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Pharmaceutical Terminology - Vol. II

Book is having 850+ B. Pharm 2nd year (3rd & 4th sem) all subjects (As per PCI syllabus) terminologies and is beneficial for B.Pharm students, GPAT, NIPER, Diploma Pharmacy Exit Exam (DPEE), DI, Gov Pharmacist exam preparation etc.

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Mantra Publication

Pharmaceutical Terminology - Vol. II

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Preface

It gives us immense pleasure to present this comprehensive volume, *Pharmaceutical Terminology – Vol. IInd*, designed especially for students and aspirants of B.Pharm Second Year (3rd and 4th Semesters) as per the Pharmacy Council of India (PCI) syllabus. The book meticulously compiles over 850 terminologies covering all key subjects including Pharmaceutical Organic Chemistry, Physical Pharmaceutics, Pharmaceutical Microbiology, Pharmaceutical Engineering, Pharmaceutical Analysis, Medicinal Chemistry, and Pharmacology.

The purpose of this book is to serve as a ready reference and a reliable companion for students, educators, and professionals preparing for competitive exams such as GPAT, NIPER, DI, Diploma Pharmacy Exit Exam (DPEE), and various government pharmacist recruitment tests. Each terminology is explained in clear, concise language, providing not only definitions but also essential context, making complex concepts easier to understand and recall.

In an era where pharmaceutical sciences are rapidly evolving, a strong grasp of foundational terms and their applications is vital. This book aims to bridge the gap between theoretical knowledge and practical understanding by presenting essential concepts in an organized and student-friendly manner.

We extend our sincere gratitude to our colleagues, students, and institutions for their continued support and encouragement. We hope this effort will contribute significantly to the academic growth and professional success of pharmacy students across the country.

Suggestions and constructive feedback from readers are most welcome and will be highly valued for further improvement in future editions.

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Acknowledgement

We express our sincere gratitude to the Almighty for giving us the strength, inspiration, and dedication to complete this book, *Pharmaceutical Terminology – Vol. IInd*.

We wish to extend our heartfelt thanks to our mentors, colleagues, and peers whose constant encouragement and valuable suggestions have helped shape this work. We are especially grateful to our students, whose curiosity and feedback have been the true driving force behind the development of this comprehensive compilation.

We deeply acknowledge the support and guidance provided by our institutions and departments, whose resources and academic environment made this book possible.

We also thank our families for their endless patience, understanding, and moral support throughout the writing and editing process.

Lastly, we are indebted to all authors and researchers whose contributions to the field of pharmacy have laid the foundation upon which this book has been built.

Constructive feedback and suggestions for improvement from our respected readers, teachers, and students are always welcome and will be sincerely considered for future editions.

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SEMESTER III

BP301T: PHARMACEUTICAL ORGANIC CHEMISTRY –II

1) **Benzene Ring**

The benzene ring is a hexagonal arrangement of six carbon atoms linked by alternating single and double bonds, forming a planar structure. This unique arrangement gives benzene its stability and characteristic aromatic nature. The delocalized electrons create a resonance system that lowers its overall energy.

2) **Aromaticity**

Aromaticity refers to the special stability possessed by benzene and similar cyclic compounds due to resonance. It results from a continuous cycle of overlapping p-orbitals, allowing electrons to be delocalized over the entire ring. This property distinguishes aromatic compounds from other unsaturated molecules.

3) **Huckel's Rule**

Huckel's rule predicts whether a planar ring molecule will be aromatic. It states that a molecule is aromatic if it contains (4n+2) π-electrons, where *n* is an integer. Benzene, with six π-electrons, satisfies this rule perfectly, confirming its aromatic character.

4) **Resonance in Benzene**

Resonance in benzene explains how its electrons are delocalized across the carbon atoms, creating equivalent bond lengths. Rather than existing as separate single and double bonds, the electrons form a continuous cloud. This resonance energy contributes to benzene's chemical stability.

5) **Electrophilic Substitution Reaction**

Benzene typically undergoes electrophilic substitution rather than addition, preserving its aromatic ring. In these reactions, an electrophile replaces a hydrogen atom on the ring. This explains reactions like nitration and sulphonation of benzene.

6) **Nitration of Benzene**

Nitration introduces a nitro group (-NO_2) into the benzene ring by reacting with a nitrating mixture of concentrated nitric and sulfuric acids. The reaction forms nitrobenzene, an important intermediate in dyes and explosives. It exemplifies aromatic electrophilic substitution.

7) **Sulphonation of Benzene**

Sulphonation adds a sulfonic acid group (-SO_3H) to the benzene ring using fuming sulfuric acid. This reaction is reversible and widely used in the preparation of detergents and dyes. Sulphonation demonstrates benzene's reactivity towards strong electrophiles.

8) **Friedel-Crafts Alkylation**

This reaction introduces an alkyl group onto the benzene ring using an alkyl halide and a Lewis acid catalyst like $AlCl_3$. It forms alkylbenzenes, which are useful industrial intermediates. Friedel-Crafts alkylation has limitations like polyalkylation and carbocation rearrangement.

9) **Friedel-Crafts Acylation**

In this reaction, an acyl group is attached to benzene using an acid chloride and a Lewis acid catalyst. It produces ketones like acetophenone. Friedel-Crafts acylation is more controlled than alkylation and avoids poly-substitution.

10) **Activating Substituents**

Substituents like -OH or -NH_2 donate electron density to the benzene ring through resonance or induction. They activate the ring, making it more reactive to electrophilic attack. They also direct incoming groups to the ortho and para positions.

11) **Deactivating Substituents**

Groups like -NO_2 or -COOH withdraw electron density from the benzene ring, deactivating it towards electrophilic substitution. These substituents make the ring less reactive and direct new substituents to the meta position.

12) **Orientation Effect**

Orientation effect describes how a substituent on benzene affects where a new substituent will attach. Activating groups favor ortho and para positions, while deactivating groups direct substitution to the meta position. This concept helps predict reaction products.

13) **DDT (Dichloro Diphenyl Trichloroethane)**

DDT is a synthetic insecticide made from chlorinated benzene derivatives. It was widely used to control pests but banned in many countries due to its environmental persistence. Its structure includes a benzene ring connected to chlorinated groups.

14) **Saccharin**

Saccharin is an artificial sweetener derived from a benzene sulfonamide. It is many times

sweeter than sugar but has no caloric value. Its aromatic structure contributes to its chemical stability and long shelf life.

15) **BHC (Benzene Hexachloride)**

BHC, also called Lindane, is an organochlorine insecticide produced by chlorinating benzene under UV light. It contains six chlorine atoms attached to the cyclohexane ring formed from benzene. It has been used in agriculture and for treating lice.

16) **Chloramine**

Chloramine is a compound formed by substituting a hydrogen atom in ammonia with a chlorine atom. In water treatment, chloramines disinfect water and maintain residual disinfection. Its stability makes it suitable for long pipeline systems.

17) **Orbital Picture of Benzene**

In benzene, each carbon atom uses sp^2 hybrid orbitals to form sigma bonds with adjacent carbons and hydrogens. The unhybridized p-orbitals overlap side-by-side, creating a continuous π-bonding system above and below the ring. This explains benzene's planarity and resonance.

18) **Synthetic Evidence for Benzene Structure**

Synthetic reactions that yield only one type of ortho-disubstituted product provide evidence for benzene's symmetrical structure. For instance, substitution reactions consistently produce predictable isomers, confirming the uniform arrangement of carbon-carbon bonds.

19) **Chemical Reactivity of Benzene**

Benzene's chemical reactivity is unique—it resists addition reactions that would break its aromaticity but readily undergoes substitution. This behavior showcases the importance of maintaining its delocalized π-electron system, which provides extra stability.

20) **Limitations of Friedel-Crafts Reactions**

Friedel-Crafts reactions have practical limitations: they do not work well with strongly deactivated rings and can lead to multiple substitutions. Also, carbocation rearrangements during alkylation can result in unexpected products, requiring careful reaction control.

21) **Phenol**

Phenol is an aromatic compound where a hydroxyl group (-OH) is directly attached to a benzene ring. This arrangement makes it more acidic than alcohols because the aromatic

ring stabilizes the negative charge on the oxygen when phenol loses a proton. Phenol is used as an antiseptic and in the production of plastics.

22) **Acidity of Phenols**

Phenols are acidic due to the resonance stabilization of the phenoxide ion formed after losing a proton. The lone pair on oxygen interacts with the aromatic ring, making the proton easier to release. This acidity is much stronger than in alcohols but weaker than in carboxylic acids.

23) **Substituent Effect on Phenol Acidity**

Electron-withdrawing groups like -NO_2 increase phenol's acidity by stabilizing the negative charge on the phenoxide ion. Conversely, electron-donating groups like -CH_3 reduce acidity by destabilizing the ion. This explains why nitrophenols are more acidic than simple phenol.

24) **Qualitative Tests for Phenols**

Phenols can be identified using the ferric chloride test, which produces a colored complex, often purple or green. Another common test is the Liebermann's test, where phenols react with nitrous acid and produce a deep blue or green color. These tests help confirm the presence of the hydroxyl group.

25) **Cresols**

Cresols are methyl-substituted phenols found in three forms: ortho, meta, and para. They occur naturally in coal tar and are used as disinfectants and in wood preservatives. Their acidity and reactivity are similar to phenol but slightly modified by the methyl group.

26) **Resorcinol**

Resorcinol is a dihydroxy benzene with hydroxyl groups at the meta positions. It's used in resins, dyes, and pharmaceuticals. Its two -OH groups make it more reactive and slightly more acidic than simple phenol.

27) **Naphthols**

Naphthols are hydroxyl derivatives of naphthalene, existing mainly as alpha- and beta-naphthol. They are used in dye manufacturing and as antiseptics. Like phenols, naphthols are weakly acidic due to resonance stabilization.

28) **Aromatic Amines**

Aromatic amines are compounds where an amino group (-NH_2) is attached to an aromatic

ring. Aniline is the simplest example. The lone pair on nitrogen can interact with the π-system of the ring, affecting its basicity and reactivity.

29) **Basicity of Aromatic Amines**

Aromatic amines are generally less basic than aliphatic amines because the lone pair on nitrogen is partially delocalized into the aromatic ring. This reduces its availability to accept a proton. Substituents can further influence this basicity.

30) **Substituent Effect on Amine Basicity**

Electron-donating groups like -CH_3 increase the basicity of aromatic amines by pushing electron density towards the nitrogen. In contrast, electron-withdrawing groups like -NO_2 decrease basicity by pulling electron density away, making protonation harder.

31) **Aniline**

Aniline is the simplest aromatic amine with one amino group attached to a benzene ring. It is an important starting material for dyes, drugs, and rubber chemicals. Its basicity is moderate due to resonance with the aromatic ring.

32) **Aryl Diazonium Salts**

Aryl diazonium salts are formed by reacting aromatic amines with nitrous acid at low temperatures. They are highly versatile intermediates in organic synthesis, especially for introducing various substituents onto the benzene ring.

33) **Diazotization Reaction**

Diazotization is the process of converting a primary aromatic amine into a diazonium salt using nitrous acid. This reaction is usually done at 0–5°C to prevent decomposition. It is key for synthesizing azo dyes and other aromatic derivatives.

34) **Sandmeyer Reaction**

The Sandmeyer reaction uses diazonium salts to substitute the diazo group with halides or cyanides. It involves copper(I) salts as catalysts. This method is widely used for preparing aryl halides and nitriles.

35) **Benzoic Acid**

Benzoic acid is the simplest aromatic carboxylic acid, consisting of a benzene ring attached to a carboxyl group. It’s naturally found in many plants and is widely used as a food preservative and in the manufacture of various chemicals.

36) **Acidity of Benzoic Acid**

Benzoic acid is acidic because the carboxyl group can donate a proton, forming a stable carboxylate ion. The aromatic ring stabilizes this ion through resonance, making benzoic acid more acidic than aliphatic carboxylic acids.

37) **Substituent Effect on Benzoic Acid**

Electron-withdrawing groups like -NO_2 increase the acidity of benzoic acid by stabilizing the carboxylate ion. Electron-donating groups like -OH or -CH_3 decrease the acidity by destabilizing the negative charge. The position of the substituent also influences the effect.

38) **Decarboxylation Reaction**

Benzoic acid derivatives can undergo decarboxylation, losing a carbon dioxide molecule under heat or with specific reagents. This reaction is useful for shortening carbon chains in aromatic compounds during synthesis.

39) **Esterification of Benzoic Acid**

Benzoic acid reacts with alcohols in the presence of an acid catalyst to form esters like methyl benzoate. These esters are used in perfumes and as flavoring agents due to their pleasant aroma.

40) **Oxidation of Aromatic Side Chains**

Aromatic compounds with side chains, like toluene, can be oxidized to benzoic acid using strong oxidizing agents such as potassium permanganate. This reaction highlights the stability of the aromatic ring while converting alkyl groups to carboxyl groups.

41) **Fats**

Fats are triglycerides that are solid at room temperature, mainly derived from animal sources. They consist of glycerol bonded to three fatty acid chains. Fats provide energy storage and insulation in living organisms.

42) **Oils**

Oils are also triglycerides but are liquid at room temperature, often from plant or fish sources. They have a higher proportion of unsaturated fatty acids compared to fats. Oils are important in nutrition, industry, and cosmetics.

43) **Fatty Acids**

Fatty acids are long-chain carboxylic acids found in fats and oils. They can be saturated

(no double bonds) or unsaturated (one or more double bonds). They determine the physical and chemical properties of fats and oils.

44) **Saturated Fatty Acids**

These fatty acids have no carbon-carbon double bonds, making them straight-chained and solid at room temperature. Examples include palmitic acid and stearic acid. High intake is linked to heart disease.

45) **Unsaturated Fatty Acids**

Unsaturated fatty acids have one or more double bonds, creating kinks in the chain and lowering melting points. Oleic acid and linoleic acid are common examples. They are considered healthier dietary fats.

46) **Hydrolysis of Fats**

Hydrolysis breaks down triglycerides into glycerol and free fatty acids in the presence of water and enzymes or alkali. This reaction is the basis of digestion and soap making. It's also called fat splitting.

47) **Hydrogenation of Oils**

Hydrogenation is the process of adding hydrogen to unsaturated fats, converting double bonds to single bonds. This turns liquid oils into semi-solid or solid fats like margarine. It improves shelf life but can form trans fats.

48) **Saponification**

Saponification is the alkaline hydrolysis of fats or oils to produce soap and glycerol. Sodium or potassium hydroxide breaks the ester bonds in triglycerides. The resulting soap molecules have cleansing properties.

49) **Rancidity**

Rancidity refers to the spoilage of fats and oils due to oxidation or hydrolysis. It produces unpleasant odors and flavors. Antioxidants are added to delay rancidity and extend shelf life.

50) **Drying Oils**

Drying oils are unsaturated oils that harden into a solid film upon exposure to air due to oxidation. Linseed oil is a classic example used in paints and varnishes. They are essential in the coatings industry.

51) **Acid Value**

The acid value measures the free fatty acid content in fats and oils. It indicates the extent of hydrolysis or spoilage. A higher acid value suggests poor quality or degradation.

52) **Saponification Value**

This value represents the amount of alkali needed to saponify one gram of fat or oil. It gives information about the average molecular weight of the fatty acids present. Higher values indicate shorter chain fatty acids.

53) **Ester Value**

The ester value is calculated by subtracting the acid value from the saponification value. It measures the amount of esterified fatty acids in fats and oils. This helps assess purity and quality.

54) **Iodine Value**

The iodine value measures the degree of unsaturation in fats and oils by determining how much iodine they can absorb. Higher iodine values indicate more double bonds. It helps classify drying and non-drying oils.

55) **Acetyl Value**

The acetyl value indicates the number of hydroxyl groups present in fats and oils. It is determined by acetylating the sample and measuring the increase in acid value. It is useful for analyzing castor oil and similar compounds.

56) **Reichert-Meissl (RM) Value**

The RM value measures the amount of volatile water-soluble fatty acids in fats and oils, mainly butter. It’s significant for detecting adulteration. Higher RM values are characteristic of genuine butterfat.

57) **Hydrolytic Rancidity**

Hydrolytic rancidity occurs when fats react with water, often catalyzed by enzymes, releasing free fatty acids. This process causes unpleasant odors. It is common in dairy products and improperly stored oils.

58) **Oxidative Rancidity**

Oxidative rancidity results from the reaction of unsaturated fats with oxygen, forming peroxides and aldehydes. It is accelerated by light, heat, and metal ions. Antioxidants help prevent this spoilage.

59) **Soap**

Soap is the sodium or potassium salt of long-chain fatty acids produced through saponification. Soap molecules have hydrophobic and hydrophilic ends, allowing them to emulsify grease and dirt for cleaning.

60) **Trans Fats**

Trans fats are formed during partial hydrogenation of oils when some cis double bonds are converted to trans configuration. They increase shelf life but are unhealthy, raising the risk of heart disease. Many countries restrict their use.

61) **Polynuclear Hydrocarbons**

Polynuclear hydrocarbons are organic compounds that contain two or more fused or linked benzene rings. They can be linear or angular in structure. These compounds are widely found in coal tar and have varied industrial and medicinal applications.

62) **Naphthalene**

Naphthalene is the simplest polynuclear hydrocarbon with two fused benzene rings. It is a white, crystalline solid with a distinctive odor. It’s mainly used in mothballs and as a starting material for dyes and insecticides.

63) **Synthesis of Naphthalene**

Industrially, naphthalene is obtained from coal tar distillation. It can also be synthesized through the Friedel-Crafts reaction starting with benzene derivatives. These methods provide a cheap source for large-scale production.

64) **Reactions of Naphthalene**

Naphthalene undergoes electrophilic substitution reactions like nitration, sulphonation, and halogenation, primarily at the alpha position. Its reactivity is higher at the alpha site due to resonance stability. Hydrogenation can convert it to decalin.

65) **Medicinal Use of Naphthalene**

Naphthalene derivatives like naphthalene sulfonates have antiseptic and antiparasitic properties. Some are used in preparation of synthetic dyes and as intermediates for certain pharmaceuticals. However, pure naphthalene itself is mostly industrial.

66) **Phenanthrene**

Phenanthrene consists of three fused benzene rings in an angular arrangement. It’s found in

coal tar and tobacco smoke. Phenanthrene is a precursor for synthesizing steroids and certain anticancer drugs.

67) **Synthesis of Phenanthrene**

Phenanthrene can be synthesized by dehydrogenation of dihydrophenanthrene or through cyclization reactions of biphenyl compounds. In labs, it's often isolated from coal tar fractions.

68) **Reactions of Phenanthrene**

Phenanthrene undergoes substitution reactions mainly at the 9 and 10 positions due to higher electron density. It also reacts with oxidizing agents to form phenanthrenequinone, an important intermediate.

69) **Medicinal Use of Phenanthrene**

Phenanthrene's skeleton is a basic structural unit for many natural compounds like alkaloids and steroids. It serves as a building block for synthetic estrogens and other hormone-related drugs.

70) **Anthracene**

Anthracene is a tricyclic aromatic hydrocarbon with three linearly fused benzene rings. It appears as a colorless solid and fluoresces under UV light. It is used to produce dyes and as a scintillator.

71) **Synthesis of Anthracene**

Anthracene is primarily extracted from coal tar. It can also be synthesized via the Friedel-Crafts acylation of benzene derivatives followed by cyclization. This makes it accessible for dye manufacturing.

72) **Reactions of Anthracene**

Anthracene reacts easily at the 9 and 10 positions due to its resonance structure. It undergoes addition, substitution, and oxidation to anthraquinone — a key intermediate for dyes like alizarin.

73) **Medicinal Use of Anthracene**

Derivatives of anthracene, such as anthraquinone, are used in laxatives and some anticancer agents. They also form the basis of many vat dyes used in textiles.

74) **Diphenylmethane**

Diphenylmethane has two benzene rings connected by a single methylene bridge. It's a

clear liquid with a pleasant smell and is used as an intermediate in fragrance and dye industries.

75) **Synthesis of Diphenylmethane**

Diphenylmethane is commonly prepared through the Friedel-Crafts alkylation of benzene using benzyl chloride. This straightforward method gives high yields.

76) **Reactions of Diphenylmethane**

The methylene bridge makes the benzylic position reactive for substitution reactions. It can undergo halogenation or oxidation to form benzophenone. Its derivatives are useful in organic synthesis.

77) **Medicinal Use of Diphenylmethane**

Diphenylmethane derivatives like promethazine and chlorpromazine are used as antihistamines and antipsychotic drugs. The core structure provides a base for several therapeutic agents.

78) **Triphenylmethane**

Triphenylmethane contains three benzene rings attached to a single central carbon atom. It's the parent structure of many synthetic dyes called triphenylmethane dyes.

79) **Synthesis of Triphenylmethane**

It's usually made by reacting benzene with chloroform in the presence of an aluminum chloride catalyst. This multi-ring framework is the backbone of brilliant dyes.

80) **Medicinal Use of Triphenylmethane**

Triphenylmethane dyes like malachite green and crystal violet have antiseptic properties and are used in microbiology. They help stain cells and tissues for microscopic studies.

81) **Cycloalkanes**

Cycloalkanes are saturated hydrocarbons containing carbon atoms arranged in a ring. Unlike open-chain alkanes, their ring structure introduces angle strain and torsional strain. Common examples are cyclopropane and cyclobutane.

82) **Ring Strain**

Ring strain arises in cycloalkanes when bond angles deviate from the ideal tetrahedral angle of 109.5°. This strain makes smaller rings more reactive than open-chain alkanes. It also influences their stability and reactivity.

83) **Baeyer's Strain Theory**

Baeyer's strain theory explains ring strain by assuming rings are planar. According to Baeyer, rings smaller or larger than five members have angle strain because their bond angles deviate from the tetrahedral value. This theory was an early attempt to explain cycloalkane stability.

84) **Limitation of Baeyer's Strain Theory**

Baeyer's strain theory assumes all rings are flat, which is true only for small rings like cyclopropane. Larger rings like cyclohexane adopt puckered conformations that relieve strain. Thus, the theory doesn't fully explain the stability of larger cycloalkanes.

85) **Coulson and Moffitt's Modification**

Coulson and Moffitt modified Baeyer's theory by introducing the concept of bent or banana bonds in small rings. These bonds reduce angle strain by allowing some bond bending, explaining why cyclopropane is less strained than Baeyer predicted.

86) **Sachse-Mohr Theory**

The Sachse-Mohr theory, also known as the theory of strainless rings, proposed that rings larger than cyclopropane can adopt non-planar conformations. For example, cyclohexane forms a chair conformation to avoid strain completely.

87) **Strainless Rings**

Rings that can adopt non-planar conformations to relieve all strain are called strainless rings. Cyclopentane and cyclohexane are classic examples. Their conformations help maintain ideal bond angles and reduce torsional strain.

88) **Banana Bonds**

In cyclopropane, carbon-carbon bonds bend outward like a banana instead of forming straight lines. This bonding reduces severe angle strain but increases torsional strain. The concept helps explain cyclopropane's unique reactivity.

89) **Cyclopropane**

Cyclopropane is the smallest cycloalkane with three carbon atoms forming a triangle. Due to severe ring strain, it is highly reactive and used as an anesthetic. Its bonds are bent, making it structurally unique.

90) **Cyclobutane**

Cyclobutane has four carbon atoms arranged in a square. To reduce torsional strain, it

adopts a puckered shape rather than remaining flat. It is less strained than cyclopropane but still more reactive than larger cycloalkanes.

91) **Conformations of Cyclopropane**

Cyclopropane is planar because it's impossible for three carbons to pucker. The ring's planarity and bent bonds result in high reactivity toward ring-opening reactions, such as hydrogenation and halogenation.

92) **Conformations of Cyclobutane**

Cyclobutane avoids total planarity by adopting a puckered "butterfly" shape. This puckering reduces torsional strain between adjacent hydrogens but retains some angle strain due to its bond angles being smaller than 109.5°.

93) **Reactions of Cyclopropane**

Cyclopropane readily undergoes ring-opening reactions. It reacts with hydrogen to form propane or with halogens to form haloalkanes. Its high ring strain drives these reactions easily under mild conditions.

94) **Reactions of Cyclobutane**

Cyclobutane can also undergo ring-opening reactions, especially under heat or in the presence of catalysts. It reacts with hydrogen to form butane or undergoes halogenation to form substituted products.

95) **Angle Strain**

Angle strain occurs when bond angles deviate from their ideal tetrahedral value. In cyclopropane, the bond angle is 60°, far from 109.5°, causing severe strain. Cyclobutane's angle is around 90°, so its strain is moderate.

96) **Torsional Strain**

Torsional strain is the resistance caused by eclipsed bonds in cyclic systems. Cyclopropane has significant torsional strain because all C-H bonds are eclipsed. Puckering in cyclobutane helps reduce its torsional strain.

97) **Chair Conformation**

Although specific to cyclohexane, the chair conformation demonstrates how larger rings avoid strain. It's an example of how Sachse-Mohr theory applies. It provides zero angle strain and minimal torsional strain, making cyclohexane very stable.

98) **Puckering**

Puckering is the bending of ring carbon atoms out of the plane to reduce strain. Cyclobutane puckers to decrease eclipsing interactions. This adjustment lowers the molecule's total energy.

99) **Hydrogenation of Cycloalkanes**

Hydrogenation reactions add hydrogen to cycloalkanes, breaking the ring and forming open-chain alkanes. Cyclopropane and cyclobutane both undergo hydrogenation easily because the process relieves ring strain.

100) **Industrial Use of Cycloalkanes**

Cycloalkanes are used as intermediates in the manufacture of fuels and chemicals. Cyclopropane was historically used as an anesthetic, while larger cycloalkanes like cyclohexane are used in the production of nylon and plastics.

BP302T: PHYSICAL PHARMACEUTICS-I

101) **Solubility**

Solubility is the maximum amount of a solute that can dissolve in a given amount of solvent at a specific temperature and pressure. It determines how well a drug can dissolve in body fluids. High solubility is crucial for effective drug absorption.

102) **Solubility Expressions**

Solubility can be expressed in various ways like molarity, molality, percentage concentration, or parts per million. These expressions help pharmacists calculate accurate doses and prepare solutions of the desired strength.

103) **Solute-Solvent Interaction**

Solute-solvent interactions explain how molecules of the solute mix and interact with molecules of the solvent. Hydrogen bonding, van der Waals forces, and ionic interactions can all influence how well a drug dissolves.

104) **Ideal Solubility Parameter**

An ideal solubility parameter predicts whether a solute will dissolve in a particular solvent. It is based on cohesive energy density. If the solubility parameters of solute and solvent are similar, better solubility occurs.

105) **Solvation**

Solvation is the process where solvent molecules surround and interact with solute particles. This stabilizes the dissolved molecules and helps keep them in solution. In aqueous systems, it’s called hydration.

106) **Association**

Association occurs when solute molecules stick together through hydrogen bonding or other forces instead of dispersing. This can reduce solubility because the solute prefers to stay in clusters rather than disperse in the solvent.

107) **Quantitative Factors Influencing Solubility**

Temperature, pressure, pH, and the presence of other solutes quantitatively affect solubility. For example, increasing temperature usually increases solubility of solids but decreases solubility of gases.

108) **Diffusion**

Diffusion is the movement of molecules from an area of high concentration to an area of low concentration. In biological systems, diffusion plays a key role in how drugs pass through cell membranes to reach their site of action.

109) **Solubility of Gases in Liquids**

Gases dissolve in liquids according to Henry's Law, which states that the amount dissolved is proportional to the gas's partial pressure. This principle is vital for oxygen transport in blood and for carbonated drinks.

110) **Solubility of Liquids in Liquids**

Liquids can be completely miscible, partially miscible, or immiscible. Ethanol and water are examples of completely miscible liquids. Oil and water are immiscible due to differences in polarity.

111) **Binary Solutions**

Binary solutions contain two components: one solute and one solvent. They are the simplest type of solution and are used as models to study solubility and miscibility behavior.

112) **Ideal Solutions**

Ideal solutions obey Raoult's Law throughout their composition range. In these, intermolecular forces between like and unlike molecules are equal, so there's no heat change or volume change on mixing.

113) **Raoult's Law**

Raoult's Law states that the vapor pressure of an ideal solution is directly proportional to the mole fraction of its components. It helps predict how solvents will evaporate in mixtures, useful in formulation design.

114) **Real Solutions**

Real solutions deviate from Raoult's Law due to differences in intermolecular interactions. Positive or negative deviations occur, leading to boiling point changes and azeotrope formation.

115) **Partially Miscible Liquids**

Partially miscible liquids only dissolve in each other to a limited extent. Examples include

phenol-water and nicotine-water systems. Temperature can expand or shrink the miscibility range.

116) **Critical Solution Temperature (CST)**

CST is the temperature above or below which two partially miscible liquids become completely miscible in all proportions. It's crucial in designing extraction and separation processes.

117) **Upper Critical Solution Temperature (UCST)**

UCST is the maximum temperature at which phase separation occurs for partially miscible liquids. Above this, the liquids mix completely. An example is phenol-water with a UCST around 68°C.

118) **Lower Critical Solution Temperature (LCST)**

LCST is the lowest temperature at which phase separation occurs. Below this, the liquids become completely miscible. The nicotine-water system is an example, with an LCST around 60°C.

119) **Distribution Law**

Nernst's Distribution Law describes how a solute distributes itself between two immiscible solvents at equilibrium. It is fundamental in extraction, partitioning, and drug delivery design.

120) **Limitations of Distribution Law**

The law assumes the solute remains in the same molecular state in both solvents. However, association or dissociation of solute can cause deviations. Such limitations must be considered during practical applications.

121) **States of Matter**

Matter exists in three common states: solid, liquid, and gas. Each state differs in molecular arrangement, energy, and movement. Understanding these helps predict how drugs behave under various conditions.

122) **Change of State**

A change of state occurs when matter transitions between solid, liquid, and gas due to temperature or pressure changes. For example, melting, boiling, and freezing affect drug formulation and storage.

123) **Latent Heat**

Latent heat is the heat absorbed or released during a change of state without a temperature change. It plays a role in processes like melting of suppositories or evaporation in inhalers.

124) **Vapour Pressure**

Vapour pressure is the pressure exerted by a vapor in equilibrium with its liquid or solid form. It affects evaporation rates and shelf life of volatile drug formulations.

125) **Sublimation**

Sublimation is the direct transition of a solid to vapor without becoming liquid. Camphor and dry ice are classic examples. It's used in freeze-drying to prepare stable drug powders.

126) **Critical Point**

The critical point is the highest temperature and pressure at which a substance can exist as a liquid and gas in equilibrium. Supercritical fluids near this point are used in drug extraction and purification.

127) **Eutectic Mixtures**

A eutectic mixture is a combination of two or more components that melt at a lower temperature than either component alone. This principle is used in suppositories and powders to enhance drug solubility.

128) **Gases**

Gases have no fixed shape or volume and expand to fill their container. Medical gases like oxygen and nitrous oxide are essential in anesthesia and respiratory therapy.

129) **Aerosols**

Aerosols are fine liquid or solid particles dispersed in a gas. Pharmaceutical aerosols deliver drugs to the lungs, making inhalers vital for treating asthma and COPD.

130) **Inhalers**

Inhalers are devices that deliver medication directly to the respiratory tract in the form of aerosols. They ensure rapid action and minimal systemic side effects.

131) **Relative Humidity**

Relative humidity is the amount of water vapor present in air expressed as a percentage of the maximum it can hold at a given temperature. It affects the stability of hygroscopic drugs.

132) **Liquid Complexes**

Liquid complexes form when two liquids interact to create a new stable liquid phase. Examples include iodine in potassium iodide solution. They help improve drug solubility and stability.

133) **Liquid Crystals**

Liquid crystals have properties between liquids and solids. They flow like liquids but have an ordered structure like crystals. Some drug delivery systems exploit liquid crystalline phases for controlled release.

134) **Glassy State**

The glassy state is a rigid, disordered solid form achieved when a liquid cools rapidly without crystallizing. Many amorphous drugs are stored in the glassy state to enhance solubility.

135) **Crystalline Solids**

Crystalline solids have a regular, repeating atomic arrangement, resulting in definite melting points. Many drugs are produced in crystalline form for easy purification and stable storage.

136) **Amorphous Solids**

Amorphous solids lack a regular structure and do not have sharp melting points. Drugs in amorphous form often have higher solubility but may be less stable than crystalline forms.

137) **Polymorphism**

Polymorphism is the ability of a compound to exist in more than one crystalline form. Different polymorphs of a drug can vary in solubility, stability, and bioavailability.

138) **Refractive Index**

The refractive index measures how much light bends when passing through a substance. It helps identify drug purity and concentration in liquid formulations.

139) **Optical Rotation**

Optical rotation is the rotation of polarized light by chiral compounds. Many drugs are optically active, and measuring this helps determine their purity and concentration.

140) **Dipole Moment**

Dipole moment is a measure of the separation of positive and negative charges in a

molecule. It influences intermolecular interactions, solubility, and drug binding with receptors.

141) **Surface Phenomenon**

Surface phenomenon refers to the unique behavior of molecules at the surface of a liquid compared to those inside. Molecules at the surface experience unequal forces, which causes surface tension. This principle is key in emulsions and foams.

142) **Interfacial Phenomenon**

Interfacial phenomenon describes the interactions at the boundary between two immiscible phases, such as oil and water. These interactions affect emulsions, suspensions, and drug delivery systems.

143) **Liquid Interface**

A liquid interface is the boundary where two immiscible liquids meet. The properties of this interface determine how well emulsions form and how stable they remain over time.

144) **Surface Tension**

Surface tension is the force that causes the surface of a liquid to contract, acting like a stretched elastic sheet. It results from cohesive forces among liquid molecules and influences droplet formation and spreading.

145) **Interfacial Tension**

Interfacial tension is the force existing at the interface between two immiscible liquids, such as oil and water. Lowering interfacial tension is crucial in forming stable emulsions and suspensions.

146) **Surface Free Energy**

Surface free energy is the excess energy at the surface of a liquid due to unbalanced molecular forces. It explains why liquids minimize their surface area and why surfactants reduce surface tension.

147) **Measurement of Surface Tension**

Surface tension can be measured using methods like the drop weight method, capillary rise method, or the Wilhelmy plate method. These techniques help evaluate surfactant effectiveness.

148) **Measurement of Interfacial Tension**

Interfacial tension is typically measured using methods such as the drop weight method or

spinning drop tensiometer. Accurate measurement helps in designing stable emulsions and detergents.

149) **Spreading Coefficient**

The spreading coefficient indicates whether one liquid will spread over another. A positive value means the liquid will spread spontaneously. This is important in ointment formulation and wetting agents.

150) **Adsorption at Liquid Interfaces**

Adsorption at liquid interfaces occurs when molecules accumulate at the surface, reducing surface or interfacial tension. Surfactants work this way to stabilize emulsions and foams.

151) **Adsorption Isotherms**

Adsorption isotherms describe how molecules distribute between the bulk phase and the surface at constant temperature. They help in understanding how surfactants arrange at interfaces.

152) **Surface Active Agents**

Surface active agents, or surfactants, reduce surface and interfacial tension. They have both hydrophilic and hydrophobic parts, making them useful as emulsifiers, detergents, and wetting agents.

153) **Hydrophilic-Lipophilic Balance (HLB) Scale**

The HLB scale quantifies the balance between the hydrophilic and lipophilic parts of a surfactant. It helps formulators choose the right surfactant for emulsions, detergents, or solubilizers.

154) **Emulsifying Agents**

Emulsifying agents are surfactants that help mix immiscible liquids like oil and water. By lowering interfacial tension, they stabilize the droplets and prevent separation.

155) **Solubilisation**

Solubilisation is the process where an insoluble or sparingly soluble substance is incorporated into an aqueous solution with the help of surfactants. Micelles formed by surfactants trap the solute and make it soluble.

156) **Micelles**

Micelles are spherical structures formed by surfactants in solution when the concentration

exceeds the critical micelle concentration. They play a key role in solubilisation and drug delivery.

157) **Detergency**

Detergency is the process of removing dirt or grease with surfactants. Surfactants lower surface tension, wet the surface, emulsify the dirt, and help wash it away.

158) **Adsorption at Solid Interfaces**

Adsorption at solid interfaces involves the accumulation of molecules on solid surfaces. It's crucial in processes like tablet coating, chromatography, and purification.

159) **Solid Adsorbents**

Solid adsorbents like activated charcoal or silica gel are used to adsorb impurities or unwanted compounds from liquids and gases. They work due to their high surface area.

160) **Contact Angle**

The contact angle measures how a liquid droplet interacts with a solid surface. A smaller angle indicates better wetting, important in coating tablets or enhancing drug dissolution.

161) **Complexation**

Complexation is the process in which two or more molecules or ions form a stable, non-covalent association. This can alter the solubility, stability, and bioavailability of drugs. Complexes play an important role in drug formulation.

162) **Complex**

A complex is the resulting compound formed when a ligand binds to a central metal ion or molecule. For example, EDTA forms complexes with metal ions, useful in chelation therapy.

163) **Classification of Complexes**

Complexes are mainly classified as coordination complexes, inclusion complexes, and molecular complexes. Each type differs in the nature of bonding and the way the guest molecule is incorporated.

164) **Coordination Complex**

Coordination complexes involve a central metal ion bonded to ligands through coordinate covalent bonds. They are common in metal ion detoxification and diagnostic imaging.

165) **Inclusion Complex**

Inclusion complexes are formed when one molecule (host) physically traps another

molecule (guest) within its structure without forming covalent bonds. Cyclodextrins are famous examples used to increase drug solubility.

166) **Molecular Complex**

Molecular complexes are held together by weak forces like hydrogen bonding or van der Waals interactions. They can be used to mask unpleasant drug tastes or odors.

167) **Chelation**

Chelation is a special type of coordination complex where a ligand forms multiple bonds with a single metal ion. EDTA is a well-known chelating agent used to treat heavy metal poisoning.

168) **Protein Binding**

Protein binding refers to the reversible attachment of drug molecules to plasma proteins like albumin. It affects the distribution, activity, and elimination of drugs in the body.

169) **Free Drug Fraction**

Only the unbound or free drug fraction is pharmacologically active and able to cross cell membranes. Highly protein-bound drugs act as reservoirs, releasing drug slowly into circulation.

170) **Factors Affecting Protein Binding**

Factors like drug concentration, binding site availability, pH, and the presence of other drugs can influence protein binding. These interactions can lead to drug displacement and side effects.

171) **Complexation and Drug Action**

Complexation can modify a drug's solubility, stability, or taste. Some drugs are administered as complexes for better therapeutic effect, such as metal ion complexes in diagnostic agents.

172) **Applications of Complexation**

Complexation is used in drug solubilization, taste masking, prolonging drug action, and enhancing bioavailability. Cyclodextrins, for example, help deliver poorly soluble drugs.

173) **Methods of Analysis**

Methods to analyze complexes include spectrophotometry, potentiometry, and polarography. These techniques help determine the concentration and stability of complexes.

174) **Job's Method**

Job's method, or the method of continuous variations, is used to find the stoichiometry of complexes. It involves measuring changes in a physical property while varying the proportion of reactants.

175) **Stability Constant**

The stability constant is an equilibrium constant that measures how strongly the components of a complex are held together. Higher stability constants indicate more stable complexes.

176) **Conditional Stability Constant**

The conditional stability constant applies to complexes in specific conditions like pH or ionic strength. It helps predict the behavior of complexes under physiological conditions.

177) **Thermodynamic Treatment**

Thermodynamic treatment involves using thermodynamic principles to study the stability of complexes. It relates stability constants to Gibbs free energy, enthalpy, and entropy.

178) **Crystalline Complexes**

Some complexes form well-defined crystalline structures. Studying these structures helps understand the arrangement of molecules and their interactions within the complex.

179) **Host-Guest Chemistry**

Host-guest chemistry studies how a host molecule (like cyclodextrin) selectively binds a guest molecule. This concept is widely applied in designing drug carriers.

180) **Metal Ion Complexes in Medicine**

Metal ion complexes are used as therapeutic agents, diagnostic tools, and imaging agents. For example, gadolinium complexes are used in MRI contrast agents to enhance image clarity.

181) **pH**

pH is a measure of hydrogen ion concentration in a solution, indicating its acidity or alkalinity. The pH scale ranges from 0 to 14, with 7 being neutral. It's crucial for drug stability and biological compatibility.

182) **Sorensen's pH Scale**

The pH scale was introduced by Søren Sørensen in 1909. It quantifies acidity and basicity

using the negative logarithm of hydrogen ion concentration. This simple scale helps control reactions in formulations.

183) **pH Determination**

Measuring pH is vital in pharmaceutical analysis. It ensures drugs stay within a stable pH range, preventing degradation and ensuring patient safety.

184) **Electrometric Method**

The electrometric method measures pH using a pH meter and electrodes. It is accurate and widely used in labs to test the pH of solutions, buffers, and biological samples.

185) **Calorimetric Method**

The calorimetric or indicator method uses pH indicators that change color within specific pH ranges. Although less precise than electrometric methods, it is simple and useful for quick tests.

186) **Buffers**

Buffers are solutions that resist changes in pH when small amounts of acid or base are added. They maintain stable pH conditions essential for drug formulations and biological systems.

187) **Buffer Equation**

The Henderson-Hasselbalch equation relates the pH of a buffer to the concentration of its acid and conjugate base. It's used to design buffer systems with desired pH.

188) **Buffer Capacity**

Buffer capacity is the ability of a buffer to resist pH changes. It depends on the concentration of buffer components and is highest when the pH equals the pKa of the acid.

189) **Pharmaceutical Buffers**

In pharmacy, buffers maintain drug stability and improve solubility. They ensure active ingredients don't degrade due to pH shifts during storage or administration.

190) **Biological Buffers**

In the body, buffers like bicarbonate and phosphate maintain physiological pH. This is vital for enzyme activity, oxygen transport, and normal cell function.

191) **Buffered Isotonic Solutions**

Buffered isotonic solutions are used to match the osmotic pressure of body fluids while

maintaining a stable pH. They prevent irritation when administered intravenously or as eye drops.

192) **Isotonic Solutions**

Isotonic solutions have the same osmotic pressure as body fluids like blood and tears. They prevent cell shrinkage or swelling when administered, ensuring patient safety.

193) **Hypotonic Solution**

A hypotonic solution has lower osmotic pressure than body fluids. When administered, it can cause cells to swell or burst. Such solutions must be adjusted to isotonicity.

194) **Hypertonic Solution**

A hypertonic solution has higher osmotic pressure than body fluids. It draws water out of cells, causing shrinkage. Hypertonic preparations must be carefully controlled.

195) **Osmotic Pressure**

Osmotic pressure is the pressure required to prevent solvent flow across a semipermeable membrane. It determines how solutions interact with body cells and tissues.

196) **Cryoscopic Method**

The cryoscopic method measures isotonicity by determining the freezing point depression of a solution. It helps pharmacists adjust solutions to match body fluid osmolarity.

197) **Isotonic Adjustment**

Isotonic adjustment involves adding substances like sodium chloride to achieve isotonicity. This is common in ophthalmic and injectable formulations.

198) **Buffer Systems in Blood**

Blood uses carbonic acid-bicarbonate and hemoglobin as buffer systems to maintain a stable pH near 7.4. This balance is critical for proper physiological function.

199) **Role of Buffers in Formulation**

Buffers prevent chemical degradation, control drug solubility, and reduce irritation at the administration site. They are essential for injectable and ophthalmic products.

200) **Examples of Pharmaceutical Buffers**

Common pharmaceutical buffers include acetate, citrate, and phosphate buffers. Each is chosen based on required pH range and compatibility with active ingredients.

BP 303 T. PHARMACEUTICAL MICROBIOLOGY

201) **Microbiology**

Microbiology is the scientific study of microscopic organisms like bacteria, viruses, fungi, and protozoa. It helps us understand infections, develop antibiotics, and produce vaccines. The field plays a vital role in medicine, pharmacy, and industry.

202) **History of Microbiology**

The history of microbiology began with Antonie van Leeuwenhoek, who first observed microorganisms using a simple microscope. Later, scientists like Pasteur and Koch laid the foundation for germ theory and aseptic techniques.

203) **Branches of Microbiology**

Microbiology has many branches: bacteriology (study of bacteria), virology (viruses), mycology (fungi), parasitology (parasites), and immunology (immune response). Each branch explores unique aspects of microbes and their interactions.

204) **Scope of Microbiology**

Microbiology's scope includes healthcare, pharmaceuticals, agriculture, and environmental studies. It helps discover new drugs, prevent diseases, improve food safety, and develop biotechnological applications.

205) **Importance of Microbiology**

Microbiology is crucial for controlling infections, producing antibiotics, and understanding disease mechanisms. It also plays a role in fermentation, waste treatment, and biotechnology.

206) **Prokaryotes**

Prokaryotes are single-celled organisms without a true nucleus. Bacteria and archaea are prokaryotes. They reproduce rapidly and adapt to various environments, making them important in research and industry.

207) **Eukaryotes**

Eukaryotes are organisms with a well-defined nucleus and membrane-bound organelles.

Fungi, protozoa, plants, and animals are eukaryotic. They have complex cellular structures and diverse life cycles.

208) **Ultra-structure of Bacteria**

Bacterial ultra-structure includes a cell wall, plasma membrane, cytoplasm, ribosomes, and sometimes a capsule or flagella. These components help in nutrient transport, protection, and movement.

209) **Morphological Classification of Bacteria**

Bacteria are classified based on shape: cocci (spherical), bacilli (rod-shaped), spirilla (spiral), and vibrios (comma-shaped). This classification helps in identification and treatment strategies.

210) **Nutritional Requirements**

Bacteria need carbon, nitrogen, minerals, and water for growth. Some require specific vitamins or amino acids. Understanding these needs helps design culture media for lab cultivation.

211) **Culture Media**

Culture media supply nutrients for bacterial growth. They contain raw materials like peptones, beef extract, agar, and salts. Media can be selective, differential, or enriched to isolate specific bacteria.

212) **Physical Parameters for Growth**

Temperature, pH, oxygen levels, and moisture affect bacterial growth. For example, mesophiles grow best at body temperature, while anaerobes require oxygen-free conditions.

213) **Bacterial Growth Curve**

The bacterial growth curve has four phases: lag, log, stationary, and death. Studying this curve helps determine optimal harvest times for antibiotics and other bacterial products.

214) **Isolation of Pure Cultures**

Pure cultures contain only one bacterial species. Isolation methods include streak plating, pour plating, and spread plating. Pure cultures are essential for studying bacterial characteristics.

215) **Preservation of Cultures**

Preserving pure cultures ensures their viability for future study. Methods include refrigeration, deep freezing, lyophilization (freeze-drying), and using mineral oil overlays.

216) **Cultivation of Anaerobes**

Anaerobic bacteria grow without oxygen. They are cultivated in special jars or chambers that remove oxygen or use reducing agents in the media to maintain anaerobic conditions.

217) **Quantitative Measurement – Total Count**

Total count measures all cells in a sample, both living and dead. Methods include direct microscopic count and electronic counters. It gives an overall idea of microbial load.

218) **Quantitative Measurement – Viable Count**

Viable count estimates only living bacteria capable of forming colonies. The pour plate or spread plate methods are commonly used for counting viable cells.

219) **Phase Contrast Microscopy**

Phase contrast microscopy enhances contrast in transparent specimens without staining. It's useful for observing live bacteria and cellular structures in detail.

220) **Electron Microscopy**

Electron microscopy uses electron beams for high-resolution imaging of ultrastructures. Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM) reveal detailed views of bacterial surfaces and internal structures.

221) **Bacterial Staining**

Staining is a technique used to color bacterial cells for easier viewing under a microscope. It helps differentiate bacteria based on cell wall properties and structure, aiding identification.

222) **Simple Staining**

Simple staining uses a single dye like methylene blue to highlight bacterial cells. It shows shape, size, and arrangement but does not differentiate between types of bacteria.

223) **Gram's Staining**

Gram's staining differentiates bacteria into Gram-positive and Gram-negative based on cell wall composition. It's a vital step in bacterial classification and guides antibiotic selection.

224) **Acid-Fast Staining**

Acid-fast staining, such as Ziehl-Neelsen staining, is used to detect Mycobacterium species. Acid-fast bacteria retain the primary stain despite acid-alcohol treatment due to waxy cell walls.

225) **IMViC Tests**

IMViC stands for Indole, Methyl Red, Voges-Proskauer, and Citrate tests. This biochemical test series distinguishes members of the Enterobacteriaceae family based on metabolic activities.

226) **Principle of Sterilization**

Sterilization aims to destroy all forms of microbial life, including spores. Methods rely on heat, chemicals, radiation, or mechanical removal to achieve sterility.

227) **Physical Sterilization**

Physical methods include dry heat (hot air oven), moist heat (autoclave), and filtration. These methods denature proteins or remove microbes without leaving toxic residues.

228) **Chemical Sterilization**

Chemical sterilization uses disinfectants like ethylene oxide, aldehydes, or alcohols. These agents kill microorganisms by disrupting cell membranes or denaturing proteins.

229) **Gaseous Sterilization**

Gaseous sterilization employs gases like ethylene oxide for sterilizing heat-sensitive items. It penetrates packaging and complex instruments but requires careful handling due to toxicity.

230) **Radiation Sterilization**

Radiation sterilization uses ionizing radiation (gamma rays) or non-ionizing UV rays to destroy microorganisms. It’s widely used for disposable medical supplies and certain pharmaceuticals.

231) **Mechanical Sterilization**

Mechanical methods like filtration remove microorganisms from liquids or air. Membrane filters and HEPA filters are common examples, especially for sterilizing heat-labile solutions.

232) **Filtration Sterilization**

Filtration passes liquids or gases through fine filters to trap microbes. It's essential for sterilizing solutions that cannot be heated, such as antibiotic solutions or vaccines.

233) **Sterilization Merits**

Sterilization ensures product safety, extends shelf life, and prevents infections. Each method has advantages, like cost-effectiveness or suitability for heat-sensitive materials.

234) **Sterilization Demerits**

Drawbacks include high costs for some methods, long processing times, possible toxic residues, or damage to sensitive materials. Proper method selection is crucial.

235) **Autoclave**

An autoclave uses steam under pressure to sterilize media, glassware, and instruments. It's the most reliable and widely used method for heat-stable items.

236) **Hot Air Oven**

The hot air oven sterilizes glassware, powders, and oils using dry heat. It requires higher temperatures and longer exposure compared to moist heat sterilization.

237) **Large-Scale Sterilization**

In industry, large autoclaves, ethylene oxide chambers, and radiation units sterilize bulk materials, surgical supplies, and packaging materials to ensure sterility on a commercial scale.

238) **Sterility Indicators**

Sterility indicators confirm the effectiveness of sterilization processes. Chemical indicators change color, while biological indicators use spores to validate complete sterilization.

239) **Biological Indicators**

Biological indicators contain highly resistant bacterial spores. If the spores are killed during sterilization, it confirms the process was successful.

240) **Evaluation of Sterilization**

Sterilization efficiency is evaluated by monitoring physical parameters, using chemical indicators, and performing sterility tests to ensure no surviving microorganisms remain.

241) **Fungi**

Fungi are eukaryotic microorganisms that include molds, yeasts, and mushrooms. They

can cause infections, produce antibiotics like penicillin, and are used in fermentation and biotechnology.

242) **Morphology of Fungi**

Fungi may appear as unicellular yeasts or multicellular molds with hyphae and mycelium. Their structural forms help in identification and influence how they spread and cause disease.

243) **Classification of Fungi**

Fungi are classified into groups like Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes based on their spore formation and reproductive structures. This aids in medical diagnosis and treatment.

244) **Reproduction in Fungi**

Fungi reproduce both sexually and asexually. Asexual reproduction occurs by budding, spore formation, or fragmentation, while sexual reproduction involves fusion of nuclei and spores.

245) **Cultivation of Fungi**

Fungi are cultivated on media like Sabouraud's dextrose agar. Proper temperature, pH, and moisture are maintained to study fungal growth for research or industrial use.

246) **Viruses**

Viruses are acellular particles that require a living host cell to replicate. They can infect bacteria (bacteriophages), plants, animals, and humans, causing diseases like influenza or HIV.

247) **Morphology of Viruses**

Viruses consist of genetic material (DNA or RNA) enclosed in a protein coat called a capsid. Some have an additional lipid envelope that helps in host infection.

248) **Classification of Viruses**

Viruses are classified by nucleic acid type (DNA or RNA), shape, presence of envelope, and replication strategy. Examples include DNA viruses like herpesvirus and RNA viruses like coronavirus.

249) **Replication of Viruses**

Viral replication involves attachment, penetration, uncoating, biosynthesis, assembly, and release. Since viruses lack cell machinery, they hijack host cells to produce new virions.

250) **Cultivation of Viruses**

Viruses are cultivated using living systems like chick embryos, cell cultures, or laboratory animals. This helps produce vaccines and study viral behavior.

251) **Disinfectants**

Disinfectants are chemical agents that kill or inhibit microorganisms on non-living surfaces. Examples include phenols, alcohols, and chlorine compounds.

252) **Classification of Disinfectants**

Disinfectants can be classified as high-level, intermediate-level, or low-level based on their effectiveness. Their selection depends on the type of microorganisms and application area.

253) **Mode of Action of Disinfectants**

Disinfectants act by disrupting cell walls, denaturing proteins, or interfering with metabolic processes. For example, alcohols damage cell membranes and cause protein coagulation.

254) **Factors Influencing Disinfection**

Factors like concentration, temperature, contact time, pH, and presence of organic matter affect the efficiency of disinfection. These must be optimized for effective microbial control.

255) **Antiseptics**

Antiseptics are chemicals used on living tissues to prevent infection by killing or inhibiting microorganisms. Common antiseptics include iodine, chlorhexidine, and alcohol.

256) **Bacteriostatic Agents**

Bacteriostatic agents inhibit bacterial growth without killing them. They depend on the host's immune system to eliminate the pathogens. Examples include tetracyclines and sulfonamides.

257) **Bactericidal Agents**

Bactericidal agents kill bacteria directly. They are essential when the immune system is compromised. Penicillins and cephalosporins are good examples.

258) **Evaluation of Bacteriostatic/Bactericidal Action**

The effectiveness of these agents is tested using methods like the phenol coefficient test or minimum inhibitory concentration (MIC) determination. This ensures proper dosage and application.

259) **Sterility Testing**

Sterility testing confirms that pharmaceutical products are free from viable microorganisms. It's mandatory for injectables, eye drops, and implants to ensure patient safety.

260) **IP, BP, USP Standards**

The Indian Pharmacopoeia (IP), British Pharmacopoeia (BP), and United States Pharmacopeia (USP) provide standardized procedures for sterility testing of solids, liquids, and ophthalmic products to ensure global quality compliance.

261) **Aseptic Area**

An aseptic area is a specially designed clean space where sterile products are prepared and handled to avoid contamination. Proper design and strict controls are vital for producing safe pharmaceuticals.

262) **Designing of Aseptic Area**

Designing an aseptic area involves using smooth, easily cleanable surfaces, proper air filtration, and controlled airflow. Entry and exit points must have airlocks to prevent contamination.

263) **Cleanroom Classification**

Cleanrooms are classified based on the number of airborne particles. Classes like ISO 5 or ISO 7 define acceptable limits, ensuring the right environment for sterile product manufacturing.

264) **Laminar Flow Equipment**

Laminar flow hoods provide a continuous flow of filtered air in one direction to remove contaminants. They create a sterile working zone for critical operations like filling ampoules.

265) **Horizontal Laminar Flow**

In horizontal laminar flow hoods, air flows horizontally across the work surface toward the operator. They are commonly used in labs for aseptic transfer of materials.

266) **Vertical Laminar Flow**

Vertical laminar flow hoods push filtered air downward onto the work surface. This design reduces the risk of particles being blown toward the operator.

267) **Sources of Contamination**

Contaminants in aseptic areas come from personnel, air, equipment, and raw materials. Proper gowning, filtration, and cleaning help minimize these contamination risks.

268) **Personnel Hygiene**

Personnel are the main source of contamination in aseptic areas. Wearing sterile gowns, gloves, masks, and practicing strict hygiene prevent shedding of skin cells and microbes.

269) **HEPA Filters**

High Efficiency Particulate Air (HEPA) filters remove 99.97% of particles ≥0.3 microns. They are essential for maintaining air purity in aseptic zones.

270) **Airlocks**

Airlocks are small chambers that separate cleanrooms from less clean areas. They help maintain pressure differentials and reduce the entry of contaminants.

271) **Cleaning and Disinfection**

Regular cleaning with disinfectants removes microbial contamination from surfaces and equipment. Rotating disinfectants prevents resistant strains from developing.

272) **Microbiological Assay**

Microbiological assays determine the potency or concentration of a drug using living microorganisms. They ensure that antibiotics, vitamins, and amino acids meet specified standards.

273) **Cylinder Plate Method**

The cylinder plate or cup-plate method is a microbiological assay where wells are filled with antibiotic solutions. Zones of inhibition measure potency against test organisms.

274) **Turbidimetric Method**

In the turbidimetric method, the growth of a microorganism in the presence of an antibiotic is measured by the resulting turbidity. Less growth means higher antibiotic activity.

275) **Standardization of Antibiotics**

Standardization ensures each antibiotic batch has consistent potency. This is done using reference standards and test organisms to compare effectiveness.

276) **Vitamin Assay**

Vitamin assays use specific microorganisms that require a vitamin for growth. The growth response indicates the vitamin concentration in the sample.

277) **Amino Acid Assay**

Amino acid assays measure essential amino acids using microorganisms that need those amino acids to grow. They verify the quality of protein supplements and pharmaceuticals.

278) **Assessment of New Antibiotic**

Evaluating a new antibiotic includes determining its spectrum of activity, potency, safety, and resistance profile. Both lab and clinical trials are needed before approval.

279) **Zone of Inhibition**

The clear area around an antibiotic disc or well on an agar plate is called the zone of inhibition. Its size indicates the drug's ability to stop bacterial growth.

280) **Bioassay Validation**

Bioassays must be validated for accuracy, precision, and reproducibility. This ensures the results are reliable for quality control and regulatory compliance.

281) **Microbial Spoilage**

Microbial spoilage occurs when microorganisms grow in pharmaceutical products, causing chemical changes, foul odors, turbidity, or loss of potency. Preventing spoilage is critical for patient safety.

282) **Types of Spoilage**

Spoilage can be physical, chemical, or microbiological. In pharmaceuticals, microbiological spoilage is most common and often involves bacteria, fungi, or yeasts contaminating products.

283) **Factors Affecting Spoilage**

Factors like moisture content, pH, temperature, packaging, and preservatives influence microbial spoilage. Controlling these conditions helps maintain product stability and shelf life.

284) **Sources of Contamination**

Contaminants can come from raw materials, water, air, equipment, or personnel during manufacturing. Good manufacturing practices help limit these sources.

285) **Types of Microbial Contaminants**

Common contaminants include bacteria (like Pseudomonas), fungi (like Aspergillus), and yeasts. Each type can degrade active ingredients or cause infections if used by patients.

286) **Microbial Contamination Assessment**

Routine microbial testing checks raw materials, intermediate stages, and finished products for contamination. Methods include total viable count and detection of specific pathogens.

287) **Microbial Spoilage Assessment**

Spoilage assessment involves visual checks, turbidity tests, pH measurement, and microbial load tests. Early detection prevents unsafe products from reaching patients.

288) **Preservation**

Preservation involves adding antimicrobial agents to formulations to inhibit microbial growth. It is essential for multi-dose products like eye drops or syrups.

289) **Antimicrobial Preservatives**

Common preservatives include parabens, benzalkonium chloride, and phenols. They prevent microbial growth during storage and after the product is opened.

290) **Evaluation of Microbial Stability**

Microbial stability tests ensure that preservatives work effectively over the product's shelf life. Challenge tests expose products to known microbes and measure survival.

291) **Preservative Efficacy Test**

This test evaluates how well a preservative kills or inhibits specific test organisms. It is required by pharmacopeias to ensure safe use of multi-dose products.

292) **Animal Cell Culture**

Animal cell culture involves growing animal cells outside the organism in controlled lab conditions. It's widely used in vaccine production and biotechnology.

293) **General Cell Culture Procedure**

Cell culture requires sterile conditions, nutrient media, proper gas exchange, and temperature control. Techniques include using laminar flow hoods and incubators.

294) **Primary Cell Culture**

Primary cultures are derived directly from animal tissues. They have limited lifespan and closely resemble natural cells, making them ideal for toxicity testing.

295) **Established Cell Lines**

Established cell lines are derived from primary cultures but adapted to grow continuously. Examples include HeLa or Vero cells, used widely in research.

296) **Transformed Cell Lines**

Transformed cell lines are genetically altered to divide indefinitely. They are used to study cancer, test drugs, or produce biological products like monoclonal antibodies.

297) **Aseptic Techniques in Cell Culture**

Aseptic techniques prevent contamination during cell culture work. This includes sterilizing equipment, using laminar flow cabinets, and handling cultures with sterile tools.

298) **Cell Culture Media**

Culture media supply essential nutrients, salts, amino acids, vitamins, and growth factors for cell survival and proliferation. Media must be sterile and pH-controlled.

299) **Applications of Cell Culture**

Cell cultures are used in vaccine development, testing drug toxicity, producing recombinant proteins, and studying cell biology or genetics under controlled conditions.

300) **Cell Culture in Pharmaceutical Research**

In pharma, cell cultures help screen drug candidates, study disease mechanisms, and develop personalized medicine approaches. They reduce reliance on animal testing.

BP 304 T. PHARMACEUTICAL ENGINEERING

301) **Manometer**

A manometer is a device used to measure fluid pressure using a column of liquid. Common types include U-tube and differential manometers. They help monitor pressure in pipelines and equipment.

302) **Types of Manometers**

Manometers can be simple, like U-tube manometers for static pressure, or more advanced, like inclined and differential manometers, which measure small pressure differences with higher accuracy.

303) **Reynolds Number**

Reynolds number is a dimensionless value that predicts flow patterns in fluids. It helps determine whether flow is laminar or turbulent, influencing pipeline design and fluid handling.

304) **Bernoulli's Theorem**

Bernoulli's theorem states that in steady, incompressible flow, the total energy remains constant along a streamline. It explains how pressure, velocity, and elevation interact in fluid systems.

305) **Applications of Bernoulli's Theorem**

Bernoulli's principle is used in devices like Venturimeters and Pitot tubes to measure fluid flow rates and velocities, aiding efficient design of pipelines and processing equipment.

306) **Energy Losses in Fluids**

Fluid flow faces energy losses due to friction, turbulence, and changes in direction or velocity. These losses must be accounted for in pipeline design to maintain desired flow rates.

307) **Orifice Meter**

An orifice meter measures fluid flow by forcing it through a thin plate with a hole. The drop in pressure across the orifice helps calculate the flow rate.

308) **Venturimeter**

A Venturimeter measures flow by narrowing the pipeline, causing fluid speed to increase

and pressure to drop. The pressure difference indicates flow rate accurately with minimal energy loss.

309) **Pitot Tube**

A Pitot tube measures fluid velocity by converting kinetic energy into potential energy. It is widely used in airspeed measurement for aircraft and in fluid flow studies.

310) **Rotameter**

A Rotameter is a variable area flowmeter where fluid lifts a float in a tapered tube. The float's position shows flow rate, making it simple and effective for liquids and gases.

311) **Size Reduction**

Size reduction is the process of breaking down large solid particles into smaller ones to increase surface area, improve mixing, and enhance dissolution in formulations.

312) **Mechanisms of Size Reduction**

Size reduction occurs through cutting, compression, impact, and attrition. The choice of mechanism depends on material properties and the desired particle size.

313) **Laws of Size Reduction**

Laws like Kick's, Rittinger's, and Bond's law describe the energy required for size reduction. They help select suitable equipment and operating conditions.

314) **Hammer Mill**

A hammer mill uses high-speed rotating hammers to crush materials by impact. It's simple and effective but may produce heat and wide particle size distribution.

315) **Ball Mill**

A ball mill grinds materials using rotating cylindrical chambers filled with balls. It works by impact and attrition and is used for fine grinding of powders.

316) **Fluid Energy Mill**

A fluid energy mill or jet mill reduces particle size by using high-velocity air streams. It's ideal for heat-sensitive materials due to its minimal heat generation.

317) **Edge Runner Mill**

The edge runner mill has heavy wheels that rotate on a horizontal bed to crush or mix materials by crushing and shearing actions. It's used for mixing pastes and ointments.

318) **End Runner Mill**

An end runner mill uses a rotating stone or metal wheel running over a bed to grind materials. It's mainly used for mixing and grinding semi-solid materials.

319) **Size Separation**

Size separation involves separating particles based on size to achieve uniformity. It ensures proper mixing, consistent drug release, and meets pharmacopeial standards.

320) **Sieve Shaker**

A sieve shaker helps separate particles by passing them through stacked sieves of decreasing mesh size. It provides reproducible size distribution for powders and granules.

321) **Heat Transfer**

Heat transfer is the process of moving thermal energy from one place or material to another. It's vital in pharmaceutical operations like drying, evaporation, and sterilization.

322) **Objectives of Heat Transfer**

In pharmaceutics, heat transfer aims to control temperatures for processing raw materials, sterilizing products, and concentrating solutions without degrading sensitive ingredients.

323) **Applications of Heat Transfer**

Heat transfer is used in drying granules, sterilizing equipment, concentrating extracts, and maintaining controlled temperatures in reactors and fermenters.

324) **Conduction**

Conduction is the transfer of heat through a solid material from a higher to a lower temperature region without movement of particles. Metals are good conductors.

325) **Convection**

Convection involves heat transfer by the movement of fluids (liquids or gases). It can be natural, due to density differences, or forced by pumps and fans.

326) **Radiation**

Radiation transfers heat through electromagnetic waves without needing a medium. It is used in sterilizing rooms or drying materials using infrared heaters.

327) **Fourier's Law**

Fourier's law explains heat conduction, stating that the rate of heat flow through a material is proportional to the temperature gradient and area perpendicular to heat flow.

328) **Heat Interchanger**

A heat interchanger transfers heat from one fluid to another without mixing them. It conserves energy and is used in many pharmaceutical and chemical processes.

329) **Heat Exchanger**

Heat exchangers like shell-and-tube or plate types transfer heat between fluids efficiently. They are common in processes where heating or cooling of large volumes is required.

330) **Evaporation**

Evaporation is the process of removing solvent, usually water, by heating to concentrate solutions. It's widely used in preparing extracts and syrups.

331) **Objectives of Evaporation**

The main goal is to reduce bulk, increase active ingredient concentration, and remove excess solvents while preserving heat-sensitive components.

332) **Factors Affecting Evaporation**

Surface area, temperature, pressure, and flow rate affect evaporation efficiency. Lower pressure and higher temperature generally increase evaporation rates.

333) **Steam Jacketed Kettle**

This equipment uses steam to heat and evaporate liquids gently. It's simple and suitable for small-scale syrup or extract preparation.

334) **Horizontal Tube Evaporator**

In this evaporator, steam passes through horizontal tubes, heating the liquid outside the tubes. It's effective for concentrating large volumes.

335) **Climbing Film Evaporator**

This evaporator forms a thin film as liquid climbs inside vertical tubes due to vapor pressure. It's used for heat-sensitive materials as it provides short contact time.

336) **Forced Circulation Evaporator**

Liquid is pumped rapidly through tubes while heat is supplied. It handles viscous or scale-forming liquids efficiently and avoids overheating.

337) **Multiple Effect Evaporator**

This system uses the vapor from one effect to heat the next, saving energy. It's common in large-scale production to reduce steam consumption.

338) **Economy of Multiple Effect Evaporator**

The economy refers to how much vapor is produced per unit of steam used. More effects mean better steam economy and lower operating costs.

339) **Distillation**

Distillation separates components based on differences in boiling points. It purifies solvents, produces sterile water, and extracts volatile oils.

340) **Fractional Distillation**

Fractional distillation uses a fractionating column to separate mixtures with close boiling points. It's vital in purifying organic solvents or separating components of essential oils.

341) **Drying**

Drying is the removal of moisture from materials by heat. It's a crucial step to improve product stability, reduce bulk, and prevent microbial growth in pharmaceutical preparations.

342) **Objectives of Drying**

The primary objective is to lower moisture content to safe levels for storage and formulation. This prevents spoilage and ensures precise dosing in solid dosage forms.

343) **Applications of Drying**

Drying is used to process granules for tablets, prepare powdered extracts, and remove solvents from wet cakes or suspensions in pharmaceutical production.

344) **Mechanism of Drying**

Drying occurs in two stages: a constant rate period where surface moisture evaporates, and a falling rate period where internal moisture diffuses to the surface.

345) **Equilibrium Moisture Content (EMC)**

EMC is the moisture level at which a material no longer gains or loses water to the surrounding air. It's important for setting drying conditions.

346) **Rate of Drying Curve**

The drying rate curve shows how quickly moisture is removed over time. Understanding this helps choose the right drying method and duration for each product.

347) **Tray Dryer**

A tray dryer uses heated air circulated over trays loaded with wet material. It's simple and widely used for drying granules and powders in batch processes.

348) **Drum Dryer**

A drum dryer dries liquids or slurries by spreading them on a rotating heated drum. The dried film is scraped off, suitable for milk powders and extracts.

349) **Spray Dryer**

A spray dryer atomizes liquid into fine droplets in a hot air stream, producing dry powders instantly. It's ideal for heat-sensitive products like antibiotics.

350) **Fluidized Bed Dryer**

This dryer blows hot air through a bed of particles, making them behave like a fluid. It ensures uniform drying and is efficient for granules and powders.

351) **Vacuum Dryer**

A vacuum dryer lowers pressure to reduce boiling point, drying materials at low temperatures. It's suitable for heat-sensitive and hygroscopic substances.

352) **Freeze Dryer (Lyophilizer)**

Freeze drying removes water by sublimation under vacuum. It preserves the structure and activity of biologicals, vaccines, and delicate drugs.

353) **Mixing**

Mixing is the process of blending two or more substances uniformly. It's essential for consistent drug dosing, uniformity of content, and stable formulations.

354) **Objectives of Mixing**

The goal is to achieve a homogeneous product. Proper mixing ensures each dosage unit contains the correct amount of active ingredient and excipients.

355) **Factors Affecting Mixing**

Particle size, shape, density, moisture content, and mixing time all influence mixing efficiency. Equipment design and mixing speed also play major roles.

356) **Solid vs. Liquid Mixing**

Solid mixing relies on diffusion and convection of particles, while liquid mixing depends on flow currents and turbulence to distribute components uniformly.

357) **Double Cone Blender**

This blender tumbles powders in a rotating double-cone shell for gentle, thorough mixing. It's suitable for free-flowing powders and granules.

358) **Ribbon Blender**

A ribbon blender uses helical ribbons that move materials inside a trough, ensuring efficient mixing of dry powders, granules, and light pastes.

359) **Sigma Blade Mixer**

A sigma blade mixer kneads and mixes viscous semi-solids like ointments and dough using two counter-rotating blades shaped like the Greek letter sigma.

360) **Silverson Emulsifier**

A Silverson emulsifier is a high-shear mixer that disperses and emulsifies liquids by intense mechanical action, ideal for creams, suspensions, and emulsions.

361) **Filtration**

Filtration is the process of separating solid particles from fluids by passing them through a porous medium. It's vital in pharmaceutical manufacturing for clarifying liquids and sterilizing solutions.

362) **Objectives of Filtration**

The main objective is to obtain a clear filtrate free of unwanted solids. It ensures the quality of injectables, syrups, and sterile solutions by removing contaminants.

363) **Applications of Filtration**

Filtration is used for sterilizing heat-sensitive liquids, recovering valuable solids, clarifying extracts, and purifying air or gases in production environments.

364) **Theories of Filtration**

Filtration operates on surface filtration, where particles are trapped on the filter's surface, and depth filtration, where particles penetrate and get trapped within the filter medium.

365) **Factors Influencing Filtration**

Particle size, temperature, pressure, filter medium type, and use of filter aids all affect filtration efficiency and flow rate.

366) **Filter Aids**

Filter aids like diatomaceous earth improve filtration by creating a porous layer, preventing clogging, and enhancing clarity of the filtrate.

367) **Filter Media**

Filter media provide the surface or depth for trapping particles. Common media include paper, cloth, membranes, or metal screens depending on the application.

368) **Plate and Frame Filter Press**

This filter has alternating plates and frames with filter cloths. Liquid passes through under pressure, separating solids and liquids. It's suitable for batch filtration.

369) **Filter Leaf**

A filter leaf is a frame covered with filter cloth, immersed in slurry. Vacuum or pressure pulls liquid through the cloth while solids form a cake.

370) **Rotary Drum Filter**

This continuous filter has a rotating drum covered with filter cloth. Part of the drum is submerged in slurry; vacuum draws liquid through while solids stick to the drum.

371) **Meta Filter**

A meta filter uses a metal frame wound with metal wires or screens. It's reusable, withstands high pressures, and is used for coarse and medium filtration.

372) **Cartridge Filter**

A cartridge filter is a disposable filter unit made of pleated membranes or fibers. It's widely used for sterilizing liquids and gases in pharmaceutical production.

373) **Membrane Filter**

Membrane filters are thin polymer films with fine pores that remove bacteria and particles. They are commonly used for sterilizing injectables and heat-sensitive solutions.

374) **Seitz Filter**

A Seitz filter uses asbestos or cellulose pads to filter liquids. It's mainly used for clarifying vaccines, sera, and heat-sensitive fluids.

375) **Centrifugation**

Centrifugation separates particles from liquids using centrifugal force. It's used to clarify suspensions, recover cells, or concentrate biological samples.

376) **Objectives of Centrifugation**

The main aim is to accelerate the separation of solids from liquids or liquids of different densities, which would otherwise settle very slowly by gravity.

377) **Principle of Centrifugation**

Centrifugation works on the principle of sedimentation: particles move outward due to centrifugal force, separating based on size, shape, and density.

378) **Perforated Basket Centrifuge**

This centrifuge has a basket with perforations lined with a filter cloth. It removes liquids from solids rapidly and is used for crystalline or fibrous materials.

379) **Non-Perforated Basket Centrifuge**

Here, the basket has no perforations; separation occurs by sedimentation alone. It's useful for separating immiscible liquids or very fine solids.

380) **Super Centrifuge**

A super centrifuge operates at very high speeds, producing strong centrifugal forces. It's used for clarifying oils, separating fine particles, and purifying biological fluids.

381) **Materials of Construction**

Materials of construction are the metals or non-metals used to build pharmaceutical equipment and plants. Their selection affects durability, product purity, and overall safety.

382) **Factors Affecting Material Selection**

Factors include chemical compatibility, corrosion resistance, mechanical strength, cost, ease of fabrication, and compliance with pharmaceutical standards for cleanliness and sterility.

383) **Ferrous Metals**

Ferrous metals contain iron, such as stainless steel and cast iron. Stainless steel is widely used due to its corrosion resistance and ease of cleaning.

384) **Non-Ferrous Metals**

Non-ferrous metals include copper, aluminum, and titanium. These are used where specific properties like lightweight, non-reactivity, or better corrosion resistance are required.

385) **Inorganic Non-Metals**

Materials like glass and ceramics are inorganic non-metals used in pharmaceutical plants for their inertness, transparency, and heat resistance, ideal for reactors and storage vessels.

386) **Organic Non-Metals**

Plastics and rubber are common organic non-metals used for flexible tubing, seals, linings, and parts that require chemical resistance but not high strength.

387) **Corrosion**

Corrosion is the gradual destruction of materials, usually metals, due to chemical or electrochemical reactions with their environment, leading to equipment failure.

388) **Theories of Corrosion**

Two main theories explain corrosion: the electrochemical theory, involving galvanic cells, and the chemical theory, describing direct reactions of metal with chemicals like acids.

389) **Types of Corrosion**

Corrosion types include uniform corrosion, galvanic corrosion, pitting, stress corrosion cracking, intergranular corrosion, and crevice corrosion — each with different mechanisms and impacts.

390) **Uniform Corrosion**

Uniform corrosion occurs evenly over a surface, slowly thinning the metal. It's predictable and easier to manage with coatings and material choice.

391) **Galvanic Corrosion**

Galvanic corrosion happens when two different metals are in electrical contact in a corrosive environment, causing one to corrode faster than it would alone.

392) **Pitting Corrosion**

Pitting is a localized form of corrosion that creates small holes or pits. It is dangerous because it can cause sudden failures with minimal overall material loss.

393) **Stress Corrosion Cracking (SCC)**

SCC is cracking caused by the combined effect of tensile stress and a corrosive environment. It often occurs unnoticed until catastrophic failure happens.

394) **Corrosion Prevention**

Methods include selecting corrosion-resistant materials, using protective coatings, applying cathodic protection, and controlling the environment (e.g., pH, humidity).

395) **Protective Coatings**

Coatings like paints, enamels, or plating (e.g., galvanizing) act as barriers to prevent corrosive substances from contacting the metal surface.

396) **Cathodic Protection**

This technique uses sacrificial anodes or impressed current to make the protected metal the cathode of an electrochemical cell, reducing its corrosion.

397) **Passivation**

Passivation forms a protective oxide layer on metals like stainless steel to reduce corrosion. This is often done chemically after fabrication.

398) **Material Handling Systems**

Material handling systems include equipment and methods used to move, store, control, and protect raw materials and products during manufacturing.

399) **Bulk Material Handling**

This involves moving large quantities of raw materials like powders and granules using conveyors, pneumatic systems, or elevators within a pharmaceutical plant.

400) **Equipment for Material Handling**

Common equipment includes belt conveyors, screw conveyors, bucket elevators, and pneumatic conveyors, all designed to handle materials efficiently and hygienically.

SEMESTER IV

BP401T. PHARMACEUTICAL ORGANIC CHEMISTRY –III

401) **Stereoisomerism**

Stereoisomerism occurs when compounds have the same molecular formula but differ in the spatial arrangement of their atoms. It plays a vital role in the biological activity of drugs.

402) **Optical Isomerism**

Optical isomerism is a form of stereoisomerism where molecules can rotate plane-polarized light. This property arises due to the presence of asymmetric carbon atoms.

403) **Optical Activity**

Optical activity refers to the ability of a compound to rotate the plane of polarized light to the right (dextrorotatory) or left (levorotatory). It is a key feature of chiral molecules.

404) **Enantiomers**

Enantiomers are non-superimposable mirror images of each other. They have identical physical properties except for the direction they rotate polarized light and how they interact with chiral environments.

405) **Diastereoisomers**

Diastereoisomers are stereoisomers that are not mirror images of each other. They differ in physical and chemical properties and can have multiple chiral centers.

406) **Meso Compounds**

Meso compounds contain multiple chiral centers but are achiral due to an internal plane of symmetry. They do not show optical activity despite having chiral carbons.

407) **Elements of Symmetry**

Elements of symmetry include planes, centers, or axes that divide a molecule into symmetrical parts. Molecules with certain symmetry elements are achiral and optically inactive.

408) **Chiral Molecules**

A chiral molecule lacks an internal plane of symmetry and cannot be superimposed on its mirror image. Chirality is a key feature in many biologically active compounds.

409) **Achiral Molecules**

Achiral molecules have symmetry elements like a plane or center of symmetry. They are superimposable on their mirror images and do not exhibit optical activity.

410) **DL System of Nomenclature**

The DL system assigns D or L to optical isomers based on their relation to D- or L-glyceraldehyde. It is commonly used for amino acids and sugars.

411) **Sequence Rules**

Sequence rules, also known as Cahn-Ingold-Prelog (CIP) rules, help assign priorities to substituents attached to chiral centers, essential for RS system nomenclature.

412) **RS System of Nomenclature**

The RS system names chiral centers as R (rectus) or S (sinister) based on the priority of groups around the asymmetric carbon. It gives an absolute configuration.

413) **Racemic Mixture**

A racemic mixture contains equal amounts of two enantiomers. It is optically inactive because the rotations of light by each enantiomer cancel each other out.

414) **Racemic Modification**

Racemic modification is the process of converting an optically active compound into a racemic mixture. It often occurs during synthesis when no control over chirality is applied.

415) **Resolution of Racemic Mixture**

Resolution separates a racemic mixture into its individual enantiomers. Techniques include using chiral resolving agents, enzymatic methods, or chromatography.

416) **Asymmetric Synthesis**

Asymmetric synthesis is a method to produce predominantly or exclusively one enantiomer of a chiral compound. It’s important in producing optically pure drugs.

417) **Partial Asymmetric Synthesis**

Partial asymmetric synthesis yields a mixture in which one enantiomer is in excess but not pure. Additional purification steps are needed to isolate the desired enantiomer.

418) **Absolute Asymmetric Synthesis**

Absolute asymmetric synthesis produces only one enantiomer in pure form without needing further separation. It uses chiral catalysts or auxiliaries to direct stereochemistry.

419) **Chiral Resolving Agent**

A chiral resolving agent converts a racemic mixture into diastereomers, which have different properties and can be separated by physical means like crystallization.

420) **Stereoselective Reaction**

A stereoselective reaction favors the formation of one stereoisomer over others. It's crucial for ensuring that the desired isomer with proper biological activity is produced.

421) **Geometrical Isomerism**

Geometrical isomerism arises due to restricted rotation around a double bond or ring structure, leading to different spatial arrangements. Classic examples include cis and trans isomers.

422) **Cis Isomer**

In cis isomers, similar groups are positioned on the same side of a double bond or ring. This arrangement affects physical properties like boiling point and solubility.

423) **Trans Isomer**

In trans isomers, similar groups are located on opposite sides of a double bond or ring. Trans isomers often have lower boiling points than their cis counterparts.

424) **E/Z Nomenclature**

The E/Z system (from German *Entgegen* and *Zusammen*) classifies double bond isomers based on priority groups. E means opposite sides; Z means same side.

425) **Syn/Anti System**

The syn and anti terms describe the relative positions of substituents in molecules, especially in aldoximes and hydrazones, where rotation is restricted.

426) **Configuration Determination**

Geometrical isomers are identified using physical methods like melting point, boiling point, and spectroscopy. X-ray crystallography provides precise structural details.

427) **Conformational Isomerism**

Conformational isomerism involves different spatial arrangements of atoms due to rotation around single bonds. These isomers readily interconvert at room temperature.

428) **Conformation of Ethane**

Ethane shows two main conformations: staggered (lowest energy, more stable) and eclipsed (highest energy, less stable). Rotation around the C–C bond interconverts them.

429) **Conformation of n-Butane**

n-Butane has anti and gauche conformations. The anti form, where bulky groups are farthest apart, is most stable. Gauche forms have higher energy due to steric hindrance.

430) **Conformation of Cyclohexane**

Cyclohexane prefers the chair conformation, which is strain-free and most stable. The boat and twist-boat forms are higher in energy due to steric and torsional strain.

431) **Atropisomerism**

Atropisomerism is a type of stereoisomerism in biphenyls where restricted rotation around a single bond leads to isolable optical isomers without chiral centers.

432) **Biphenyl Compounds**

Biphenyls can be optically active if bulky groups prevent free rotation around the central bond, maintaining stable chiral conformations.

433) **Conditions for Optical Activity in Biphenyls**

Substituents must be large enough to hinder rotation. Additionally, the molecule should lack a plane of symmetry to exhibit chirality.

434) **Stereospecific Reactions**

A stereospecific reaction produces only one stereoisomer from a given stereoisomeric reactant. For example, SN2 reactions invert the configuration at the reaction center.

435) **Stereoselective Reactions**

Stereoselective reactions favor the formation of one stereoisomer over others, but not exclusively. Many organic syntheses aim for high stereoselectivity for desired products.

436) **Restricted Rotation**

Restricted rotation occurs around double bonds or crowded single bonds, creating stable isomers that cannot easily interconvert at room temperature.

437) **Ring Strain**

In cycloalkanes like cyclohexane, ring strain affects conformational isomerism. The chair form minimizes angle and torsional strain, making it the most stable.

438) **Newman Projection**

Newman projections visualize conformations by looking down a bond axis. This helps compare staggered and eclipsed forms in molecules like ethane and butane.

439) **Axial and Equatorial Bonds**

In cyclohexane, hydrogens occupy axial (parallel to the axis) or equatorial (around the equator) positions. Equatorial positions are favored by bulky groups due to less steric hindrance.

440) **Dynamic Equilibrium**

Conformations interconvert rapidly in dynamic equilibrium. Understanding this helps predict reactivity, steric interactions, and preferred product formation in reactions.

441) **Heterocyclic Compounds**

Heterocyclic compounds are organic molecules where the ring contains at least one atom other than carbon, such as nitrogen, oxygen, or sulfur. They are key scaffolds in medicinal chemistry.

442) **Nomenclature of Heterocycles**

Heterocycles are named by combining prefixes indicating the heteroatom (e.g., “oxa” for oxygen, “thia” for sulfur) with a suffix describing ring size and saturation.

443) **Classification of Heterocycles**

They can be classified by ring size (five-membered, six-membered) and number/nature of heteroatoms. For example, pyrrole, furan, and thiophene are five-membered, mono-heteroatom rings.

444) **Pyrrole**

Pyrrole is a five-membered aromatic ring with one nitrogen atom. It’s found in important biological molecules like heme and has unique chemical reactivity due to its electron-rich nature.

445) **Furan**

Furan is a five-membered aromatic ring with one oxygen atom. It’s less aromatic than benzene and reacts readily under acidic conditions, often used as a starting point in organic synthesis.

446) **Thiophene**

Thiophene is a five-membered aromatic ring containing a sulfur atom. It’s stable and widely used as a building block in drugs and conducting polymers.

447) **Relative Aromaticity**

Thiophene is more aromatic than furan but slightly less so than pyrrole. This affects their chemical stability and tendency to undergo electrophilic substitution.

448) **Reactivity of Pyrrole**

Pyrrole is highly reactive towards electrophilic substitution due to its electron-rich nitrogen. Substitution usually occurs at the alpha position next to nitrogen.

449) **Reactivity of Furan**

Furan is less aromatic than pyrrole and undergoes electrophilic substitution easily but can be unstable under strong acid conditions, leading to ring opening.

450) **Reactivity of Thiophene**

Thiophene is the most stable of the three under acidic conditions. It undergoes electrophilic substitution mainly at the 2-position (alpha to sulfur)

451) **Synthesis of Pyrrole**

Pyrrole can be synthesized by the Paal-Knorr synthesis, where 1,4-dicarbonyl compounds cyclize in the presence of ammonia or primary amines.

452) **Synthesis of Furan**

Furan can be prepared by the Paal-Knorr synthesis too, using 1,4-diketones under acidic conditions, which cyclize to form the furan ring.

453) **Synthesis of Thiophene**

Thiophene can be synthesized by the Paal-Knorr thiophene synthesis or by heating a 1,4-dicarbonyl compound with phosphorus pentasulfide (P_2S_5).

454) **Electrophilic Substitution in Pyrrole**

Pyrrole reacts with halogens, nitrating agents, or sulfonating agents. However, mild conditions are needed to prevent ring degradation.

455) **Electrophilic Substitution in Furan**

Furan easily undergoes halogenation and Friedel-Crafts reactions, but strong acids can polymerize or degrade the ring.

456) **Electrophilic Substitution in Thiophene**

Thiophene readily undergoes halogenation, nitration, and sulfonation at the 2-position. Its reactivity resembles benzene more than furan or pyrrole.

457) **Medicinal Uses of Pyrrole Derivatives**

Pyrrole derivatives are found in drugs like tolmetin (anti-inflammatory) and atorvastatin (cholesterol-lowering). They are also part of porphyrins in heme.

458) **Medicinal Uses of Furan Derivatives**

Furan derivatives include furosemide (a diuretic) and nitrofurantoin (an antibiotic). Their structure enhances binding and activity against bacteria.

459) **Medicinal Uses of Thiophene Derivatives**

Thiophene rings are present in drugs like thiophanate (fungicide) and tenoxicam (anti-inflammatory). They improve lipophilicity and stability in drug molecules.

460) **Paal-Knorr Synthesis**

The Paal-Knorr synthesis is a classic method to prepare five-membered heterocycles like pyrrole, furan, and thiophene from 1,4-dicarbonyl compounds using amines, acids, or sulfurizing agents.

461) **Pyrazole**

Pyrazole is a five-membered heterocycle with two adjacent nitrogen atoms. It's known for its presence in anti-inflammatory and analgesic drugs like phenylbutazone.

462) **Synthesis of Pyrazole**

Pyrazoles are commonly synthesized by reacting hydrazines with 1,3-dicarbonyl compounds. This cyclization yields the heterocyclic ring efficiently.

463) **Reactions of Pyrazole**

Pyrazoles undergo electrophilic substitution reactions mainly at the 4-position due to the electron-donating nature of nitrogen atoms.

464) **Medicinal Uses of Pyrazole Derivatives**

Pyrazole derivatives are used as antipyretics, analgesics, and anti-inflammatory agents. Examples include celecoxib and antipyrine.

465) **Imidazole**

Imidazole is a five-membered ring with two non-adjacent nitrogen atoms. It's an important pharmacophore in many biologically active molecules.

466) **Synthesis of Imidazole**

Imidazoles can be prepared by the Debus-Radziszewski reaction, which involves the condensation of glyoxal, ammonia, and aldehydes.

467) **Medicinal Uses of Imidazole Derivatives**

Imidazole rings are found in antifungal agents like miconazole and ketoconazole and also in the amino acid histidine.

468) **Oxazole**

Oxazole is a five-membered aromatic ring containing an oxygen and a nitrogen atom. It's less stable than imidazole or thiazole due to its weaker aromaticity.

469) **Synthesis of Oxazole**

Oxazoles are synthesized via cyclodehydration of α-acylamino ketones under acidic conditions.

470) **Medicinal Uses of Oxazole Derivatives**

Oxazole derivatives possess antibacterial, anti-inflammatory, and anticancer properties. They're used as building blocks in synthetic drug design.

471) **Thiazole**

Thiazole is a five-membered ring containing both sulfur and nitrogen atoms. It is aromatic and more stable than oxazole.

472) **Synthesis of Thiazole**

Thiazoles can be synthesized by the Hantzsch thiazole synthesis using α-haloketones and thiourea.

473) **Medicinal Uses of Thiazole Derivatives**

Thiazole rings are present in vitamin B1 (thiamine) and drugs like sulfathiazole, which is an antibacterial agent.

474) **Pyridine**

Pyridine is a six-membered aromatic ring containing one nitrogen atom. It resembles benzene but is more basic and reactive towards nucleophiles.

475) **Basicity of Pyridine**

The lone pair on the nitrogen atom makes pyridine a weak base. It is less basic than aliphatic amines because the lone pair is in an sp2 orbital, not delocalized.

476) **Quinoline**

Quinoline is a fused heterocycle containing a benzene ring fused to a pyridine ring. It's widely used in antimalarial drugs like quinine and chloroquine.

477) **Isoquinoline**

Isoquinoline has a structure similar to quinoline but with the nitrogen at a different position in the ring. It's a key skeleton in many alkaloids.

478) **Acridine**

Acridine is a tricyclic compound with two benzene rings fused on either side of a pyridine ring. Acridine derivatives are known for their antiseptic and antimalarial activities.

479) **Indole**

Indole is a bicyclic structure combining a benzene ring fused to a pyrrole ring. It's the core structure in tryptophan and many plant alkaloids.

480) **Pyrimidine and Purine**

Pyrimidine is a six-membered heterocycle with two nitrogen atoms at positions 1 and 3, found in nucleic acids. Purine is a fused bicyclic heterocycle combining a pyrimidine and an imidazole, forming the core of adenine and guanine.

BP402T. MEDICINAL CHEMISTRY – I

481) **Medicinal Chemistry**

Medicinal chemistry is the discipline that combines chemistry and pharmacology to design, synthesize, and develop bioactive compounds for therapeutic use.

482) **History of Medicinal Chemistry**

Medicinal chemistry evolved from early herbal remedies to the systematic design of synthetic drugs. Major milestones include the discovery of sulfa drugs and penicillin.

483) **Physicochemical Properties**

Physicochemical properties such as solubility, ionization, and partition coefficient directly influence how a drug interacts with biological systems and its bioavailability.

484) **Ionization**

Ionization refers to the process where a molecule gains or loses electrons to form ions. The degree of ionization affects a drug's absorption and distribution in the body.

485) **Solubility**

Solubility is a drug's ability to dissolve in a solvent. Adequate solubility is critical for a drug's absorption and therapeutic effectiveness.

486) **Partition Coefficient**

The partition coefficient (P) indicates how a drug distributes between aqueous and lipid phases. It reflects the drug's lipophilicity and predicts membrane permeability.

487) **Hydrogen Bonding**

Hydrogen bonding occurs when a hydrogen atom interacts with electronegative atoms like oxygen or nitrogen. It influences drug-receptor binding and solubility.

488) **Protein Binding**

Protein binding is the reversible interaction of a drug with plasma proteins. High protein binding affects a drug's free concentration and duration of action.

489) **Chelation**

Chelation involves the binding of a drug to metal ions through multiple coordination sites. Chelating agents are used to treat heavy metal poisoning.

490) **Bioisosterism**

Bioisosterism is the replacement of an atom or group with another having similar physical or chemical properties to improve drug activity or reduce side effects.

491) **Optical Isomerism**

Optical isomerism occurs when molecules have chiral centers, producing enantiomers that may differ in biological activity and metabolism.

492) **Geometrical Isomerism**

Geometrical isomerism involves compounds with restricted rotation, resulting in cis/trans or E/Z forms that can show different pharmacological properties.

493) **Drug Metabolism**

Drug metabolism is the biochemical modification of drugs by the body, mainly in the liver. It converts lipophilic drugs to more water-soluble forms for excretion.

494) **Phase I Metabolism**

Phase I metabolism introduces or exposes functional groups through oxidation, reduction, or hydrolysis, often using cytochrome P450 enzymes.

495) **Phase II Metabolism**

Phase II metabolism involves conjugation reactions where the drug or its Phase I metabolites combine with endogenous molecules like glucuronic acid, enhancing excretion.

496) **Cytochrome P450 Enzymes**

Cytochrome P450 enzymes are a family of oxidative enzymes that play a major role in Phase I metabolism, determining drug clearance and interactions.

497) **Prodrugs**

Prodrugs are inactive compounds that become active after metabolic conversion. They are designed to improve solubility, absorption, or target specificity.

498) **Factors Affecting Metabolism**

Drug metabolism is influenced by age, genetics, enzyme induction or inhibition, diet, disease states, and stereochemistry of the drug.

499) **Stereochemical Aspects of Metabolism**

Enantiomers can be metabolized differently, leading to variations in pharmacological effect and toxicity. Stereochemistry is crucial in drug design.

500) **Therapeutic Window**

The therapeutic window is the range of drug concentration between the minimum effective level and the minimum toxic level. Understanding metabolism helps maintain this window.

501) **Adrenergic Neurotransmitters**

Adrenergic neurotransmitters include catecholamines like norepinephrine, epinephrine, and dopamine. They transmit signals in the sympathetic nervous system, preparing the body for 'fight or flight'.

502) **Catecholamine Biosynthesis**

Catecholamines are synthesized from the amino acid tyrosine, which is converted to DOPA, then dopamine, norepinephrine, and finally epinephrine through enzymatic steps.

503) **Catecholamine Catabolism**

Catecholamines are broken down by enzymes like monoamine oxidase (MAO) and catechol-O-methyl transferase (COMT), which help regulate their levels in the nervous system.

504) **Adrenergic Receptors**

Adrenergic receptors are classified into alpha (α) and beta (β) subtypes. They are G-protein coupled receptors that mediate the actions of catecholamines throughout the body.

505) **Alpha Receptors**

Alpha receptors (α1 and α2) are found in vascular smooth muscle and central nervous system. They cause vasoconstriction and regulate neurotransmitter release.

506) **Beta Receptors**

Beta receptors (β1, β2, β3) are distributed in the heart, lungs, and adipose tissue. Activation leads to increased heart rate, bronchodilation, and lipolysis.

507) **Sympathomimetic Agents**

Sympathomimetics mimic the effects of endogenous catecholamines by stimulating adrenergic receptors. They are used for conditions like asthma, hypotension, and nasal congestion.

508) **SAR of Sympathomimetics**

The structure-activity relationship (SAR) of sympathomimetics shows that modifications to the amine group, side chain, or aromatic ring can influence receptor selectivity and duration.

509) **Epinephrine**

Epinephrine (adrenaline) is a direct-acting catecholamine that stimulates both α and β receptors. It's used in anaphylaxis, cardiac arrest, and asthma emergencies.

510) **Norepinephrine**

Norepinephrine primarily activates α receptors with some β1 activity. It's used clinically to treat shock and severe hypotension.

511) **Phenylephrine**

Phenylephrine is a selective α1 agonist used as a nasal decongestant and to raise blood pressure in hypotensive states.

512) **Dopamine**

Dopamine acts on dopaminergic and β1 receptors. At high doses, it also stimulates α receptors. It's used for cardiogenic and septic shock.

513) **Methyldopa**

Methyldopa is a centrally acting α2 agonist that reduces sympathetic outflow, used to treat hypertension, especially during pregnancy.

514) **Clonidine**

Clonidine is an α2 adrenergic agonist that decreases sympathetic tone. It's prescribed for hypertension and withdrawal syndromes.

515) **Hydroxyamphetamine**

Hydroxyamphetamine is an indirect sympathomimetic that promotes the release of norepinephrine. It is used in ophthalmology to test sympathetic innervation.

516) **Ephedrine**

Ephedrine acts by both direct receptor stimulation and indirect norepinephrine release. It's used for nasal congestion and mild asthma.

517) **Tolazoline**

Tolazoline is a non-selective α-adrenergic blocker used to manage peripheral vascular diseases by causing vasodilation.

518) **Propranolol**

Propranolol is a non-selective β-blocker used for hypertension, angina, arrhythmias, and migraine prevention. It blocks both β1 and β2 receptors.

519) **Beta Blockers SAR**

Beta blocker SAR shows that an aromatic ring with an oxypropanolamine side chain is essential. Substitutions affect β1-selectivity and lipophilicity.

520) **Atenolol**

Atenolol is a cardioselective β1-blocker used for hypertension and angina. It has fewer CNS side effects due to its low lipid solubility.

521) **Acetylcholine (ACh)**

Acetylcholine is the primary cholinergic neurotransmitter in the parasympathetic nervous system. It plays a key role in muscle contraction, glandular secretion, and neural transmission.

522) **Biosynthesis of Acetylcholine**

Acetylcholine is synthesized in nerve terminals from choline and acetyl-CoA through the action of the enzyme choline acetyltransferase.

523) **Catabolism of Acetylcholine**

ACh is rapidly broken down in the synaptic cleft by the enzyme acetylcholinesterase into choline and acetate, terminating its action.

524) **Cholinergic Receptors**

Cholinergic receptors are classified into muscarinic and nicotinic types. They mediate the effects of ACh in different tissues like smooth muscle, glands, and the CNS.

525) **Muscarinic Receptors**

Muscarinic receptors are G-protein coupled receptors found in organs innervated by the parasympathetic system. They control smooth muscle contraction, heart rate, and glandular secretion.

526) **Nicotinic Receptors**

Nicotinic receptors are ligand-gated ion channels located at neuromuscular junctions and autonomic ganglia. Activation leads to rapid depolarization and muscle contraction.

527) **Parasympathomimetic Agents**

These agents mimic ACh by stimulating muscarinic or nicotinic receptors, producing effects like pupil constriction, increased GI motility, and salivation.

528) **SAR of Parasympathomimetics**

The structure–activity relationship shows that the quaternary ammonium group and ester linkage are crucial for cholinergic activity and receptor binding.

529) **Carbachol**

Carbachol is a direct-acting cholinergic agonist resistant to cholinesterase. It's used to treat glaucoma by increasing aqueous humor outflow.

530) **Bethanechol**

Bethanechol selectively stimulates muscarinic receptors, enhancing bladder and GI motility. It is used in postoperative urinary retention.

531) **Pilocarpine**

Pilocarpine is a natural alkaloid that activates muscarinic receptors. It's used topically to manage glaucoma and to stimulate saliva in xerostomia.

532) **Physostigmine**

Physostigmine is a reversible cholinesterase inhibitor that crosses the blood-brain barrier. It's used to treat glaucoma and anticholinergic poisoning.

533) **Neostigmine**

Neostigmine is a reversible cholinesterase inhibitor that enhances neuromuscular transmission. It is widely used for myasthenia gravis and postoperative ileus.

534) **Isofluorphate**

Isofluorphate is an irreversible cholinesterase inhibitor used in ophthalmology for chronic glaucoma treatment. It binds covalently to the enzyme.

535) **Parathione & Malathion**

These are organophosphate insecticides that irreversibly inhibit acetylcholinesterase, leading to toxic accumulation of ACh at synapses.

536) **Pralidoxime Chloride**

Pralidoxime is a cholinesterase reactivator that regenerates the enzyme after organophosphate poisoning. It must be given promptly to be effective.

537) **Cholinergic Blocking Agents**

These agents, also called anticholinergics, block muscarinic receptors to reduce parasympathetic activity, causing effects like pupil dilation and reduced secretions.

538) **Atropine Sulphate**

Atropine is a naturally occurring anticholinergic from Atropa belladonna. It is used to dilate pupils, treat bradycardia, and as an antidote for organophosphate poisoning.

539) **Ipratropium Bromide**

Ipratropium is a synthetic anticholinergic used as an inhaler for bronchial asthma and chronic obstructive pulmonary disease to cause bronchodilation.

540) **Dicyclomine Hydrochloride**

Dicyclomine is a synthetic antispasmodic that blocks muscarinic receptors in the GI tract. It is used to relieve intestinal cramps and irritable bowel syndrome.

541) **Sedatives and Hypnotics**

Sedatives and hypnotics are CNS depressants used to calm patients (sedation) or induce sleep (hypnosis). Their therapeutic goal is to reduce anxiety and aid sleep without significant side effects.

542) **Benzodiazepines**

Benzodiazepines enhance GABAergic transmission by binding to the GABA-A receptor complex, increasing chloride ion influx, causing neuronal hyperpolarization and CNS depression.

543) **SAR of Benzodiazepines**

The SAR shows that a diazepine ring fused with a benzene ring is essential. Electron-withdrawing groups at position 7 enhance activity.

544) **Diazepam**

Diazepam is a widely used benzodiazepine for anxiety, muscle spasms, and as a sedative-hypnotic. It has a long half-life and active metabolites.

545) **Barbiturates**

Barbiturates are derivatives of barbituric acid. They act by enhancing GABA activity at GABA-A receptors, prolonging chloride channel opening.

546) **SAR of Barbiturates**

The SAR of barbiturates indicates that substituents at the C-5 position determine hypnotic potency and duration. Alkyl or aryl groups modify lipid solubility.

547) **Phenobarbital**

Phenobarbital is a long-acting barbiturate used as a sedative and an anticonvulsant for tonic-clonic and partial seizures.

548) **Meprobamate**

Meprobamate is a carbamate derivative with sedative and anxiolytic properties. It acts on the limbic system and reticular formation.

549) **Triclofos Sodium**

Triclofos sodium is a sedative-hypnotic aldehyde derivative. It is used mainly as a pediatric sedative due to its pleasant taste and efficacy.

550) **Antipsychotics**

Antipsychotics are drugs used to treat schizophrenia and other psychoses by blocking dopamine D2 receptors in the brain.

551) **Phenothiazines**

Phenothiazines are typical antipsychotics that block dopamine receptors. They have additional antihistaminic and anticholinergic effects.

552) **SAR of Phenothiazines**

The SAR indicates that electron-withdrawing substituents at position 2 increase potency. The side chain length and nitrogen substitution affect activity.

553) **Chlorpromazine Hydrochloride**

Chlorpromazine is a typical phenothiazine antipsychotic. It is used to manage schizophrenia, manic episodes, and severe nausea.

554) **Haloperidol**

Haloperidol is a potent butyrophenone antipsychotic with strong D2 receptor antagonism. It is used in schizophrenia and acute psychosis.

555) **Risperidone**

Risperidone is an atypical antipsychotic with dopamine and serotonin receptor antagonism. It treats schizophrenia and bipolar disorder.

556) **SAR of Anticonvulsants**

The SAR of anticonvulsants shows that substitution at the C-5 position in barbiturates or hydantoins influences anticonvulsant potency and spectrum

557) **Phenytoin**

Phenytoin is a hydantoin derivative used to control tonic-clonic and partial seizures by stabilizing neuronal membranes and reducing repetitive firing.

558) **Carbamazepine**

Carbamazepine is used for partial and generalized tonic-clonic seizures. It works by blocking sodium channels, preventing repetitive firing.

559) **Valproic Acid**

Valproic acid is a broad-spectrum anticonvulsant that increases GABA levels and blocks sodium channels. It is also used for bipolar disorder.

560) **Gabapentin**

Gabapentin is an anticonvulsant that binds to voltage-gated calcium channels, reducing neurotransmitter release. It is used for partial seizures and neuropathic pain.

561) **General Anesthetics**

General anesthetics are drugs that induce reversible loss of consciousness and sensation. They are used during surgical procedures to ensure unconsciousness and analgesia.

562) **Inhalation Anesthetics**

Inhalation anesthetics like Halothane and Isoflurane are volatile agents administered through inhalation. They provide rapid induction and recovery but require careful monitoring for toxicity.

563) **Halothane**

Halothane is a potent inhalation anesthetic known for smooth induction but carries a risk of hepatotoxicity. It depresses the CNS and reduces pain sensation.

564) **Ultra-Short Acting Barbiturates**

These barbiturates, like Methohexital and Thiopental, induce anesthesia quickly for short surgical procedures. They act by enhancing GABA-mediated CNS depression.

565) **Methohexital Sodium**

Methohexital is an ultra-short acting barbiturate used for induction of anesthesia. It has a rapid onset and short duration due to quick redistribution.

566) **Ketamine Hydrochloride**

Ketamine is a dissociative anesthetic that induces anesthesia by blocking NMDA receptors. It produces analgesia and amnesia without full loss of consciousness.

567) **Narcotic Analgesics**

Narcotic analgesics (opioids) like morphine relieve severe pain by binding to opioid receptors in the brain and spinal cord, altering the perception of pain.

568) **SAR of Morphine Analogues**

The structure–activity relationship of morphine shows that modifications at the phenolic hydroxyl and nitrogen bridge affect potency and receptor affinity.

569) **Morphine Sulphate**

Morphine is a natural opioid used for severe pain relief. It binds strongly to μ-opioid receptors, producing analgesia and euphoria but with addiction risk.

570) **Codeine**

Codeine is a mild opioid used for moderate pain and cough suppression. It is metabolized to morphine in the body to exert its effect.

571) **Meperidine Hydrochloride**

Meperidine is a synthetic opioid analgesic with anticholinergic properties. It is used for acute pain but less preferred due to neurotoxic metabolites.

572) **Fentanyl Citrate**

Fentanyl is a highly potent synthetic opioid used for severe pain and as an adjunct in anesthesia. It has rapid onset and short duration of action.

573) **Methadone Hydrochloride**

Methadone is a synthetic opioid used for chronic pain and opioid dependence treatment. It has a long half-life and helps prevent withdrawal symptoms.

574) **Narcotic Antagonists**

Narcotic antagonists like Naloxone block opioid receptors, reversing opioid overdose effects such as respiratory depression.

575) **Naloxone Hydrochloride**

Naloxone is an opioid antagonist used as an emergency antidote for opioid overdose. It rapidly reverses respiratory depression caused by opioids.

576) **Non-Narcotic Analgesics**

Non-narcotic analgesics like NSAIDs reduce pain by inhibiting prostaglandin synthesis. They have anti-inflammatory, analgesic, and antipyretic effects.

577) **Aspirin**

Aspirin is an NSAID that irreversibly inhibits COX enzymes, reducing prostaglandin synthesis. It is used for pain, inflammation, fever, and cardiovascular protection.

578) **Mefenamic Acid**

Mefenamic acid is an anthranilic acid derivative NSAID. It is mainly used to treat mild to moderate pain, including menstrual pain.

579) **Ibuprofen**

Ibuprofen is a widely used NSAID with analgesic, antipyretic, and anti-inflammatory properties. It is commonly used for headaches, arthritis, and muscle pain.

580) **Acetaminophen (Paracetamol)**

Acetaminophen is a non-opioid analgesic and antipyretic. It relieves mild to moderate pain and fever but lacks significant anti-inflammatory action.

BP 403 T. PHYSICAL PHARMACEUTICS-II

581) **Colloidal Dispersions**

Colloidal dispersions are heterogeneous systems where the dispersed phase consists of particles sized between 1–1000 nm dispersed in a continuous medium. They appear homogeneous to the naked eye but scatter light.

582) **Dispersed Systems**

Dispersed systems are classified into true solutions, colloidal dispersions, and coarse dispersions, based on particle size. Colloids lie between solutions and suspensions in terms of particle size and stability.

583) **General Characteristics of Colloids**

Colloids are characterized by their particle size, high surface area, ability to pass through ordinary filter paper but not membranes, and by their unique optical and electrical properties.

584) **Particle Size**

Colloidal particles range from 1 nm to 1000 nm. Their small size contributes to unique behaviors like light scattering and Brownian movement.

585) **Particle Shape**

Colloidal particles can be spherical, rod-like, disc-shaped, or irregular. Shape affects properties like viscosity, stability, and optical behavior.

586) **Classification of Colloids**

Colloids can be classified as lyophilic (solvent-loving) and lyophobic (solvent-hating). Lyophilic colloids are more stable due to strong affinity for the dispersion medium.

587) **Lyophilic Colloids**

These colloids, like gelatin and gum, form easily when mixed with a solvent and are reversible — they can be precipitated and re-dispersed without altering properties.

588) **Lyophobic Colloids**

Lyophobic colloids, like gold sols, require special methods for preparation. They are less stable and easily coagulate on addition of small amounts of electrolytes.

589) **Optical Properties**

Colloids exhibit the Tyndall effect — scattering of light by colloidal particles, making the path of light visible. This effect distinguishes colloids from true solutions.

590) **Tyndall Effect**

The Tyndall effect is due to the scattering of light by colloidal particles. It helps in visualizing colloidal systems and understanding particle size and distribution.

591) **Kinetic Properties**

Colloids display Brownian motion — random, zig-zag movement of particles due to collisions with dispersion medium molecules, aiding in stability against sedimentation.

592) **Brownian Movement**

Brownian motion keeps colloidal particles dispersed, preventing them from settling under gravity, thus contributing to the apparent stability of colloidal systems.

593) **Electrical Properties**

Colloidal particles carry an electrical charge that causes mutual repulsion, preventing them from aggregating. The charge comes from ion adsorption or ionization.

594) **Electrophoresis**

Electrophoresis is the movement of colloidal particles under an electric field. It is used to study charge properties and separate colloidal particles.

595) **Electro-osmosis**

In electro-osmosis, the dispersion medium moves while the particles remain stationary when an electric field is applied. It shows the double-layer structure around particles.

596) **Effect of Electrolytes**

Addition of electrolytes can neutralize the surface charge on colloids, causing them to coagulate and precipitate. This property is used for purification and separation.

597) **Coacervation**

Coacervation is the separation of colloidal particles from a solution as a dense phase due to the addition of a third substance like an electrolyte or another polymer.

598) **Peptization**

Peptization is the process of converting a precipitate back into a colloidal dispersion by adding a peptizing agent, which adsorbs on particles and prevents aggregation.

599) **Protective Colloids**

Protective colloids stabilize lyophobic sols by forming an adsorbed layer around them, preventing coagulation. Gelatin and casein are common protective colloids.

600) **Gold Number**

Gold number measures the protective power of a colloid. It is defined as the minimum amount of protective colloid required to prevent coagulation of a gold sol by an electrolyte.

601) **Rheology**

Rheology is the study of the flow and deformation of matter. In pharmacy, it helps understand the flow properties of liquids, semisolids, and powders during formulation and processing.

602) **Newtonian Systems**

A Newtonian fluid has a constant viscosity regardless of the shear rate applied. Water and simple syrups are typical examples that obey Newton's law of flow.

603) **Law of Flow**

The law of flow for Newtonian systems states that shear stress is directly proportional to the rate of shear. The proportionality constant is the coefficient of viscosity.

604) **Viscosity**

Viscosity is the resistance offered by a fluid to flow. It is a key property in designing liquid and semisolid pharmaceutical dosage forms.

605) **Kinematic Viscosity**

Kinematic viscosity is the ratio of dynamic viscosity to fluid density. It is used when fluid flow is influenced by gravity, such as in capillary viscometers.

606) **Effect of Temperature on Viscosity**

Generally, increasing temperature decreases the viscosity of liquids due to reduced intermolecular forces, but it may increase the flow resistance in some non-Newtonian systems

607) **Non-Newtonian Systems**

Non-Newtonian fluids do not have a constant viscosity. Their viscosity changes with varying shear rate, making their flow behavior complex.

608) **Pseudoplastic Flow**

Pseudoplastic or shear-thinning systems become less viscous with increasing shear rate. Many pharmaceutical gels and suspensions show this behavior.

609) **Dilatant Flow**

Dilatant or shear-thickening systems become more viscous as the shear rate increases. High solid content suspensions can show dilatant flow under stress.

610) **Plastic Flow**

Plastic systems behave like solids under low stress but flow like liquids above a certain yield stress. Toothpaste is a common example.

611) **Thixotropy**

Thixotropy is the reversible, time-dependent decrease in viscosity when shear is applied, followed by recovery when shear is removed. It is useful in suspensions and emulsions.

612) **Thixotropy in Formulation**

Thixotropy ensures stability of suspensions by preventing settling during storage while allowing easy pouring or spreading when shear is applied.

613) **Capillary Viscometer**

Capillary viscometers measure viscosity by observing the time a fluid takes to flow through a narrow tube under gravity or pressure.

614) **Falling Sphere Viscometer**

This method determines viscosity by measuring the time a sphere takes to fall through a fluid. Stokes' law is applied to calculate viscosity.

615) **Rotational Viscometer**

Rotational viscometers measure viscosity by determining the torque needed to rotate a spindle in a fluid at a constant speed.

616) **Deformation of Solids**

Deformation refers to the change in shape of a solid under an applied force. It may be elastic (temporary) or plastic (permanent).

617) **Elastic Deformation**

Elastic deformation is reversible. When stress is removed, the material returns to its original shape. It is described by Hooke's law.

618) **Plastic Deformation**

Plastic deformation is permanent. Once the applied stress exceeds the elastic limit, the material undergoes non-reversible changes in shape.

619) **Heckel Equation**

The Heckel equation describes powder compaction behavior under pressure. It relates porosity to the applied pressure and helps in tablet formulation studies.

620) **Elastic Modulus**

Elastic Modulus (Young's Modulus) measures a material's stiffness. It is the ratio of stress to strain within the elastic region and indicates how much a solid resists deformation.

621) **Coarse Dispersions**

Coarse dispersions are heterogeneous systems where the dispersed particles are larger than 1 μm. Suspensions and emulsions are common pharmaceutical coarse dispersions.

622) **Suspension**

A suspension is a two-phase system in which solid particles are dispersed in a liquid vehicle. Proper formulation prevents rapid settling and caking.

623) **Interfacial Properties**

Suspended particles have interfacial properties that affect stability, like surface charge and wettability. These influence how particles interact with the continuous phase.

624) **Settling in Suspensions**

Settling describes how particles move downward due to gravity. Stokes' law predicts settling velocity, which is minimized by reducing particle size and modifying viscosity.

625) **Flocculated Suspension**

In flocculated suspensions, particles form loose aggregates or flocs. Flocculation prevents hard cake formation and allows easy redispersion.

626) **Deflocculated Suspension**

Deflocculated suspensions have discrete particles that settle slowly but may form a dense, hard cake that is difficult to redisperse.

627) **Flocculating Agents**

Flocculating agents, like electrolytes or polymers, promote controlled flocculation by reducing repulsive forces between particles.

628) **Emulsion**

An emulsion is a coarse dispersion of two immiscible liquids, where one liquid is dispersed as droplets in the other with the help of an emulsifying agent.

629) **Theories of Emulsification**

Theories include surface tension theory (reduces interfacial tension), oriented wedge theory (formation of interfacial film), and plastic/complex film theory.

630) **Microemulsion**

Microemulsions are thermodynamically stable, clear dispersions of oil and water stabilized by surfactants. They have droplet sizes in the nanometer range.

631) **Multiple Emulsions**

Multiple emulsions contain more than one emulsion type within each other, such as water-in-oil-in-water (w/o/w). They are used for controlled release.

632) **Stability of Emulsions**

Stability issues include creaming, coalescence, cracking, and phase inversion. Proper emulsifier choice and viscosity control help maintain emulsion stability.

633) **Creaming**

Creaming occurs when dispersed droplets rise or settle, forming a concentrated layer. It is reversible but affects dose uniformity.

634) **Coalescence**

Coalescence is the merging of smaller droplets into larger ones, leading to phase separation and breaking of the emulsion.

635) **Cracking of Emulsions**

Cracking is irreversible phase separation due to complete coalescence. Once cracked, the emulsion cannot be restored by shaking.

636) **Preservation of Emulsions**

Emulsions need preservatives to prevent microbial growth in the aqueous phase. Proper pH and preservative selection are critical.

637) **Rheology of Emulsions**

The rheological behavior of emulsions affects spreadability, stability, and pourability. Viscosity depends on droplet size, phase ratio, and emulsifier.

638) **HLB Method**

The HLB (Hydrophilic-Lipophilic Balance) method helps choose the right surfactant blend for stable emulsions. Oils have specific required HLB values.

639) **Surfactants**

Surfactants reduce interfacial tension and stabilize droplets in emulsions. They can be anionic, cationic, nonionic, or amphoteric.

640) **Emulsion Formulation**

Formulating a stable emulsion involves selecting suitable oil, aqueous phase, emulsifier, stabilizers, and preservatives, and using appropriate mixing techniques.

641) **Micromeretics**

Micromeretics is the science of studying small particles — their size, shape, surface area, porosity, and flow behavior. It is essential for understanding powder behavior in formulations.

642) **Particle Size**

Particle size is a key parameter affecting drug dissolution, bioavailability, flow, mixing, and stability. It can range from nanometers to millimeters in pharmaceutical powders.

643) **Particle Size Distribution**

This describes the range and proportion of different particle sizes in a sample. Narrow distributions provide uniformity, while wide distributions affect mixing and packing.

644) **Mean Particle Size**

The mean particle size is an average representing the central value of particle sizes in a sample. Different means like number mean, volume mean, and weight mean are used.

645) **Number and Weight Distribution**

Particle size can be represented by number distribution (how many particles per size range) or weight distribution (mass contribution of each size range).

646) **Particle Number**

Particle number refers to the total count of individual particles in a given weight or volume. It influences dissolution rate and drug absorption.

647) **Particle Shape**

Shape impacts flow, packing, and dissolution. Particles can be spherical, needle-like, flaky, or irregular, influencing their behavior during processing.

648) **Specific Surface Area**

Specific surface area is the total surface area per unit weight or volume of a powder. Smaller particles have higher specific surface areas, enhancing dissolution.

649) **Methods for Particle Size Determination**

Particle size can be measured by microscopy, sieving, sedimentation, laser diffraction, or Coulter counter methods, depending on particle size and material.

650) **Counting Method**

The counting method, such as microscopic counting, directly counts and measures individual particles under a microscope to estimate size distribution.

651) **Separation Method**

Separation methods like sieving or sedimentation classify particles based on size. Sieves are used for coarse powders, while sedimentation is useful for fine particles.

652) **Surface Area Determination**

Surface area is measured using methods like gas adsorption (BET method) or air permeability (Blaine method) to determine specific surface area.

653) **Permeability Method**

This measures surface area by passing air through a packed powder bed. Higher resistance indicates smaller particles and larger surface areas.

654) **Adsorption Method**

Gas adsorption methods determine surface area by measuring how much gas adsorbs onto the particle surfaces under controlled conditions.

655) **Derived Properties of Powders**

Derived properties include characteristics that depend on particle arrangement and interaction, like porosity, packing, density, and flowability.

656) **Porosity**

Porosity is the void space between particles in a powder bed. High porosity means more air spaces, which can affect compressibility and flow.

657) **Packing Arrangement**

Packing arrangement describes how particles arrange themselves in a container. It can be loose or dense, affecting porosity and bulk density.

658) **Densities**

True density is the density of the solid material only. Bulk density includes the volume of voids between particles, important for packaging and flow.

659) **Bulkiness**

Bulkiness is the reciprocal of bulk density. Powders with low bulk density are more bulky and need larger containers for storage and transport.

660) **Flow Properties**

Flow properties describe how easily powders move. They depend on particle size, shape, moisture, and surface texture and are critical for tablet and capsule manufacturing.

661) **Drug Stability**

Drug stability refers to the capacity of a pharmaceutical product to maintain its identity, strength, quality, and purity throughout its shelf life under specified conditions.

662) **Reaction Kinetics**

Reaction kinetics studies the rate at which a chemical reaction proceeds and the factors that influence this rate. It helps predict the shelf life of drugs.

663) **Zero-Order Kinetics**

In zero-order reactions, the rate of degradation is constant and independent of the concentration of the reactant. Many suspensions follow zero-order kinetics.

664) **Pseudo-Zero Order Reaction**

A pseudo-zero order reaction appears to have zero-order behavior under certain conditions, such as when a reactant is present in large excess or is constantly replenished.

665) **First-Order Kinetics**

In first-order reactions, the rate of degradation is directly proportional to the concentration of the reactant. Most drug solutions follow first-order kinetics.

666) **Second-Order Kinetics**

Second-order reactions depend on the concentrations of two reactants or the square of the concentration of a single reactant. Some bimolecular degradation pathways follow this.

667) **Rate Constant**

The rate constant is a proportionality factor that links the reaction rate to the concentrations of reactants. Its units vary depending on the reaction order.

668) **Determination of Reaction Order**

Reaction order can be determined graphically by plotting concentration versus time and checking which plot yields a straight line (zero, first, or second order).

669) **Temperature Effect**

Temperature influences reaction rate significantly. An increase in temperature usually accelerates drug degradation due to increased molecular collisions.

670) **Arrhenius Equation**

The Arrhenius equation relates the rate constant to temperature and activation energy. It helps estimate shelf life and the effect of temperature on stability.

671) **Solvent Effect**

The choice of solvent can alter reaction rates by affecting solubility, ionization, or stabilization of intermediates, impacting degradation pathways.

672) **Ionic Strength**

Ionic strength affects reaction kinetics by influencing the activity coefficients of ions in solution, which can speed up or slow down degradation.

673) **Dielectric Constant**

The dielectric constant of a solvent affects ionization and thus reaction rates. Polar solvents can stabilize charged intermediates, influencing reaction speed.

674) **Specific Acid-Base Catalysis**

Specific acid-base catalysis occurs when the reaction rate is affected directly by the concentration of hydronium (H^+) or hydroxide (OH^-) ions.

675) **General Acid-Base Catalysis**

In general acid-base catalysis, molecules other than H^+ or OH^- (like buffers) contribute protons or accept protons to accelerate the reaction.

676) **Hydrolysis**

Hydrolysis is a common degradation reaction where drug molecules react with water, breaking chemical bonds. Esters and amides are especially susceptible.

677) **Oxidation**

Oxidation involves the loss of electrons and often leads to color change or loss of potency. Drugs with phenolic or unsaturated groups are prone to oxidation.

678) **Stabilization of Drugs**

Stabilization techniques include adding antioxidants, pH adjustment, using buffers, or packaging in airtight containers to prevent hydrolysis and oxidation.

679) **Accelerated Stability Testing**

This method subjects drugs to elevated stress conditions to predict shelf life quickly. Data from such tests help determine expiration dates.

680) **Photolytic Degradation**

Photolytic degradation is caused by exposure to light, which can break chemical bonds. Protection involves using amber containers or opaque packaging.

BP 404 T. PHARMACOLOGY-I

681) **Pharmacology**

Pharmacology is the branch of medical science that studies the effects of drugs on living systems. It involves understanding how drugs interact with biological targets to produce therapeutic or adverse effects.

682) **Historical Landmarks in Pharmacology**

Key milestones like the discovery of penicillin, insulin, and vaccines laid the foundation for modern pharmacology, transforming it into an evidence-based science for drug development.

683) **Scope of Pharmacology**

Pharmacology covers drug discovery, drug action, therapeutic applications, side effects, toxicology, and the rational use of medicines in humans and animals.

684) **Nature and Source of Drugs**

Drugs can be natural (plant, animal, mineral origin), semi-synthetic, or fully synthetic. They can also come from biotechnology, like monoclonal antibodies or recombinant proteins.

685) **Essential Drugs Concept**

Essential drugs are medicines that meet the priority healthcare needs of a population. They should be available at all times in adequate amounts and at an affordable price.

686) **Routes of Drug Administration**

Routes include oral, parenteral (injections), topical, inhalation, and others. The choice affects drug onset, duration, bioavailability, and patient compliance.

687) **Agonists**

Agonists are drugs that bind to receptors and mimic the action of natural ligands, producing a physiological response. Examples include adrenaline and morphine.

688) **Antagonists**

Antagonists bind to receptors but do not activate them. They block or reduce the effect of agonists. They can be competitive (reversible) or non-competitive (irreversible).

689) **Competitive Antagonists**

Competitive antagonists compete with agonists for the same binding site. Increasing the agonist concentration can overcome their effect. Example: Atropine blocks acetylcholine.

690) **Non-Competitive Antagonists**

Non-competitive antagonists bind to a different site or irreversibly bind to the receptor, preventing agonist action regardless of agonist concentration.

691) **Spare Receptors**

Spare receptors are extra receptors present in a system that do not need to be occupied to produce a maximal response. They increase tissue sensitivity to agonists.

692) **Addiction**

Addiction is a psychological and behavioral pattern characterized by compulsive drug use despite harmful consequences. It is common with drugs like opioids and nicotine.

693) **Tolerance**

Tolerance is a reduced response to a drug after repeated use, requiring higher doses to achieve the same effect. Example: opioid analgesics.

694) **Dependence**

Dependence is a state where abrupt drug withdrawal leads to physical or psychological symptoms. Physical dependence occurs with substances like alcohol and benzodiazepines.

695) **Tachyphylaxis**

Tachyphylaxis is the rapid decrease in drug response after repeated administration over a short period. For example, repeated doses of ephedrine lose effectiveness quickly.

696) **Idiosyncrasy**

Idiosyncrasy is an unusual or abnormal drug response due to genetic differences, not explained by pharmacological action. An example is severe hemolysis with primaquine in G6PD deficiency.

697) **Allergy**

A drug allergy is an immunological reaction to a drug, unrelated to its dose or pharmacological action. It can lead to rashes, anaphylaxis, or other hypersensitivity reactions.

698) **Membrane Transport**

Drugs cross biological membranes by passive diffusion, facilitated diffusion, active transport, or pinocytosis. Membrane transport affects absorption and distribution.

699) **Enzyme Induction**

Enzyme induction increases the metabolic activity of drug-metabolizing enzymes, speeding up drug clearance and reducing drug effect. For example, rifampicin induces liver enzymes.

700) **Enzyme Inhibition**

Enzyme inhibition slows down drug metabolism, increasing plasma concentration and effect. For example, cimetidine inhibits hepatic enzymes, raising levels of other drugs.

701) **Pharmacodynamics**

Pharmacodynamics describes what a drug does to the body. It includes the study of mechanisms of action, receptor interactions, and the resulting physiological and biochemical effects.

702) **Mechanisms of Drug Action**

Drugs act by interacting with specific biological targets like enzymes, receptors, ion channels, or transporters to produce therapeutic or adverse effects.

703) **Receptor Theories**

Receptor theories explain how drugs interact with receptors. The occupancy theory, rate theory, and induced fit theory describe how drug binding leads to a response.

704) **Classification of Receptors**

Receptors can be classified as ion channel receptors, G-protein–coupled receptors (GPCRs), enzyme-linked receptors, and intracellular receptors that affect gene transcription.

705) **Receptor Regulation**

Receptors can be upregulated (increase in number) or downregulated (decrease) due to prolonged exposure to agonists or antagonists, influencing drug sensitivity.

706) **Drug-Receptor Interactions**

This involves the binding of a drug (ligand) to its receptor site to trigger or block a biological response. The strength and duration of binding affect the response.

707) **Signal Transduction**

Signal transduction is the process by which receptor activation is converted into a cellular response, often involving second messengers like cAMP or calcium ions.

708) **G-Protein–Coupled Receptors (GPCRs)**

GPCRs are the largest class of receptors, transmitting signals inside the cell via G-proteins. They regulate many physiological processes like vision, taste, and neurotransmission.

709) **Ion Channel Receptors**

These receptors open or close ion channels in response to ligand binding, allowing ions like Na+, K+, or Ca^{2+} to flow across cell membranes, altering cell activity.

710) **Enzyme-Linked Receptors**

These receptors, like receptor tyrosine kinases, activate intracellular enzymes upon ligand binding, triggering cascades that regulate cell growth, metabolism, or differentiation.

711) **JAK-STAT Receptors**

These transmembrane receptors activate the Janus kinase (JAK)–signal transducer and activator of transcription (STAT) pathway, which controls gene expression in response to cytokines.

712) **Transcription Factor Receptors**

These intracellular receptors, like steroid hormone receptors, directly bind DNA and regulate gene transcription to alter protein synthesis and cell function.

713) **Dose-Response Relationship**

This relationship shows how the magnitude of drug response changes with dose. It helps determine the potency and efficacy of drugs.

714) **Therapeutic Index (TI)**

The TI is a ratio of the toxic dose to the effective dose of a drug. A higher TI indicates greater drug safety.

715) **Combined Effects of Drugs**

Drugs can interact synergistically, additively, or antagonistically when given together. Understanding combined effects is vital for safe combination therapy.

716) **Factors Modifying Drug Action**

Age, weight, sex, genetics, disease state, diet, and concurrent drug use can all modify how a drug works in the body.

717) **Adverse Drug Reactions (ADRs)**

ADRs are harmful or unintended effects of drugs given at normal doses. They can be predictable (dose-related) or unpredictable (allergic or idiosyncratic).

718) **Drug Interactions**

Drug interactions occur when one drug affects the action of another. They can be pharmacokinetic (affecting absorption, metabolism) or pharmacodynamic (affecting receptor action).

719) **Drug Discovery**

Drug discovery involves identifying new chemical entities through target identification, lead optimization, and screening for biological activity.

720) **Clinical Trials & Pharmacovigilance**

Clinical trials test drug safety and efficacy in humans in phases I–IV. Pharmacovigilance monitors and reports adverse effects of marketed drugs to ensure ongoing safety.

721) **Autonomic Nervous System (ANS)**

The ANS controls involuntary bodily functions like heart rate, digestion, and respiration. It has two main divisions: the sympathetic and parasympathetic nervous systems.

722) **Organization of ANS**

The ANS consists of preganglionic and postganglionic neurons. The sympathetic system prepares the body for ‘fight or flight’, while the parasympathetic system promotes ‘rest and digest’.

723) **Function of ANS**

The ANS maintains homeostasis by regulating smooth muscle, cardiac muscle, and glands. Drugs can modify ANS activity to treat various conditions.

724) **Neurohumoral Transmission**

This is the process where chemical messengers (neurotransmitters) transmit signals across synapses or neuromuscular junctions to produce physiological responses.

725) **Co-Transmission**

Co-transmission means that neurons can release more than one type of neurotransmitter, which can modulate the effect on the target tissue.

726) **Neurotransmitters**

Key neurotransmitters in the ANS include acetylcholine (ACh) and norepinephrine (NE). ACh mediates parasympathetic effects; NE mediates most sympathetic effects.

727) **Parasympathomimetics**

These drugs mimic the effects of the parasympathetic system by stimulating muscarinic and nicotinic receptors. Examples include pilocarpine and bethanechol.

728) **Parasympatholytics**

Also called anticholinergics, these drugs block the action of the parasympathetic system. Atropine and scopolamine are classic examples.

729) **Sympathomimetics**

These drugs stimulate the sympathetic nervous system by activating adrenergic receptors. Drugs like epinephrine, salbutamol, and dopamine are commonly used.

730) **Sympatholytics**

These drugs inhibit sympathetic activity by blocking adrenergic receptors. Examples include beta-blockers (propranolol) and alpha-blockers (prazosin).

731) **Adrenergic Receptors**

These receptors are targets for sympathomimetic and sympatholytic drugs. They are classified into alpha (α1, α2) and beta (β1, β2, β3) subtypes.

732) **Neuromuscular Blocking Agents**

These agents block transmission at the neuromuscular junction, causing muscle relaxation. They are used during surgeries. Examples include succinylcholine and pancuronium.

733) **Depolarizing Blockers**

Depolarizing neuromuscular blockers like succinylcholine cause continuous depolarization, leading to muscle paralysis. Their effect is short-lived.

734) **Non-Depolarizing Blockers**

These agents, like vecuronium and rocuronium, competitively block acetylcholine at nicotinic receptors, leading to muscle relaxation.

735) **Skeletal Muscle Relaxants**

These drugs reduce muscle tone and spasm. Peripheral agents act at the neuromuscular junction, while central agents act in the CNS.

736) **Local Anesthetics**

Local anesthetics block nerve conduction by inhibiting sodium channels. They cause reversible loss of sensation in a specific area. Examples include lidocaine and bupivacaine.

737) **Mechanism of Local Anesthetics**

They prevent depolarization of nerve membranes by blocking voltage-gated Na+ channels, stopping pain transmission.

738) **Myasthenia Gravis**

This is an autoimmune disease characterized by weakness due to destruction of nicotinic receptors. It is treated with cholinesterase inhibitors like neostigmine.

739) **Drugs for Myasthenia Gravis**

Drugs like neostigmine and pyridostigmine increase acetylcholine levels at neuromuscular junctions, improving muscle strength.

740) **Drugs for Glaucoma**

Parasympathomimetic drugs like pilocarpine reduce intraocular pressure by increasing aqueous humor outflow, treating glaucoma effectively.

741) **Neurohumoral Transmission in CNS**

Neurohumoral transmission in the CNS involves the release of neurotransmitters that modulate neuronal activity. Proper balance is essential for mood, cognition, and movement.

742) **GABA (Gamma-Aminobutyric Acid)**

GABA is the main inhibitory neurotransmitter in the CNS. It reduces neuronal excitability and plays a key role in sedation, hypnosis, and anti-epileptic action.

743) **Glutamate**

Glutamate is the primary excitatory neurotransmitter in the CNS. It is crucial for learning, memory, and synaptic plasticity but can cause neurotoxicity if excessively released.

744) **Glycine**

Glycine acts as an inhibitory neurotransmitter, mainly in the spinal cord and brainstem. It helps regulate motor and sensory pathways.

745) **Serotonin (5-HT)**

Serotonin modulates mood, sleep, appetite, and pain perception. Imbalances are linked to depression, anxiety, and other mood disorders.

746) **Dopamine**

Dopamine regulates movement, reward, and emotion. Its deficiency is linked to Parkinson's disease, while excess dopamine is implicated in psychosis.

747) **General Anesthetics**

General anesthetics induce reversible loss of consciousness and sensation. They depress the CNS and are used during surgical procedures.

748) **Pre-Anesthetics**

Pre-anesthetic medications prepare patients for anesthesia by reducing anxiety, pain, and secretions. Examples include benzodiazepines and anticholinergics.

749) **Inhalation Anesthetics**

Inhalation anesthetics like halothane and sevoflurane are gases or vapors used to maintain general anesthesia during surgery.

750) **Intravenous Anesthetics**

IV anesthetics like propofol and thiopental rapidly induce unconsciousness for short procedures or as induction agents before inhalation anesthesia.

751) **Sedatives**

Sedatives are drugs that calm patients without inducing sleep. They reduce anxiety and nervousness. Examples include low doses of benzodiazepines.

752) **Hypnotics**

Hypnotics induce sleep and are used for short-term treatment of insomnia. They include drugs like zolpidem and higher doses of benzodiazepines.

753) **Barbiturates**

Barbiturates are older CNS depressants used as sedatives, hypnotics, and anticonvulsants. Due to safety issues, they are less common now.

754) **Centrally Acting Muscle Relaxants**

These drugs reduce skeletal muscle tone by acting on the CNS. They are used to treat muscle spasms and spasticity. Example: diazepam.

755) **Anti-Epileptics**

Anti-epileptics prevent or reduce the frequency of seizures by stabilizing neuronal membranes and modifying neurotransmitter activity. Examples: phenytoin, valproic acid.

756) **Mechanism of Anti-Epileptics**

Anti-epileptics work by enhancing GABA activity, inhibiting sodium or calcium channels, or blocking glutamate to prevent excessive neuronal firing.

757) **Alcohol (Ethanol)**

Alcohol acts as a CNS depressant. In low doses, it causes euphoria and disinhibition; in high doses, it can lead to respiratory depression and coma.

758) **Disulfiram**

Disulfiram is used in alcohol dependence treatment. It inhibits aldehyde dehydrogenase, causing unpleasant reactions when alcohol is consumed.

759) **Tolerance and Dependence on Alcohol**

Chronic alcohol use can lead to tolerance and physical dependence. Withdrawal can cause severe symptoms like seizures and delirium tremens.

760) **Alcohol as a Drug**

Though legal, alcohol is a psychoactive substance with abuse potential. Its misuse can cause liver disease, neuropathy, and neuropsychiatric disorders.

761) **Psychopharmacological Agents**

Psychopharmacological agents are drugs that affect mood, behavior, and mental processes. They include antipsychotics, antidepressants, anxiolytics, mood stabilizers, and hallucinogens.

762) **Antipsychotics**

Antipsychotics, also called neuroleptics, are used to treat psychotic disorders like schizophrenia. They block dopamine receptors to reduce hallucinations and delusions.

763) **Antidepressants**

Antidepressants treat depression and some anxiety disorders by increasing levels of neurotransmitters like serotonin and norepinephrine in the brain.

764) **Anti-Anxiety Agents**

Also called anxiolytics, these drugs reduce anxiety and tension. Benzodiazepines like diazepam and alprazolam are common examples.

765) **Anti-Manic Agents**

Anti-manics, or mood stabilizers, manage manic episodes in bipolar disorder. Lithium is the classic example, along with certain anticonvulsants like valproate.

766) **Hallucinogens**

Hallucinogens are substances that cause profound distortions in perception and mood. Examples include LSD, psilocybin, and mescaline.

767) **Parkinson's Disease**

Parkinson's disease is a neurodegenerative disorder marked by dopamine deficiency in the brain, leading to tremors, rigidity, and bradykinesia.

768) **Drugs for Parkinson's Disease**

Treatment includes levodopa (dopamine precursor), dopamine agonists (bromocriptine), and anticholinergics to restore dopamine-acetylcholine balance.

769) **Alzheimer's Disease**

Alzheimer's disease is characterized by progressive memory loss and cognitive decline due to degeneration of cholinergic neurons.

770) **Drugs for Alzheimer's Disease**

Drugs like donepezil, rivastigmine, and memantine slow symptoms by enhancing cholinergic transmission or modulating glutamate.

771) **CNS Stimulants**

CNS stimulants increase alertness and reduce fatigue. Examples include amphetamines and methylphenidate, commonly used for ADHD and narcolepsy.

772) **Nootropics**

Nootropics, or cognitive enhancers, improve memory, creativity, or motivation in healthy or impaired individuals. Piracetam is a classic example.

773) **Opioid Analgesics**

Opioid analgesics relieve severe pain by binding to opioid receptors in the CNS. Morphine, codeine, and fentanyl are important examples.

774) **Mechanism of Opioids**

Opioids inhibit pain pathways by blocking transmission of pain signals and altering pain perception in the brain and spinal cord.

775) **Opioid Antagonists**

Opioid antagonists like naloxone and naltrexone reverse opioid effects by competitively blocking opioid receptors, useful in overdose cases.

776) **Drug Addiction**

Drug addiction is a chronic brain disease involving compulsive drug seeking and use despite harmful consequences, often due to dopamine reward pathways.

777) **Drug Abuse**

Drug abuse refers to the misuse of substances for non-medical purposes, leading to social, physical, and psychological harm.

778) **Tolerance**

Tolerance is the need for higher drug doses to achieve the same effect due to repeated use. It commonly develops with opioids and stimulants.

779) **Dependence**

Dependence is a state where the body adapts to a drug, leading to withdrawal symptoms when its use is stopped abruptly.

780) **Withdrawal Symptoms**

When a dependent person stops using a drug suddenly, they may experience withdrawal symptoms like anxiety, tremors, or seizures, depending on the drug.

BP 405 T.PHARMACOGNOSY AND PHYTOCHEMISTRY I

781) **Pharmacognosy**

Pharmacognosy is the branch of pharmacy that deals with the scientific study of crude drugs obtained from natural sources like plants, animals, and minerals. It covers identification, classification, cultivation, and uses.

782) **History of Pharmacognosy**

Pharmacognosy has its roots in ancient civilizations where medicinal plants were used for healing. Over centuries, it evolved from folk medicine to a scientific discipline with microscopy and phytochemistry.

783) **Scope of Pharmacognosy**

Pharmacognosy plays a crucial role in drug discovery, herbal product development, standardization, and quality control of natural products. It bridges traditional medicine and modern drug development.

784) **Development of Pharmacognosy**

The discipline has advanced with modern analytical techniques, molecular biology, and tissue culture. These innovations help in authentication, extraction, and production of bioactive compounds.

785) **Sources of Drugs**

Drugs of natural origin come from plants (roots, leaves, bark), animals (hormones, enzymes), marine organisms (algae, sponges), and biotechnological sources like tissue culture.

786) **Organized Drugs**

Organized drugs are crude drugs that retain their cellular structure. Examples include leaves, seeds, flowers, and barks, which can be easily identified microscopically.

787) **Unorganized Drugs**

Unorganized drugs lack cellular structure and include dried latex (opium), dried juices (aloe), dried extracts (catechu), gums (acacia), mucilages, oleoresins, and oleo-gum-resins (myrrh).

788) **Alphabetical Classification**

In this system, drugs are arranged alphabetically by their common or botanical names. It is simple but does not provide scientific relationships.

789) **Morphological Classification**

Drugs are grouped according to the part of the plant used, such as leaves (folia), roots (radix), barks (cortex), and flowers (flos).

790) **Taxonomical Classification**

This groups plants based on botanical hierarchy and family, genus, and species. It helps understand plant relationships and characteristics.

791) **Chemical Classification**

Drugs are categorized by their chief chemical constituents, such as alkaloids, glycosides, tannins, volatile oils, and resins.

792) **Pharmacological Classification**

This system groups drugs based on their therapeutic action, like expectorants, diuretics, laxatives, or antiseptics.

793) **Chemo-Taxonomical Classification**

This combines chemical and taxonomic features for classification. It groups plants with similar chemical markers within related botanical families.

794) **Sero-Taxonomical Classification**

Sero-taxonomy uses serological techniques to classify plants based on antigen-antibody reactions, supporting identification and authentication.

795) **Adulteration of Drugs**

Adulteration refers to the substitution or mixing of crude drugs with inferior, spurious, or worthless substances, lowering their quality and therapeutic value.

796) **Organoleptic Evaluation**

This involves sensory evaluation of crude drugs using senses like sight, taste, smell, and touch to check color, odor, taste, and texture.

797) **Microscopic Evaluation**

Microscopic evaluation examines cellular features like stomata, trichomes, and other tissue structures for authentication and detection of adulteration.

798) **Physical Evaluation**

Physical evaluation measures properties like moisture content, ash value, extractive value, and volatile matter, which help assess drug purity.

799) **Chemical Evaluation**

Chemical evaluation includes qualitative and quantitative chemical tests to detect active principles and impurities in crude drugs.

800) **Quantitative Microscopy**

This method measures microscopic features such as stomatal index, vein-islet number, and uses techniques like the lycopodium spore method. Tools like the camera lucida help create scaled drawings.

801) **Cultivation of Medicinal Plants**

Cultivation refers to the systematic growing of medicinal plants under controlled conditions. Good cultivation ensures quality, uniformity, and sustainable supply of crude drugs.

802) **Collection of Drugs**

Collection involves harvesting plant parts at the right time of maturity to ensure maximum active constituent yield. Correct collection practices help maintain potency.

803) **Processing of Crude Drugs**

Processing includes cleaning, sorting, cutting, drying, and packaging of plant material. Proper processing minimizes spoilage and preserves active compounds.

804) **Storage of Crude Drugs**

Storage requires suitable conditions to protect drugs from moisture, insects, and contamination. Airtight containers and dry, cool places are ideal.

805) **Factors Influencing Cultivation**

Soil type, climate, altitude, rainfall, and sunlight affect the growth and active constituent content of medicinal plants. These factors must be optimized for high-quality yields.

806) **Soil Quality**

The physical and chemical properties of soil determine nutrient availability and plant health. Loamy, well-drained soil is usually preferred for most medicinal plants.

807) **Climate Conditions**

Temperature, humidity, and seasonal variations impact plant growth and the synthesis of secondary metabolites like alkaloids and glycosides.

808) **Altitude**

Altitude affects atmospheric pressure, temperature, and sunlight intensity, influencing the concentration of active principles in plants like tea and cinchona.

809) **Irrigation**

Adequate and timely watering is vital for plant growth. Over-irrigation or drought can reduce the yield and quality of crude drugs.

810) **Manures and Fertilizers**

Organic manures and chemical fertilizers supply essential nutrients for healthy plant growth. Balanced nutrition boosts yield and phytochemical content.

811) **Pest and Disease Control**

Proper pest and disease management protects crops from damage. Biological and chemical methods ensure healthy, uncontaminated plants.

812) **Plant Hormones**

Plant hormones or phytohormones like auxins, gibberellins, and cytokinins regulate plant growth and development. They are used to enhance yield and control flowering.

813) **Auxins**

Auxins promote cell elongation, root initiation, and control of flowering and fruiting. They are used to propagate medicinal plants through cuttings.

814) **Gibberellins**

Gibberellins stimulate stem elongation, seed germination, and flowering. They help increase biomass and secondary metabolite production.

815) **Cytokinins**

Cytokinins promote cell division and delay leaf senescence. They are used in tissue culture to multiply medicinal plants rapidly.

816) **Polyploidy**

Polyploidy involves increasing the number of chromosome sets in plants. Induced polyploidy can enhance plant size, vigor, and active compound concentration.

817) **Mutation Breeding**

Mutation breeding creates new plant varieties by inducing genetic mutations using chemicals or radiation. It helps develop disease-resistant or high-yielding medicinal plants.

818) **Hybridization**

Hybridization involves crossing different plant species or varieties to combine desirable traits like disease resistance, high yield, and improved phytochemical content.

819) **Conservation of Medicinal Plants**

Conservation ensures sustainable use of plant resources. It includes in-situ (in natural habitat) and ex-situ (botanical gardens, seed banks) methods.

820) **Cultivation for Conservation**

Cultivating endangered medicinal plants helps reduce pressure on wild populations and maintains biodiversity for future use.

821) **Plant Tissue Culture**

Plant tissue culture is a method of growing plant cells, tissues, or organs on a sterile nutrient medium under controlled conditions. It allows rapid multiplication and production of disease-free plants.

822) **Historical Development**

Plant tissue culture emerged in the early 20th century with the work of Haberlandt, the "Father of Plant Tissue Culture." Advances by White, Murashige, and Skoog refined culture techniques.

823) **Types of Cultures**

Tissue culture includes callus culture, suspension culture, organ culture, embryo culture, meristem culture, and protoplast culture. Each has unique uses in plant research and propagation.

824) **Callus Culture**

Callus culture involves growing an unorganized mass of cells from plant explants. It is used for regeneration, genetic studies, and production of secondary metabolites.

825) **Suspension Culture**

In suspension culture, plant cells grow freely suspended in liquid medium. It's ideal for large-scale production of bioactive compounds.

826) **Organ Culture**

Organ culture maintains the structure and function of organs like shoots, roots, or buds in vitro. It helps in studying organ development.

827) **Embryo Culture**

This involves growing isolated embryos in nutrient medium. It is useful for overcoming seed dormancy and rescuing hybrid embryos.

828) **Meristem Culture**

Meristem culture uses the shoot tip or apical meristem to produce virus-free plants. It is widely used for micropropagation.

829) **Protoplast Culture**

Protoplast culture uses cells with their walls removed. It aids in somatic hybridization and genetic modification of plants.

830) **Nutritional Requirements**

Culture media must supply macro- and micronutrients, carbon sources, vitamins, growth regulators, and gelling agents to support cell growth.

831) **MS Medium**

The Murashige and Skoog (MS) medium is a standard nutrient medium widely used in tissue culture due to its balanced composition.

832) **Growth Regulators**

Plant hormones like auxins and cytokinins in the medium influence callus formation, organogenesis, or somatic embryogenesis.

833) **Aseptic Conditions**

Strict sterile techniques prevent microbial contamination in tissue culture labs. Instruments, media, and explants must be sterilized.

834) **Inoculation and Subculturing**

Explants are transferred (inoculated) into culture medium under sterile conditions. Subculturing helps maintain healthy growth by renewing nutrients.

835) **Hardening**

Plants grown in vitro are gradually acclimatized to external conditions before being transferred to soil — a process called hardening.

836) **Micropropagation**

Micropropagation uses tissue culture techniques for rapid multiplication of elite plant varieties, ensuring genetic uniformity.

837) **Secondary Metabolite Production**

Tissue culture can be used to produce valuable phytochemicals continuously, independent of seasonal and environmental variations.

838) **Germplasm Conservation**

Plant tissue culture techniques help preserve endangered species by maintaining living plant cells or tissues in vitro.

839) **Applications in Pharmacognosy**

Plant tissue culture supports mass production of medicinal plants, disease-free planting material, and enhanced secondary metabolite yield.

840) **Edible Vaccines**

Edible vaccines are produced by genetically modifying plants to express vaccine antigens. This approach combines tissue culture and biotechnology to develop cost-effective immunization.

841) **Pharmacognosy in Allopathy**

In modern allopathic medicine, pharmacognosy helps discover, isolate, and standardize bioactive compounds that serve as raw materials for semi-synthetic or synthetic drug development.

842) **Pharmacognosy in Ayurveda**

Ayurveda, an ancient Indian system, heavily depends on herbs. Pharmacognosy validates, standardizes, and ensures the safety and efficacy of herbal formulations.

843) **Pharmacognosy in Unani**

Unani medicine combines Greek and Arab knowledge. Pharmacognosy aids in the quality control and authentication of Unani single and compound herbal drugs.

844) **Pharmacognosy in Siddha**

Siddha, one of India's oldest systems, uses plant, mineral, and animal-based drugs. Pharmacognosy supports identification and standardization of raw materials used.

845) **Pharmacognosy in Homeopathy**

Homeopathy uses diluted plant extracts for treatment. Pharmacognosy ensures the correct sourcing, identification, and quality of plant-based tinctures and mother solutions.

846) **Pharmacognosy in Chinese Medicine**

Traditional Chinese Medicine (TCM) relies on herbs and natural products. Pharmacognosy supports global acceptance through scientific validation and quality assurance.

847) **Secondary Metabolites**

Secondary metabolites are organic compounds produced by plants not directly involved in growth but essential for defense, pigmentation, and interaction with the environment.

848) **Classification of Secondary Metabolites**

They are broadly classified into alkaloids, glycosides, tannins, flavonoids, volatile oils, resins, and others, based on chemical nature and function.

849) **Alkaloids**

Alkaloids are nitrogen-containing compounds with pronounced physiological activity. Morphine, quinine, and nicotine are classic examples used as drugs.

850) **Properties of Alkaloids**

They are mostly bitter, crystalline solids, soluble in alcohol and slightly soluble in water, and form salts with acids for better solubility.

851) **Tests for Alkaloids**

Mayer's, Dragendorff's, and Wagner's reagents are commonly used to test alkaloids, giving precipitates that confirm their presence in plant extracts.

852) **Glycosides**

Glycosides are compounds where a sugar is bonded to a non-sugar moiety. They exert significant therapeutic actions like cardiotonic, laxative, or anti-inflammatory effects.

853) **Properties of Glycosides**

They are generally water-soluble, tasteless in intact form but yield active aglycones after hydrolysis. They often decompose on long storage.

854) **Tests for Glycosides**

Legal's test, Keller-Killiani test, and Borntrager's test help detect cardiac and anthraquinone glycosides in crude drugs.

855) **Flavonoids**

Flavonoids are polyphenolic compounds widely present in fruits and flowers. They have antioxidant, anti-inflammatory, and vascular protective effects.

856) **Properties of Flavonoids**

They are generally yellow pigments, soluble in alcohol and slightly soluble in water, and exhibit characteristic UV absorption patterns.

857) **Tests for Flavonoids**

Shinoda test and Alkaline reagent test are simple chemical reactions to confirm flavonoids in plant extracts.

858) **Tannins**

Tannins are astringent polyphenolic compounds used for tanning leather and medicinally for their antimicrobial and wound-healing properties.

859) **Tests for Tannins**

Ferric chloride test and Goldbeater's skin test detect tannins by forming colored complexes or showing tanning action.

860) **Volatile Oils & Resins**

Volatile oils are aromatic, evaporative oils used in aromatherapy and flavoring. Resins are non-volatile, solid, sticky substances with applications in varnishes and medicines.

861) **Fibers**

Fibers are elongated plant structures used industrially and pharmaceutically. In pharmacy, they're valued for surgical dressings and absorbent materials.

862) **Cotton**

Cotton is the most widely used plant fiber. In pharmacy, it's sterilized and used in dressings, tampons, and filters due to its high absorbency.

863) **Jute**

Jute is a coarse fiber used mainly for packing materials like sacks. In pharmacy, it may be used as secondary packing for crude drugs.

864) **Hemp**

Hemp fiber is obtained from *Cannabis sativa*. It's used for making ropes, coarse textiles, and has limited pharmaceutical applications in binding.

865) **Hallucinogens**

Hallucinogens are substances of plant origin that produce altered perceptions or hallucinations. Examples include peyote and psilocybin mushrooms.

866) **Teratogens**

Teratogens are natural agents that can cause developmental abnormalities in embryos. Some plant alkaloids have teratogenic effects and must be monitored.

867) **Natural Allergens**

Certain plants produce allergens that cause hypersensitivity reactions. Ragweed pollen and latex are classic examples triggering allergies in sensitive individuals.

868) **Primary Metabolites**

Primary metabolites are essential compounds like carbohydrates, proteins, and lipids that directly support growth and development in plants.

869) **Acacia**

Acacia is a carbohydrate obtained from the gum exudates of *Acacia senegal*. It's used as a demulcent, emulsifying agent, and binding agent in tablets.

870) **Agar**

Agar is a gelatinous carbohydrate derived from red algae. It's used as a laxative, suspending agent, and in microbiological culture media.

871) **Tragacanth**

Tragacanth is a natural gum from *Astragalus* species. It serves as a suspending, emulsifying, and thickening agent in pharmaceutical preparations.

872) **Honey**

Honey is a natural sweetener produced by bees. Medicinally, it acts as a demulcent, mild antiseptic, and is used in wound healing.

873) **Gelatin**

Gelatin is a protein obtained by hydrolyzing collagen from animal tissues. It's widely used in making capsules, suppositories, and as a plasma expander.

874) **Casein**

Casein is the major protein in milk. In pharmacy, it's used in nutritional supplements and for manufacturing biodegradable films and adhesives.

875) **Papain**

Papain is a proteolytic enzyme extracted from papaya latex. It aids digestion and is used in deworming preparations and anti-inflammatory enzyme therapy.

876) **Bromelain**

Bromelain is an enzyme from pineapple stems. It's used for anti-inflammatory effects, wound debridement, and to promote digestion.

877) **Serratiopeptidase**

Serratiopeptidase is a proteolytic enzyme from *Serratia* bacteria. It's used to reduce inflammation and edema in soft tissue injuries.

878) **Urokinase**

Urokinase is an enzyme used medically as a thrombolytic agent. It dissolves blood clots in cases like myocardial infarction and pulmonary embolism.

879) **Bees Wax**

Bees wax is a lipid secreted by honeybees. It's used in ointment bases, polishes, and as a stiffening agent in cosmetics and pharmaceuticals.

880) **Marine Drugs**

Marine drugs are novel medicinal agents derived from marine organisms like algae, sponges, and corals. They are explored for anticancer, antiviral, and antimicrobial activities.

About the Editors

Dr. Narendra Kumar Nyola is a prominent academician, researcher, and administrator in the field of pharmaceutical sciences. With over 16 years of experience in academia and administration, he has significantly contributed to the advancement of pharmacy education and research in India. Dr.Nyola holds an M. Pharm.(Pharmaceutical Analysis) and a Ph.D. in Pharmaceutical sciences, underlining his strong academic foundation. His scholarly output includes 35 National and International publications, reflecting his active engagement in pharmaceutical research, particularly in analytical method development and validation. In addition to his publications, Dr.Nyola is the holder of five patents, highlighting his innovative contributions to the pharmaceutical domain. He has guided a number of M.Pharm and Ph.D Students and is the author of several books in the field of Pharmaceutical sciences.He is also a life member of numerous prestigious professional organizations. He is currently serving as the Principal of the School of Pharmacy at Shridhar University, Pilani, Rajasthan, where he plays a key role in shaping academic strategies, promoting research excellence, and fostering a collaborative educational environment.

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