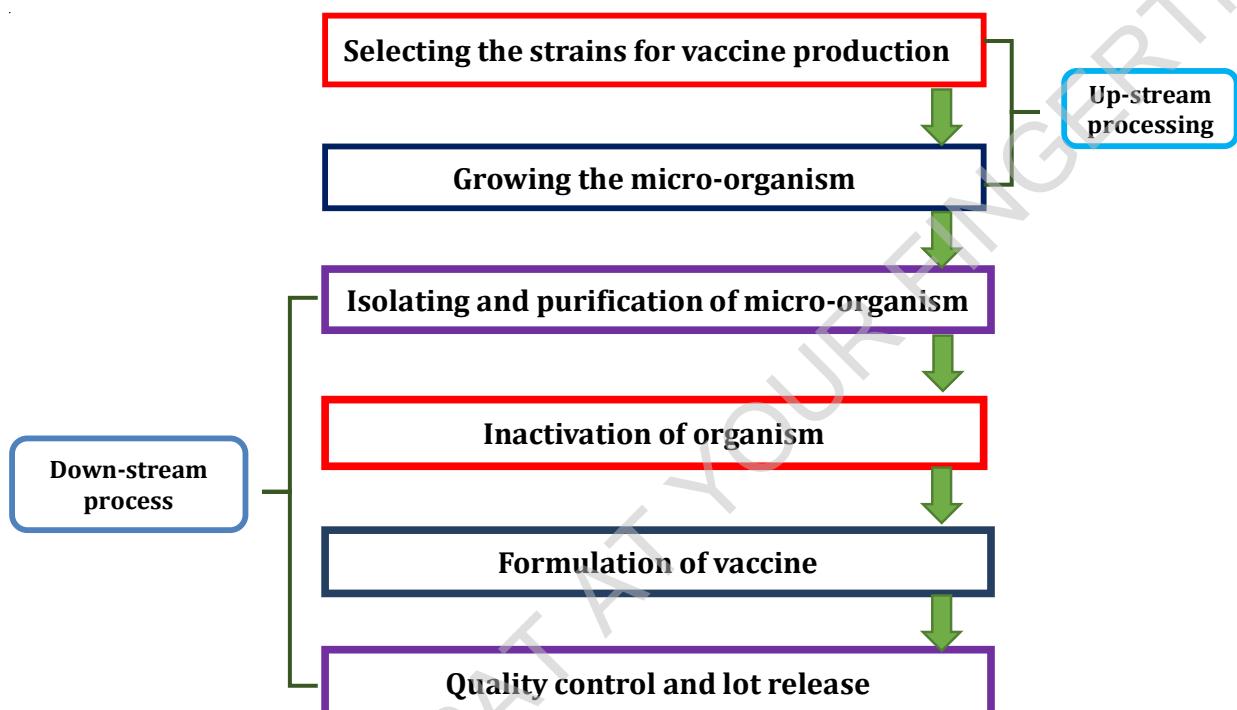
Antiserum	Antiserum is human or non-human blood serum containing monoclonal or polyclonal antibodies & it acts against many infections by passive immunity
Antitoxin	Antitoxin is antibody with ability to neutralize a specific toxin

VACCINE COMPOSITION

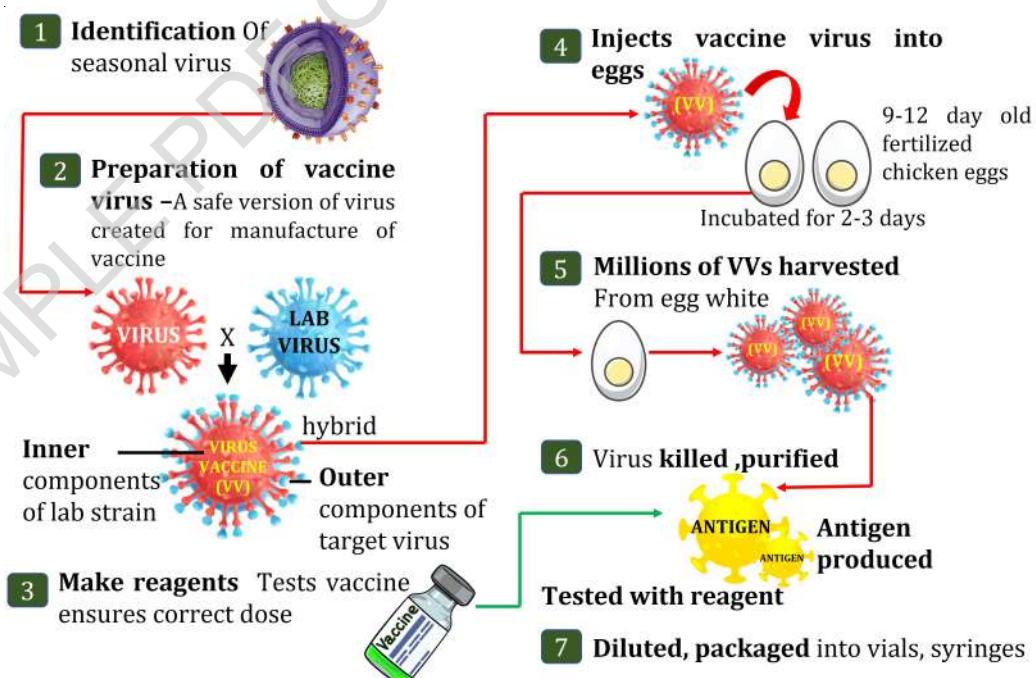
1. Antigenic material (**Killed or attenuated**)
 2. Stabilizer monosodium
 3. Adjuvant: Increase the immune response
 4. Preventative (**Antibiotic, Formalin, Thiomersal**)



■ STEPS IN VACCINE PREPARATION



VACCINE PREPARATION FROM EMBRYONATED EGG





Pharmaceutical Management

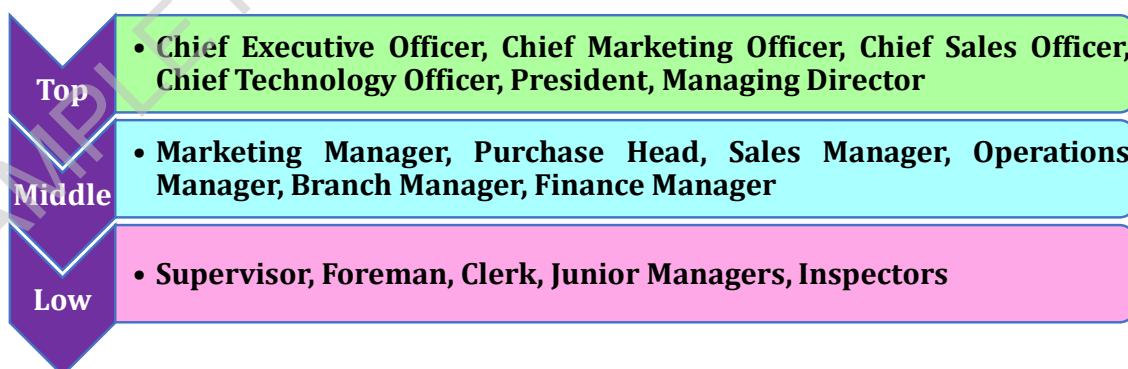
Introduction of Management

- Harold Koontz and Heinz Weihrich defined management as, "The process of designing and maintaining an environment in which individuals working together in groups efficiently accomplish selected aim".
- When the principles and practices of management are applied to pharmaceutical industry and drug store, it is known as "Pharmaceutical Management".

FUNCTION OF MANAGEMENT

Primary function of management	Planning, Organizing, Directing, Coordinating, Controlling, Staffing, Leading
Secondary function of management	Decision making, Leadership, Delegation of authority/responsibility
Founder of modern management methods	Henri Fayol
Father of management theory	Peter Drucker
Inputs of Management	Human, Capital, Managerial, Technological, Goals
Outputs of Management	Products, Services, Satisfaction, Goal integration, Profits
SWOT analysis	Strength, Weakness, Opportunity, Threats
P-D-C-A Cycle	Plan, Do, Check, Act

LEVELS OF MANAGEMENT



- Management by objective (MBO) defined as a management system that measures employees' performance against a series of set targets or goals to gauge their overall performance in their role.



Fig :- Process of MBO

- **MBO** as explained by **Peter Drucker**.
- MBO is most closely associated with **goal setting theory** of work motivation.

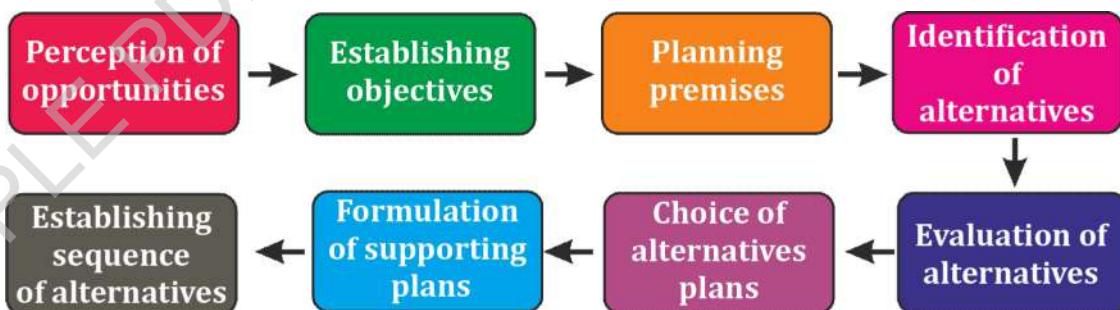
Planning and Forecasting

- Planning is referred to forecasting future circumstances and **requirements, deciding objectives, making long-term and short-term plans, determining policies and setting standards**.

Planning is classified

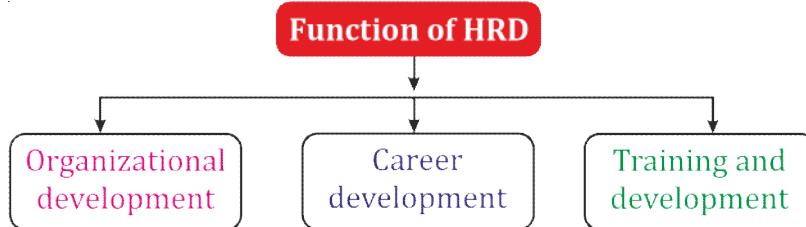
Corporate planning, Functional planning, Strategic Planning, Tactical planning

Process of planning



- **Forecasting** is the process of **projecting past sales demand into the future**.

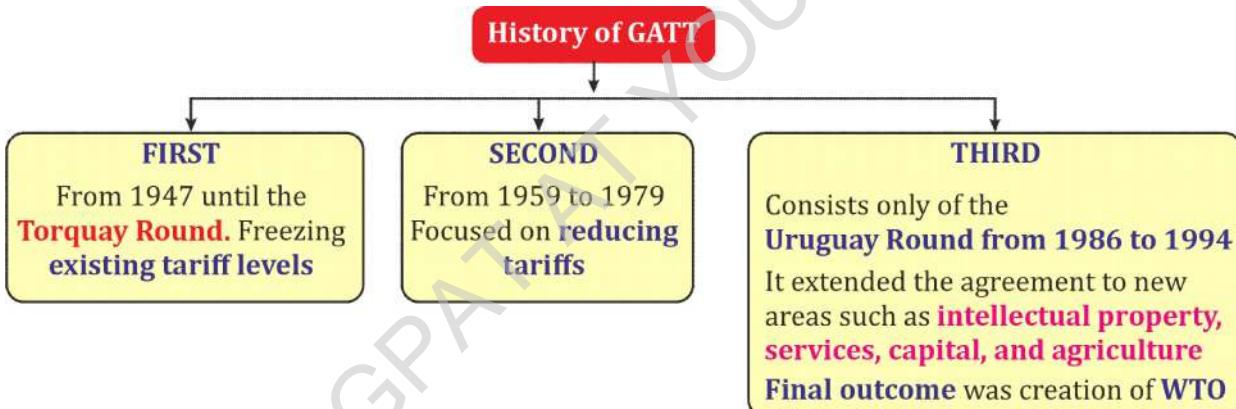
- Human Resource Development (HRD) is the framework for helping employees develop their **personal and organizational skills, knowledge, and abilities.**



General Agreement on Tariffs and Trade (GATT)

The General Agreement on Tariffs and Trade (GATT) was **signed by 23 countries in October 1947, after World War II, and became law on Jan. 1, 1948.**

- The purpose of the GATT was to make **international trade easier.**
- In **1995**, the GATT was absorbed into World Trade Organization (WTO), which extended it.



World Trade Organization and Trips (WTO)

- Officially commenced on **1st Jan 1995 under the Marrakesh Agreement.**
- Signed by **123 nations in 1994.**
- **WTO had replaced GATT (General agreement on tariffs and trade).**
- They deal with **agriculture, textiles and clothing, banking, telecommunications, government purchases, industrial standards and product safety, food sanitation regulations, intellectual property.**
- **Location :- Geneva, Switzerland**
- Established - **1 January 1995**
- Created by - **Uruguay Round negotiations (1986-94)**
- Membership - **162 countries since 30 November 2015**
- Head - **Roberto Azevedo (Director-General)**

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